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LOCAL FUEL PLC

SHOREHAM OIL TERMINAL

OVERFILL PROTECTION

SAFETY INSTRUMENT SYSTEM

MANAGEMENT MANUAL

Contents

1. Policy and Lifecycle Activities
2. Management of Functional Safety Plan
3. Functional Safety Assessments
- 3.1 Functional Safety Assessment Stage 5



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LOCAL FUEL PLC
SHOREHAM OIL TERMINAL
SAFETY INSTRUMENTED SYSTEMS
POLICY AND LIFECYCLE ACTIVITIES

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Contents

| | | |
|------|--|----|
| 1 | REVISION HISTORY | 4 |
| 2 | INTRODUCTION | 4 |
| 3 | POLICY | 5 |
| 4 | BS EN 61511 LIFECYCLE | 6 |
| 5 | ACTIVITIES THROUGHOUT THE LIFECYCLE..... | 7 |
| 5.1 | Safety Plan..... | 7 |
| 5.2 | Systematic Capability and Failure | 7 |
| 5.3 | Hazard and Risk Assessment..... | 7 |
| 5.4 | Allocation of Safety Functions | 7 |
| 5.5 | Safety Requirement Specification | 8 |
| 5.6 | Design and Engineering of the Safety Instrumented System | 9 |
| 5.7 | Installation, Commissioning and Validation | 10 |
| 5.8 | Operation & Maintenance | 10 |
| 5.9 | Modification | 12 |
| 5.10 | Decommissioning | 12 |
| 5.11 | Functional Safety Assessments | 12 |
| 6 | ROLES AND RESPONSIBILITIES | 13 |
| 6.1 | Roles and responsibilities include: | 13 |
| 7 | COMPETENCE..... | 15 |
| 7.1 | HRA and Allocation of Safety Functions..... | 15 |
| 7.2 | Design & Engineering of the SIS | 16 |
| 7.3 | Installation, Commissioning and Validation | 17 |
| 7.4 | Operation and Maintenance..... | 17 |
| 7.5 | Modification | 18 |
| 7.6 | Decommissioning | 18 |
| 7.7 | Verification..... | 18 |
| 7.8 | Management of Functional Safety..... | 19 |



References

The following standards and guidance are relevant to Managing Functional Safety of Safety Instrumented Systems in the Oil Storage Sector of the Process Industry.

1. BS EN 61508 Parts 1 – 7: 2010
Functional Safety of Electrical/Electronic/Programmable Electronic Safety-Related Systems.
2. BS EN 61511 Parts 1 – 3: 2004
Functional Safety – Safety Instrumented Systems for the Process Industry Sector.
3. EEMUA Publication 222 – Guide to the Application of IEC 61511 to Safety Instrumented Systems.
4. PSLG Final Report – Safety and Environmental Standards for Fuel Storage Sites.
5. API 2350 – Overfill Protection for Storage Tanks in Petroleum Facilities.
6. HSE Managing Competence for Safety-Related Systems Parts 1 & 2.
7. HSE Guidance OG54 – Proof Testing of Safety Instrumented Systems in the Onshore Chemical/Specialist Industry.
8. HSE Guidance OG46 – Management of Instrumented Systems Providing Safety Functions of Low/Undefined Safety Integrity.
9. HSE 428/2002 – Principles for Proof Testing of Safety Instrumented System in the Chemical Industry.
10. CDOIF – Demonstrating Prior Use of Elements of a Safety Instrumented Function in support of BS EN 61511.



1 REVISION HISTORY

| Rev | Description |
|-----|---|
| A | Original Issue. |
| B | References: Ref 7 updated to OG54, Ref 7 updated to OG46. 5.2 Systematic Capability and Failure statement added. Remaining Section 5 items incremented by .1 5.5 Note added regarding the full requirements of the SRS. 5.8 Operation and Maintenance added. Remaining Section 5 items incremented by .1 5.11 Functional Safety Assessments statement added. 7.4 Inspection activities added Appendix removed |
| C | Minor typographical errors corrected. |
| D | |

2 INTRODUCTION

Local Fuel plc own and operate a fuel storage facility at Shoreham. The terminal is classified as a low tier COMAH site. Local Fuel plc manage and employ operators and maintenance personnel for the day to day running of the terminal. As and when necessary Local Fuel plc employ the services of outside organisations to assist in specialist advice and services.

In the case of Management of Functional Safety related to the terminal's SIL rated overfill protection system, Local Fuel plc have engaged P & I Design Ltd to assist and support the company in ensuring compliance to BS EN 61511.



3 POLICY

The objective of Local Fuel plc's management is to conduct its business in a manner which fully conforms to the Clients' Contractual Requirements, together with ensuring that Operational, Environmental, Safety and Regulatory requirements are adhered to.

In order to achieve this objective relevant to Safety Instrumented Systems (SIS), it is the policy of this company to ensure that an effective and efficient Functional Safety Management system is established, maintained and improved upon. This is achieved through each member of the Company accepting that they are responsible for whatever part they play in the organisation, together with managing all lifecycle phases relevant to the SIS.

This Policy section gives an overview of how Local Fuel plc will manage the requirements of BS EN 61511 – Functional Safety – Safety Instrumented Systems for the Process Sector.

Management of Functional Safety

Management of Functional Safety applies across all safety lifecycle phases. Local Fuel plc utilises the services of external organisations to assist in certain lifecycle phases. However, Local Fuel plc ensure that all external organisations are aware of their responsibilities and the deliverables required of them.

Roles, Responsibilities and Competence

The Managing Director will adopt the role of Functional Safety Manager (FSM) and be responsible for ensuring compliance to this procedure. He is also responsible in ensuring the competence of both employees and external contractors and consultants who carry out all activities associated with the SIS. Specific required competencies are identified in this Policy and Lifecycle Activities document.

Planning

Local Fuel plc will utilise the BS EN 61511 lifecycle as a methodology and will plan for all lifecycle phases of the SIS by creating a Safety Plan. The Safety Plan will define the applicable tasks required at each lifecycle phase and identify those responsible in carrying out the relevant activities.

Verification and Validation

Local Fuel plc will ensure Verification is performed by review, analysis and/or testing and that the required deliverables satisfy the defined requirements for the appropriate phases of the safety life cycle. Procedures will be developed to provide for Validation through inspection and testing, that the installed and commissioned safety instrumented system and its associated safety instrumented functions achieve the requirements as stated in the safety requirement specification.

Functional Safety Assessments

Functional Safety Assessments (FSA) will be conducted at relevant lifecycle phases, the Safety Plan will identify when and what Stage FSA is to be conducted.



4 BS EN 61511 LIFECYCLE

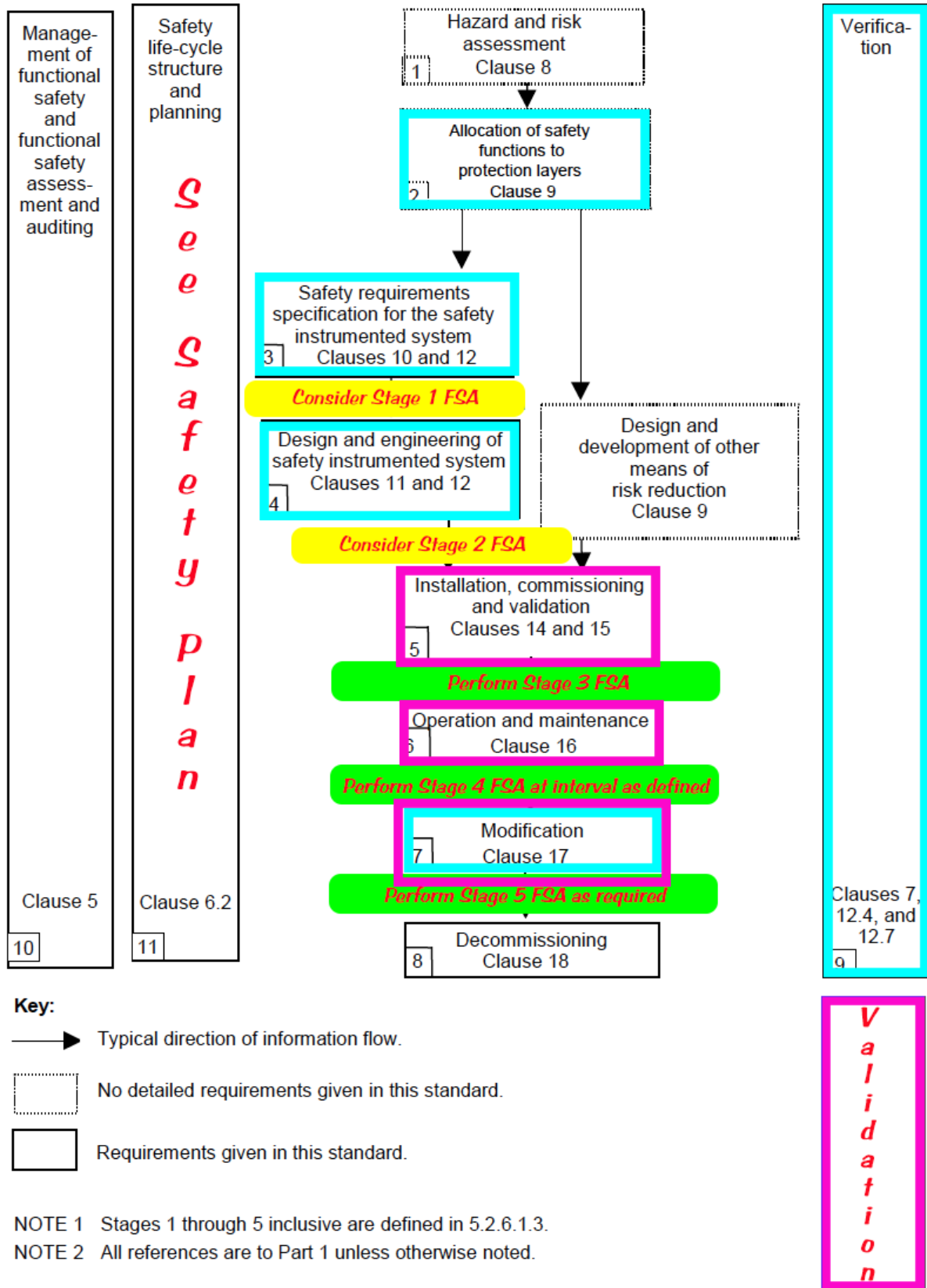


Figure 1: BS EN 61511 Lifecycle with Verification, Validation and FSA processes.

5 ACTIVITIES THROUGHOUT THE LIFECYCLE

5.1 Safety Plan

Local Fuel plc will open a Safety Plan when it is anticipated that a Safety Instrumented System is required. The Safety Plan will be updated with the lifecycle documentation, starting at the Hazard and Risk Assessment stage of the lifecycle. The Safety Plan will identify for each lifecycle activity the criteria, techniques, measures and procedures together with roles and responsibilities of employees and external organisations to ensure the activity is correctly administered.

5.2 Systematic Capability and Failure

Local Fuel plc appreciate that by the nature of a systematic failure that a potential failure could be present in the Safety Instrumented System and be dormant until a unique set of circumstances occur. Systematic failures, together with dangerous undetected random hardware failures are difficult to identify. In order to reduce the likelihood of Systematic failures occurring checking, verification and validation is carried out throughout the lifecycle.

5.3 Hazard and Risk Assessment

The Functional Safety Manager is responsible for ensuring that Hazard and Risk Assessment (HRA) is conducted and for the appointment of an appropriate multi-disciplined team.

All HRA studies will be conducted by a multi-disciplined team with the relevant knowledge and skills appropriate to the terminal, the process and operations, together with control and instrumentation systems.

The objective of a HRA is to review the process and identify hazardous events arising from possible failures, including failures of the process, operations and control systems, where the consequence of a failure may lead to cause a harmful event to people, the environment or the business of Local Fuel plc.

Local Fuel plc utilise the most appropriate of the following techniques to perform HRA: Hazard Identification (HAZID), Hazard and Operability Studies (HAZOP), Risk Graphs, Fault Trees Analysis, Layer of Protection Analysis (LOPA) or Quantitative Risk Assessments (QRA).

5.4 Allocation of Safety Functions

When the HRA derives that a SIS is required the Safety Integrity Level (SIL) Determination is conducted utilising Risk Graphs, LOPA or QRA. Local Fuel plc policy is that if a Risk Assessment deems a Safety Instrumented Function (SIF) is required with a Safety Integrity Level SIL 1 or greater then a LOPA study or QRA will be employed to ensure that the study is neither over conservative nor over pessimistic.

As shown in Figure 1, verification of the allocation of Safety Functions are required at this lifecycle phase. The Functional Safety Manager is responsible to ensure that this verification is completed as defined in the Safety Plan. Local Fuel plc will develop checklists to record the verification process.



5.5 Safety Requirement Specification

Local Fuel plc will produce or have produced for them a Safety Requirement Specification, the purpose of which is to:

- Define Safety Instrumented Functions and Safety Integrity Levels.
- Provide information to fully define the intended SIS, by defining: ¹
 - The Process and the Process Safe State.
 - System Architecture.
 - Time of response.
 - The demand on the System.
 - Settings, Calibrated Ranges and Levels of Concerns.
 - Process and Environmental Limitations.
 - Interface with other control systems and protection layers.
 - Manual Shutdown methods.
 - Override facilities if required. (Overrides are avoided unless absolutely necessary).
 - Spurious Trip acceptability.
 - Proof Test Requirements.
- Provide the System Integrator and or suppliers the Basis of Design for development of the SIS.

As shown in Figure 1, verification of the Safety Requirement Specification is required at this lifecycle phase. The Functional Safety Manager is responsible to ensure that this verification is completed as defined in the Safety Plan. Local Fuel plc have developed checklists to record the verification process.

The Safety Plan will have identified if a Functional Safety Assessment (FSA) Stage 1 is to be performed. If it is required then the Functional Safety Manager will arrange for an assessment to be conducted.

¹ A full list of requirements to be detailed within the SRS can be found in BS EN 61511 - 2004 Clause 10.3



5.6 Design and Engineering of the Safety Instrumented System

Local Fuel plc will utilise the services of suitable competent consultants, suppliers and sub-contractors for the realisation phase of the BS EN 61511 lifecycle. The Functional Safety Manager is responsible to ensure that all external organisations are aware of what is required of them and he will liaise with them in providing the necessary design input and ensure that the deliverables received by them comply with the company's requirements.

The design shall meet the requirements of BS EN 61511 with respect to system architecture, hardware fault tolerance, common cause failures, random hardware failures and Probability of Failing in Demand PFD_{AVG} calculations together with system capability and systematic failures.

The design will include all necessary documentation to provide for the specification, implementation, procurement, installation, verification testing including Factory Acceptance Test (FAT) and Site Acceptance Tests (SAT) together with Validation documentation for initial and on-going proof testing of the SIS.

SIL Verification calculations shall be included using failure rate data, preference in the selection of hardware will be given to SIL Certified to BS EN 61508 components.

As shown in Figure 1, verification of the Design is required at this lifecycle phase. The Functional Safety Manager is responsible to ensure that this verification is completed as defined in the Safety Plan. Local Fuel plc have developed checklists to record the verification process.

The Safety Plan will have identified if a Functional Safety Assessment (FSA) Stage 2 is to be performed. If it is required then the Functional Safety Manager will arrange for an assessment to be conducted.



5.7 Installation, Commissioning and Validation

Local Fuel plc or the System Integrator will employ sub-contractors to install the SIS. All installation work will be carried out by technicians who are competent in both SIS and hazardous areas working and will be undertaken by CompEx certified technicians, or at a minimum the final inspections, prior to energising the system, must be carried out and documented by a CompEx certified technician.

Local Fuel plc will ensure that the Installation Contractor has all required documentation in order that the installation will comply with the design. It is the Installation Contractor's responsibility to ensure that any changes during the installation are advised and agreed with the designer and supported with information to allow As Built documentation.

Installation testing documentation is to be provided by the Installation Contractor to Local Fuel plc or their representative for inclusion into the Safety Instrumented System Manual.

On completion of the installation the full system will be pre-commissioned and validated to ensure the installed SIS meets the requirement of the design for both functional safety and in compliance with BS EN 61511.

Full and comprehensive records will be produced and retained of the installation, commissioning and validation detailing test results, instrumentation calibration, procedures used and any discrepancies between actual and expected results. This documentation will be included in the Safety Instrumented System Manual.

As shown in Figure 1, validation of the Installation and Commissioning is required at this lifecycle phase. The Functional Safety Manager is responsible to ensure that this validation is completed as defined in the Safety Plan. Local Fuel plc have developed checklists to record the verification of the validation process.

A Functional Safety Assessment (FSA) Stage 3 is to be performed. The Functional Safety Manager will arrange for an assessment to be conducted.

5.8 Operation & Maintenance

To ensure that the functional safety of the SIS is maintained during operation and maintenance Local Fuel plc. ensure that SIS/SIF are maintained, tested and inspected.

Inspection, maintenance and test procedures will be produced for the SIS. All testing will be fully documented and analysed. Inspection, maintenance and test procedures should be approved by the FSM.

The test procedures should address the following:

- A statement of the “purpose and scope”.
- Consideration and documentation of all precautions that must be observed whilst performing the tests in order to avoid potential hazards.
- Identification of any special tools or equipment required and evidence that the personnel are competent to use such equipment.



- Any initial conditions which must be satisfied prior to undertaking the test.
- Adequate cross references to any other documents, manuals etc.
- Clear and concise procedural steps which adequately define the tasks necessary to perform the test safely and efficiently.

Proof test procedures should be designed in order to detect dangerous undetected failures by, where possible, providing realistic end to end testing. Where full testing cannot be conducted, partial testing will be utilised, but the testing plan will identify when a full test is required to ensure the PFD of the component and system is not compromised.

Any warnings or specific issues that should be drawn to the attention of the tester should be clearly and conspicuously stated.

The FSM will schedule the inspection, maintenance and test routines utilising the site competent personnel or an organisation to carry out the inspection, maintenance and test routines.

Full documentation of the findings of every inspection, maintenance and test routine, including any failures or faults will be produced by, or on behalf of Local Fuel plc. The documentation associated with proof testing and inspection should a minimum contain:

- SIF tag number.
- Inspection, maintenance and test procedure tag number.
- Brief description of inspection, maintenance and test.
- Date carried out.
- Name/s of person/s carrying out inspection, maintenance and test routine.
- Results of inspection and test routine including “as found” and “as left” condition.
- Any critical steps which following the tests may leave the system in-operable.
 - If critical steps are identified then independent checks of that task should be identified and recorded on the test procedure.

Any reports of overdue tests, demands upon the SIF, or spurious operation and failures during operation or under test, shall be investigated and documented by the FSM.

Periodically the FSM shall ensure that a review of the data from demands, mean time to restore, spurious trips and testing is performed to verify that assumptions made during the SIL Determination and design activities were accurate and complete.

Local Fuel plc ensure that terminal operating personnel understand what is required of them in the case of activation of the SIS. The FSM will ensure that operators log and record all SIS activities, such as activations, spurious events and failures using a dedicated SIS failures report.

The FSM will review each and every report to ensure Functional Safety is maintained.

All terminal operations and procedures are conducted utilising Standard Operating Procedures (SOP's) to which operators are trained and competent in carrying out.



5.9 Modification

Local Fuel plc appreciate that modifications to the originally installed SIS may be required from time to time. This may result from operational changes at the terminal requiring changes to the SIS, enhancements to the SIS or corrections to shortfalls in the operation of the SIS.

Any modification to the SIS can only be authorised by the Functional Safety Manager and must be controlled utilising the company's Management of Change Procedure.

Before any modification is authorised, consideration will be given to the requirement of a FSA Stage 5. This will then decide at what stage of the Safety Lifecycle the modification process requires to be reviewed.

The Safety Plan will be utilised to manage the modification.

Local Fuel plc have developed checklists to record the verification of the validation process.

5.10 Decommissioning

Local Fuel plc will utilise its Management of Change Procedure to instigate the decommissioning of the SIS.

The Functional Safety Manager will arrange for a FSA 5 to be conducted on the proposed decommissioning of the SIS and the FSA will be conducted as for a modification to the SIS, with emphasis that the decommissioning of the SIS cannot put a further demand on any other remaining protection systems.

Local Fuel plc have developed checklists to record the verification of the validation process.

5.11 Functional Safety Assessments

The Functional Safety Manager will arrange for FSAs to be conducted in accordance with the Safety Plan.

The following will be considered when planning a FSA.

- The scope of the functional safety assessment.
- Who is to participate in the functional safety assessment.
- The skills, responsibilities and authorities of the functional safety assessment team.
- The information that will be generated as a result of the functional safety assessment activity.
- The identity of any other safety bodies involved in the assessment.
- The resources required to complete the functional safety assessment activity.
- The level of independence of the assessment team.
- The means by which the functional safety assessment will be revalidated after modifications.



6 ROLES AND RESPONSIBILITIES

Local Fuel plc ensures that all its employees who are involved in the management, operation or maintenance of the SIS are aware of their responsibilities related to the SIS. All such employees will undergo BS EN 61511 awareness training and where necessary more specific on the job or other specialist training.

