FUNCTIONAL SAFETY CERTIFICATE

This is to certify that the

Hydraulic Series of DN3, DN5 & DN10 Valve

manufactured by

Rotork Midland Ltd
Patrick Gregory Rd
Wolverhampton
West Midlands
WV11 3DZ
UK

has been assessed by Sira Certification Service with reference to the CASS methodologies and found to meet the requirements of

IEC61508-1:2010 (Clause 6)
IEC 61508-2:2010

The Product and its associated data contained herein can be considered for use in the design of safety functions up to and including

SIL 3*

when used in accordance with the scope and conditions of this certificate.

* The Product that has been certified is not implicit of the achieved Safety Integrity Level (SIL) of the safety related system

Certification Manager: W Thomas

Initial Certification:	06/01/2012
This certificate issued:	16/02/2017
Renewal date:	15/02/2022

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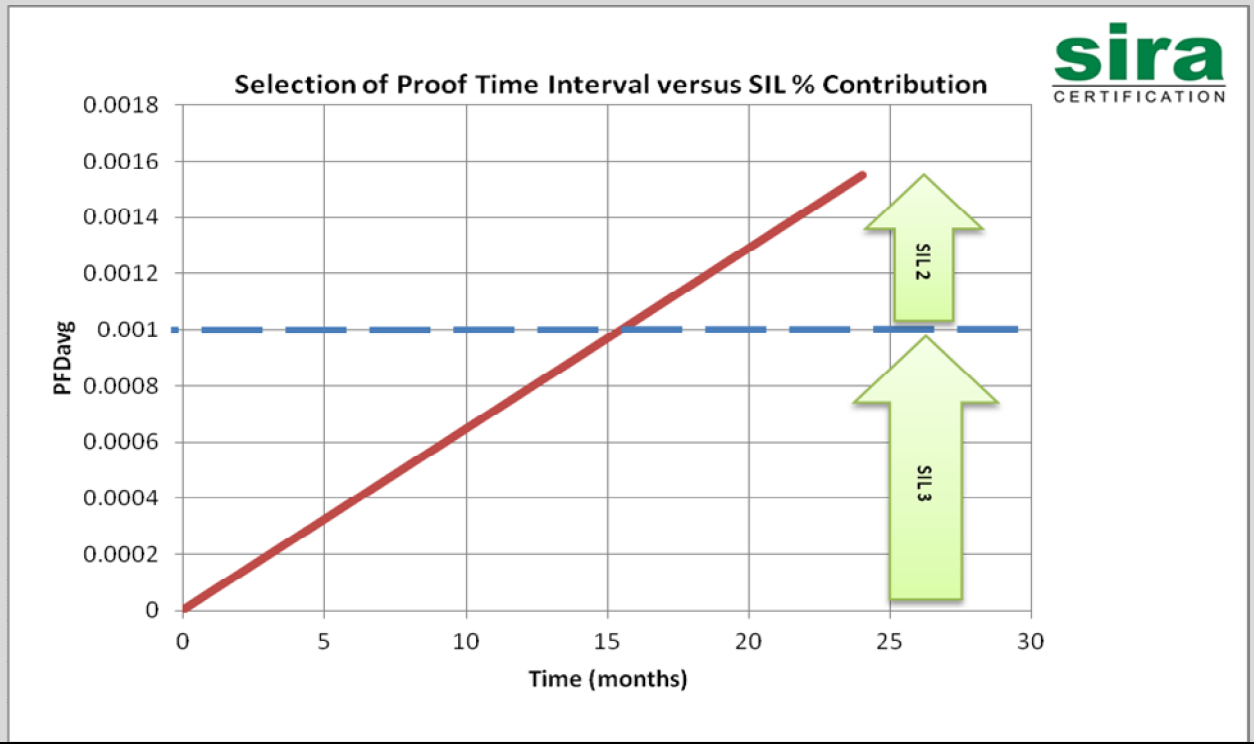
Product description and scope of certification

DN3 3/2 NC Valve with EXD solenoid			
Safety Function: *'To ensure the Valve returns to a spring extended position when de-energized'*			
Architectural constraints:	Type A HFT=0 SFF 98.87%	Proof Test Interval =8760Hrs[4] MTTR = 8 Hrs[4]	SIL3
Random hardware failures:	λ_{DD} = 0 λ_{DU} = 1.77E-07	λ_{SD} = 0 λ_{SU} = 1.54E-05	
Probability of failure on demand:	PFD_{AVG}=7.76E-04 (Low Demand Mode)		SIL3
Probability of Dangerous failure on safety function:	PFH = 1.77E-07 (High Demand Mode)		SIL2
Hardware safety integrity compliance[1]	Route 1_H		
Systematic safety integrity compliance[1]	Route 1_S		
Systematic Capability[2]	SC 3		
Overall SIL-capability achieved[3]	SIL 3 (Low Demand) SIL 2 (High Demand)		



[1] These are new parameters used in IEC61508 Part 2 Sections 7.4.2 & 7.4.4.
[2] This is a new measurable scale for the systematic safety integrity level; refer to IEC61508 Part 4 Section 3.5.9.
[3] This is determined by the lowest SIL indicated by each of the parameters given above.
[4] These figures are used only for demonstration purposes.