6.1 Roles and responsibilities include:

6.1.1 Managing Director

The Managing Director assumes the role of Functional Safety Manager and is responsible for the management and control of the SIS:

- He ensures that the hazard and risk assessments are carried out.
- Arranges for a multi-discipline team to carry out HRA, SIL Determination and FSA studies, and to arrange external expertise when required.
- Ensures that the design of the SIS fulfils the safety requirement for functional safety and target SIL/ PFD_{AVG}.
- Ensures that all SIFs are correctly installed, tested and commissioned according to the design.
- Ensures that the SIS is maintained, tested and inspected as detailed in the inspection, maintenance and test procedures.
- Performs Analysis and Approval of all data from demands, spurious trips and testing to verify that assumptions made during the SIL Determination and design activities were accurate and complete.
- Arranges for all necessary training to ensure employees are competent to carry out their responsibilities.
- Selects competent personnel or an organisation to carry out the design and installation of SIS.
- Ensures any SIS modifications are controlled and managed as per the modifications procedure.

6.1.2 Operations Manager - SIS

- To manage SIS inspection, maintenance and test procedures.
- To maintain the inspection, maintenance and test procedures and results of all activities.
- Schedules the inspection, maintenance and proof test.
- Selects competent personnel or an organisation for inspection, maintenance and proof test.
- Participation in SIS risk assessments, installation, commissioning and validation planning.



6.1.3 Maintenance Technicians

- Carries out inspection, maintenance, testing and reinstatement of the SIS (in co-operation with specialist SIS Technicians).
- Ensures any faults detected during inspection, maintenance and testing are fully documented in the inspection and testing report.

6.1.4 Operations Personnel

- Be knowledgeable with the operation of the SIS.
- Know how to react to an activation of the SIS without having to refer to any additional guidance.
- Log and report any activations, spurious trips or other faults with the SIS.
- Know how and when to activate a manual shutdown of the system.
- Be aware of other employees or sub-contractors responsibilities when they request to work on the SIS.



7 COMPETENCE

Local Fuel plc utilise the guidelines of EEMUA 222 to define the competencies required to perform each of the lifecycle phases. These are detailed below in a simplified form, for more information refer to EEMUA 222.

7.1 HRA and Allocation of Safety Functions

| Safety lifecycle phase | Activity | Required Competencies |
|---|---|--|
| Hazard and Risk Analysis | HAZID studies HAZOP studies SIL determination | <ul style="list-style-type: none"> Understands principles of hazard identification, analysis and HAZOP studies Understands where hazards may be introduced by the SIS. Has experience of participating in HRA studies. |
| Allocation of Safety Functions to protection layers | SIL determination | <ul style="list-style-type: none"> Understands the effectiveness of different types Of protection layers, Has experience of allocating safety functions to layers. Has experience of participating in or leading SIL determination. |
| Safety requirement specification | SRS preparation or approval of SRS | <ul style="list-style-type: none"> Knows and understands how to develop specifications. Has experience of developing role statements functional and integrity specifications for SIS. |



7.2 Design & Engineering of the SIS

| Safety lifecycle Phase | Activity | Required Competencies |
|-------------------------------|----------------------|---|
| Design and engineering of SIS | Design Engineering | <ul style="list-style-type: none"> • Knows and understands how to select the most appropriate sensors and final elements to meet the process conditions and safety integrity requirements. • Knows and understands how to select an appropriate logic solver to meet the safety requirements. • Has experience of selecting sensors and final elements for SIS applications at the required SILs. • Has experience of specifying a logic solver for SIS application at the required SILs. • Has experience of configuring a logic solver for SIS application at the required SILs. • Has experience of integrating and factory testing a logic solver to meet specified functional requirements. • Has experience of developing documentation for SIS including Factory and Site Acceptance Test procedures. |
| | Software Development | <ul style="list-style-type: none"> • Understands the requirements of BE EN 61511 for Software. • Is familiar with the Safety Manual for the programmable logic solver and how to comply with all its requirements. |
| | Project Management | <ul style="list-style-type: none"> • Knows and understands principles of BS EN 61508 and BS EN 61511 and their application to the process sector. • Knows and understands company's project lifecycle and associated procedures. • Knows and understands the companies quality system. |
| | Functional Safety | <ul style="list-style-type: none"> • Knows and understands details of BE EN 61511 and its application to the process sector. • Knows and understands company's project lifecycle and associated procedures. • Knows and understands company's quality system • Knows, understands and has experience of SIS software and hardware technology in a similar application. • Experience of participating in at least one Safety Integrity Level Assessment. • Experience of performing SIL verification (achieved PFD) calculations. |



7.3 Installation, Commissioning and Validation

| Safety lifecycle Phase | Activity | Required Competencies |
|--|--------------------------------|--|
| Installation, commissioning and validation | Installation and commissioning | <ul style="list-style-type: none"> Knows and understands installation and commissioning issues with SIS field equipment and logic solvers. Has managed site installation of SIS equipment and systems. |
| | Testing and validation | <ul style="list-style-type: none"> Knows and understands Site Acceptance Testing issues with SIS field equipment and logic solvers. Has managed site commissioning and acceptance testing activities against test procedures. Understands requirements of BE EN 61511 for Verification. |

7.4 Operation and Maintenance

| Safety lifecycle Phase | Activity | Required Competencies |
|---------------------------|--------------------------------------|---|
| Operation and Maintenance | Operation and Maintenance Management | <ul style="list-style-type: none"> Knows and understands how to manage SIS to ensure functional and integrity requirements are achieved. Has developed procedures for maintenance and testing of SIS. Has reviewed testing results to ensure that functional and integrity requirements are achieved and amended, testing scopes and test intervals as necessary. Has developed and implemented procedural controls for management of overrides and inhibits. |
| | Routine Proof Testing | <ul style="list-style-type: none"> Knows and understands Proof Testing issues with SIS field equipment and logic solvers. Has managed site commissioning and acceptance testing activities against test procedures. Understands requirements of BE EN 61511 for Verification. |
| | SIS Inspection | <ul style="list-style-type: none"> Knows and understands how to manage SIS to ensure functional and integrity requirements are achieved. Knows and understands maintenance issues with SIS field equipment and logic solvers. Complex certification if SIS is located in electrical hazardous area. |



7.5 Modification

| Safety lifecycle Phase | Activity | Required Competencies |
|------------------------|---|--|
| Modification | Management of Change Control | <ul style="list-style-type: none"> Knows and understands site procedures for management of change. Has carried out a risk assessment for management of change. Knows how to modify SIS to achieve required revised functionality and integrity and implications of the changes. Has managed and/or developed revised documentation and procedures associated with SIS modifications. |
| | Specification, Design, Implementation and Testing of Modification | <ul style="list-style-type: none"> For any activities included in Design and Engineering, Installation Commissioning and Validation or Operation and Maintenance above, the same competencies are required for modifications. |

7.6 Decommissioning

| Safety lifecycle Phase | Activity | Required Competencies |
|------------------------|-----------------|--|
| Decommissioning | Decommissioning | <ul style="list-style-type: none"> Knows and understands how to decommission SIS while ensuring hazards are managed. Has experience of decommissioning SIS in a safe manner. |

7.7 Verification

| Safety lifecycle Phase | Activity | Required Competencies |
|------------------------|--|---|
| Verification | Checking and approval of lifecycle documentation | <ul style="list-style-type: none"> Knows how to carry out verification reviews. Has experience of verifying two or more lifecycle activities. |



7.8 Management of Functional Safety

| Safety lifecycle Phase | Activity | Required Competencies |
|---|------------------------------|---|
| Management of Functional Safety | Management of SIS Lifecycle | <ul style="list-style-type: none"> • Knows and understands details of BE EN 61511 and its application to the process sector. • Knows and understands company's project lifecycle and associated procedures • Has experience of project management involving people, and resources including financial resources. • Has experience of carrying out audits and incorporating recommendations into action plans. Has experience of managing clients, suppliers or sub-contractors. |
| | Functional Safety Assessment | <ul style="list-style-type: none"> • Knows and understands details of BE EN 61511 and its application to the process sector. • Has experience of carrying out functional safety assessment or audit of SIS. |
| Safety Lifecycle Structure and Planning | | <ul style="list-style-type: none"> • Knows and understands how to create a lifecycle structure and planning process with defined inputs, outputs and verification requirements for each activity. • Has experience of creating a SIS lifecycle structure for planning and project management purposes. • Has experience of successfully implementing a lifecycle planning process. |



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LOCAL FUEL PLC
THE SHOREHAM OIL TERMINAL
SAFETY INSTRUMENTED SYSTEM
MANAGEMENT OF FUNCTIONAL SAFETY
SAFETY PLAN

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| B | 27.03.15 | D R Ransome | D S Regan | L Salvidge | Typographical errors corrected and action history updated | |
| C | 27.05.15 | D R Ransome | D S Regan | L Salvidge | Updated for latest documentation | |
| D | 07.06.16 | M. Morgan | D.B. Faulkner | L Salvidge | Updated for XV162 replacement | |
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Contents

| | | |
|----|---|----|
| 1 | REVISION CONTROL | 3 |
| 2 | SCOPE | 4 |
| 3 | ORGANISATIONS AND RESOURCES..... | 4 |
| 4 | SAFETY POLICY & LIFECYCLE ACTIVITIES..... | 5 |
| 5 | SAFETY INSTRUMENTED SYSTEM..... | 6 |
| 6 | FUNCTIONAL SAFETY ASSESSMENTS | 7 |
| 7 | RISK ANALYSIS AND ALLOCATION OF SAFETY FUNCTIONS..... | 8 |
| 8 | SPECIFICATION OF SAFETY INSTRUMENT SYSTEM | 11 |
| 9 | FUNCTIONAL SAFETY ASSESSMENT – STAGE 1..... | 12 |
| 10 | DESIGN & DEVELOPMENT OF SIS..... | 13 |
| 11 | FUNCTIONAL SAFETY ASSESSMENT – STAGE 2..... | 15 |
| 12 | INSTALLATION, COMMISSIONING AND VALIDATION | 16 |
| 13 | TRAINING | 19 |
| 14 | FUNCTIONAL SAFETY ASSESSMENT – STAGE 3..... | 21 |
| 15 | OPERATION AND MAINTENANCE..... | 22 |
| 16 | FUNCTIONAL SAFETY ASSESSMENT – STAGE 4..... | 24 |
| 17 | MODIFICATION..... | 25 |
| 18 | FUNCTIONAL SAFETY ASSESSMENT – STAGE 5 MODIFICATION | 26 |
| 19 | DECOMMISSIONING..... | 27 |
| 20 | FUNCTIONAL SAFETY ASSESSMENT – STAGE 5 DECOMMISSIONING..... | 28 |



1 REVISION CONTROL

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| D | Action History Updated: <ul style="list-style-type: none">• XV162 replacement and associated FSA 5• Annual proof testing |



2 SCOPE

This safety plan details the Management of the Safety Instrumented Overfill Protection System at Local Fuel plc’s Shoreham Terminal. It is intended to reflect the life cycle of the SIS in accordance with BS EN 61511 and to be a working document throughout the life cycle of the Safety System.

The objective of this document is to identify the various lifecycle phases of the SIS and the management activities, together with the inputs and outputs required to ensure that the appropriate deliverables are achieved at the various lifecycle phases to ensure the functional safety objectives are met.

This document is to be read in conjunction with Local Fuel plc Policy and Lifecycle Activities Document Ref: LF364003_RPT

3 ORGANISATIONS AND RESOURCES

Persons, departments and organisations who are responsible for carrying out and reviewing each of the safety lifecycle phases shall be identified and be informed of the responsibilities assigned to them.

Persons, departments or organisations involved in safety life-cycle activities shall be competent to carry out the activities for which they are accountable.

Local Fuel plc Management Procedures identify the responsibility of persons assigned to this Safety Instrumented System and ensure the competence of such persons.

Local Fuel plc Management Procedures include the following elements specific to the Safety Instrumented System.

- Safety Planning, organisation and procedures.
- Identification of roles and responsibilities.
- Competence of persons and accountability.
- Implementation and monitoring of procedures.
- Management of Change.

This document is controlled by Local Fuel plc’s Functional Safety Manager.

Date

Functional Safety Manager Date



4 SAFETY POLICY & LIFECYCLE ACTIVITIES

Local Fuel plc have a Safety Policy for the implementation and management of Safety Instrumented Systems, this is detailed in document LF364003_RPT – Safety Policy & Lifecycle Activities Document.

That document and this Safety Plan refer to the Safety Instrumented System detailed in Section 5 of this document.

4.1 Safety Instrumented System Lifecycle

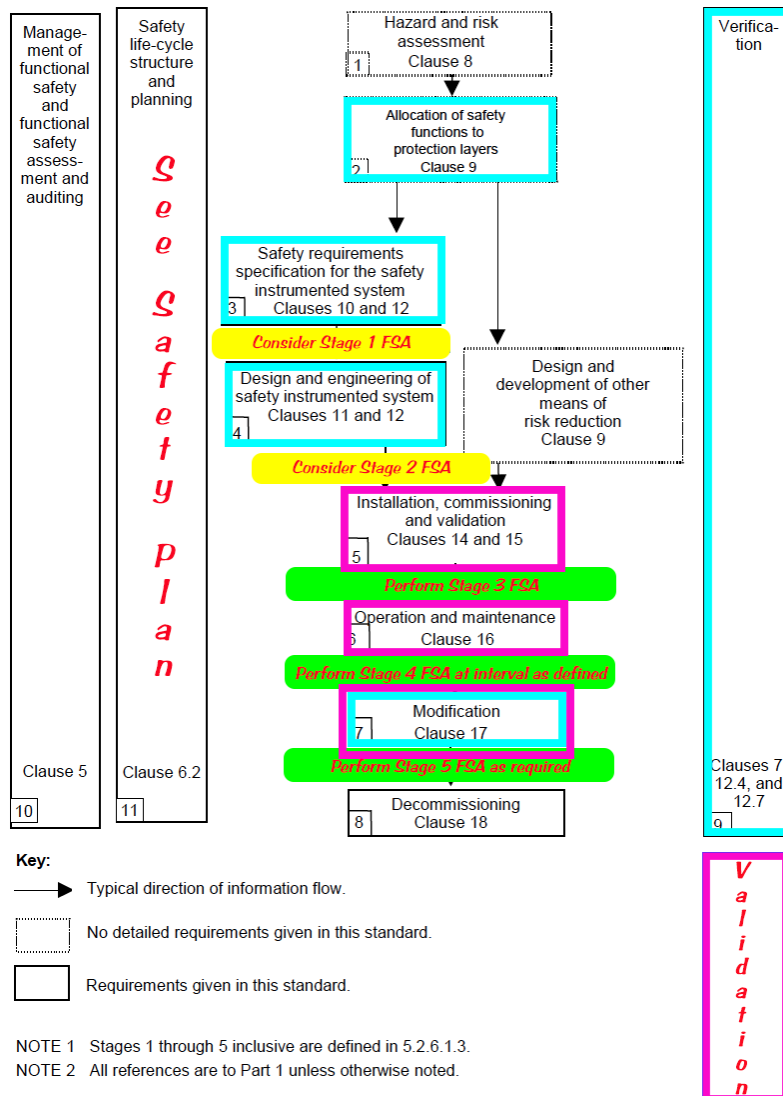


FIGURE 1 – SIS LIFECYCLE

4.2 Safety Plan

Throughout this Safety Plan each section is prefaced with a Table depicting the activity together with the objectives, inputs, outputs, deliverables and responsible persons/organisations. This plan follows the guidance of EEMUA 222 – Application of IEC 61511 to safety instrumented systems.

5 SAFETY INSTRUMENTED SYSTEM

The Safety Instrumented Functions of the Safety Instrumented Systems are:

Gasoline Tank Overfill Protection at Local Fuel plc's Shoreham Terminal.



6 FUNCTIONAL SAFETY ASSESSMENTS

In addition to roles, responsibilities, inputs, outputs and deliverables this document will provide the control of the Functional Safety Assessment through the lifecycle of the SIS to ensure the necessary objectives of functional safety are met. Functional Safety Assessments (FSA) will be documented in separate documents but referenced within this document.

In accordance with BS EN 61511 the defined stages for FSA are:

- Stage 1 – After the HAZOP and risk assessment has been carried out, the required protection layers have been identified and the safety requirement specification (SRS) has been developed.
- Stage 2 - After the SIS has been designed.
- Stage 3 After the installation, pre-commissioning and final validation of the SIS has been completed and operating and maintenance procedures have been developed.
- Stage 4 – After gaining experience in operating and maintenance.
- Stage 5 – After modification and prior to decommissioning of the SIS.

The number, size and scope of Functional Safety Assessments is decided upon specific circumstances and considering the following:

- Size of project;
- Degree of complexity;
- Safety integrity Level;
- Duration of Project;
- Consequence in the event of failure;
- Degree of standardisation of design features;
- Safety regulatory requirements;
- Previous experience with a similar design.

The constitution of the FSA team is based upon the following:

- The scope of the FSA;
- Who is to participate in the FSA;
- The skills, responsibilities and authorities of the FSA team
- The information that will be generated as a result of the FSA;
- The identity of any safety bodies if required;
- The resources required to complete the FSA;
- The level of independence of the FSA team;
- The means by which the FSA will be revalidated after modifications.

BS EN 61511 states that at least one FSA shall be undertaken before the hazards are present.

6.1 Functional Safety Assessment Plan

It is envisaged that the following FSA's will be conducted for this SIS:

- Stage 3
- Stage 4
- Stage 5



7 RISK ANALYSIS AND ALLOCATION OF SAFETY FUNCTIONS

7.1.1 Risk Analysis Requirements

| | | | | | |
|-----------------------------|--|--|---|--|---|
| Lifecycle phase in Figure 1 | Activity | | | | |
| 1 | Hazard and Risk Analysis | | | | |
| | Objectives | Inputs | Outputs | Deliverables | Responsible persons and or organisations |
| | To determine the hazards and hazardous events of the process and associated equipment. The sequence of events leading to the hazardous event and the process risks associated with the hazardous event. The requirements for risk reduction and the safety functions required to achieve the necessary risk reduction. | Process design Safety and Environmental targets | Description of Hazards Required Safety Functions Required risk reduction for each safety function | HAZOP Report Risk Graphs LOPA QRS | Functional Safety Manager Designers Operators |
| Lifecycle phase in Figure 1 | Verification Plan | | | | |
| 9 | Utilise QSF022_SIS – Stage 1 – Hazard & Risk Assessment - Checklist A | | | | |



7.1.2 Risk Analysis Action History

| Activity History – Terminal in Texaco/Chevron/Valero ownership | | | | |
|--|----------------------------|--|---|---|
| Date | Reference | Description | Roles | Persons assigned |
| 25.01.07 | SI087007_RPT Revision A | An original LOPA was performed for and on behalf of the original owners of the Terminal – Chevron. | LOPA Team Chair Member Member Member | D R Ransome BA CEng FlntstMC – P & I Design Ltd I Goldsworthy – Facility Engineer – Simon Management Ltd Miss L Dixon – H&S Department – Chevron Ltd D Crook – Terminal Manager – Simon Management Ltd D S Regan BEng – Process Engineer – P & I Design Ltd |
| 20.10.10 | SI087007_RPT Revision B | LOPA study re-conducted following CA request and PSLG Guidance. | LOPA Team Chair Member Member Member | D R Ransome BA CEng FlntstMC – P & I Design Ltd I Goldsworthy – Facility Engineer – Chevron Ltd Miss L Dixon – H&S Department – Chevron Ltd D Crook – Terminal Manager – Chevron Ltd D S Regan BEng – Process Engineer – P & I Design Ltd |
| 20.10.10 | SI087007_RPT Revision C | Chevron comments added and LOPA re-issued. | LOPA Team Chair Member Member Member | D R Ransome BA CEng FlntstMC – P & I Design Ltd I Goldsworthy – Facility Engineer – Chevron Ltd Miss L Dixon – H&S Department – Chevron Ltd D Crook – Terminal Manager – Chevron Ltd D S Regan BEng – Process Engineer – P & I Design Ltd |
| 20.10.10 | SI087007_RPT Revision D | LOPA re-written following Chevron discussions with HSE. | LOPA Team Chair Member Member Member | D R Ransome BA CEng FlntstMC – P & I Design Ltd I Goldsworthy – Facility Engineer – Chevron Ltd Miss L Dixon – H&S Department – Chevron Ltd D Crook – Terminal Manager – Chevron Ltd D S Regan BEng – Process Engineer – P & I Design Ltd |
| 20.10.10 | SI087007_RPT Revision E | Details of Societal Risk Added. | LOPA Team Chair Member Member Member | D R Ransome BA CEng FlntstMC – P & I Design Ltd I Goldsworthy – Facility Engineer – Chevron Ltd Miss L Dixon – H&S Department – Chevron Ltd D Crook – Terminal Manager – Chevron Ltd D S Regan BEng – Process Engineer – P & I Design Ltd |

| Activity History – Terminal in Local Fuel PLC ownership | | | | |
|---|----------------------------|---|---|--|
| Date | Reference | Description | Roles | Persons assigned |
| 08.12.14 | LF364002_RPT Revision A | Valero LOPA re-visited and revised to reflect current practices and procedures of Local Fuel plc. | LOPA Team Chair Member Member | D R Ransome BA CEng FlntstMC – P & I Design Ltd L Salvidge – Managing Director – Local Fuel plc D Winser – Operations Manager – Local Fuel plc D S Regan BEng – Process Engineer – P & I Design Ltd |
| 11.02.15 | LF364002_RPT Revision B | Local Fuel LOPA re-visited and revised to reflect HSE Comment. | LOPA Team Chair Member Member | D R Ransome BA CEng FlntstMC – P & I Design Ltd L Salvidge – Managing Director – Local Fuel plc D Winser – Operations Manager – Local Fuel plc D S Regan BEng – Process Engineer – P & I Design Ltd |
| 30.03.15 | LF364002_RPT Revision C | Local Fuel LOPA re-visited and revised to reflect HSE and Local Fuel comments | LOPA Team Chair Member Member | D R Ransome BA CEng FlntstMC – P & I Design Ltd L Salvidge – Managing Director – Local Fuel plc D Winser – Operations Manager – Local Fuel plc D S Regan BEng – Process Engineer – P & I Design Ltd |
| 01.04.15 | LF364002_RPT Revision D | Local Fuel LOPA re-visited and revised to reflect Local Fuel comments | LOPA Team Chair Member Member | D R Ransome BA CEng FlntstMC – P & I Design Ltd L Salvidge – Managing Director – Local Fuel plc D Winser – Operations Manager – Local Fuel plc D S Regan BEng – Process Engineer – P & I Design Ltd |



7.2.1 Allocation of Safety Functions Requirements

| | | | | | |
|-----------------------------|---|---|---|-------------------|--|
| Lifecycle phase in Figure 1 | Activity | | | | |
| 2 | Allocation of safety functions to protection layers | | | | |
| | Objectives | Inputs | Outputs | Deliverables | Responsible persons and or organisations |
| | Allocation of safety functions to protection layers and for each safety instrumented function, the associated safety integrity level. | Required safety functions and associated integrity levels | Description of safety functions allocation to different systems | SIL Determination | Functional Safety Manager Designers |
| Lifecycle phase in Figure 1 | Verification Plan | | | | |
| 9 | Utilise QSF022_SIS – Stage 1 – Hazard & Risk Assessment - Checklist A | | | | |

7.2.2 Allocation of Safety Functions Action History

| Activity History – Terminal in Chevron/Valero ownership | | |
|---|-------------------------|--|
| Date | Reference | Description |
| 25.01.07 | SI087007_RPT Revision A | The LOPA concluded that an additional layer of protection was required and that a Safety Instrumented System with integrity of SIL 2 be designed and installed. The Safety Instrumented Function being that if any gasoline tank level was above the existing high level alarm then it would activate the closure of the jetty import line valve and stop the gasoline flow to the terminal. |

7.3 Risk Analysis and Allocation of Safety Functions Verification History

| | | |
|-----------------------------|---|--|
| Lifecycle phase in Figure 1 | Verification -Terminal in Chevron/Valero ownership | |
| 9 | Utilise QSF022_SIS – Stage 1 – Hazard & Risk Assessment - Checklist A | |
| | Verification Checklist | Notes |
| | SI157105_RPT Revision A – Compliance Document - Section 4 | QSF022 did not exist under Chevron ownership, all checklists were contained in a compliance document. Section 4 was a combined HRA – SRS Checklist |



8 SPECIFICATION OF SAFETY INSTRUMENT SYSTEM

8.1 Safety Requirement Specification Requirements

| | | | | | |
|-----------------------------|--|---|---|--|--|
| Lifecycle phase in Figure 1 | Activity | | | | |
| 3 | SIS safety requirement specification | | | | |
| | Objectives | Inputs | Outputs | Deliverables | Responsible persons and or organisations |
| | To specify the requirements for each SIS, in terms of the required safety instrumented functions and their associated safety integrity, to achieve the required functional safety. | Description of safety functions allocation to different systems | SIS functional and integrity requirements by system software safety requirements. | Safety Requirement Specification Software Requirement Specification | Functional Safety Manager Designers SIS Supplier |
| Lifecycle phase in Figure 1 | Verification Plan | | | | |
| 9 | Utilise QSF010_SIS – Stage 1 – Safety Requirement Specification - Checklist 1 | | | | |

8.2 Safety Requirement Specification Action History

| Activity History – Terminal in Texaco/Chevron/Valero ownership | | | | |
|--|-------------------------|---|--|-------------------------------------|
| Date | Reference | Description | Roles | Persons assigned |
| 18.08.08 | SI157007_RPT Revision A | SRS included as Section 6 in SIS Design document Original Issue. | P&I Design Ltd Simon Management Ltd | D S Regan BEng I Goldsworthy |
| 23.03.10 | SI157007_RPT Revision B | SRS included as Section 6 in SIS Design document Revised Post Installation. | P&I Design Ltd Chevron Ltd | D S Regan BEng I Goldsworthy |
| 20.02.14 | SI157007_RPT Revision C | SRS included as Section 6 in SIS Design document Revised for new panel trip amplifiers. | P&I Design Ltd Chevron Ltd | D S Regan BEng I Goldsworthy |

| Activity History – Terminal in Local Fuel PLC ownership | | | | |
|---|-------------------------|---|------------------------------|----------------------------------|
| Date | Reference | Description | Roles | Persons assigned |
| 11.02.15 | LF364005_RPT Revision A | Original Issue | P&I Design Ltd Local Fuel | D S Regan BEng L Salvidge |
| 05.05.15 | LF364005_RPT Revision B | Revised following SIS Design | P&I Design Ltd Local Fuel | D S Regan BEng L Salvidge |
| 14.08.15 | LF364005_RPT Revision C | Revised following FSA 5 for XV162 replacement | P&I Design Ltd Local Fuel | D S Regan BEng L Salvidge |

8.3 Safety Requirement Specification Verification History

| | | |
|-----------------------------|---|---|
| Lifecycle phase in Figure 1 | Verification - Terminal in Chevron/Valero ownership | |
| 9 | Utilise QSF010_SIS – Stage 1 – Safety Requirement Specification - Checklist 1 | |
| | Verification Checklist | Notes |
| | SI157105_RPT Revision A – Compliance Document - Section 4 | QSF010 did not exist under Chevron ownership, all checklist were contained in a compliance document |



9 FUNCTIONAL SAFETY ASSESSMENT – STAGE 1

Stage 1 – After the HAZOP and risk assessment has been carried out, the required protection layers have been identified and the safety requirement specification (SRS) has been developed.

9.1 Functional Safety Assessment Stage 1 Requirements

| Lifecycle phase in Figure 1 | Activity | | | | |
|--|--|--|---|---|--|
| 10 | Functional Safety Assessment Stage 1 | | | | |
| | Objectives | Inputs | Outputs | Deliverables | Responsible persons and or organisations |
| | To investigate and arrive at a judgement on the functional safety achieved by the SIS. | Planning for SIS functional safety assessment LOPA SRS | Results of SIS functional safety assessment | Functional Safety Assessment Stage 1 Document | Functional Safety Manager FSA Chairperson FSA Team |
| Functional Safety Assessment | | | | | |
| Proposed Agenda: The FSA will address the following as a minimum: <ul style="list-style-type: none"> • That the hazard and risk assessment considers the following: <ul style="list-style-type: none"> ○ Determined the hazards and hazardous events of the process and associated equipment; ○ Determined the sequence of events leading to the hazardous event; ○ Determined the process risk associated with the hazardous event; ○ Determined the requirements for risk reduction; ○ Determined the safety functions required to achieve the necessary risk reduction; ○ Determined the safety instrumented functions and Safety integrity level • The recommendations from the hazard and risk assessment are in place and have been properly defined in the SRS. • The SRS fully defines the Safety Instrumented System and the safety instrumented functions necessary to achieve the required functional safety; • That a software safety requirements specification shall be derived from the SRS; • That project design change procedures are in place and properly implemented. • Plans or strategies for implementing further FSA's are in place | | | | | |

9.2 Functional Safety Assessment Stage 1 Action History

| Activity History – Terminal in Texaco/Chevron/Valero ownership | | |
|--|-----------|---|
| Date | Reference | Description |
| | | A Functional Safety Assessment Stage 1 was not conducted. |



10 DESIGN & DEVELOPMENT OF SIS

10.1 Design and Engineering Requirements

| Lifecycle phase in Figure 1 | Activity | | | | |
|-----------------------------|---|---|--|---|--|
| 4 | SIS design and engineering | | | | |
| | Objectives | Inputs | Outputs | Deliverables | Responsible persons and or organisations |
| | To design the SIS to meet the requirements for safety instrumented functions and safety integrity. | SIS functional and integrity requirements by system. Software safety requirements. Subsystem failure rates. | Design of SIS to functional and integrity requirements. SIS integration test plan. SIF reliability calculations and HFT report. SIS operations & maintenance plan including proof test intervals. | Safety Instrumented System. Safety Instrumented System Manual. | Functional Safety Manager Designers SIS Supplier |
| Lifecycle phase in Figure 1 | Verification Plan | | | | |
| 9 | Utilise QSF011_SIS – Stage 2 – Safety Instrument Design - Checklist 2 - General | | | | |
| 9 | Utilise QSF012_SIS – Stage 2 – Safety Instrument Design - Checklist 3 – Components & Sub-Systems | | | | |
| 9 | Utilise QSF013_SIS – Stage 2 – Safety Instrument Design - Checklist 4 – Interfaces | | | | |
| Lifecycle phase in Figure 1 | Validation Verification Plan | | | | |
| 9/9a | Utilise QSF014_SIS – Stage 3 – SIS Validation - Checklist 5 – Factory Acceptance Test – Planning | | | | |
| 9/9a | Utilise QSF015_SIS – Stage 3 – SIS Validation - Checklist 6 – Factory Acceptance Test | | | | |
| 9/9a | Utilise QSF016_SIS – Stage 2 – SIS Validation - Checklist 7 – Installation & Pre-Commissioning (Prior to SAT) | | | | |

10.2 Design and Engineering Action History

| Activity History – Terminal in Texaco/Chevron/Valero ownership | | | | |
|--|-------------------------|--|--|---------------------------------|
| Date | Reference | Description | Roles | Persons assigned |
| 18.08.08 | SI157007_RPT Revision A | Gasoline Overfill Protection Safety Instrument System Manual Original Issue | P&I Design Ltd Simon Management Ltd | D S Regan BEng I Goldsworthy |
| 23.03.10 | SI157007_RPT Revision B | Gasoline Overfill Protection Safety Instrument System Manual Revised Post Installation | P&I Design Ltd Chevron Ltd | D S Regan BEng I Goldsworthy |
| 20.02.14 | SI157007_RPT Revision C | Gasoline Overfill Protection Safety Instrument System Manual Revised for new panel trip amplifiers | P&I Design Ltd Chevron Ltd | D S Regan BEng I Goldsworthy |



| Activity History – Terminal in Local Fuel PLC ownership | | | | |
|---|----------------------------|--------------------------------------|---------------------------------|------------------------------|
| Date | Reference | Description | Roles | Persons assigned |
| 27.05.15 | LF364006_RPT Revision A | Original Issue | P&I Design Ltd Local Fuel | D S Regan BEng L Salvidge |
| 09.05.16 | LF364006_RPT Revision B | Following FSA 5 | P&I Design Ltd Local Fuel | D S Regan BEng L Salvidge |
| 13.05.16 | LF364006_RPT Revision C | Updated following 2016 proof test | P&I Design Ltd Local Fuel | D S Regan BEng L Salvidge |

10.3 Design and Engineering Verification History

| Lifecycle phase in Figure 1 | Verification |
|--|---|
| 9 | Utilise QSF011_SIS – Stage 2 – Safety Instrument Design - Checklist 2 - General |
| 9 | Utilise QSF012_SIS – Stage 2 – Safety Instrument Design - Checklist 3 – Components & Sub-Systems |
| 9 | Utilise QSF013_SIS – Stage 2 – Safety Instrument Design - Checklist 4 – Interfaces |
| SI157105_RPT Revision A – Compliance Document - Section 5 – Checklist 2 - General | QSF011 did not exist under Chevron ownership, all checklist were contained in a compliance document |
| SI157105_RPT Revision A – Compliance Document - Section 5 – Checklist 3 – Components & Sub Systems | QSF012 did not exist under Chevron ownership, all checklist were contained in a compliance document |
| SI157105_RPT Revision A – Compliance Document - Section 5 – Checklist 4 – Interfaces | QSF013 did not exist under Chevron ownership, all checklist were contained in a compliance document |

10.4 Design and Engineering Validation Verification History

| Lifecycle phase in Figure 1 | Validation - Terminal in Chevron/Valero ownership |
|---|---|
| 9/9a | Utilise QSF014_SIS – Stage 3 – SIS Validation - Checklist 5 – Factory Acceptance Test – Planning |
| 9/9a | Utilise QSF015_SIS – Stage 3 – SIS Validation - Checklist 6 – Factory Acceptance Test |
| 9/9a | Utilise QSF016_SIS – Stage 2 – SIS Validation - Checklist 7 – Installation & Pre-Commissioning (Prior to SAT) |
| SI157105_RPT Revision A – Compliance Document - Section 6 – Checklist 5 – FAT - Planning | QSF014 did not exist under Chevron ownership, all checklist were contained in a compliance document |
| SI157105_RPT Revision B – Compliance Document - Section 6 – Checklist 6 – FAT | QSF015 did not exist under Chevron ownership, all checklist were contained in a compliance document |
| SI157105_RPT Revision B – Compliance Document - Section 6 – Checklist 7 – Installation & Pre-Commissioning (Prior to SAT) | QSF016 did not exist under Chevron ownership, all checklist were contained in a compliance document |



11 FUNCTIONAL SAFETY ASSESSMENT – STAGE 2

Stage 2 - After the SIS has been designed

11.1 Functional Safety Assessment Stage 2 Requirements

| Lifecycle phase in Figure 1 | Activity | | | | |
|---|--|--|---|---|--|
| 10 | Functional Safety Assessment Stage 2 | | | | |
| | Objectives | Inputs | Outputs | Deliverables | Responsible persons and or organisations |
| | To investigate and arrive at a judgement on the functional safety achieved by the SIS. | Planning for SIS functional safety assessment SRS Design Manual PFD & SIL Verification Calculations | Results of SIS functional safety assessment | Functional Safety Assessment Stage 2 Document | Functional Safety Manager FSA Chairperson FSA Team |
| Functional Safety Assessment | | | | | |
| Proposed Agenda: The FSA will address the following as a minimum: <ul style="list-style-type: none"> • The recommendations and actions arising from the Stage 1 FSA have been resolved and completed; • That project design change procedures are in place and properly implemented. • The SIS is designed in accordance with the SRS, any differences to be identified and resolved. • Plans or strategies for implementing further FSA's are in place. | | | | | |

11.2 Functional Safety Assessment Stage 2 Action History

| Activity History – Terminal in Texaco/Chevron/Valero ownership | | |
|--|-----------|---|
| Date | Reference | Description |
| | | A Functional Safety Assessment Stage 2 was not conducted. |



12 INSTALLATION, COMMISSIONING AND VALIDATION

12.1 SIS Installation, Commissioning and Validation Requirements

| Lifecycle phase in Figure 1 | Activity | | | | |
|-----------------------------|---|--|---|---|---|
| 5 | Installation, Commissioning and Validation | | | | |
| | Objectives | Inputs | Outputs | Deliverables | Responsible persons and or organisations |
| | <p>To integrate and test the SIS</p> <p>To validate that the SIS meets in all respects the requirements for safety in terms of the required safety instrumented functions and the required safety integrity</p> | <p>SIS design</p> <p>SIS integration test plan</p> <p>SIS safety requirements</p> <p>Plan for the safety validation of the SIS</p> | <p>Fully functioning SIS in conformance with the SIS design</p> <p>Results of SIS integration tests</p> <p>Results of the installation, commissioning and validation activities</p> | <p>Fully functioning SIS</p> <p>Safety Instrumented System Manual with all testing documentation included</p> | <p>Functional Safety Manager</p> <p>Designers</p> <p>SIS Supplier</p> |
| Lifecycle phase in Figure 1 | Validation Verification Plan | | | | |
| 9/9a | Utilise QSF017_SIS – Stage 3 – SIS Validation - Checklist 8 – Site Acceptance Test | | | | |



12.2 SIS Installation, Commissioning and Validation Action History

12.2.1 SIS Test Procedures

| Activity History – Terminal in Texaco/Chevron/Valero ownership | | | | |
|--|----------------------------|---|-------------------|--------------------------------|
| Date | Reference | Description | Roles | Persons assigned |
| 10.04.08 | SI157035_RPT Revision A | SIS Panel FAT Procedure - Original Issue | P&I Design Ltd | D S Regan BEng D R Ransome |
| 09.07.08 | SI157035_RPT Revision B | SIS Panel FAT Procedure – Panel Test | P&I Design Ltd | D S Regan BEng D B Faulkner |
| 22.10.13 | SI157035_RPT Revision C | SIS Panel FAT Procedure | P&I Design Ltd | D S Regan BEng D B Faulkner |
| 26.03.08 | SI157036_RPT Revision A | SIS Shutdown Conditions Functional Test Procedure – Original Issue | P&I Design Ltd | D S Regan BEng D R Ransome |
| 17.11.08 | SI157036_RPT Revision B | SIS Shutdown Conditions Functional Test Procedure – Tankside Valves Removed | P&I Design Ltd | D S Regan BEng D R Ransome |
| 27.07.12 | SI157036_RPT Revision C | SIS Shutdown Conditions Functional Test Procedure – Wet Testing Added | P&I Design Ltd | D S Regan BEng D B Faulkner |
| 30.07.12 | SI157036_RPT Revision D | SIS Shutdown Conditions Functional Test Procedure – Wet Testing Corrected | P&I Design Ltd | D S Regan BEng D B Faulkner |
| 28.04.08 | SI157037_RPT Revision A | SIS Documentation & Hardware Verification Test Procedure – Original Issue | P&I Design Ltd | P Lynch D R Ransome |
| 09.05.11 | SI157037_RPT Revision B | SIS Documentation & Hardware Verification Test Procedure – 2011 Testing Update | P&I Design Ltd | P Lynch D S Regan BEng |
| 08.06.12 | SI157037_RPT Revision C | SIS Documentation & Hardware Verification Test Procedure – 2012 Testing Update | P&I Design Ltd | P Lynch D S Regan BEng |
| 26.03.08 | SI157038_RPT Revision A | SIS Power Failure Functional Testing Procedure – Original Issue | P&I Design Ltd | D S Regan BEng D R Ransome |
| 17.11.08 | SI157038_RPT Revision B | SIS Power Failure Functional Testing Procedure – Tankside Valves Removed | P&I Design Ltd | D S Regan BEng D R Ransome |
| 23.07.12 | SI157038_RPT Revision C | SIS Power Failure Functional Testing Procedure – Tank 3 Relay No Corrected | P&I Design Ltd | D S Regan BEng D R Ransome |



| | | | | |
|----------|----------------------------|--|-------------------|---------------------------|
| 09.05.11 | SI157211_RPT Revision A | SIS Drexelbrook PCB Replacement & Testing Procedure – Original Issue | P&I Design Ltd | P Lynch D S Regan BEng |
|----------|----------------------------|--|-------------------|---------------------------|

| Activity History – Terminal in Local Fuel PLC ownership | | | | |
|---|----------------------------|---|-------------------|--------------------------|
| Date | Reference | Description | Roles | Persons assigned |
| 20.05.15 | LF364011_RPT Revision A | LFS-SIS1 Documentation Verification | P&I Design Ltd | D B Faulkner M Morgan |
| 20.05.15 | LF364012_RPT Revision A | LFS-SIS1 Shutdown Conditions Proof Testing | P&I Design Ltd | D B Faulkner M Morgan |

12.2.2 SIS Panel Factory Acceptance Tests

| Activity History – Terminal in Texaco/Chevron/Valero ownership | | | | |
|--|---|---------------|-------------------|------------------|
| Date | Reference | Description | Roles | Persons assigned |
| 09.07.08 | SI157035_RPT Revision B Controlled Copy 09.07.08 | SIS Panel FAT | P&I Design Ltd | S Micklewright |
| 25.10.13 | SI157035_RPT Revision C Controlled Copy 23.10.13 | SIS Panel FAT | P&I Design Ltd | D B Faulkner |

12.2.3 SIS Shutdowns Conditions Functional Testing

| Activity History – Terminal in Texaco/Chevron/Valero ownership | | | | |
|--|---|--|-------------------|------------------|
| Date | Reference | Description | Roles | Persons assigned |
| 11.09.08 | SI157036_RPT Revision B Controlled Copy 17.11.08 | SIS Shutdown Conditions Functional Testing | P&I Design Ltd | P Lynch |
| 11.09.08 | SI157037_RPT Revision A Controlled Copy 17.11.08 | SIS Documentation & Hardware Verification | P&I Design Ltd | P Lynch |
| 11.09.08 | SI157038_RPT Revision B Controlled Copy 17.11.08 | SIS Power Failure Testing | P&I Design Ltd | P Lynch |
| 19.05.11 | SI157211_RPT Revision A Controlled Copy 11.05.11 | SIS PCB Replacement Testing | P&I Design Ltd | P Lynch |
| 19.05.11 | SI157037_RPT Revision B Controlled Copy 11.05.11 | SIS Documentation & Hardware Verification | P&I Design Ltd | P Lynch |
| 15.06.12 | SI157037_RPT Revision C Controlled Copy 08.06.12 | SIS Documentation & Hardware Verification | P&I Design Ltd | P Lynch |
| 15.06.12 | SI157036_RPT Revision B Controlled Copy 08.06.12 | SIS Shutdown Conditions Functional Testing | P&I Design Ltd | P Lynch |



| | | | | |
|----------|---|--|-------------------|-----------------------------|
| 18.11.13 | SI157037_RPT Revision C Controlled Copy 15.11.13 | SIS Documentation & Hardware Verification Test Procedure | P&I Design Ltd | D R Pearson D B Faulkner |
| 19.11.13 | SI157036_RPT Revision D Controlled Copy 08.11.13 | SIS Shutdown Conditions Functional Testing | P&I Design Ltd | D R Pearson D B Faulkner |

12.3 Post Installation

Upon Completion of the installation, commissioning and validation, and prior to wet commissioning, the installation is to be tested and the design to be verified and all completed documentation is to be reviewed.