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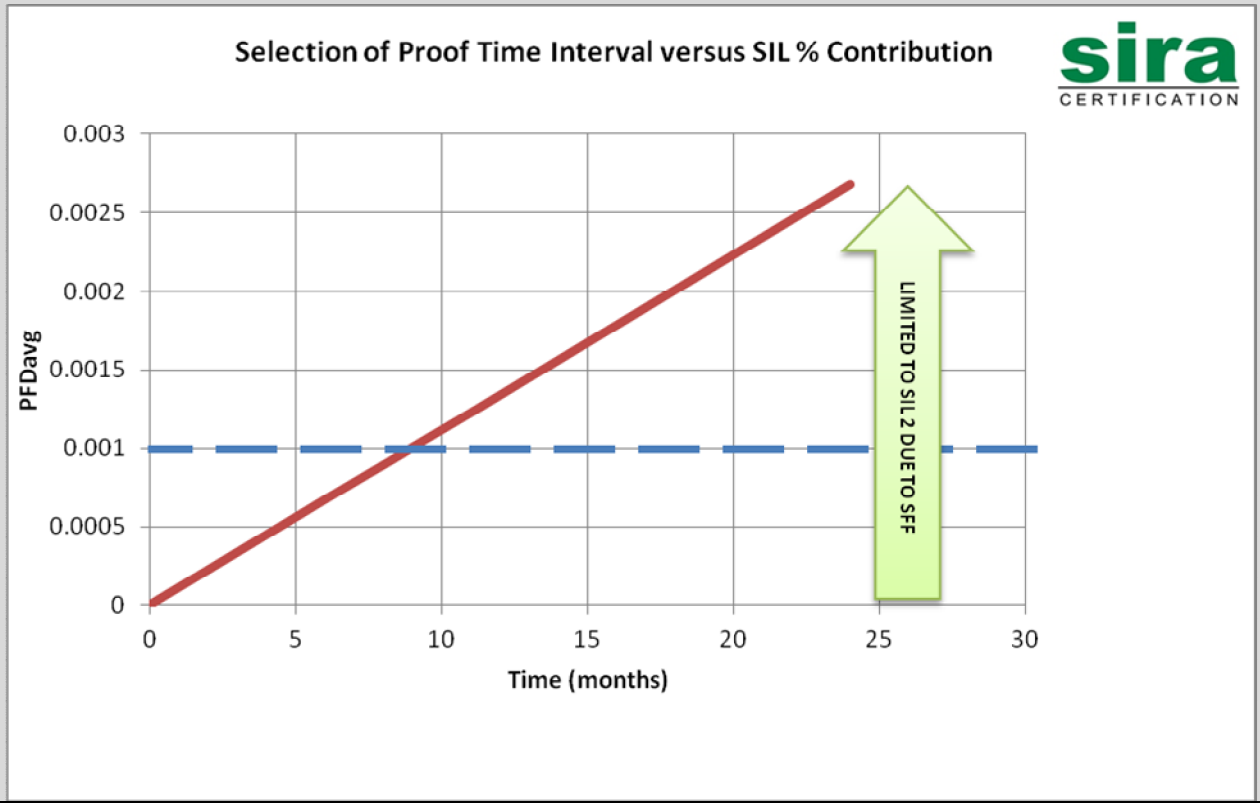
DN3 3/2 NC Pilot on DN10 Main stage Valve with EXD Solenoid			
Safety Function: *'To ensure the Valve returns to a spring extended position when de-energized'*			
Architectural constraints:	Type A HFT=0 SFF 98.31%	Proof Test Interval =8760Hrs[4] MTTR = 8 Hrs[4]	SIL3
Random hardware failures:	λ_{DD} = 0 λ_{DU} = 3.05E-07	λ_{SD} = 0 λ_{SU} = 1.78E-05	
Probability of failure on demand:	PFD_{AVG}=1.34E-03 (Low Demand Mode)		SIL2
Probability of Dangerous failure on safety function:	PFH = 3.05E-07 (High Demand Mode)		SIL2
Hardware safety integrity compliance[1]	Route 1_H		
Systematic safety integrity compliance[1]	Route 1_S		
Systematic Capability[2]	SC 3		
Overall SIL-capability achieved[3]	SIL 2 (Low Demand) SIL 2 (High Demand)		