12.3.1 Installation and Commissioning Verification History

| | | | |
|--|---|--|--|
| Lifecycle phase in Figure 1 | Validation - Terminal in Chevron/Valero ownership | | |
| 9/9a | Utilise QSF017_SIS – Stage 3 – SIS Validation - Checklist 8 – Site Acceptance Test | | |
| SI157105_RPT Revision A – Compliance Document - Section 6 – Checklist 8 – Site Acceptance Test | QSF017 did not exist under Chevron ownership, all checklist were contained in a compliance document | | |

| Activity History – Terminal in Local Fuel PLC ownership | | | | |
|---|--------------|----------------------------------|----------------|--------------------------------------|
| Date | Reference | Description | Roles | Persons assigned |
| 11.02.16 | LF364001_QSF | XV162 actuator replacement - SAT | P&I Design Ltd | C. Dales D B Faulkner M Morgan |



13 TRAINING

Local Fuel plc are responsible for ensuring that all personnel involved in the operation and maintenance of the facility are aware of their responsibilities and are trained in operation and maintenance with respect to the SIS.

Training is to be completed to ensure that management operators and maintenance personnel understand the following:

- How the SIS functions
- The hazards the SIS is protecting against
- The operation of and consequences of:
- Override facilities
- Reset functions
- Manual shutdown facilities
- Interpretation of Alarms
- Interpretation of diagnostics
- Management understand the life cycle requirements BS EN 61511 relevant to the SIS

13.1 Training Requirements

| Lifecycle phase in Figure 1 | Activity | | | | |
|-----------------------------|--|--|---|---|--|
| | Training | | | | |
| | Objectives | Inputs | Outputs | Deliverables | Responsible persons and or organisations |
| | To ensure all operations and maintenance staff are aware of BS EN 61511 and to carry out there responsibilities competently. | SIS design BS EN 61511 awareness training Site specific toolbox training | Awareness training package On the job training | Operators and maintenance staff competent in their roles within the SIS | Functional Safety Manager |

13.2 Training History

| Activity History – Terminal in Texaco/Chevron/Valero ownership | | | |
|--|---|-----------|--|
| Date | Description | Trainer | Trainees |
| 17-18/11/2008 | Training Course on Brighton Terminal Tank Overfill Safety Instrumented System | D S Regan | Dave Crook Dan Newman Neil Perry Ian Goldsworthy Lawrence Wade Dave Winser Dan Parsons |



14 FUNCTIONAL SAFETY ASSESSMENT – STAGE 3

Stage 3 FSA - After the installation, pre-commissioning and final validation of the SIS has been completed and operating and maintenance procedures have been developed.

14.1 Functional Safety Assessment Stage 3 Requirements

| Lifecycle phase in Figure 1 | Activity | | | | |
|---|---|--|---|---|--|
| 10 | Functional Safety Assessment Stage 3 | | | | |
| | Objectives | Inputs | Outputs | Deliverables | Responsible persons and or organisations |
| | To investigate and arrive at a judgement on the functional safety achieved by the SIS | Planning for SIS functional safety assessment SRS Design Manual As Built Documentation PFD & SIL Verification Calculations | Results of SIS functional safety assessment | Functional Safety Assessment Stage 3 Document | Functional Safety Manager FSA Chairperson FSA Team |
| Functional Safety Assessment | | | | | |
| Proposed Agenda: The FSA will address the following as a minimum: <ul style="list-style-type: none"> • The recommendations and actions arising from the Stage 1 & 2 FSA have been resolved and completed; • That project design change procedures are in place and properly implemented. • The SIS is installed and pre-commissioned in accordance with the design and the SRS, any differences to be identified and resolved; • The safety, operating, maintenance and emergency procedures pertaining to the SIS are in place; • The employee training has been completed and appropriate information about the SIS has been provided to the maintenance and operating personnel; • Plans or strategies for implementing further FSA's are in place; | | | | | |

14.2 Functional Safety Assessment Stage 3 Action History

| Activity History – Terminal in Texaco/Chevron/Valero ownership | | | | |
|--|--------------|---|-------------------------------|--|
| Date | Reference | Description | Roles | Persons Assigned |
| 27.06.08 | SI157001.RPT | A Functional Safety Assessment Stage 3 was conducted for all terminals in a joint assessment. | Chair FSA Team FSA Team | D R Ransome BA CEng FlrstMC – P & I Design Ltd I Goldworthy – Facility Engineer – Chevron Ltd D S Regan BEng – Process Engineer – P & I Design Ltd |



15 OPERATION AND MAINTENANCE

Local Fuel plc are responsible for operating and maintaining the SIS in order that it's performance does not degrade.

15.1 Operation and Maintenance Requirements

| Lifecycle phase in Figure 1 | Activity | | | | |
|-----------------------------|---|---|---|--|--|
| 6 | Operation and Maintenance | | | | |
| | Objectives | Inputs | Outputs | Deliverables | Responsible persons and or organisations |
| | To ensure that the functional safety of the SIS is maintained during operation and maintenance. | SIS functional and integrity requirements SIS operations and maintenance plan including proof test intervals | SIFs actual functionality and integrity Any required changes to testing Scope of any required modifications to maintain integrity | Proof Testing Reports Fully functioning SIS | Functional Safety Manager |
| Lifecycle phase in Figure 1 | Verification Plan | | | | |
| 9 | Utilise QSF018_SIS – Stage 4 – Safety Instrument Operation & Maintenance Checklist 9 - Operation & Management | | | | |
| 9 | Utilise QSF019_SIS – Stage 4 – Safety Instrument Operation & Maintenance Checklist 10 – Proof Testing & Maintenance | | | | |



15.2 Operation and Maintenance Action History

15.2.1 SIS Testing Plan

| Activity History – Terminal in Local Fuel PLC ownership | | | | |
|---|----------------------------|--|-------------------|--------------------------|
| Date | Reference | Description | Roles | Persons assigned |
| 20.05.15 | LF364013_RPT Revision A | SIS Operation, Maintenance and Modification Lifecycle | P&I Design Ltd | D B Faulkner M Morgan |

15.2.2 SIS Shutdown Conditions Functional Test

Proof testing history recorded on LF364004_SCH – Testing Lifecycle Matrix

15.3 Operation and Maintenance Verification History

| Lifecycle phase in Figure 1 | Verification |
|--|---|
| 9 | Utilise QSF018_SIS – Stage 4 – Safety Instrument Operation & Maintenance Checklist 9 - Operation & Management |
| 9 | Utilise QSF019_SIS – Stage 4 – Safety Instrument Operation & Maintenance Checklist 10 – Proof Testing & Maintenance |
| SI157105_RPT Revision A – Compliance Document - Section 7 – Checklist 9 - Operation & Management | QSF018 did not exist under Chevron ownership, all checklist were contained in a compliance document |
| SI157105_RPT Revision A – Compliance Document - Section 7 – Checklist 10 – Proof Testing & Maintenance | QSF019 did not exist under Chevron ownership, all checklist were contained in a compliance document |



16 FUNCTIONAL SAFETY ASSESSMENT – STAGE 4

Stage 4 – After gaining experience in operating and maintenance.

16.1 Functional Safety Assessment Stage 4 Requirements

| Lifecycle phase in Figure 1 | Activity | | | | |
|---|---|--|---|---|--|
| 10 | Functional Safety Assessment Stage 4 | | | | |
| | Objectives | Inputs | Outputs | Deliverables | Responsible persons and or organisations |
| | To investigate and arrive at a judgement on the functional safety achieved by the SIS | Planning for SIS functional safety assessment SRS Design Manual Testing Records Report of all activations, spurious trips, failures and maintenance activities | Results of SIS functional safety assessment | Functional Safety Assessment Stage 4 Document | Functional Safety Manager FSA Chairperson FSA Team |
| Functional Safety Assessment | | | | | |
| Proposed Agenda: The FSA will address the following as a minimum: <ul style="list-style-type: none"> • The recommendations and actions arising from the Stage 1, 2 & 3 FSA have been resolved and completed; • Review all proof testing, activation and false alarms of the SIS; • Review any issues in operation, maintenance and proof testing of the SIS; • Review the status of operating manuals and documentation; • Plans or strategies for implementing further FSA's are in place; | | | | | |

16.2 Functional Safety Assessment Stage 4 Action History

| Activity History – Terminal in Texaco/Chevron/Valero ownership | | |
|--|-----------|---|
| Date | Reference | Description |
| | | A Functional Safety Assessment Stage 4 was not conducted. Discussions on the management of functional safety and review of each terminal was conducted by the SIS Safety Committee. |



17 MODIFICATION

17.1 Modification Requirements

| | | | | | |
|-----------------------------|--|---|---|---------------|--|
| Lifecycle phase in Figure 1 | Activity | | | | |
| 7 | Modification | | | | |
| | Objectives | Inputs | Outputs | Deliverables | Responsible persons and or organisations |
| | To make corrections, enhancements or adaptations to the SIS, ensuring that the required safety integrity level is achieved and maintained. | Scope of any required modifications to maintain integrity | As-built documentation, records and back-ups. | Modified SIS. | Functional Safety Manager |
| Lifecycle phase in Figure 1 | Verification Plan | | | | |
| 9 | Utilise QSF020_SIS – Stage 5 – Safety Instrument System Modification Checklist 11 - Modifications | | | | |

17.2 Modification Action History

| Activity History – Terminal in Texaco/Chevron/Valero ownership | | | | |
|--|---|---|--|---------------------------------|
| Date | Reference | Description | Roles | Persons assigned |
| 09.05.11 | SI157211_RPT Revision A | Drexelbrook Level Switch PCB Replacement Test Procedure | P&I Design Ltd Simon Management Ltd | D S Regan BEng I Goldsworthy |
| 11.05.11 | SI157211_RPT Revision A Controlled Copy | Drexelbrook Level Switch PCB Replacement Test Procedure Results | P&I Design Ltd Simon Management Ltd | P Lynch I Goldsworthy |
| 16.01.12 | SI157052_RPT Revision A | Trip Amplifier Wiring Modifications | P&I Design Ltd Chevron Ltd | P Lynch I Goldsworthy |

| Activity History – Terminal in Local Fuel ownership | | | | |
|---|-----------|----------------------------|----------------------------------|-------------------------------|
| Date | Reference | Description | Roles | Persons assigned |
| 15.06.15 | | XV162 actuator replacement | P&I Design Ltd Local Fuel plc | D S Regan BEng L. Salvidge |

17.3 Modification Verification History

| | | |
|--|---|--|
| Lifecycle phase in Figure 1 | Verification | |
| 9 | Utilise QSF020_SIS – Stage 5 – Safety Instrument System Modification Checklist 11 - Modifications | |
| SI157105_RPT Revision A – Compliance Document - Section 8 – Checklist 11 – Modifications | QSF020 did not exist under Chevron ownership, all checklists were contained in a compliance document. | |



18 FUNCTIONAL SAFETY ASSESSMENT – STAGE 5 MODIFICATION

Stage 5 – After modification and prior to decommissioning of the SIS.

18.1 Functional Safety Assessment Stage 5 Requirements

| Lifecycle phase in Figure 1 | Activity | | | |
|--|--|---|---|--|
| 10 | Functional Safety Assessment Stage 5 | | | |
| Objectives | Inputs | Outputs | Deliverables | Responsible persons and or organisations |
| To investigate and arrive at a judgement on the functional safety achieved by the SIS | Planning for SIS functional safety assessment SRS Design Manual Management of Change procedure for modification | Results of SIS functional safety assessment | Functional Safety Assessment Stage 5 Document | Functional Safety Manager FSA Chairperson FSA Team |
| Functional Safety Assessment | | | | |
| Proposed Agenda: The FSA will address the following as a minimum: <ul style="list-style-type: none"> • The recommendations and actions arising from the Stage 1, 2, 3 & 4 FSA have been resolved and completed; • Review of the following; <ul style="list-style-type: none"> ○ Description of the modification; ○ Reason for the modification ○ Hazards which may be affected by the modification; ○ An analysis of the impact on functional safety as a result of the proposed modification; ○ Approvals for the modification; ○ Test used to verify that the change was properly implemented and the SIS performs as required. • Assess how far within the SIS lifecycle to go back and review the impact of the modification; <ul style="list-style-type: none"> ○ LOPA ○ SRS ○ Design ○ Installation ○ Testing ○ Operation ○ Maintenance • Review the status of operating manuals and documentation in respect to the implemented modification; • Plans or strategies for implementing further FSA's are in place; | | | | |

18.2 Functional Safety Assessment 5 Action History

| Activity History | | |
|------------------|----------------|--|
| Date | Reference | Description |
| 15.06.15 | LF364100_RPT_A | FSA 5 Rev. A – XV162 Replacement – Issued with Actions |
| 07.06.16 | LF364100_RPT_B | FSA 5 Rev. B – XV162 Replacement – Final Issue |



19 DECOMMISSIONING

19.1 Decommissioning Requirements

| | | | | |
|-----------------------------|---|---|------------------------------------|--|
| Lifecycle phase in Figure 1 | Activity | | | |
| 8 | Decommissioning | | | |
| | Objectives | Inputs | Outputs | Responsible persons and or organisations |
| | To ensure that safety instrumented functions remain appropriate during decommissioning and that safety integrity of interfacing systems is not compromised. | Decommissioning plan. As-built SIS and process information | SIS and SIFs placed out of service | Decommissioned SIS. Functional Safety Manager |
| Lifecycle phase in Figure 1 | Verification Plan | | | |
| 9 | Utilise QSF021_SIS – Stage 5 – Safety Instrument System Decommissioning Checklist 12 - Decommissioning | | | |

19.2 Decommissioning Action History

| Activity History | | | | |
|------------------|-----------|-------------|-------|------------------|
| Date | Reference | Description | Roles | Persons assigned |
| | | | | |

19.3 Decommissioning Verification History

| | | |
|--|---|--|
| Lifecycle phase in Figure 1 | Verification | |
| 9 | Utilise QSF020_SIS – Stage 5 – Safety Instrument System Modification Checklist 12 - Decommissioning | |
| SI157105_RPT Revision A – Compliance Document - Section 8 – Checklist 12 – Decommissioning | QSF021 did not exist under Chevron ownership, all checklist were contained in a compliance document | |



20 FUNCTIONAL SAFETY ASSESSMENT – STAGE 5 DECOMMISSIONING

Stage 5 – Prior to decommissioning of the SIS.

20.1 Functional Safety Assessment Stage 5 Requirements

| Lifecycle phase in Figure 1 | Activity | | | |
|---|--|---|---|--|
| 10 | Functional Safety Assessment Stage 5 | | | |
| Objectives | Inputs | Outputs | Deliverables | Responsible persons and or organisations |
| To investigate and arrive at a judgement on the functional safety achieved by the SIS | Planning for SIS functional safety assessment SRS Design Manual Management of Change procedure for modification | Results of SIS functional safety assessment | Functional Safety Assessment Stage 5 Document | Functional Safety Manager FSA Chairperson FSA Team |
| Functional Safety Assessment | | | | |
| Proposed Agenda: The FSA will address the following as a minimum: <ul style="list-style-type: none"> • The recommendations and actions arising from the Stage 1, 2, 3 & 4 FSA have been resolved and completed; • The FSA will address the following as a minimum: <ul style="list-style-type: none"> ○ Review of functional safety during the decommissioning ○ Review the impact of decommissioning | | | | |

20.2 Functional Safety Assessment 5 Action History

| Activity History – Terminal in Texaco/Chevron/Valero ownership | | | | |
|--|--------------|--|-------------------------------|---|
| Date | Reference | Description | Roles | Persons Assigned |
| 02.12.12 | SI157301.RPT | A Functional Safety Assessment Stage 5 was conducted on 03.12.2012 due to the anticipated decommissioning of the Brighton Terminal. The decommissioning was later revoked, so some the actions of the FSA remain un-completed and unnecessary. | Chair FSA Team FSA Team | D R Ransome BA CEng FInstMC – P & I Design Ltd I Goldsworthy – Facility Engineer – Chevron Ltd D S Regan BEng – Process Engineer – P & I Design Ltd |



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LOCAL FUEL PLC

SHOREHAM OIL TERMINAL

SAFETY INSTRUMENTED SYSTEM

FUNCTIONAL SAFETY ASSESSMENT STAGE 5

LFS-SIS1

| Rev | Date | By | Checked | Approved | Description | Client Ref. |
|-----|----------|--------------------------------------|----------------------------|----------|-----------------------------------|-------------------------------------|
| A | 15.06.15 | D.R. Ransome | Les Salvidge | Client | Prepared for FSA 5 Meeting | |
| B | 07.06.16 | D. R. Ransome <i>D.R. Ransome</i> | Les Salvidge (Reviewed) | Client | Action Status Updated, FSA Closed | |
| | | | | | | Document No. LF364100_RPT |

IF NOT SIGNED THIS DOCUMENT IS UNCONTROLLED

Contents

| | |
|--|----|
| 1 REVISION CONTROL..... | 3 |
| 2 SCOPE & DEFINITIONS..... | 3 |
| 2.1 Scope..... | 3 |
| 2.2 Definitions..... | 3 |
| 3 INTRODUCTION..... | 5 |
| 3.1 Proposed Modification..... | 5 |
| 3.2 Team Membership..... | 5 |
| 4 FUNCTIONAL SAFETY ASSESSMENT – DEFINITIONS AND STAGES..... | 6 |
| 4.1 Stage 5 Functional Safety Assessment - Modification..... | 6 |
| 4.2 Actions from Previous FSA and Competent Authority Reports..... | 7 |
| 4.3 Proposed Modification..... | 10 |
| 4.4 Description of the Modification..... | 10 |
| 4.5 Reason for the Modification..... | 10 |
| 4.6 Hazards Which May Be Affected By The Modification..... | 11 |
| 4.7 The Impact On Functional Safety..... | 11 |
| 4.8 Approvals For The Modification and Competencies..... | 11 |
| 4.9 Timescale and Timelines..... | 11 |
| 4.10 Verification Process To Ensure Proper Implementation..... | 12 |
| 4.11 SIS Lifecycle Requirements Of The Modification..... | 12 |
| 4.12 Documentation That Will Require Updating:..... | 12 |
| 4.13 Operating Manuals And Documentation..... | 12 |
| 4.14 Training Requirements Following Modification..... | 13 |
| 5 REVIEW OF REVISED LIFECYCLE DOCUMENTATION..... | 14 |
| 5.1 Layer of Protection Analysis..... | 14 |
| 5.2 Safety Requirement Specification..... | 14 |
| 5.3 SIL Verification..... | 19 |
| 5.4 Design Documentation..... | 23 |
| 5.5 Validation and Testing Documentation..... | 28 |
| 5.6 Operating, maintenance and emergency procedures..... | 29 |
| 5.7 Suitability and Performance of the SIS..... | 29 |
| 5.8 Training..... | 32 |
| 5.9 Further Safety Assessments..... | 32 |
| 5.10 Compliance to BS EN 61511..... | 32 |
| 5.11 Separate Hazards..... | 32 |
| 5.12 Other Protection Layers..... | 32 |
| 6 CONCLUSIONS..... | 34 |
| 6.1 FSA meeting..... | 34 |
| 6.2 System Enhancements..... | 34 |
| 7 ACTION STATUS..... | 35 |



1 REVISION CONTROL

| Rev | Description |
|-----|--|
| A | Original Issue prior to FSA Meeting and initial review |
| B | Section 5.3 revised to reflect new data, Section 5.5 and 5.6 updated, Section 6 updated, section 7 added and updated for Action Status |
| | |
| | |

2 SCOPE & DEFINITIONS

2.1 Scope

Local Fuel plc – Shoreham Terminal has an Independent High Level Alarm system to provide a SIL 2 rated automatic shutdown system to prevent gasoline storage tank overfills.

The overfill protection systems are required to comply with the international standard BS EN 61511.

Functional Safety Assessment (FSA) is a component part of the process to demonstrate compliance with BS EN 61511 and that the system is providing the intended protection.

This report has been prepared as a Functional Safety Assessment Stage 5 “Modification”.

2.2 Definitions

The following abbreviations and symbols may be used within this document:

ALARP As low as reasonably practicable
BPCS Basic process control system
BSTG Buncefield Standards Task Group
CCF Common cause failure
COMAH Control of Major Accident Hazards Regulations
DC Diagnostic coverage
EC&I Electrical, Control and Instrumentation
E/E/PE Electrical/electronic/programmable electronic
E/E/PES Electrical/electronic/programmable electronic system
EMC Electro-magnetic compatibility
ESV Emergency Shutdown Valve
FAT Factory acceptance testing
FIT Failure in Time expressed as failures that can be expected in 10⁹ device hours of operation
FMEA Failure mode and effects analysis
FMEDA Failure mode effects and diagnostic analysis
FSA Functional Safety Assessment
FPL Fixed program language
FTA Fault tree analysis
FVL Full variability language
HAZOP Hazard and Operability Study
HFT Hardware fault tolerance



HMI Human machine interface
HSE Health & Safety Executive
HSL Health & Safety Laboratories
HRA Hazard risk assessment
HRA Human reliability analysis
IHLA Independent High Level Alarm
LOPA Layer of Protection Analysis
LVL Limited variability language
MIIB Major Incident Investigation Board
MOC Management of Change
MODBUS a serial communications protocol originally published by Modicon
Moon “M” out of “N”
MTBF Mean Time Between Failure
MTTR Mean Time to Repair
P&I Process and Instrumentation
PE Programmable electronics
PES Programmable electronic system
PFD Probability of failure on demand
PFD_{avg} Average probability of failure on demand
PFD_g Group probability of failure on demand
PLC Programmable logic controller
PSLG Process Safety Leadership Group
ROSOV Remotely Operated Shutoff Valve
RTC Risk Tolerance Criteria
PVST Partial Valve Stroke Testing
SAT Site acceptance test
SCADA Supervisory Control & Data Acquisition
SFF Safe failure fraction
SIF Safety instrumented function
SIL Safety integrity level
SIS Safety instrumented system
SMS Safety Management System
SRS Safety requirement
T₁ Proof Test Interval
TORA Trip Override Risk Assessment
UPS Uninterruptible Power Supply
 β = Common Cause Failure Fraction
 β_D = Detected Common Cause Failures
 λ = Failure rate (per hour)
 λ_D = Dangerous Failure Rate
 λ_{DD} = Dangerous Detected Failures
 λ_{DU} = Dangerous Undetected Failures
 λ_{SD} = Safe Detected Failures
 λ_{DU} = Safe Undetected Failures



3 INTRODUCTION

The fuel storage depot is owned and managed by Local Fuel plc and classified as a low tier site under the COMAH Regulations.

In 2014 Local Fuel plc acquired the Shoreham Terminal from Valero Energy. The existing SIS system has been in operation for a number of years, with various reviews and assessments conducted by or on behalf of Valero.

As part of Local Fuel plc responsibility and following reviews of the SIS by the Health & Safety Executive it was decided to update all documentation to reflect the new ownership. As part of these reviews it was also decided to implement a modification on components within the SIS which were not SIL rated to BS EN 61508.

This Functional Safety Assessment builds upon functional safety and lifecycle planning and management by assessing the proposed modifications to the system. It will also review all documentation of the SIS following documentation update to reflect change of ownership as well as the modification.

3.1 Proposed Modification

3.1.1 To replace the final element actuator on valve XV 162 and to update all documentation to reflect the new system owner.

3.1.2 To change the duty on two of the existing gasoline tanks to Marine Oil duty.

3.2 Team Membership

Date of Initial Review – 4th June 2015 at Local Fuel plc, Shoreham Terminal.

The FSA review team:-

Local Fuel plc

Les Salvidge is a Chartered Engineer and a Member of the Energy Institute and a Member of the Institute of Energy Technology. He is the Managing Director of Locals Fuel and has extensive experience in the petroleum industry. He has been acting in an advisory role on HSE at the Shoreham Oil Terminal due to his experience in Health and Safety management.

FSA Chair
D.R. Ransome

David Ransome is a Chartered Engineer and a Fellow of the Institute of Measurement and Control with over 40 years' experience in the Chemical and Process Industry. Formerly the Managing Director of P & I Design Ltd he now has no involvement in projects or day to day running in the business. He served on the Buncefield Standards Task Group and Process Standards leadership Group, together with contributing to the guidance produced for the PSLG final report and CDOIF guidance.



4 FUNCTIONAL SAFETY ASSESSMENT – DEFINITIONS AND STAGES

A Functional Safety Assessment is an investigation, based on evidence to judge the functional safety achieved by one or more protection layers (BS EN 61511, Definition 3.2.26). An FSA is a team activity where there is at least one senior competent person who is not involved in the project design team (BS EN 61511, Clause 5.2.6.1.2).

BS EN 61511-1 Clause 5.2.6.1.3 identifies five stages in the project lifecycle where an FSA is recommended:-

Stage 1: After the hazard and risk assessment has been carried out, the required protection layers have been identified and the safety requirement specification has been developed.

Stage 2: After the safety instrumented system has been designed.

Stage 3: After the installation, pre-commissioning and final validation of the safety instrumented system has been completed and the operation and maintenance procedures have been developed.

Stage 4: After gaining experience in operating and maintenance.

Stage 5: After modification and prior to decommissioning of a safety instrumented system.

BS EN 61511-1 Clause 5.2.6.1.4 states that “as a minimum the assessment shall be carried out prior to the identified hazards being present (i.e. stage 3)”.

4.1 Stage 5 Functional Safety Assessment - Modification

Primarily this assessment is to review the changes made by a modification to ensure that the SIS is not compromised by the modification. However, as the system has been in use for several years under Valero ownership and latterly under Local Fuel ownership elements that would have been reviewed in a FSA1, 2 & 4 will be included, as far as practicable.

The FSA will address the following:

The recommendations and actions arising from previous FSA have been resolved and completed;

Review of the following;

- Description of the modification;
- Reason for the modification
- Hazards which may be affected by the modification;
- An analysis of the impact on functional safety as a result of the proposed modification;
- Approvals for the modification;
- Test used to verify that the change was properly implemented and the SIS performs as required.



Assess how far within the SIS lifecycle to go back and review the impact of the modification, i.e;

- LOPA
- SRS
- Design
- Installation
- Testing
- Operation
- Maintenance

Review the status of operating manuals and documentation in respect to the implemented modification;

Plans or strategies for implementing further FSA's are in place;

4.2 Actions from Previous FSA and Competent Authority Reports

A FSA Stage 2 was conducted on 19th June 2008 by Chevron (previous company name of Valero). This assessment of the design was conducted for all Valero terminals as the design intent was identical. No actions remain open from this assessment.

A FSA Stage 3 was conducted by way of a compliance document between March 2009 and March 2010 the final issue being revised post installation. No actions remain open from this assessment.

With regard to FSA Stage 4, Valero were in the process of conducting Stage 4 assessments when the decision was taken to either sell or de-commission the terminal, so a FSA Stage 4 has not be conducted at the Shoreham Terminal.

In December 2012 a FSA Stage 5 was initiated for the de-commissioning of the SIS, this FSA was only partly completed as Valero then sold the terminal as opposed to de-commissioning. No actions are therefore relevant to the SIS.

On 30th July 2014 an assessment was conducted by the COMAH Competent Authority. Nine actions were raised from the assessment of which:

- actions one to seven were related to functional safety,
- action eight related to Automatic Tank Gauging system which provides a layer of protection albeit the system is providing a safety function of low/undefined safety integrity as defined in HSE/SPC/Technical/General/51.
- Action nine related to DSEAR.

The functional safety actions are detailed below, however, not to duplicate with other control documents the action history is not detailed in the assessment, other than showing action status.

Action control for this FSA is conducted utilising a live action tracker called ASANA. This allows up to date status of all actions. A snapshot from ASANA will be appended to this FSA for the status of each action relevant to the issue of the FSA.



HSE Visit Actions

| No. | Action | Status |
|--|--|--------|
| 300714/1 | Functional Safety Implementation Plan | Closed |
| Description | | |
| <p>Gaps were identified against recommended good practice and these have been raised as individual actions (2 through 8). A Functional Safety implementation plan should be produced which identifies how and when these gaps will be closed. The plan should include all the stages of the FS safety lifecycle.</p> | | |

| No. | Action | Status |
|--|--|--------|
| 300714/2 | Management of Functional Safety | Closed |
| Description | | |
| <p>The Company does not have SIS management policies and procedures in place that describe how the Shoreham Terminal plan, specify, design, install, commission, operate and test SIS. The Company should therefore produce and implement suitable Functional Safety management policies and associated procedures for the Shoreham Terminal. These documents should detail how all the safety lifecycle stages are managed and implemented including defined roles and responsibilities, SIS asset register, obsolescent equipment (end of life), logging true demands, spurious trips, management of change (modification of SIS) and decommissioning.</p> | | |

| No. | Action | Status |
|---|---|--------|
| 300714/3 | Hazard Analysis, SIL Assessment & Safety Requirements Specifications | Closed |
| Description | | |
| <p>The Company should complete the hazard analysis and SIL assessments for the Shoreham Terminal operations including MLA's, Tanker Loading and Jetty operations. The HA activities should include all credible Major Accident Scenarios and result in the identification of all safety functions.</p> <p>The Company should determine SIS integrity using a suitable SIL assessment technique (stated to be the LOPA). The assessments should consider Human Response, utility failure and IPL's should be independent and reliability data justified and referenced (traceable).</p> <p>Safety Requirements Specifications for each SIS should be produced to include (but not be limited to) documented Safety function, integrity, architecture, response times, operation, diagnostics, inhibits, interfaces, test frequency and MTTR.</p> | | |



| No. | Action | Status |
|---|-----------------------------------|--------|
| 300714/4 | SIS Design and Engineering | Closed |
| Description | | |
| <p>The Company should use the results of the HA and SIL assessment work (Action 300714/3) to;</p> <ol style="list-style-type: none"> 1. Design new SIS as necessary in alignment with the SIF and SIL requirements identified and documented from the HA and SIL assessment activities. New SIS should conform to benchmark standard BS EN 61511 or equivalent. 2. Perform gap analysis of existing (legacy) systems against the SIF and SIL requirements identified and documented from the HA and SIL assessment activities. The analysis should be used to re-engineer the existing systems where necessary to fulfil the SIS requirements and conform to BS EN 61511 or equivalent as far as is reasonably practicable. | | |

| No. | Action | Status |
|--|---|--------|
| 300714/5 | Installation, Commissioning and Verification | Closed |
| Description | | |
| <p>The Company should use the design and engineering documentation (Action 300714/4) to complete the installation of new and modification (re-engineering) of existing systems where necessary. All SIS should be verified through commissioning and validation activities as appropriate. This should include identification and as-built drawings.</p> | | |

| No. | Action | Status |
|---|----------------------------------|--------|
| 300714/6 | Operation and Maintenance | Closed |
| Description | | |
| <p>The Company should develop written operating, inspection and maintenance procedures for the SIS on the Shoreham Terminal. Operating procedures should include logging demands, resets and inhibits. Proof testing procedures should be developed to reveal all undiagnosed dangerous failures specific for each SIF, end-to-end, unauthorised modifications, labelling, weathering, erosion, corrosion, security, diagnostics, pass/fail criteria, approvals, defects and follow-up. Consideration should be given to the inspection of the Drexelbrook and Rotork valve ('XV162') in alignment with the manufacturers recommendations. Training should be provided to personnel involved with SIS at the Shoreham Terminal (BS EN 61511, clause 5.2.2).</p> | | |



| No. | Action | Status |
|--|------------------------------|--------|
| 300714/7 | Functional Safety Assessment | Closed |
| Description | | |
| The Company should perform a suitable (including suitable independence) Functional Safety Assessment on all SIS on the Shoreham Terminal. For new systems this will be at minimum stage 3 (before the identified hazard is introduced), for legacy systems this may need to be a stage 4 assessment. | | |

4.3 Proposed Modification

The FSA Meeting was held at the terminal on 4th June 2015. The purpose of the meeting was to review the proposed modification and identify all requirements to ensure the modification was performed in accordance with BS EN 61511 and did not compromise functional safety.

4.4 Description of the Modification

- a). Replacement of a non SIL certified component with a BS EN 61508 certified component and update of all appropriate lifecycle documentation. This involves replacement of the electro-hydraulic actuator on XV 162.
- b). Currently gasoline is imported to Tanks 1, 2, 3 & 4. It is intended that gasoline in future will only be imported into Tanks 1 & 3 and that Tanks 2 & 4 will be converted to Marine Gas oil service. As a result of this the SIS requires modifying to remove Tanks 2 & 4 from operating XV 162. Tanks 2 & 4 will retain their sensors and become alarm only, they will however, be proof tested in line with the SIS. Local Fuel plc decided that they intended to leave Tanks 2 & 4 connected to the SIS as they felt this would not interfere with the operations and provided diversity in future for the existing tanks protected by the SIS.

4.5 Reason for the Modification

- a). As part of the HSE inspection visit see Action 4 above. The fact that a single valve is installed on a SIL 2 system requires further justification for a non BS EN 61508 certified component. This requires specific consideration (hardware fault tolerance) which was justified under Valero ownership by 'proven in use' data i.e. extensive use of that type of valve across their terminals worldwide for many years. Local Fuel can not use that justification and this means that either a second valve is required or use equipment having an BS EN 61508 certificate. For the final element components, the PEKOS ball valve does have certification, although the current actuator is not SIL certified the new equivalent Rotork actuator has obtained certification. Following discussions with Rotork they advise that it does not apply retrospectively and as such it has been decided that a replacement of the actuator will be necessary to gain compliance of the overall system in providing SIL 2 capability with HFT = 0. In addition Valero has a spare actuator in their UK facilities. Local Fuel do not have a spare actuator and as such, the lack of a spare could result in the MTTR being unacceptable. This could further impact on terminal operations effectively shutting down the terminal due to a single failure. In order to satisfy all of these constraints it is intended to replace the actuator and utilise the non-SIL rated actuator as a spare in the unlikely event of the SIL rated actuator failing and not being able to be repaired by the UK facility of the manufacturer. Local Fuel



appreciate that additional management procedures may need to be implemented should the change over be required until the SIL rated actuator is returned to service. This should produce a MTTR in accordance with the SIL verification of within 24 hours.

b). Current company strategy is diversity in the Terminal and as the quantities of gasoline have reduced the extra storage capacity will be utilised for Marine Gas oil because recent legislation has increased the demand for MGO in the location.

4.6 Hazards Which May Be Affected By The Modification

No change in the hazard perceived.

a). The Rotork actuator should perform identically to the existing installed device. However, there may be subtle differences within the actuators firmware and as such the complete system is to be proof tested following completion of the installation.

The sensors and logic solver are as original for Tanks 1, 2, 3 & 4 gasoline tanks.

Distillate tanks 5, 6, 7, 8, 9, 10, 11, 18, 18A, 21 & 22 utilise RF technology sensors but are alarm only.

b). The change of Tank duty will reduce the terminals current capacity for the storage of gasoline from four to two tanks. This was addressed in the LOPA report LF364002_RPT.

4.7 The Impact On Functional Safety

a). As this is a change of actuator it is essential that it performs as specified. Checks must be completed to ensure that systematic failures are not induced through the design phase, and manufacturing phases, including:

- Ensure sufficient oversizing and torque to close against ships pumps
- Ensure slow closing not to induce pressure surge issues in import line
- Confirm failures mode operation including loss of power

b). No impact on functional safety is perceived from the reduction in gasoline storage.

4.8 Approvals For The Modification and Competencies

For the modification, Local Fuel MOC's will be completed and this FSA Stage 5 will be conducted to ensure compliance to functional safety and to BS EN 61511 lifecycle.

4.9 Timescale and Timelines

a). At the FSA meeting it was advised that the Rotork is on a long delivery. However, design has commenced with the Safety Requirement Specification having been updated.

The documentation has been revised with the references to Chevron/Valero being removed and creating new issue drawings for Local Fuel plc. These drawings at Revision A will be reviewed by this FSA. It may become necessary to revise them further for the modifications.



4.10 Verification Process To Ensure Proper Implementation

The design is to be verified by the designer in accordance with the quality and management of functional safety policies and in accordance with BS EN 61511. At the design stage testing documentation is to be produced the purpose of which is to provide a series of testing procedures which will ensure that the probability of failure on demand figure of the installed system is maintained through the operating life of the SIS. Where known, dangerous undetected failures should be identified and a method of detecting for these included within the testing regime.

In addition necessary FAT and SAT are to be conducted to ensure the installed system performs in the required manner.

All testing documentation to be reviewed as part of this FSA on completion of the modification.

Local Fuel plc will also utilise their documents LF363003_RPT – Policy & Lifecycle Activities and LF363004_RPT – SIS Safety Plan for Management of Functional safety purposes.

4.11 SIS Lifecycle Requirements Of The Modification

As stated previously all lifecycle documentation is being updated and as such is to be reviewed as part of this FSA.

4.12 Documentation That Will Require Updating:

Layer of Protection Analysis – depending on outcome of Action 1.
Safety Requirement Specification
System Verification Document
Loop Drawings
Cable & Wiring Drawings
Testing Documentation
Management of Functional Safety Document

4.13 Operating Manuals And Documentation

All design documentation is to be re-issued together with manufacturers maintenance manuals. Local Fuel to develop operator manuals or other suitable guidelines for operation and actions to take in the result of SIS activation.

Action 2:



4.14 Training Requirements Following Modification

Local Fuel employees who were originally employed by Valero have already been provided with SIS awareness and on the job training.

Additional awareness training was conducted on 4th June 2015 to Local Fuel plc employees with further on the job training following installation of the modified system.



5 REVIEW OF REVISED LIFECYCLE DOCUMENTATION

5.1 Layer of Protection Analysis

The LOPA has been reviewed and accepted by the HSE. The SIL 2 Overfill Protection System within the LOPA was estimated with a PFD of 0.005.

5.2 Safety Requirement Specification

Although this FSA is a Stage 5, it was decided to fully review all documentation, not just that required as part of the modification. This was decided upon as all documentation has been re-issued for Local Fuel plc and is effectively new issues.

In order to ensure compliance to BS EN 61511 the SRS was reviewed as follows:

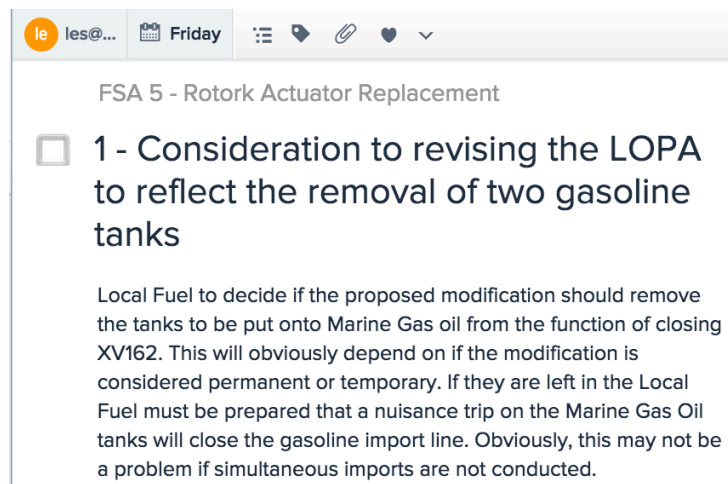
5.2.1 *Do the Safety Instrumented Functions (SIF) derive from a HAZOP or LOPA study, if not where are they derived from. BS EN Clause 8 & 9.*

Section 2.1 of the SRS references the LOPA and the requirements for a SIL 2 SIS to be installed on the gasoline tanks.

5.2.2 *Has the Safety Integrity Level (SIL) for each SIF been allocated. BS EN Clause 9.*

Section 4.6 of the SRS details the SIF requirements for Tanks 1, 2, 3 & 4, which prior to the proposed Marine Gas Oil modification were all available for gasoline. As stated previously the LOPA considered that only two of these tanks would be utilised.

ACTION 1:



5.2.3 *Has the demand on the SIF been specified (demand or continuous). BS EN Clause 10.*

Section 3 of the SRS confirms that the system is a low demand SIS with a demand on the SIF of no more frequently that one in every ten years.



5.2.4 *Is each SIF described adequately, together with a definition of the safe state. BS EN Clause 10.*

Section 4.6 of the SRS provides information of the function and safe state.

5.2.5 *Have common cause failures been considered. BS EN Clause 10.*

Section 2.3 of the SRS details that the SIF's are non-redundant and as such common cause failure should not be an issue. However, although not really a common cause failure as such, the failure of XV162 is common to all gasoline tanks and as such a total failure of this valve will have the effect of preventing gasoline imports to both tanks.

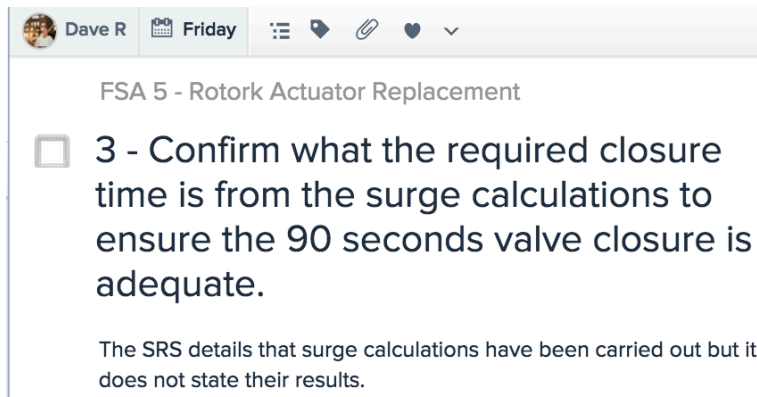
5.2.6 *Have process conditions been considered which could have an effect on the limitations of sensors or final elements. (e.g corrosion, plugging, coating). BS EN Clause 10.*

Section 3 of the SRS defines the conditions likely to have an effect of the SIS.

5.2.7 *Are performance requirements defined. (e.g speed of closure of valve). BS EN Clause 10.*

Section 4.6 of the SRS defines the requirements of slow closure of the final element to prevent pipeline surge. As the actuator is electrically operated there should be no difficulty in achieving the stated 90 seconds closure time. Section 2.3 defines that surge calculations have been carried out but it does not define what the actual safe closure time is.

Action 3:



The screenshot shows a task list item in a software interface. At the top, there is a header bar with a profile picture of 'Dave R', a calendar icon showing 'Friday', and several utility icons (list, location, link, heart, dropdown). Below the header, the task title is 'FSA 5 - Rotork Actuator Replacement'. The main task description is '3 - Confirm what the required closure time is from the surge calculations to ensure the 90 seconds valve closure is adequate.' There is a small square checkbox to the left of the task number. Below the task description, there is a note: 'The SRS details that surge calculations have been carried out but it does not state their results.'

5.2.8 *Are sensor inputs defined with respect to range, accuracy etc. BS EN Clause 10.*

The SIF operates at a selected location in the tanks and as such is a switch, so no range is required.

5.2.9 *Have the process setpoints and trips been defined. BS EN Clause 10.*

The process setpoint is provided in Section 4.6 of the SRS.



5.2.10 *Is there a description of the relationship between inputs, logic solver and outputs and any specific requirements requiring 1oo2, 2oo2 systems or specific requirements regarding nuisance tripping. BS EN Clause 10.*

Section 2.4 of the SRS provides a simplified system model of the SIF, this together with Section defines the inputs, logic solver and outputs of the SIS.