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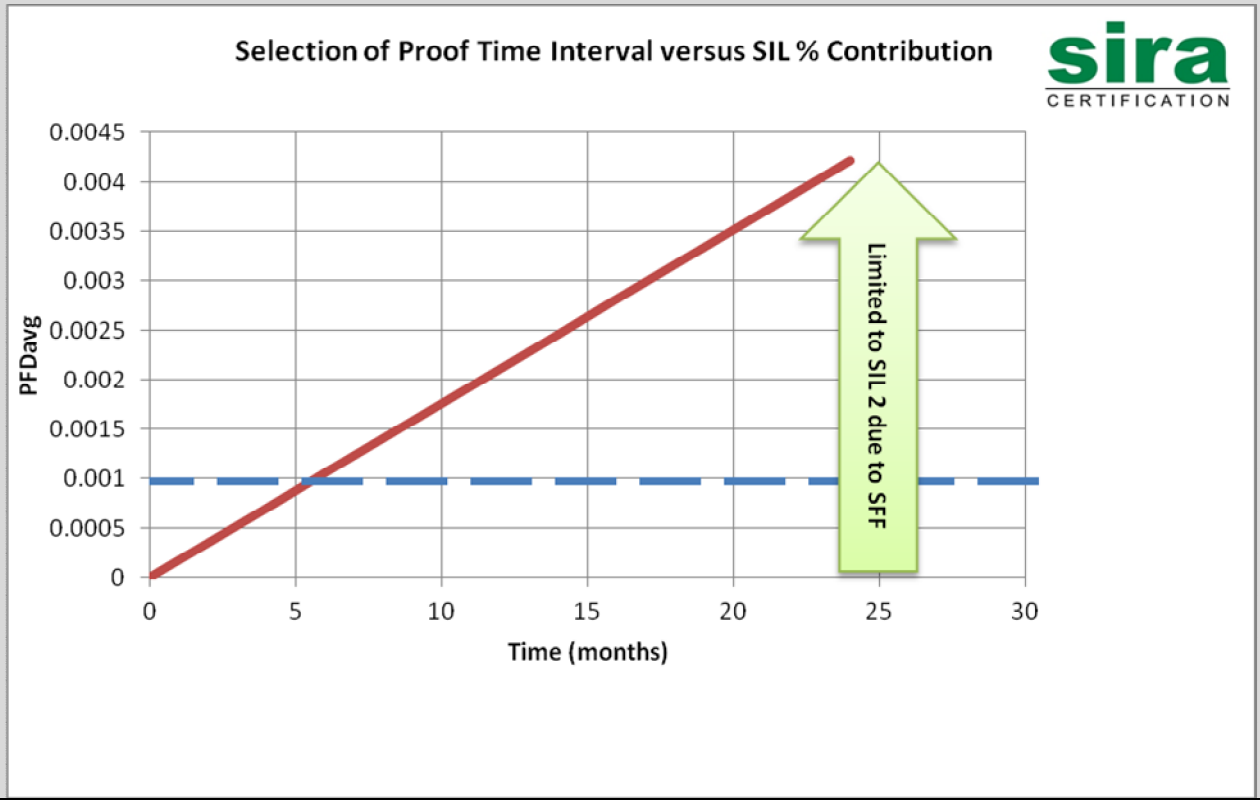
DN3 3/2 NC Pilot on DN10 Main Stage Valve with Pneumatic (LP Hyd) Operator			
Safety Function: *'To ensure the Valve returns to a spring extended position when de-energized'*			
Architectural constraints:	Type A HFT=0 SFF 86.78%	Proof Test Interval =8760Hrs[4] MTTR = 8 Hrs[4]	SIL2
Random hardware failures:	λ_{DD} = 0 λ_{DU} = 4.82E-07	λ_{SD} = 0 λ_{SU} = 3.17E-06	
Probability of failure on demand:	PFD_{AVG}=2.11E-03 (Low Demand Mode)		SIL2
Probability of Dangerous failure on safety function:	PFH = 4.82E-07 (High Demand Mode)		SIL2
Hardware safety integrity compliance[1]	Route 1_H		
Systematic safety integrity compliance[1]	Route 1_S		
Systematic Capability[2]	SC 3		
Overall SIL-capability achieved[3]	SIL 2 (Low Demand) SIL 2 (High Demand)		



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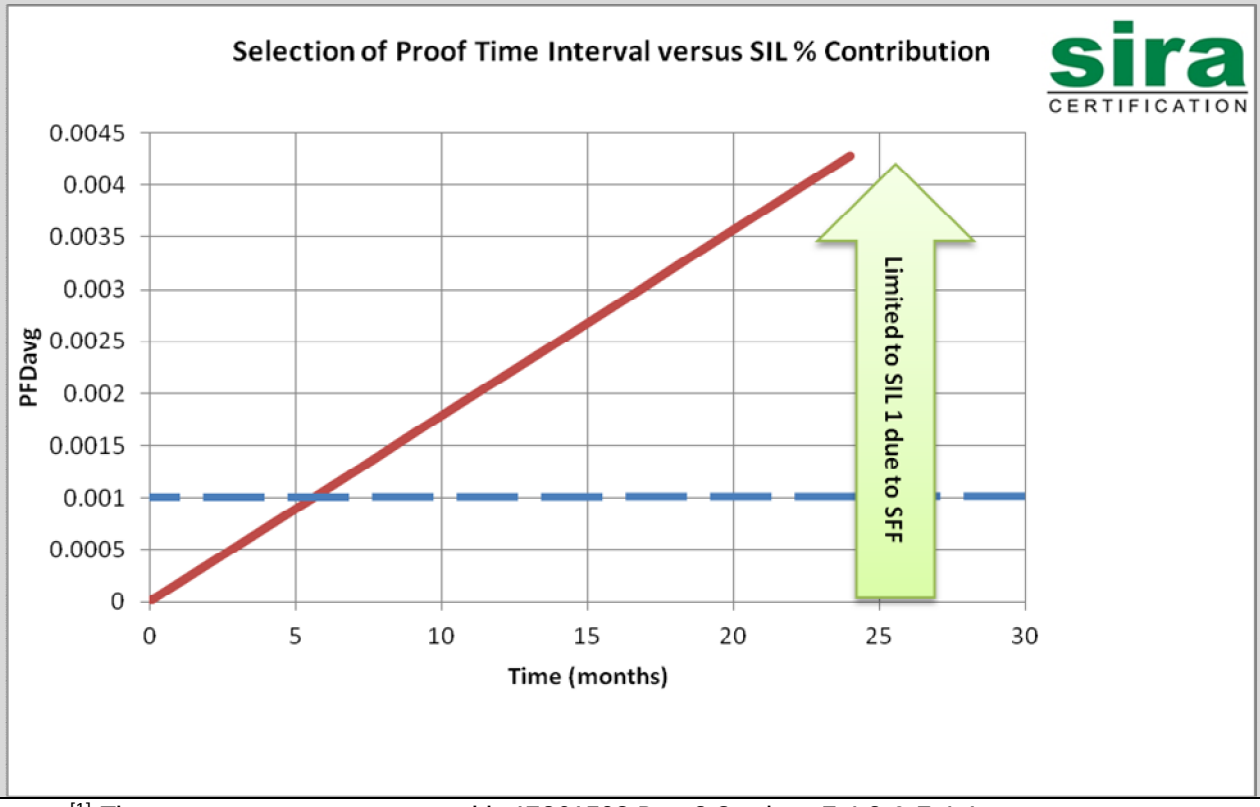
DN3 3/2 NC Pilot with Pneumatic (LP Hydraulic) Operator			
Safety Function: *'To ensure the Valve returns to a spring extended position when de-energized'*			
Architectural constraints:	Type A HFT=0 SFF 57.01%	Proof Test Interval =8760Hrs[4] MTTR = 8 Hrs[4]	SIL1
Random hardware failures:	λ_{DD} = 0 λ_{DU} = 4.89E-07	λ_{SD} = 0 λ_{SU} = 6.48E-07	
Probability of failure on demand:	PFD_{AVG}=2.14E-03 (Low Demand Mode)		SIL2
Probability of Dangerous failure on safety function:	PFH = 4.89E-07 (High Demand Mode)		SIL2
Hardware safety integrity compliance[1]	Route 1_H		
Systematic safety integrity compliance[1]	Route 1_S		
Systematic Capability[2]	SC 3		
Overall SIL-capability achieved[3]	SIL 1 (Low Demand) SIL 1 (High Demand)		



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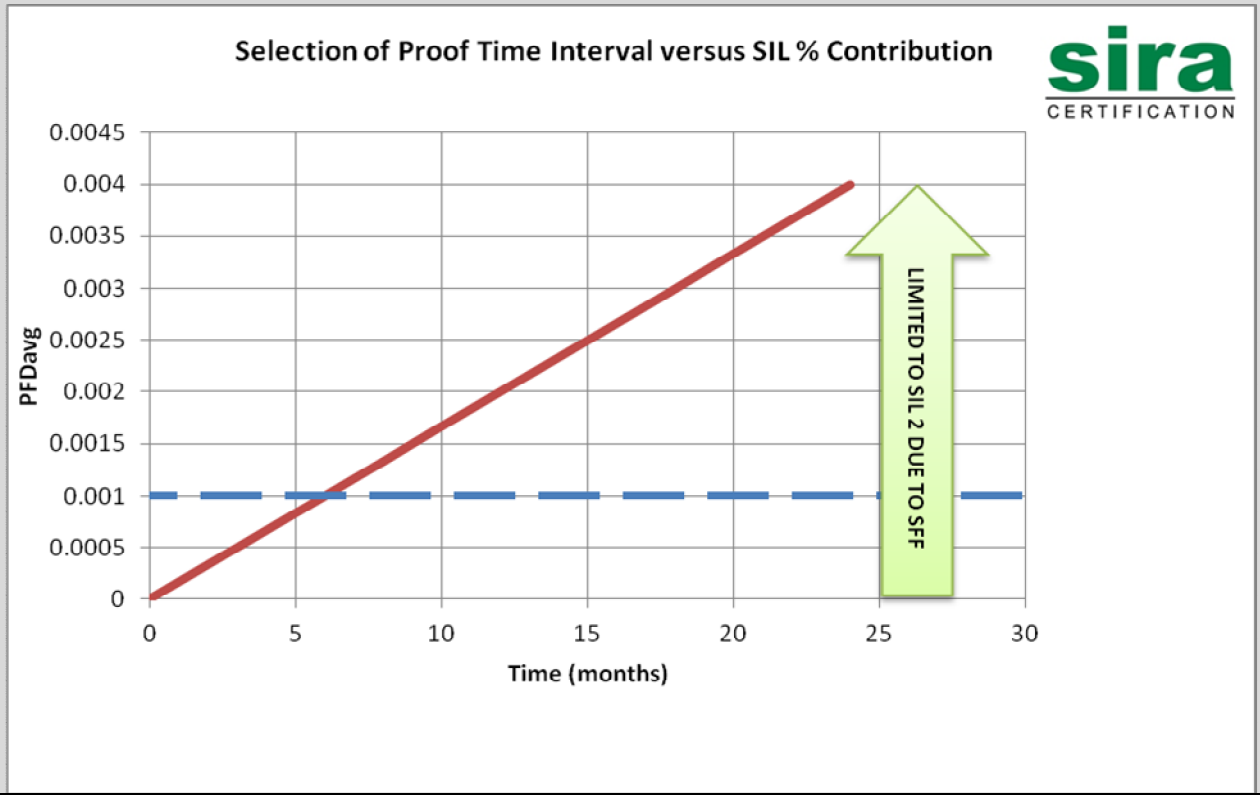
DN3 3/2 NC Pilot on DN5 Main Stage Valve with EXD solenoid			
Safety Function: *'To ensure the Valve returns to a spring extended position when de-energized'*			
Architectural constraints:	Type A HFT=0 SFF 97.20%	Proof Test Interval =8760Hrs[4] MTTR = 8 Hrs[4]	SIL3
Random hardware failures:	λ_{DD} = 0 λ_{DU} = 4.55E-07	λ_{SD} = 0 λ_{SU} = 1.58E-05	
Probability of failure on demand:	PFD_{AVG}=1.99E-03 (Low Demand Mode)		SIL2
Probability of Dangerous failure on safety function:	PFH = 4.55E-07 (High Demand Mode)		SIL2
Hardware safety integrity compliance[1]	Route 1_H		
Systematic safety integrity compliance[1]	Route 1_S		
Systematic Capability[2]	SC 3		
Overall SIL-capability achieved[3]	SIL 2 (Low Demand) SIL 2 (High Demand)		