5.2.11 *Has the mean time to repair been specified with consideration to availability of spares and labour. BS EN 61511 Clause 10.*

Section 3 of the SRS defines a MTTR of 24 hours, it further states that the filling of the tanks are on a batch process with extremely long intervals between imports providing for proof testing and other maintenance to be carried out in these time intervals. Section 4.5 of this FSA defines further the proposed intention of a spare valve.

5.2.12 *Have manual shutdowns been considered. BS EN 61511 Clause 10.*

Section 4.6 of the SRS states that manual shutdown is available by manual control of the valve and also on operation of the ESD pushbutton.

5.2.13 *Is there a requirement for overrides and if so has the effect on the SIF been considered. BS EN Clause 10.*

Section 2.3 of the SRS states that there are no facilities for overriding the SIF.

5.2.14 *Have the interfaces with the Basic Process Control System (BPCS) been defined. BS EN Clause 10.*

Section 4.4 of the SRS defines BPCS interface.

5.2.15 *Can the BPCS interfere with the safe operation of the SIF. BS EN 61511 Clause 10.*

Section 4.4 that the BPCS can have no effect on the operation of the SIS.

5.2.16 *Has the method of resetting the system been defined. BS EN Clause 10.*

Section 3 of the SRS states that automatic reset of the final element shall not be possible.

5.2.17 *Have environmental and abnormal events been considered. (e.g. temperature, humidity, fire etc.) BS EN Clause 10.*

Section 3 of the SRS provides information on the environmental operating parameters of the SIS.

5.2.18 *If the SIS logic solver is software based have the application software requirements been specified. BS EN Clause 10 & 12.*

The logic solver is not software based.



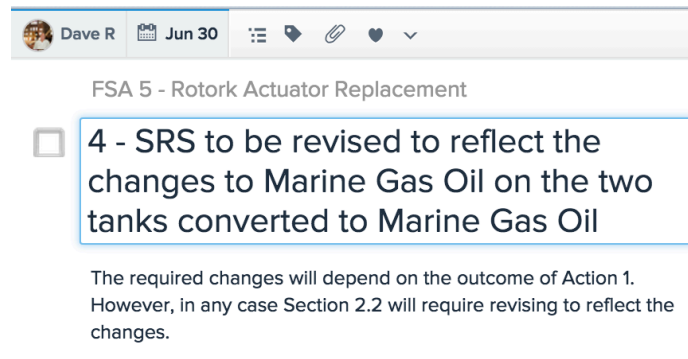
5.2.19 SRS Review

Sections 5.2.1 to 5.2.18 of this FSA review the SRS with respect to it providing the required information to comply with the relevant clauses of BS EN 61511.

The following details are more general review of the SRS in respect to the requirements of the functionality of the SIS.

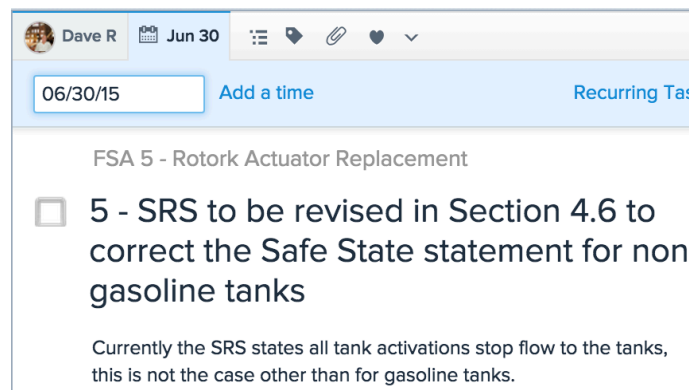
- Section 2.2 of the SRS details that activation of a high level in any of the four gasoline tanks Tank 1, 2, 3 & 4 will close the common import valve XV162. Activation of any of the remaining Tank high level sensors will provide an alarm. However, Section 4.6 of the SRS contradicts this is stating in the section “Safe State” that they also stop the flow to all tanks.
 - Action 1 previously requires Local Fuel plc to consider if the Tanks to be converted to Marine Gas Oil should operate on the gasoline import valve. The conclusion to this will also have an impact in modifying the SRS to reflect how the modified system is to operate.

Action 4:



The screenshot shows a task management interface. At the top, there is a header bar with a user profile icon labeled 'Dave R', a calendar icon labeled 'Jun 30', and several utility icons. Below the header, the task title is 'FSA 5 - Rotork Actuator Replacement'. The main content area contains a task item with a checkbox on the left and the text '4 - SRS to be revised to reflect the changes to Marine Gas Oil on the two tanks converted to Marine Gas Oil'. Below the task text, there is a descriptive paragraph: 'The required changes will depend on the outcome of Action 1. However, in any case Section 2.2 will require revising to reflect the changes.'

Action 5:

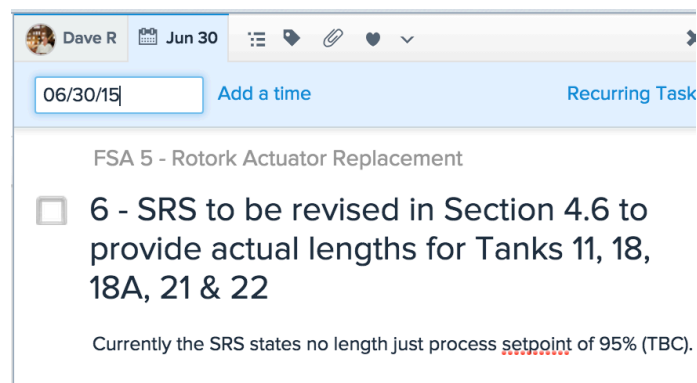


The screenshot shows a task management interface. At the top, there is a header bar with a user profile icon labeled 'Dave R', a calendar icon labeled 'Jun 30', and several utility icons. Below the header, there is a date input field containing '06/30/15' and buttons for 'Add a time' and 'Recurring Task'. The task title is 'FSA 5 - Rotork Actuator Replacement'. The main content area contains a task item with a checkbox on the left and the text '5 - SRS to be revised in Section 4.6 to correct the Safe State statement for non gasoline tanks'. Below the task text, there is a descriptive paragraph: 'Currently the SRS states all tank activations stop flow to the tanks, this is not the case other than for gasoline tanks.'



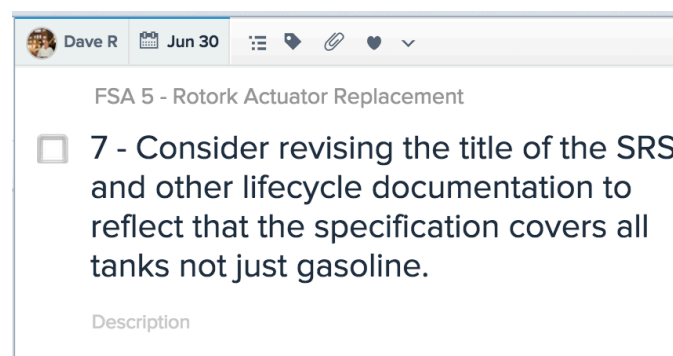
- Section 4.6 details the individual tank activation point for all tanks with the exception of tanks 11, 18, 18A, 21 & 22 were it states 95% (TBC).

Action 6:

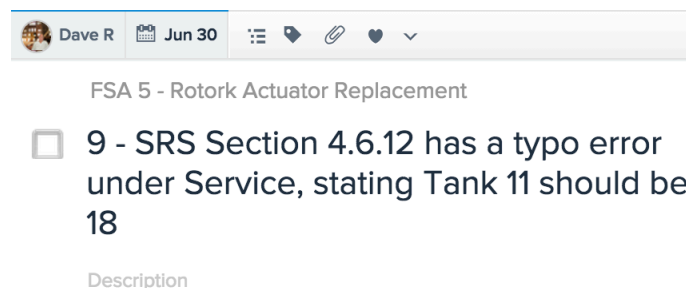


- The title of the SRS and other lifecycle documentation is confusing as it is specific in stating Gasoline Import Safety Instrumented System yet the documents are written for all tanks not just gasoline. The SRS also provides for future individual tankside valves. This obviously derives from the previous owner with future plans to provide individual tank isolation in addition to or opposed to common pipeline isolation.

Action 7:



- Section 4.6.12 – there is a typo error should be Tank 18 not Tank 11 as described in the Service section.



5.3 SIL Verification

Document LF364006_RPT Revision A was reviewed as part of this FSA. It was noted that it has been written for inclusion of the new SIL rated XV162 actuator but not for the later modification for the change of two gasoline tanks to Marine Oil tanks. Again, depending on the outcome of Action 1, this document may also need revising, see also Action 7 regarding the title.

As part of the FSA SIL Verification, the data used to calculate the pfd was reviewed and detailed below:

Sensor:

The sensors employed within the SIS are Drexelbrook IntelliPoint RF transmitters providing a 4 – 20mA signal, although this is not analog in normal understanding of analog. The devices utilises this as a carrier signal and depending on the status of the sensor provides a corresponding mA signal: 8mA - Alarm, 16mA - Normal, 22mA – Fault.

The failure data is provided as:

Table 1: Failure rates according to IEC 61508

| Safety IntelliPoint RF™ Series Point Level Switch | λ^{sd} | λ^{su2} | λ^{dd} | λ^{du} | SFF |
|---|----------------|-----------------|----------------|----------------|-------|
| High Level Fail Safe application | 0 FIT | 300 FIT | 686 FIT | 73 FIT | 93.2% |

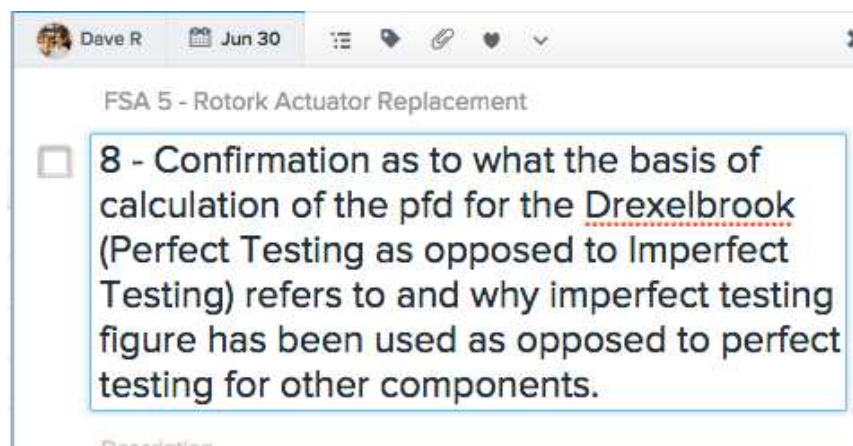
These failure rates are valid for the useful lifetime of the product, see Appendix A.

A user of the Safety IntelliPoint RF™ Series Point Level Switch can utilize these failure rates in a probabilistic model of a safety instrumented function (SIF) to determine suitability in part for safety instrumented system (SIS) usage in a particular safety integrity level (SIL). A full set of failure rates is presented in section 4.5 along with all assumptions.

The calculation within the SIL Verification document Section 6.5 utilises the above data and confirms that a PFD = 3.38×10^{-4} it is noted that the calculation refers to this pfd being for perfect testing and imperfect testing provides a pfd of 8.57×10^{-4} . The device has a SFF of 0.93 and as such satisfies HFT = 0 in accordance with BS EN 61508.

REVISION B OF FSA – ACTION 8 CONFIRMS 8.57×10^{-4} .

Action 8:



Logic Solver:

As stated in the above section that the sensor provides a 4 – 20mA signal which changes relevant to its status. The safety manual for the sensor requires a logic solver which can monitor and act upon this change of mA signal, it further states that it the signal should be monitored for a 1mA change.

This is provided for within the logic solver by utilising a trip amplifier which is set at 15mA falling and 17mA rising, mA signal outside this range will result in the de-energising of the trip amplifiers relay output which is fed into the coil of a PILZ safety relay.

The pfd data on the Trip Amplifier is:

Acc. Table 3: Summary for the Transmitter Supply Isolators KF-CRG2-*** (relay output)**

| T[Proof] = 1 year | T[Proof] = 2 years | T[Proof] = 5 years | SFF | DC _S | DC _D |
|-------------------------------|-------------------------------|-------------------------------|-------|-----------------|-----------------|
| PFD _{AVG} = 3.94E-04 | PFD _{AVG} = 7.88E-04 | PFD _{AVG} = 1.97E-03 | > 83% | 3% | 50% |

$$\lambda_{sd} = 9,00E-09 \text{ 1/h} = 9 \text{ FIT}$$

$$\lambda_{su} = 3,47E-07 \text{ 1/h} = 347 \text{ FIT}$$

$$\lambda_{dd} = 8,90E-08 \text{ 1/h} = 89 \text{ FIT}$$

$$\lambda_{du} = 9,00E-08 \text{ 1/h} = 90 \text{ FIT}$$

The calculation within the SIL Verification document Section 6.5 utilises the above data and confirms that a $PFD_S = 3.98 \times 10^{-4}$ it is noted that the calculation refers to this pfd being for perfect testing and imperfect testing provides a pfd of 3.94×10^{-4} . The device has a SFF of 0.83 and as such would not satisfy HFT = 0 in accordance with BS EN 61508. However, the device has been assessed and certified by Exida Prior Use against the requirements of BS EN 61511 and is certified as appropriate for a single device in a SIL 2 system.

The second part of the logic solver is a PILZ PNOZ s2 safety relay. The device has internal architecture providing a 1oo2D with internal diagnostic coverage of 99% and providing a SFF of 0.99. In accordance with BS EN 61508 the device can be utilised in a SIL 3 system. However, in accordance with BS EN 61511 the device is limited to SIL 2 for a single device. The pfd is certified as 2.13×10^{-5} . REVISION B OF THE FSA CONFIRMED AS 2.2×10^{-5} .





Safety Relay Type PNOZ s2
Internal Safety Integrity Details

| Description | Type A Logic Subsystem (pre-designed) |
|---|---------------------------------------|
| Device | Safety Relay |
| Manufacturer | Pilz Automation |
| Model | PNOZ s2 |
| BSEN 61508 internal architecture | 1oo2D* |
| Internal Diagnostic Coverage...DC | 99% |
| Safe Failure Fraction.....SFF | 99% |
| Common Cause Failure.....CCF | 2% |
| Sensor Sub-System input | 1oo1 |
| MTTF _L | 5.0E-07 |
| Probability of Dangerous failure on Demand | |
| BSEN 61508.....PFD | 2.13E-05 |
| BSEN61508 Sil claim limit for relay...SILCL | 3 |
| BSEN61511 Sil claim limit for relay...SILCL | 3 |
| Probability of Dangerous Failure per Hour | |
| BSEN61508.....PFH _d | 2.5E-09 |
| BSEN62061 Sil claim limit for relay...SILCL | 3 |
| BSEN 954-1 category | 4 |
| BSENISO 13849-1 performance level...PL | e |
| BSENISO 13849-1 category... | 4 |
| Proof Test IntervalT (yrs) | 20 |

Final Element:

The PILZ safety relay provides normally open volt free contacts. A 24V dc supply originating in the Rotork actuator is fed through these contacts and back to the hardwired ESD circuit contained with the actuator. The actuator is capable of being operated remotely, however, without the 24V dc input to the ESD circuit the actually will fail closed.

It is certified to BS EN 61508 by SIRA for use in a SIL 2 SIS with HFT = 0. As it has fairly recently being certified it also has a Systematic Capability assessment with a resulting SC3.

REVISION B OF FSA ACTUAL DEVICE SI-2Q REVISED DATA.

| Safety Function: 'To move the actuator to the end position by means of a spring when the ESD signal is removed'. | | | | |
|---|---|---|---|--|
| Summary of clauses 2/7.4.2&2/7.4.4 | Best Config Value | Worst Config Value | Average Value | Verdict |
| Architectural constraints | HFT=0 | | | Type A |
| Safe Failure Fraction (SFF) | 83% | 87% | 85% | SIL 2 |
| Random hardware failures: [h ⁻¹] | λ_{DB} λ_{DU} | 0.00×10^0 1.20×10^{-7} | 0.00×10^0 2.66×10^{-7} | 0.00×10^0 1.82×10^{-7} |
| Random hardware failures: [h ⁻¹] | λ_{SD} λ_{SU} | 0.00×10^0 5.81×10^{-7} | 0.00×10^0 1.83×10^{-6} | 0.00×10^0 1.11×10^{-6} |
| PFD @ PTI = 8760Hrs ⁽¹⁾ MTTR = 8 Hrs ⁽¹⁾ | | 5.27×10^{-4} | 1.17×10^{-3} | 7.99×10^{-4} SIL 2 |
| Hardware safety integrity compliance | Route 1 _H | | | |
| Systematic safety integrity compliance | Route 1 _S | | | |
| Systematic capability | SC3* (See report 56A28091B) | | | |
| Overall SIL achieved | SIL 2 due to architectural constraints (SFF) | | | |

Table 1b: Summary of Failure Data of SI-2Q.

REVISION A - The value used for the actuator in LF364006_RPT utilises the average value from the certified data. This FSA checked what the overall pfd of the SIS would be if the worst case value was used, this changed the PFD_{sys} from 3.57×10^{-3} to 3.94×10^{-3} which is still within the required 5.00×10^{-3} required from the LOPA.

REVISION B - The value used for the actuator in LF364006_RPT_Revision B utilises the worst config value 1.17×10^{-3} value from the certified data. Resulting in a PFD_{sys} from 3.93×10^{-3} which is still within the required 5.00×10^{-3} required from the LOPA.



The second part of the final element sub-system is a PEKOS ball valve. Exida have certified this component as SIL 3 capable. In accordance with BS EN 61511 the device can be used in a SIL 3 with HFT = 1 and SIL 2 with HFT = 0 with a PFD of 1.48×10^{-3} .

Type A device, IEC 61508 failure rates in FIT [$\lambda := 10^{-9}/h$]

| Valve and application | Full Stroke | | | Tight Shutoff | | | Open to trip | | |
|----------------------------|------------------|----------------|----------------|------------------|----------------|----------------|------------------|----------------|----------------|
| | λ_{safe} | λ_{dd} | λ_{du} | λ_{safe} | λ_{dd} | λ_{du} | λ_{safe} | λ_{dd} | λ_{du} |
| V1 Clean service | 1650 | 0 | 626 | 614 | 0 | 1662 | 1834 | 0 | 442 |
| V1 Clean service with PVST | 1650 | 292 | 334 | 614 | 292 | 1370 | 1834 | 292 | 150 |
| V2 Clean service | 2092 | 0 | 644 | 1103 | 0 | 1633 | 2276 | 0 | 460 |
| V2 Clean service with PVST | 2092 | 303 | 341 | 1103 | 303 | 1330 | 2276 | 303 | 157 |
| V3 Clean service | 1782 | 0 | 726 | 381 | 0 | 2127 | 2056 | 0 | 452 |
| V3 Clean service with PVST | 1782 | 298 | 428 | 381 | 298 | 1829 | 2056 | 298 | 154 |

PVST - Partial Valve Stroke Test

Calculation Summary:

REVISION B- From the supplied components and BS EN 61508 certification it confirms that the system does comply to the requirements of a PFD and HFT for a SIL 2 SIS, with a PFD_{SYS} of 3.93×10^{-3} .

SAFETY INTEGRITY LEVEL REQUIRED

SIL 2 ▼

SAFETY INTEGRITY LEVEL ACHIEVED

Valid

CALCULATION SUMMARY

| | | | | | | | |
|---------------|---|-----------------|-------|-----------------|-------|-----------------|-------|
| $PFD_{(SYS)}$ | = | $PFD_{(S)}$ | | $PFD_{(L)}$ | | $PFD_{(FE)}$ | |
| 3.93E-03 | = | 8.57E-04 | Valid | 2.20E-05 | Valid | 1.17E-03 | Valid |
| | | | Valid | 3.98E-04 | Valid | 1.48E-03 | Valid |
| Valid | | <u>8.57E-04</u> | Valid | <u>4.20E-04</u> | Valid | <u>2.65E-03</u> | Valid |

SPURIOUS TRIP SUMMARY

| | | | | | | | |
|-------------------------|---|-----------------------|-------|-----------------------|-------|------------------------|-------|
| S.Trip _(SYS) | = | S.Trip _(S) | | S.Trip _(L) | | S.Trip _(FE) | |
| 16.0 | = | 115.8 | Years | 59.1 | Years | 62.4 | Years |
| Years | | | Years | 2.6E+02 | Years | 5.9E+01 | Years |
| | | | Years | | Years | | Years |



5.4 Design Documentation

As stated in Section 4.12 the following documentation requires to be modified to reflect the modifications.

5.4.1 Safety Requirement Specification

This is detailed in Section 5.2.

5.4.2 SIL Verification Document

This is detailed in Section 5.3.