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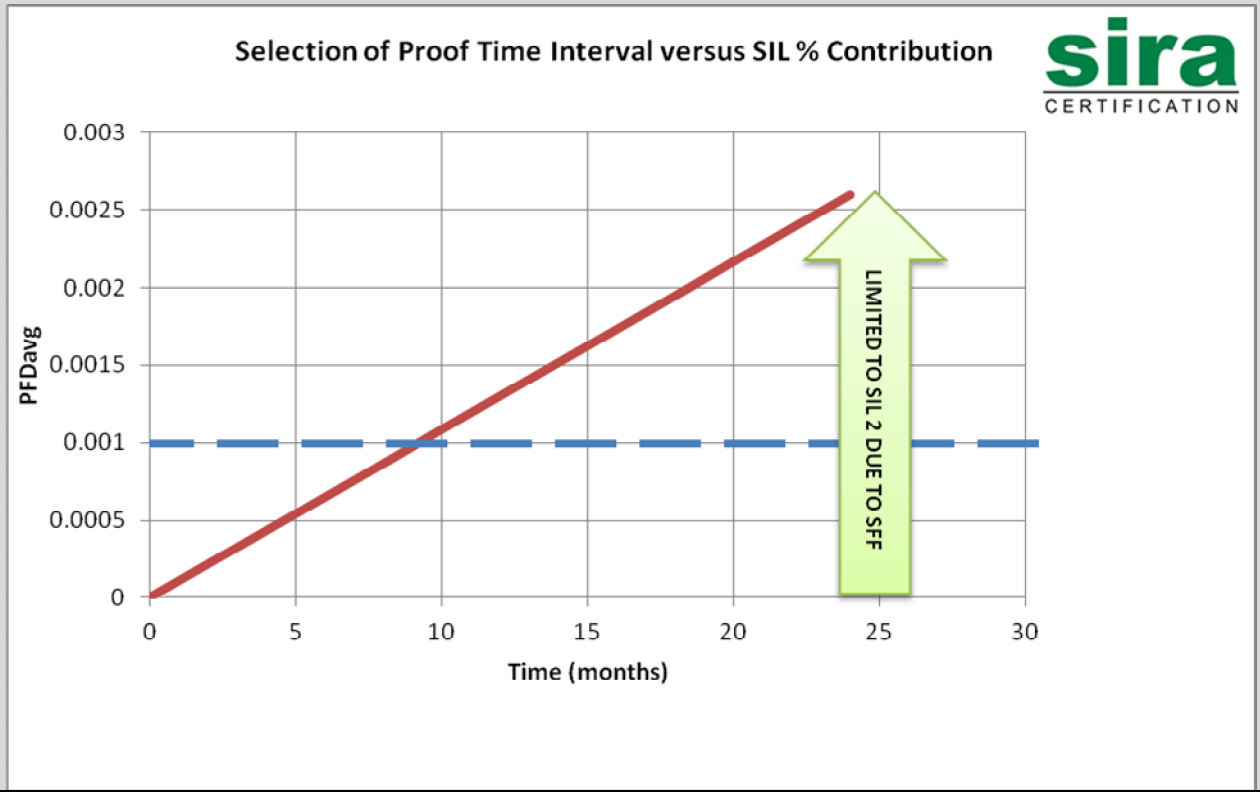
1oo2 DN3 3/2 NC Pilot with EXD Solenoid on DN5 Main Stage Valve			
Safety Function: *'To ensure the Valve returns to a spring extended position when de-energized'*			
Architectural constraints:	Type A HFT=0 SFF 93.07%	Proof Test Interval =8760Hrs[4] MTTR = 8 Hrs[4]	SIL3
Random hardware failures:	λ_{DD} = 0 λ_{DU} = 2.96E-07	λ_{SD} = 0 λ_{SU} = 3.97E-06	
Probability of failure on demand:	PFD_{AVG}=1.30E-03 (Low Demand Mode)		SIL2
Probability of Dangerous failure on safety function:	PFH = 2.96E-07 (High Demand Mode)		SIL2
Hardware safety integrity compliance[1]	Route 1_H		
Systematic safety integrity compliance[1]	Route 1_S		
Systematic Capability[2]	SC 3		
Overall SIL-capability achieved[3]	SIL 2 (Low Demand) SIL 2 (High Demand)		



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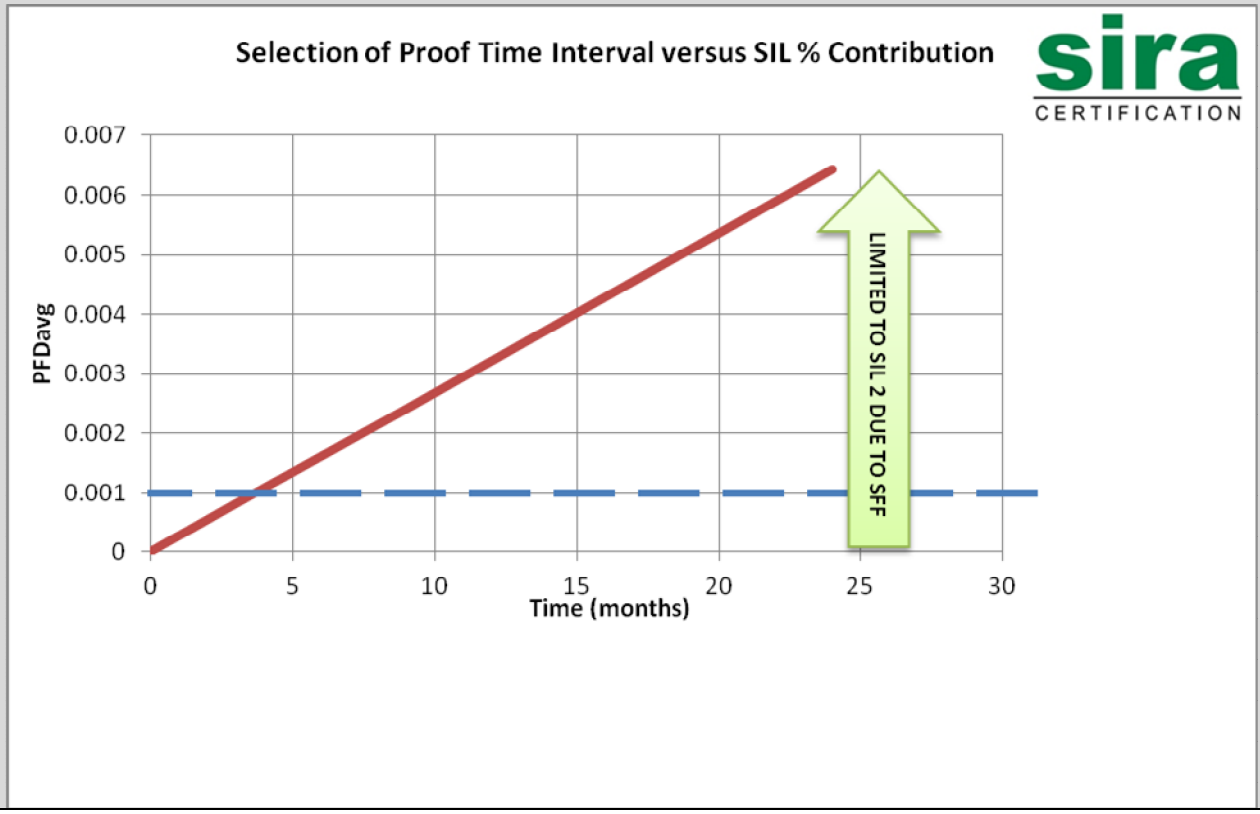
DN3 3/2 NC Pilot on Two DN5 Main Stage Valves with EXD Solenoid			
Safety Function: *'To ensure the Valve returns to a spring extended position when de-energized'*			
Architectural constraints:	Type A HFT=0 SFF 95.65%	Proof Test Interval =8760Hrs[4] MTTR = 8 Hrs[4]	SIL3
Random hardware failures:	λ_{DD} = 0 λ_{DU} = 7.33E-07	λ_{SD} = 0 λ_{SU} = 1.61E-05	
Probability of failure on demand:	PFD_{AVG}=3.21E-03 (Low Demand Mode)		SIL2
Probability of Dangerous failure on safety function:	PFH = 7.33E-07 (High Demand Mode)		SIL2
Hardware safety integrity compliance[1]	Route 1_H		
Systematic safety integrity compliance[1]	Route 1_S		
Systematic Capability[2]	SC 3		
Overall SIL-capability achieved[3]	SIL 2 (Low Demand) SIL 2 (High Demand)		