5.4.3 Equipment Specifications

| Specification Number | Title | Revision |
|----------------------|--|----------|
| LF364001_SPC | Level Switch – Floating Deck Switching points to be checked with LOC document when received see Action 10. | A |
| LF364002_SPC | Level Switch – Fixed Roof Switching points to be checked with LOC document when received see Action 10. Actual insertion lengths for Tanks 11, 18, 18A 21 and 22 to be added following Action 10. | A |
| LF364005_SPC | Annunciator | A |
| LF364006_SPC | Pipeline Import Valve There is no mention of the valve slow closing on the specification. Reference is made to actuator details appearing on sheet 2, yet sheet 2 is Documentation Requirements, it should say see specification LF364021_SPC | A |
| LF364007_SPC | Overfill protection/ESD Safety Relays | A |
| LF346008_SPC | Isolating units | A |
| LF346009_SPC | Isolating units | A |
| LF364021_SPC | Valve Actuator Add reference to valve details on LF364006_SPC | A |
| LF364056_SPC | East Bund SIS AC JB | A |
| LF364057_SPC | West Bund SIS AC JB | A |
| LF364058_SPC | East Bund SIS DC JB | A |
| LF364059_SPC | West Bund SIS DC JB | A |
| LF364060_SPC | East Bund SIS IS JB | A |
| LF364061_SPC | West Bund SIS IS JB | A |
| LF364062_SPC | Additive Tanks SIS IS JB | A |
| | | |



Action 14:



5.4.4 Reports

| Report Number | Title | Revision |
|---------------|---|----------|
| LF364001_RPT | Functional Safety Implementation Plan This document was specific to Local Fuel implementing improvements to their management and operation of SIS. It is not a lifecycle document and has not been reviewed by this FSA. | B |
| LF364002_RPT | Layer of Protection Analysis See Action 1. | D |
| LF364003_RPT | Policy & Lifecycle Activities To be updated. | B |
| LF364004_RPT | Safety Plan To be updated. | C |
| LF364005_RPT | Safety Requirement Specification See Section 5.2 | B |
| LF364006_RPT | SIL Verification See Section 5.3 | A |

5.4.5 IHLA Calculation Sheet

As the products and Tanks are changing there is a requirement to up date the Level of Concerns document which details the Tanks, associated products, alarm activation point and high high alarm setting.

Action 10:



5.4.6 Design Drawings

| Drawing Number | Title | Revision |
|----------------|--|----------|
| LF364001_DWG | <p>East Bund Cable Overview Drawing</p> <p>XV162 is shown as going to AC JB and XVa62/1 as going to DC JB. These descriptions are reversed and should be XV162 to DC JB and VX162/1 to AC JB.</p> <p>Arrows are shown on tankside VRU valves indicating flow direction, yet they are missing for the import and export valves, add arrows to import and export valves.</p> | A |
| LF364002_DWG | West Bund Cable Overview Drawing | A |
| LF364003_DWG | Additive Tanks Cable Overview Drawing | A |
| LF364004_DWG | East Bund I.S. Junction Box Connection Details | A |
| LF364005_DWG | West Bund I.S. Junction Box Connection Details | A |
| LF364006_DWG | Additive Tanks I.S. Junction Box Connection Details | A |
| LF364007_DWG | East Bund DC Junction Box Connection Details – TB1 | A |
| LF364008_DWG | East Bund DC Junction Box Connection Details – TB2 | A |
| LF364009_DWG | West Bund DC Junction Box Connection Details | A |
| LF364010_DWG | Valve Power Distribution Board | A |
| LF364011_DWG | East Bund AC Junction Box Connection Details | A |
| LF364012_DWG | East Bund AC Junction Box Connection Details – TB2 | A |
| LF364013_DWG | West Bund AC Junction Box Connection Details – TB1 | A |
| LF364014_DWG | West Bund AC Junction Box Connection Details – TB2 | A |
| LF364015_DWG | Site Plan – SIS Equipment | A |
| LF364016_DWG | Rotork Valve Control Network | A |
| LF364017_DWG | Alarm Annunciator Connection Details – AN001 | A |
| LF364018_DWG | Alarm Annunciator Connection Details – AN002 | A |
| LF364019_DWG | Alarm Annunciator Connection Details – AN003 | A |
| LF364020_DWG | Logic Panel Drawing 1 | A |
| LF364021_DWG | Logic Panel Drawing 2 | A |
| LF364022_DWG | Logic Panel Drawing 3 | A |
| LF364023_DWG | Logic Panel Drawing 4 | A |
| LF364024_DWG | Logic Panel Drawing 5 | A |
| LF364025_DWG | Logic Panel Drawing 6 | A |
| LF364026_DWG | Logic Panel Drawing 7 | A |
| LF364027_DWG | Logic Panel Drawing 8 | A |
| LF364030_DWG | Logic Panel External Layout | A |
| LF364031_DWG | Logic Panel Internal Layout | A |
| LF364040_DWG | <p>Loop Sheet – XV162</p> <p>There are two drawings referencing the power distribution to the XV's, loop sheets reference varies, add reference to LF364010_DWG.</p> | A |
| LF364041_DWG | <p>Loop Sheet – XV123</p> <p>There are two drawings referencing the power distribution to the XV's, loop sheets reference varies, add reference to LF364010_DWG.</p> | A |
| LF364042_DWG | <p>Loop Sheet – XV124</p> <p>The title is incorrect, this is an export valve not import.</p> <p>There are two drawings referencing the power distribution to the XV's, loop sheets reference varies, add reference to LF364010_DWG.</p> | A |



| | | |
|--------------|--|---|
| LF364043_DWG | Loop Sheet – XV155 There are two drawings referencing the power distribution to the XV's, loop sheets reference varies, add reference to LF364010_DWG. | A |
| LF364044_DWG | Loop Sheet – XV156 There are two drawings referencing the power distribution to the XV's, loop sheets reference varies, add reference to LF364010_DWG. | A |
| LF364045_DWG | Loop Sheet – XV121 There are two drawings referencing the power distribution to the XV's, loop sheets reference varies, add reference to LF364010_DWG. | A |
| LF364046_DWG | Loop Sheet – XV122 There are two drawings referencing the power distribution to the XV's, loop sheets reference varies, add reference to LF364010_DWG. | A |
| LF364047_DWG | Loop Sheet – XV157 There are two drawings referencing the power distribution to the XV's, loop sheets reference varies, add reference to LF364010_DWG. | A |
| LF364048_DWG | Loop Sheet – XV158 There are two drawings referencing the power distribution to the XV's, loop sheets reference varies, add reference to LF364010_DWG. | A |
| LF364049_DWG | Loop Sheet – XV129 There are two drawings referencing the power distribution to the XV's, loop sheets reference varies, add reference to LF364010_DWG. | A |
| LF364050_DWG | Loop Sheet – XV130 There are two drawings referencing the power distribution to the XV's, loop sheets reference varies, add reference to LF364010_DWG. | A |
| LF364051_DWG | Loop Sheet – XV159 There are two drawings referencing the power distribution to the XV's, loop sheets reference varies, add reference to LF364010_DWG. | A |
| LF364052_DWG | Loop Sheet – XV126 There are two drawings referencing the power distribution to the XV's, loop sheets reference varies, add reference to LF364010_DWG. | A |
| LF364053_DWG | Loop Sheet – XV127 There are two drawings referencing the power distribution to the XV's, loop sheets reference varies, add reference to LF364010_DWG. | A |
| LF364054_DWG | Loop Sheet – XV160 There are two drawings referencing the power distribution to the XV's, loop sheets reference varies, add reference to LF364010_DWG. | A |
| LF364055_DWG | Loop Sheet – XV161 There are two drawings referencing the power distribution to the XV's, loop sheets reference varies, add reference to LF364010_DWG. | A |
| LF364056_DWG | Loop Sheet – XV118 There are two drawings referencing the power distribution to the XV's, loop sheets reference varies, add reference to LF364013_DWG. | A |
| LF364057_DWG | Loop Sheet – XV119 There are two drawings referencing the power distribution to the XV's, loop sheets reference varies, add reference to LF364013_DWG. | A |
| LF364058_DWG | Loop Sheet – XV116 There are two drawings referencing the power distribution to the XV's, loop sheets reference varies, add reference to LF364013_DWG. | A |
| LF364059_DWG | Loop Sheet – XV117 There are two drawings referencing the power distribution to the XV's, loop sheets reference varies, add reference to LF364013_DWG. The cable number VCOM24 is incorrect it is VCO23. | A |
| LF364060_DWG | Loop Sheet – XV114 There are two drawings referencing the power distribution to the XV's, loop sheets reference varies, add reference to LF364013_DWG. | A |



| | | |
|--------------|--|---|
| LF364061_DWG | Loop Sheet – XV115 The title does not contain the XV number as do other loop sheets, add XV115 to title. There are two drawings referencing the power distribution to the XV's, loop sheets reference varies, add reference to LF364013_DWG. | A |
| LF364062_DWG | Loop Sheet – XV110 There are two drawings referencing the power distribution to the XV's, loop sheets reference varies, add reference to LF364013_DWG. | A |
| LF364063_DWG | Loop Sheet – XV111 There are two drawings referencing the power distribution to the XV's, loop sheets reference varies, add reference to LF364013_DWG. | A |
| LF364064_DWG | Loop Sheet – XV108 There are two drawings referencing the power distribution to the XV's, loop sheets reference varies, add reference to LF364014_DWG. | A |
| LF364065_DWG | Loop Sheet – XV109 There are two drawings referencing the power distribution to the XV's, loop sheets reference varies, add reference to LF364014_DWG. | A |
| LF364066_DWG | Loop Sheet – XV106 There are two drawings referencing the power distribution to the XV's, loop sheets reference varies, add reference to LF364014_DWG. | A |
| LF364067_DWG | Loop Sheet – XV107 There are two drawings referencing the power distribution to the XV's, loop sheets reference varies, add reference to LF364014_DWG. | A |
| LF364070_DWG | Loop Sheet – LS01 | A |
| LF364071_DWG | Loop Sheet – LS02 | A |
| LF364072_DWG | Loop Sheet – LS03 | A |
| LF364073_DWG | Loop Sheet – LS04 | A |
| LF364074_DWG | Loop Sheet – LS05 | A |
| LF364075_DWG | Loop Sheet – LS06 | A |
| LF364076_DWG | Loop Sheet – LS07 | A |
| LF364077_DWG | Loop Sheet – LS08 | A |
| LF364078_DWG | Loop Sheet – LS09 | A |
| LF364079_DWG | Loop Sheet – LS10 | A |
| LF364080_DWG | Loop Sheet – LS11 | A |
| LF364081_DWG | Loop Sheet – LS18 | A |
| LF364082_DWG | Loop Sheet – LS18A | A |
| LF364083_DWG | Loop Sheet – LS21 | A |
| LF364084_DWG | Loop Sheet – LS22 | A |
| LF364075_DWG | Loop Sheet – LS06 | A |
| LF364076_DWG | Loop Sheet – LS07 | A |
| LF364077_DWG | Loop Sheet – LS08 | A |

Action 12:



5.4.7 Schedules

| Schedule Number | Title | Revision |
|-----------------|-------------------------------|----------|
| LF364001_SCH | Trip Matrix | A |
| LF364002_SCH | Instrument Schedule | A |
| LF364003_SCH | Testing matrix | A |
| LF364004_SCH | Testing Lifecycle matrix | A |
| LF364010_SCH | Cable Schedule – Sheet 1 of 2 | A |
| LF364010_SCH | Cable Schedule – Sheet 2 of 2 | A |

Not reviewed within Revision A of this FSA. Revision B See Section 5.5.

5.4.8 Testing and Inspection Documentation

| Report Number | Title | Revision |
|---------------|--|----------|
| LF364011_RPT | Documentation Verification | A |
| LF364012_RPT | Shutdown Conditions Proof Testing | A |
| LF364013_RPT | Operation Maintenance and Modification Lifecycle | A |

Not reviewed within Revision A of this FSA. Revision B See Section 5.5.

5.4.9 Management of Functional Safety Document

The Management of Safety Plan requires to be updated to reflect the changes in the documentation, together with the proposed modification and details of this FSA.

Action 11:



5.5 Validation and Testing Documentation

Following the installation of the new actuator, site acceptance tests were conducted. These tests are documented and recorded within the following:

- LF364040_DWG Marked up Controlled Copy Loop Diagram
- LF364003_QSF Instrument Installation Certificate of Conformance
- LF364004_QSF Instrument Installation Conformance Control – Cold & Hot tests
- Rotork – Actuator Commissioning Report Dated 18-19th January 2016
- LS364001-QSF Site Acceptance Test Validation Checklist



Following the SAT a proof test was conducted on the SIS on 11th February 2016. The proof test utilised the following documentation:

LF364001_HDR Handover certificate
LF364011_RPT SIS LFS-SIS1 Documentation Verification
LF364012_RPT SIS LFS-SIS1 Shutdown Conditions Proof Testing

The following were noted from the testing:

A coms cable showing SWA was removed as it was no longer used.

Closing time not in specified limits, this was reviewed and revised in the appropriate documentation and safety plan.

LF364013_RPT SIS LFS-SIS1 Operation, Maintenance and Modification Lifecycle
LF364002_SCH controlled copy Instrument Schedule
LF364003_SCH controlled copy Cause & Affect Matrix

5.6 Operating, maintenance and emergency procedures

During the installation phase, operators are to be made familiar of the changes to the SIS. It is not envisaged that any additional training, other than on the job familiarisation will be required.

Action 2 details that Local Fuel have revised and created new procedures utilising an external consultant.

5.7 Suitability and Performance of the SIS

5.7.1 Description of Operation

Existing Gasoline Tanks

The SIS is a combination of four (prior to Marine Gas Oil modification) SIF's albeit they are interactive with each other in that operation of any sensor results in the final element going to its safe state. In addition there are eleven other tanks which are fitted with a similar type of SIL rated sensor and utilise the same logic solver albeit just to provide an alarm. The description below just relates to the SIF's on the gasoline tanks, the other tanks utilise the same technique, however, there is no automatic final element, the operator is warned of operation of a high high level by annunciation and on the SCADA system, he is then required to take manual intervention. Annunciation and SCADA repeats are also provided for Tanks 1, 2, 3 & 4.

Each of the four gasoline Tank sensors is connected to a trip amplifier which detects for a change in mA signal from the sensor, although the device is in effect a switch it provides an analog output equating to 8mA = Alarm, 16mA = Normal, 22mA = Fault, the trip amplifier is fitted with two relay output setpoints one at 17mA rising and the other at 15mA falling. Hence, if the sensor output is not above 15mA and below 17mA then the corresponding relay will open circuit. A 24Vdc feed is fed into the trip amplifier and through both relay contacts, the output from the trip amplifier is wired to the coil of a further safety relay via a safety relay contacts which are operated by the site ESD system. The sensor is fitted with an external test facility to simulate high level.



Tank 1:

Sensor – Drexelbrook Intellipoint – Tag Number – LE 01
Trip Amplifier – Pepperl & Fuchs KFD2 – Tag Number – LS 01
Safety Relay – PILZ PNOZ-S2 – Tag Number – R252

Tank 2:

Sensor – Drexelbrook Intellipoint – Tag Number – LE 02
Trip Amplifier – Pepperl & Fuchs KFD2 – Tag Number – LS 02
Safety Relay – PILZ PNOZ-S2 – Tag Number – R292

Tank 3:

Sensor – Drexelbrook Intellipoint – Tag Number – LE 03
Trip Amplifier – Pepperl & Fuchs KFD2 – Tag Number – LS 03
Safety Relay – PILZ PNOZ-S2 – Tag Number – R332

Tank 4:

Sensor – Drexelbrook Intellipoint – Tag Number – LE 04
Trip Amplifier – Pepperl & Fuchs KFD2 – Tag Number – LS 04
Safety Relay – PILZ PNOZ-S2 – Tag Number – R372

The final element wiring comprises a 24Vdc feed fed from XV162 Rotork actuator into Tank 1 Safety Relay which has two positively guided contacts per output, the safety function utilises channel three of the relay. The output from this relay is then fed in series through the safety relays of Tank 2, 3 and 4 all having two positively guided contacts, the output from Tank 4 safety relay is fed back to the ESD circuit of the Rotork actuator.

Each of the safety relays, R252, R292, R332 and R372 require resetting following de-energisation, this is achieved by a reset pushbutton operating onto a relay R805. This ensures that following an activation the system cannot re-open any valve without firstly all level sensors being in their normal mode.

The final element sub-system comprises of an isolator switch located in the field then to the rotork actuator. This isolator isolates the mains supply to the valve.

Gasoline Pipeline:

Isolator – Tag Number – HS162
Rotork Actuator and Ball Valve – XV162

There is no facility for overriding the system and it is noted that any spurious trip or sensor fault will result in total shutdown of all four tanks as any sensor activation or fault shuts down the common import valve.

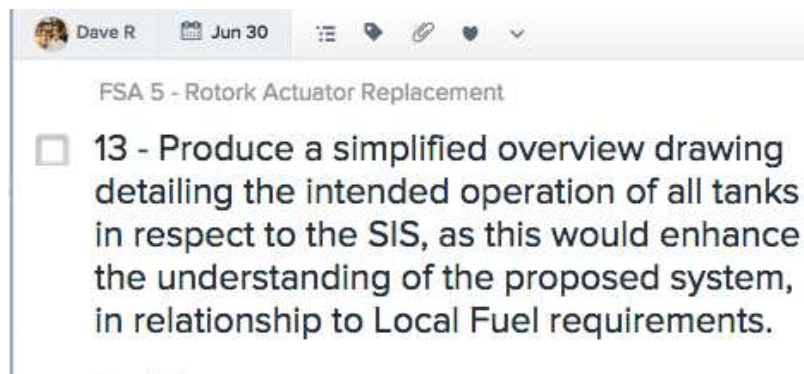
In addition to the shutdown facility of the logic solver with regard to the common pipeline valve, the logic solver has future enhancement built into by the previous owners in order to provide for closing of a tankside inlet valve and return flow from the VRU. In addition the logic solver provides for closing the tankside export valve and VRU feed valve on activation of the ESD.

It is felt that it would be unpractical to remove this enhancement, in line with the current operating methods of Local Fuel, however, it is felt that a simplified overview drawing



detailing the intended operation of all tanks in respect to the SIS would enhance the understanding of the proposed system, in relationship to Local Fuel requirements.

Action 13:



5.7.2 Performance

The FSA reviewed the performance of the SIS over the 18 months that it has been in the ownership of Local Fuel, the following were considered:

Actual Activations: (Demand on System)

No activations have occurred.

Spurious Trips:

No spurious trips have occurred.

Random Hardware Failure:

No hardware failures have occurred.

Systematic Capability and Systematic Failures:

No systematic failures have been identified.

Operating Difficulties:

Local Fuel plc have taken over the operation of the Terminal and the SIS with no handover from Valero. They have now operated the system for 18 months and have had no difficulty or problems with the system.

Interface with BPCS:

The import valve is opened and closed via the HMI system. However, the BPCS can not interfere with the operation of the SIS system as this is performed on the dedicated hardwired input to the valve.



The SIS sensors are all displayed on the HMI, but again this is indication only and cannot interfere with the SIF.

Maintenance Issues:

No issues have been identified.

Functional Capability:

The functional capability of the SIS has not been affected by this modification. The required protection remains as defined, in that any high level on Tanks 1, 2,3 & 4 will automatically close the jetty import pipeline valve XV162.

5.8 Training

As stated previously SIS awareness training has been conducted for all operational staff of Local Fuel plc.

5.9 Further Safety Assessments

Other than for any FSA 5's due to modification, which will be conducted as and when, it is not expected to perform a further FSA 4 for approximately three years when Local Fuel plc will have approximately five years of Terminal ownership and experience in operation of these systems.

5.10 Compliance to BS EN 61511

The SIS, in general, is based upon the requirements of the BS EN 61511 lifecycle. Additional lifecycle documentation has been created and updated as a result of this FSA, to assist in proof testing and management of functional safety of the SIS. The PFD of the installed system complies to the requirements of the LOPA and HFT of BS EN 61511, by the utilisation of SIL certified components.

5.11 Separate Hazards

The FSA discussed if any additional hazards were created by having the SIS. The only identified hazard is the un-expected closure of the import valve resulting in an increased back pressure to the ship. This is a know issue and the valve is specified to close slowly, typically 90 seconds, furthermore, a siren is provided at the jetty to inform the ship that the SIS has activated and the valve is closing.

5.12 Other Protection Layers

Within the LOPA a number of other protection layers, mitigation layers, enabling events and cross checks were included that were not part of the Safety Instrumented System but need to be operated and maintained as they are fundamental to the calculated SIL of the SIS. It is considered important that these non SIS protection layers are monitored to ensure they are independent, effective and auditable.



Local Fuel plc confirmed that Motherwell provide maintenance and six monthly checks on the tank gauging system. They provide full visit reports which are maintained by Local Fuel plc.

Prior to Local Fuel plc taking over the Terminal, no drawings were available for the BPCS. This has now been rectified and all documentation is available on site comprising of 48 drawings.



6 CONCLUSIONS

6.1 FSA

Following this FSA, all actions have now been completed, the SIS has been fully tested and is now within the operational phase of the SIS lifecycle. The PFD of the installed system complies to the requirements of a SIL 2 system and management procedures have been developed to control the SIS throughout the late lifecycle phases. It is necessary for the system owner to ensure that the SIS provides the calculated level of protection by monitoring, recording and analysing all activities associated with the SIS, including activations, spurious activations, maintenance activities, proof testing also to ensure that any proposed further modifications are reviewed prior to the modification commencing.

6.2 System Enhancements

There are no intended system enhancements planned or needed for the SIS at this moment in time.



7 ACTION STATUS

FSA 5 - Rotork Actu...

✓ 1 - Consideration to revising the LOPA to reflect the removal of two gasoline tanks

Local Fuel to decide if the proposed modification should remove the tanks to be put onto Marine Gas oil from the function of closing XV162. This will obviously depend on if the modification is considered permanent or temporary. If they are left in the Local Fuel must be prepared that a nuisance trip on the Marine Gas Oil tanks will close the gasoline import line. Obviously, this may not be a problem if simultaneous imports are not conducted.