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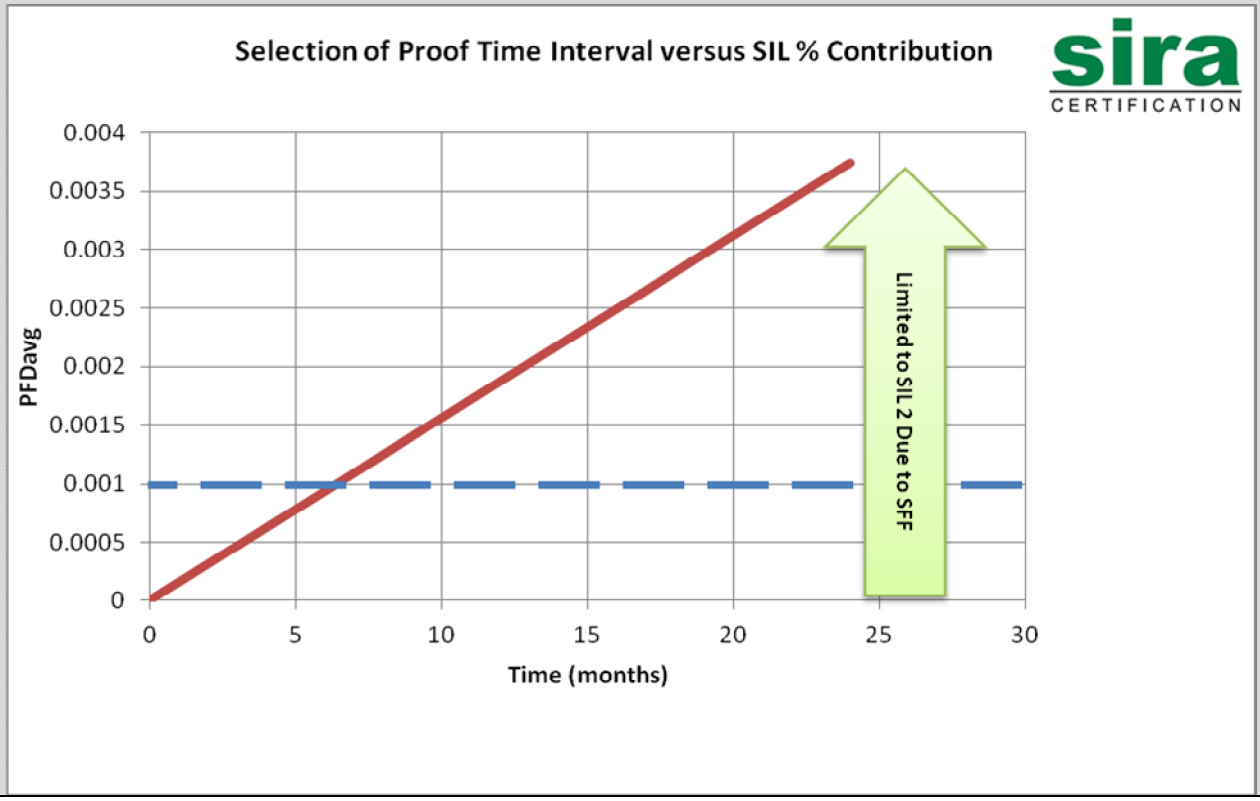
DN5 3/2 NC Air Operated Hydraulic Interface Valve			
Safety Function: *'To ensure the Valve returns to a spring extended position when de-energized'*			
Architectural constraints:	Type A HFT=0 SFF 64.71%	Proof Test Interval =8760Hrs[4] MTTR = 8 Hrs[4]	SIL2
Random hardware failures:	λ_{DD} = 0 λ_{DU} = 4.27E-07	λ_{SD} = 0 λ_{SU} = 7.83E-07	
Probability of failure on demand:	PFD_{AVG}=1.87E-03 (Low Demand Mode)		SIL2
Probability of Dangerous failure on safety function:	PFH = 4.27E-07 (High Demand Mode)		SIL2
Hardware safety integrity compliance[1]	Route 1_H		
Systematic safety integrity compliance[1]	Route 1_S		
Systematic Capability[2]	SC 3		
Overall SIL-capability achieved[3]	SIL 2 (Low Demand) SIL 2 (High Demand)		



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DN3

The Hydraulic series of DN3 is a ball seated hydraulic control valve. The stainless steel seat and ceramic ball design ensures a leak tight shut off. The DN3 valve design incorporates a balanced internal piloting system and a lever mechanism to enable low powered operators to switch the valve at high pressures.

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DN5
The Hydraulic series of DN5 is a metal to metal seated hydraulic control valve. The stainless steel seat design ensures a leak tight shut off. The DN5 valve design incorporates a balanced internal piloting system to enable the low powered solenoid coil to switch the valve at high pressures.

DN5 Interface Valve
The Hydraulic series of DN5 interface valve is a high pressure interface valve provides a reliable, high quality, cost effective solution for wellhead controls. The rugged piston operator and ball seated design, ensures a leak tight shut off and positive control.

DN10
The Hydraulic series of DN10 is a metal to metal seated hydraulic control valve. The stainless steel seat design ensures a leak tight shut off. The DN5 valve design incorporates a balanced internal piloting system to enable the low powered solenoid coil to switch the valve at high pressures.

Element Safety Function(s)[1]

The safety function of the various configurations is defined as:

'To ensure the [main] valve returns to the spring extended position when the solenoid is de-energised'

That is to say: -
- To Close a Normally Closed (NC) Valve

The *Safe State*[1] of the *EUC*[1] is to be achieved when the product closes a NC direct acting valve.
The element safety function is intended for use in low / high or continuous demand *Mode Of Operation*[1] as indicated by the certified failure data overleaf.

The failure data above is supported by the base information given in Table 2 below.

Table 2: Information supporting the failure rate data

1	Product identification:	Hydraulic Series of DN3, DN5 & DN10 Solenoid Pilot Valves as described in manufacturer's product catalogue.
2	Functional specification:	Refer to paragraph above 'Use in safety functions' and full specification in manufacturer's product catalogue.
3	Environment limits:	Temperature range: -50 to +60°C Standard
4	Lifetime/replacement limits:	Refer to Installation, Operation and Maintenance Manual
5	Proof Test requirements:	Refer to user manual

[1] Refer to IEC 61508-4 for a definition of this term

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6	Maintenance requirements:	Refer to user manual
7	Diagnostic coverage:	N/A
8	Diagnostic test interval:	N/A
9	Repair constraints:	Refer to user manual
10	Evidence of similar conditions in previous use:	Compliance Route 2_H (proven-in-use) not used
11	Evidence supporting the application under different conditions of use:	Compliance Route 2_H (proven-in-use) not used
12	Evidence of period of operational use:	Compliance Route 2_H (proven-in-use) not used
13	Statement of restrictions on functionality:	Compliance Route 2_H (proven-in-use) not used
14	Systematic capability:	SC3
15	Systematic fault avoidance measures:	Refer to Systematic Assessment report 56A25037B
16	Systematic fault tolerance measures:	Refer to Systematic Assessment report 56A25037B
17	Validation records:	Refer to Validation Report.

Identification of certified equipment

The certified equipment and its safe use are defined in the manufacturer's documentation listed in Table 3 below.

Table 3: Certified drawings

Hydraulic Series of DN3, DN5 & DN10 Solenoid Pilot Valves

Description		
DN3 3/2 NC Valve with EXD solenoid		
Drawing Description	**Issue**	**Drawing Number**
EXD Solenoid	1	20894-DN3-SOL-SPMO
DN3 3/2 Pilot Valve	1	20909-DN3
DN3 3/2 NC Internal Kit	1	19575
Description		
DN3 3/2 NC Pilot on DN10 Main stage Valve with EXD Solenoid		
Drawing Description	**Issue**	**Drawing Number**
EXD Solenoid	1	20894-DN3-SOL-SPMO
DN3 3/2 Pilot Valve	1	20909-DN3
DN3 3/2 NC Internal Kit	1	19575
DN10 3/2 Pilot Valve	1	20909-DN10
DN10 3/2 Mainstage Valve	1	17689CV
DN10C Cartridge	2	17440
Description		
DN3 3/2 NC Pilot on DN10 Main Stage Valve with Pneumatic (LP Hyd) Operator		
Drawing Description	**Issue**	**Drawing Number**
DN3 Pneumatic (LP) Operator	2	C11644-02
DN10 3/2 Pilot Valve	1	20909-DN10
DN10 3/2 Mainstage Valve	1	17689CV
DN10C Cartridge	2	17440
Description		
DN3 3/2 NC Pilot with Pneumatic (LP Hydraulic) Operator		
Drawing Description	**Issue**	**Drawing Number**
DN3 Pneumatic (LP) Operator	2	C11644-02
Description		
DN3 3/2 NC Pilot on DN5 Main Stage Valve with EXD solenoid		
Drawing Description	**Issue**	**Drawing Number**

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EXD Solenoid	1	20894-DN3-SOL-SPMO
DN5 3/2 Valve	1	C14697-CV
DN5 Cartridge	4	C15432
DN3 3/2 Pilot Valve	1	20909-DN3
DN3 3/2 NC Internal Kit	1	19575

Description	
1oo2 DN3 3/2 NC Pilot with EXD Solenoid on DN5 Main Stage Valve	

Drawing Description	Issue	Drawing Number
EXD Solenoid	1	20894-DN3-SOL-SPMO
DN3 3/2 Pilot Valve	1	20909-DN3
DN3 3/2 NC Internal Kit	1	19575
DN5 3/2 Valve	1	C14697-CV
DN5 Cartridge	4	C15432

Description	
DN3 3/2 NC Pilot on Two DN5 Main Stage Valves with EXD Solenoid	

Drawing Description	Issue	Drawing Number
EXD Solenoid	1	20894-DN3-SOL-SPMO
DN3 3/2 Pilot Valve	1	20909-DN3
DN3 3/2 NC Internal Kit	1	19575
DN5 3/2 Valve	1	C14697-CV
DN5 Cartridge	4	C15432

Description	
DN5 3/2 NC Air Operated Hydraulic Interface Valve	

Drawing Description	Issue	Drawing Number
DN5 3/2 NC Air Operated Hyd Interface Valve	1	20812

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Conditions of Certification

The validity of the certified base data is conditional on the manufacturer complying with the following conditions:

1. The manufacturer shall analyse failure data from returned products on an on-going basis. Sira Certification Service shall be informed in the event of any indication that the actual failure rates are worse than the certified failure rates. (A process to rate the validity of field data should be used. To this end, the manufacturer should co-operate with users to operate a formal field-experience feedback programme).
2. Sira shall be notified in advance (with an impact analysis report) before any modifications to the certified equipment or the functional safety information in the user documentation is carried out. Sira may need to perform a re-assessment if modifications are judged to affect the product's functional safety certified herein.
3. On-going lifecycle activities associated with this product (e.g., modifications, corrective actions, field failure analysis) shall be subject to surveillance by Sira in accordance with 'Regulations Applicable to the Holders of Sira Certificates'.

Conditions of Safe Use

The validity of the certified base data in any specific user application is conditional on the user complying with the following conditions:

1. The user shall comply with the requirements given in the manufacturer's user documentation (referred to in Table 3 above) in regard to all relevant functional safety aspects such as application of use, installation, operation, maintenance, proof tests, maximum ratings, environmental conditions, repair, etc;
2. Selection of this equipment for use in safety functions and the installation, configuration, overall validation, maintenance and repair shall only be carried out by competent personnel, observing all the manufacturer's conditions and recommendations in the user documentation.
3. All information associated with any field failures of this product should be collected under a dependability management process (e.g., IEC 60300-3-2) and reported to the manufacturer.
4. The unit should be tested at regular intervals to identify any malfunctions; in accordance with the safety manual.

General Conditions and Notes

1. This certificate is based upon a functional safety assessment of the product described in Sira Test & Certification Assessment Report R56A25037A4 and any further reports referenced in that report (under previous Sira projects).
2. If certified product or system is found not to comply, Sira Certification Service should be notified immediately at the address shown on this certificate.
3. The use of this Certificate and the Sira Certification Mark that can be applied to the product or used in publicity material are subject to the 'Regulations Applicable to the Holders of Sira Certificates' and 'Supplementary Regulations Specific to Functional Safety Certification'.
4. This document remains the property of Sira and shall be returned when requested by the issuer.

Certificate History

Issue	Date	Project No.	Comment
03	16/02/2016	70113700	Re-issue of certificate post successful recertification.

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