 [LF364002_RPT - LOPA Review.doc](#)

David Ransome created task. May 26, 2015

David Ransome changed the due date to June 12. Jun 4, 2015

David Ransome changed the name to "1 - Consideration to revising the LOPA to reflect the removal of two gasoline tanks". [Show Original](#) Jun 9, 2015

David Ransome changed the description. [Show Difference](#) Jun 9, 2015

David Ransome assigned the task. Jun 9, 2015

David Ransome changed the due date to August 14. Aug 12, 2015

David Ransome assigned to Les Salvidge. Jan 19

David Ransome changed the due date to January 22. Jan 19

David Ransome assigned to Dave Regan. Feb 3

David Ransome changed the due date to February 5. Feb 3



David Ransome Feb 3 at 10:52am



Dave has the LOPA been updated to reflect above.



Dave Regan  attached Feb 3 at 11:00am



[LF364002_RPT - LOPA Review.doc](#)



Dave Regan Feb 3 at 11:00am



The LOPA was updated to include for the change of duty. If you consider this acceptable, close out the action.

Martin Morgan assigned to you. Yesterday

Martin Morgan changed the due date to May 6. Yesterday

Martin Morgan marked today. Yesterday



David Ransome Today at 8:45am



LOPA has been updated to reflect change of duty to gasoline tanks. The LOPA under review was specifically for gasoline so id different products are to b e considered. it would not be part of this LOPA .




David Ransome completed this Task. Today at 8:45am





LS Les S  Jan 22     

FSA 5 - Rotork Actu...

 **2 - Local Fuel to develop operator manuals or other suitable guidelines for operation and actions to take in the result of SIS activation.**

Description



[View earlier activity](#)

 **David Ransome** Jan 12 at 10:08am 
Martin

Did the operating manuals get produced.

David Ransome changed the due date to January 15. Jan 12

David Ransome changed the due date to January 22. Jan 19



 **Martin Morgan** Feb 4 at 7:38am 
Example flowchart handed to Les at last HSE visit for development into Local Fuel procedures

Martin Morgan assigned to Les Salvidge. Feb 4

 **David Ransome** May 6 at 12:13pm 
Response from Les Salvidge:

We did employ Valero's H&S Officer at the back end of last year. Linda Dixon has life long experience managing H&S and Environment with Texaco, Chevron and Valero. With Linda and Martins help all of last year's Actions are now closed including Action 9 (Electrical Inspections Policy).


Linda with our in house help wrote up all operator instructions and put them onto a database which does prompt us when actions are due. She is confident that it complies.

 **David Ransome** May 6 at 12:13pm 
Action Closed

 **David Ransome completed this Task.** May 6 at 12:13pm 





FSA 5 - Rotork Actu...

 **3 - Confirm what the required closure time is from the surge calculations to ensure the 90 seconds valve closure is adequate.**


The SRS details that surge calculations have been carried out but it does not state their results.

David Ransome created task. Jun 9, 2015
David Ransome added to FSA 5 - Rotork Actuator Replacement. Jun 9, 2015
David Ransome assigned to Dave Regan. Jun 9, 2015
David Ransome changed the due date to June 12. Jun 9, 2015

 **Dave Regan completed this Task.** Jun 12, 2015 at 8:50am 

 **Dave Regan** Jun 12, 2015 at 8:52am 
In document SI157001.MIN, minutes of meeting 14th May 2007, Ian Goldsworthy confirmed a closure time of 90 seconds was suitable for Pipeline surge calculations.

FSA 5 - Rotork Actu...

 **4 - SRS to be revised to reflect the changes to Marine Gas Oil on the two tanks converted to Marine Gas Oil**

The required changes will depend on the outcome of Action 1. However, in any case Section 2.2 will require revising to reflect the changes.

David Ransome created task. Jun 10, 2015
David Ransome added to FSA 5 - Rotork Actuator Replacement. Jun 10, 2015
David Ransome assigned to Dave Regan. Jun 10, 2015
David Ransome changed the due date to June 30. Jun 10, 2015

David Ransome changed the due date to August 14. Aug 12, 2015

 **Dave Regan** Aug 20, 2015 at 2:15pm 
SRS Updated

David Ransome changed the due date to January 22. Jan 19

Martin Morgan assigned to you. Yesterday
Martin Morgan changed the due date to May 6. Yesterday
Martin Morgan marked today. Yesterday

 **David Ransome completed this Task.** Today at 9:03am 





David R



May 6



FSA 5 - Rotork Actu...



5 - SRS to be revised in Section 4.6 to correct the Safe State statement for non gasoline tanks

Currently the SRS states all tank activations stop flow to the tanks, this is not the case other than for gasoline tanks.

David Ransome created task. Jun 10, 2015



Dave Regan Aug 20, 2015 at 2:14pm
SRS Revised



David Ransome changed the due date to January 22. Jan 19

Martin Morgan assigned to you. May 2
Martin Morgan changed the due date to May 6. May 2
Martin Morgan marked today. May 2



David Ransome completed this Task. May 3 at 9:03am





✓ 6 - SRS to be revised in Section 4.6 to provide actual lengths for Tanks 11, 18, 18A, 21 & 22 ✕



95% (TBC).

 [LF364005_RPT_C - Safety Requirement Specification.pdf](#)

[Hide earlier activity](#)

David Ransome created task. Jun 10, 2015



 **Dave Regan** Aug 20, 2015 at 2:14pm 
Tanks Removed form SRS, tanks no longer in service

 **Martin Morgan** Feb 4 at 10:41am 
Although Tanks have been taken out of service and the inputs linked to a healthy state in the panel, all documentation other than SRS still reflects the fact they are physically installed. This is confusing when coming to test the system. Recommend all documentation is aligned or potentially level systems removed and documentation updated accordingly ?

Martin Morgan assigned to you. May 2




Martin Morgan changed the due date to May 6. May 2

Martin Morgan marked today. May 2

 **Martin Morgan** May 4 at 3:25pm 
Further comment - Tanks listed above are still present on all other documentation e.g. SIL verification report, drawings, spec sheets, testing documentation. Extensive work required to fully remove them, certainly beyond the scope of the current modification. SRS LF364005_RPT_C section 2.3.2 does make mention of the tanks and the fact they are currently out of service. Section 4.6 data will be retained in previous revisions of the SRS and could be reinstated and verified if these tanks are ever brought back into service.

 **Martin Morgan**  **attached** May 4 at 3:25pm 
[LF364005_RPT_C - Safety Requirement Specification.pdf](#)

Martin Morgan assigned to you. May 4

 **David Ransome** May 6 at 9:25am  
This seems a sensible approach, Action Closed

✓ **David Ransome completed this Task.** May 6 at 9:25am 





Dave R



May 6



FSA 5 - Rotork Actu...



7 - Consider revising the title of the SRS and other lifecycle documentation to reflect that the specification covers all tanks not just gasoline.

Description

David Ransome created task. Jun 10, 2015



Dave Regan Aug 20, 2015 at 2:14pm

Titel Cahnged to remove refernce to Gasoline Import



Martin Morgan Feb 4 at 10:45am

Title on SRS only changed, the action required this for all lifecycle documentation.



Martin Morgan marked today. Feb 4

Martin Morgan changed the due date to February 12. Feb 4

Martin Morgan changed the due date to May 6. May 2



David Ransome completed this Task. May 3 at 9:04am





David R



May 13



FSA 5 - Rotork Actu...



8 - Confirmation as to what the basis of calculation of the pfd for the Drexelbrook (Perfect Testing as opposed to Imperfect Testing) refers to and why imperfect testing figure has been used as opposed to perfect testing for other components.

Description



[LF364006_RPT_B - Safety Instrument System - Shoreham.pdf](#)

[View earlier activity](#)



Dave Regan May 11 at 9:09am



The basis of calculation should have included imperfect testing and the SIS Design document has been updated.

Dave Regan unmarked today. May 11

Dave Regan assigned to Martin Morgan. May 11

Dave Regan changed the due date to May 13. May 11



Martin Morgan attached May 13 at 1:01pm



[LF364006_RPT_B - Safety Instrument System - Shoreham.pdf](#)

Martin Morgan assigned to you. May 13



Martin Morgan May 13 at 1:01pm



LF364006_RPT_B attached for FSA sign off. Rev A working copy on server.



Martin Morgan May 13 at 1:12pm



Note also that Rotork PFD data updated as SI 1 data had been used and this has now been changed to SI2.1 data. FSA report section 5.3 and screen dumps will need updating.



David Ransome Today at 11:27am



FSA5 Revision B updated to reflect changes.



David Ransome completed this Task. Today at 11:27am





Dave R



May 6



FSA 5 - Rotork Actu...



9 - SRS Section 4.6.12 has a typo error under Service, stating Tank 11 should b

Description

David Ransome created task. Jun 11, 2015

David Ransome added to FSA 5 - Rotork Actuator Replacement. Jun 11, 2015

David Ransome assigned to Dave Regan. Jun 11, 2015

David Ransome changed the due date to June 30. Jun 11, 2015

David Ransome changed the due date to August 14. Aug 12, 2015



Dave Regan Aug 20, 2015 at 2:13pm



Tanks 11 & 18 removed from SRS. Tanks no longer in service

Martin Morgan changed the name to "9 - SRS Section 4.6.12 has a typo error under Service, stating Tank 11 should b". [Show Original](#) Jan 18

David Ransome changed the due date to January 22. Jan 19

Martin Morgan changed the due date to May 6. May 2

Martin Morgan marked today. May 2



David Ransome completed this Task. May 3 at 9:05am





David R



May 13



FSA 5 - Rotork Actu...



10 - Update Level of Concerns document

Description



[Tank Levels of Concern \(LOCs\) Worksheet Updated July 2015.pdf](#)

[Copy of TANK LEVEL OF CONCERNS.xlsx](#)

David Ransome created task. Jun 11, 2015



Dave Regan attached Aug 12, 2015 at 2:30pm

[Tank Levels of Concern \(LOCs\) Worksheet Updated July 2015.pdf](#)



Dave Regan completed this Task. Aug 12, 2015 at 2:30pm



Dave Regan Aug 12, 2015 at 2:30pm

LOC document received

Dave Regan marked incomplete. May 11



Martin Morgan May 13 at 1:03pm

See also comments under action 14 - LF364001_SPC

Martin Morgan assigned to you. May 13

Martin Morgan marked today. May 13

Martin Morgan changed the due date to May 13. May 13



David Ransome attached Today at 11:39am

[Copy of TANK LEVEL OF CONCERNS.xlsx](#)



David Ransome Today at 11:40am

LoC Document revised.



David Ransome completed this Task. Today at 11:40am





David R



May 13



FSA 5 - Rotork Actu...



11 - Update SIS Safety Plan

The Management of Safety Plan requires to be updated to reflect the changes in the documentation, together with the proposed modification and details of this FSA.



[LF364004_RPT_C_WC - Management of Functional Safety Plan.pdf](#)

David Ransome created task. Jun 11, 2015

Martin Morgan changed the due date to May 6. May 2
Martin Morgan marked today. May 2



Martin Morgan May 4 at 4:30pm
Updated but needs final check



Dave Regan changed the due date to May 31. May 11



Martin Morgan May 13 at 11:59am
Management of functional safety plan updated. Rev C with working copy changes showing, attached. Rev D will be completed and final version of FSA 5 added to section 18.2



Martin Morgan unmarked today. May 13
Martin Morgan assigned to you. May 13
Martin Morgan marked today. May 13
Martin Morgan changed the due date to May 13. May 13



Martin Morgan attached May 13 at 2:38pm
[LF364004_RPT_C_WC - Management of Functional Safety Plan.pdf](#)



David Ransome completed this Task. Today at 11:43am



✓ 12 - Update drawings to reflect comments from the FSA

Phil Potter assigned to Martin Morgan. May 6
Phil Potter changed the due date to May 9. May 6

PP Phil Potter May 6 at 1:44pm 
Drawings updated with FSA5 comments

MM Martin Morgan  attached May 13 at 1:06pm 
[LF364002_DWG_B - LFS-SIS1 West Bund Cable Overview.pdf](#)

MM Martin Morgan  attached May 13 at 1:06pm 
[LF364010_DWG_B - Valve Power Distribution Board.pdf](#)

MM Martin Morgan  attached May 13 at 1:06pm 
[LF364011_DWG_B - East Bund A.C. Junction Box TB1.pdf](#)

MM Martin Morgan  attached May 13 at 1:06pm 
[LF364012_DWG_B - East Bund A.C. Junction Box TB2.pdf](#)

MM Martin Morgan  attached May 13 at 1:06pm 
[LF364013_DWG_B - West Bund A.C. Junction Box TB1.pdf](#)

MM Martin Morgan  attached May 13 at 1:06pm 
[LF364014_DWG_B - West Bund A.C. Junction Box TB2.pdf](#)

MM Martin Morgan  attached May 13 at 1:06pm 
[LF364040_DWG_B - XV162 Pipeline Import Valve Loop Sheet.pdf](#)

MM Martin Morgan  attached May 13 at 1:06pm 
[LF364059_DWG_B - XV117 Tank 6 Export Valve Loop Sheet.pdf](#)

MM Martin Morgan  attached May 13 at 1:06pm 
[LF364061_DWG_B - XV115 Tank 7 Export Valve Loop Sheet.pdf](#)

MM Martin Morgan May 13 at 1:07pm 
Updated drawings attached. Further cross referencing also added to LF364011 to 014_DWG

Martin Morgan marked today. May 13
Martin Morgan assigned to you. May 13
Martin Morgan changed the due date to May 13. May 13

MM Martin Morgan  attached May 17 at 11:26am 
[LF364001_DWG_B - LFS-SIS1 East Bund Cable Overview.pdf](#)

MM Martin Morgan May 17 at 11:27am 
LF364001_DWG_B updated to reflect pipework connections shown on new schematic drawing LF364000_DWG

✓ **David Ransome completed this Task.** Today at 11:45am 





David R



May 13



FSA 5 - Rotork Actu...



13 - Produce a simplified overview drawing detailing the intended operation of all tanks in respect to the SIS, as this would enhance the understanding of the proposed system, in relationship to Local Fuel requirements.

Description



[LF364000_DWG_A - LFS-SIS1 Schematic Overview.pdf](#)

David Ransome created task. Jun 15, 2015

Martin Morgan marked today. Feb 4

Martin Morgan changed the due date to February 12. Feb 4

Martin Morgan changed the due date to May 6. May 2

Dave Regan unmarked today. May 11

Dave Regan assigned to Phil Potter. May 11

Dave Regan changed the due date to May 13. May 11



Phil Potter completed this Task. May 17 at 9:33am



Martin Morgan attached May 17 at 11:27am



[LF364000_DWG_A - LFS-SIS1 Schematic Overview.pdf](#)

Martin Morgan marked incomplete. May 17

Martin Morgan assigned to you. May 17



David Ransome Today at 11:47am



Reviewed by FSA 5. It was noted that the overview drawing shows the possibility for future tankside valves.



David Ransome completed this Task. Today at 11:47am





David R



May 6



FSA 5 - Rotork Actu...



14 - Update Specification to reflect comments in FSA

Description

David Ransome created task. Jun 15, 2015

Martin Morgan marked today. Feb 4

Martin Morgan changed the due date to February 12. Feb 4



Martin Morgan Feb 4 at 1:50pm



Rotork have confirmed installed actuator to be:

Model No. - SI-2.1-Q80-031-51-10AG

Serial No. - RS463901



Martin Morgan Feb 5 at 1:26pm



Valve and actuator specs updated. Details to be confirmed at new actuator SAT w/c 8th Feb. Further spec updates required as detailed in FSA 5.

Martin Morgan changed the due date to May 6. May 2

Martin Morgan unmarked today. May 4

Martin Morgan assigned to you. May 4



David Ransome May 6 at 9:29am










See additional individual actions for specs.

Action Closed.




David Ransome completed this Task. May 6 at 9:29am





 David R  May 4     


FSA 5 - Rotork Actu...

 **14 - LF364001_SPC**

FSA 5 Action 14 on LF364001_SPC



 [Tank Levels of Concern \(LOCs\) Worksheet Updated July 2015.pdf](#)

 [Copy of Chevron Independant highhigh switch lengths rev 09-09-09.pdf](#)




 [email 26_08_15.pdf](#)

Martin Morgan created task. May 4




Martin Morgan added to FSA 5 - Rotork Actuator Replacement. May 4

 **Martin Morgan** May 4 at 2:13pm 




LOC July 2015 received (attached). Discrepancy over column titles queried. Attached email confirms that Independent High High level is set as the same value as the High High on UCOS. Referring back to Chevron LOC worksheet (also attached) this confirms the switch lengths to be correct as per LF364001_SPC_A and therefore this action can be closed.

 **Martin Morgan**  attached May 4 at 2:13pm 

[Tank Levels of Concern \(LOCs\) Worksheet Updated July 2015.pdf](#)

 **Martin Morgan**  attached May 4 at 2:14pm 

[Copy of Chevron Independant highhigh switch lengths rev 09-09-09.pdf](#)



 **Martin Morgan**  attached May 4 at 2:15pm 

[email 26_08_15.pdf](#)



Martin Morgan assigned to you. May 4

Martin Morgan marked today. May 4

Martin Morgan changed the due date to May 4. May 4

 **David Ransome** May 6 at 9:26am 

Action Closed

 **David Ransome completed this Task.** May 6 at 9:26am 





David R



May 6



FSA 5 - Rotork Actu...

✓ 14 - LF364002_SPC

Level Switch – Fixed Roof

Switching points to be checked with LOC document when received see Action 10.

Actual insertion lengths for Tanks 11, 18, 18A 21 and 22 to be added following Action 10.

Martin Morgan created task. May 4

Martin Morgan added to FSA 5 - Rotork Actuator Replacement. May 4

Martin Morgan assigned to Martin Morgan. May 4

Martin Morgan changed the due date to May 6. May 4



Martin Morgan May 4 at 2:51pm



Refer to action taken under 14 - LF364001_SPC : levels from LOC match spec sheet LF364002_SPC_A for tanks 5 to 10.

Tanks 11, 18, 18A 21 and 22 do not appear on LOC. Tanks are now out of service. We could either

(a) remove them from the spec sheet (retaining Rev A for reference)

(b) Leave spec sheet in current position or

(c) Local Fuel could measure probes and then we can update spec sheet.

Martin Morgan assigned to you. May 4



David Ransome May 6 at 9:28am










I believe that they should be left on the spec sheet, and if they are re-instated an FSA 5 would need to be conducted together with MoC which would require confirmation of LOC's.

Action Closed.




David Ransome completed this Task. May 6 at 9:28am





 David R  May 4     

FSA 5 - Rotork Actu...



 **14 - LF364006_SPC**




Pipeline Import Valve




There is no mention of the valve slow closing on the specification. Reference is made to actuator details appearing on sheet 2, yet sheet 2 is Documentation Requirements, it should say see specification LF364021_SPC

 [LF364006_SPC_B - 10-inch Pipeline Valve.pdf](#)
 [LF364021_SPC_B- Actuator for 10inch Pipeline Valve - Shoreham.pdf](#)



Martin Morgan created task. May 4
Martin Morgan added to FSA 5 - Rotork Actuator Replacement. May 4



 **Martin Morgan** May 4 at 2:21pm 
LF364006_SPC_B attached - Cross reference to actuator spec sheet LF364021_SPC added. Slow closing time added to actuator spec LF364021_SPC_B also attached

 **Martin Morgan**  attached May 4 at 2:22pm 
[LF364006_SPC_B - 10-inch Pipeline Valve.pdf](#)








 **Martin Morgan**  attached May 4 at 2:23pm 
[LF364021_SPC_B- Actuator for 10inch Pipeline Valve - Shoreham.pdf](#)

Martin Morgan assigned to you. May 4
Martin Morgan marked today. May 4
Martin Morgan changed the due date to May 4. May 4


 **David Ransome** May 6 at 9:28am 
Action Closed

 **David Ransome completed this Task.** May 6 at 9:28am 





 **David R**  **May 4**     

FSA 5 - Rotork Actu...



 **14 - LF364021_SPC**




Valve Actuator

Add reference to valve details on LF364006_SPC



  [LF364021_SPC_B- Actuator for 10inch Pipeline Valve - Shoreham.pdf](#)



Martin Morgan created task. May 4
Martin Morgan added to FSA 5 - Rotork Actuator Replacement. May 4

 **MM** **Martin Morgan** May 4 at 2:22pm 
LF364021_SPC_B attached - Cross reference to valve spec added.

 **MM** **Martin Morgan**  **attached** May 4 at 2:22pm 
[LF364021_SPC_B- Actuator for 10inch Pipeline Valve - Shoreham.pdf](#)

Martin Morgan assigned to you. May 4
Martin Morgan marked today. May 4
Martin Morgan changed the due date to May 4. May 4

 **David Ransome** May 6 at 9:28am 
Action Closed

 **David Ransome completed this Task.** May 6 at 9:29am 



Signature Certificate

 Document Reference: KINZ43JLGI9Y3BIYR3HB3A

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Easy Online Document Signing



David Ransome
Party ID: MVZDCFJJP2235D4S5BGEFV
IP Address: 86.14.218.30

VERIFIED EMAIL: drr@pidesign.co.uk

Electronic Signature:

Multi-Factor
Digital Fingerprint Checksum

9e7e525e3c3e05bbf5531a5ac4730b61757eeca6



Timestamp

2016-06-07 05:49:42 -0700

2016-06-07 05:49:42 -0700

2016-06-07 05:49:12 -0700

2016-06-07 05:48:46 -0700

Audit

All parties have signed document. Signed copies sent to: David Ransome and P I Design Ltd.

Document signed by David Ransome (drr@pidesign.co.uk) with drawn signature. - 86.14.218.30

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Document created by P I Design Ltd (signature@pidesign.co.uk). - 86.14.218.30



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