

<b>Project: Refinery Expansion</b>	Rev.1 by JB
<b>SIL verification of Safety Instrumented Functions</b>	

## Sample: Detailed Report

# Refinery Expansion SIL verification Report

## Annex I

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1					
0	27/01/2020	First review		AHT	AHT
Rev.	Date	Description		Prepared	Reviewed
				JB	Approved

**Project: Refinery Expansion** Rev.1 by JB

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**SIL verification of Safety Instrumented Functions**

**SIF: M4-LT-1111-01**

Required		Achieved
SIL-1	SIL	<b>SIL-1</b>
20	RRF	<b>56</b>
Route 1H	PFDavg	<b>1,79E-02</b>
10	MTTFS (y)	<b>71</b>

Achieved	
PFDavg	SIL-1
Arch. C.	SIL-1
SC	SIL-2

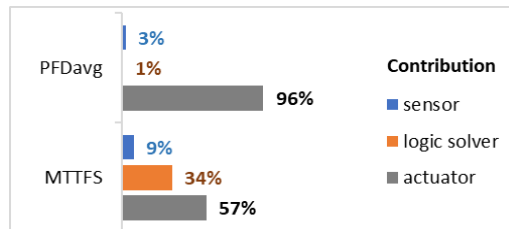
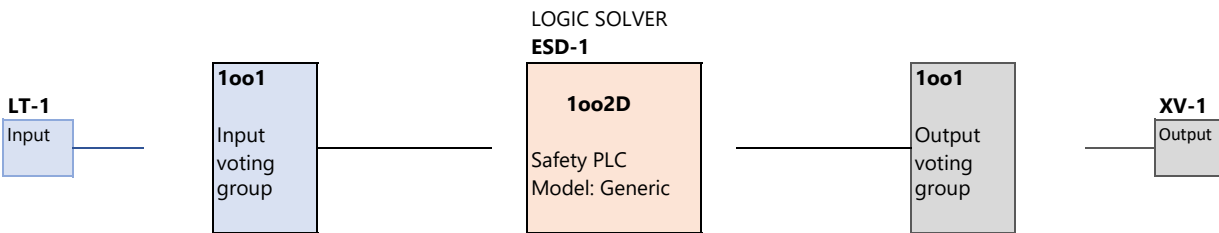
	Achieved	PFDavg	MTTFS (years)
sensor	SIL-1	5,77E-04	836
logic solver	SIL-3	1,65E-04	209
actuator	SIL-1	1,72E-02	125
other	--	--	--

On High High Level (LT-1) [1oo1] in Tank 100-1111 close valve XV-1 [1oo1]

Used Tables of IEC61508 for all SIFs (Route 1H)

Factors for Maintenance Capability:  
Cpt=1 TI=1

Out of range diagnostic: ON      Sensor Fault: U.R.      Channel Trip: No



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SIF: M4-LT-1111-01

Subsystem	Tags	Logic	PFDavg	SIL (pfd)	HFT	SC	SIL (arch)	MTTFS (y)
sensor	LT-1	1oo1	5,77E-04	3	0	2	1	836
sen_part	transmitter	--			--	3	--	--
sen_part	process	--			--		--	--
sen_part	interface	--			--	2	--	--
logicsolver	ESD-1	1oo2D	1,65E-04	3	1	3	3	209
actuator	XV-1	1oo1	1,72E-02	1	0	3	1	125
act_part	valve	--			--	3	--	--
act_part	actuator	--			--	3	--	--
act_part	solenoid	--			--	3	--	--
act_part	isolator	--			--	3	--	--

Subsystem	Tags	Logic	Cpt	TI (y)	LT (y)	Beta	MTTRdd	Startup(h)
sensor	LT-1	1oo1	95%	1,0	15		48	24
sen_part	transmitter	--						
sen_part	process	--						
sen_part	interface	--						
logicsolver	ESD-1	1oo2D	99%	4,0	15	2%	48	24
actuator	XV-1	1oo1	73%	1,0	15		0	24
act_part	valve	--						
act_part	actuator	--						
act_part	solenoid	--						
act_part	isolator	--						

Subsystem	Tags	Logic	SD	SU	DD	DU	Type	SFF
sensor	LT-1	1oo1	53	84	377	77	B	87,0%
sen_part	transmitter	--	24	84	234	32	B	91,4%
sen_part	process	--	0	0	0	0	A	0,0%
sen_part	interface	--	29	0	143	45	A	79,4%
logicsolver	ESD-1	1oo2D	11617	129	3815	241	B	98,5%
actuator	XV-1	1oo1	0	916	0	829	A	52,5%
act_part	valve	--	0	0	0	442	A	0,0%
act_part	actuator	--	0	286	0	199	A	59,0%
act_part	solenoid	--	0	516	0	188	A	73,3%
act_part	isolator	--	0	114	0	0	A	100,0%

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**SIF: M4-PT-2312-06**

Required	SIL	Achieved
SIL-2	SIL	<b>SIL-2</b>
200	RRF	<b>459</b>
Route 1H	PFDavg	<b>2,18E-03</b>
10	MTTFS (y)	<b>49</b>

Achieved	
PFDavg	SIL-2
Arch. C.	SIL-2
SC	SIL-3

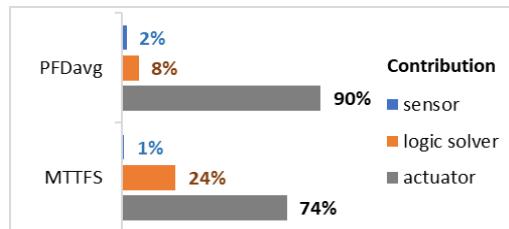
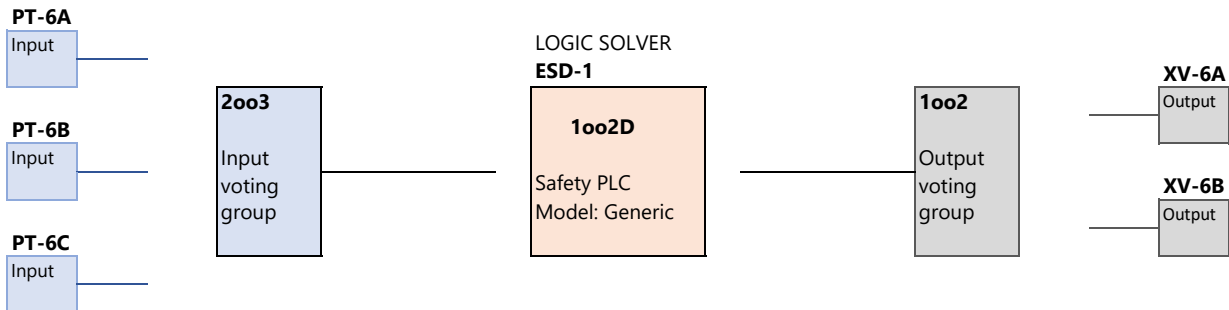
	Achieved	PFDavg	MTTFS (years)
sensor	SIL-2	5,25E-05	3866
logic solver	SIL-3	1,73E-04	201
actuator	SIL-2	1,95E-03	66
other	--	--	--

On High High Pressure (PT-6A/B/C) [2oo3] in Vessel 100-2312 close valves XV-6A/B [1oo2]

Used Tables of IEC61508 for all SIFs (Route 1H)

Factors for Maintenance Capability:  
Cpt=1 TI=1

Out of range diagnostic: ON      Sensor Fault: --      Channel Trip: Yes



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SIF: M4-PT-2312-06

Subsystem	Tags	Logic	PFDavg	SIL (pfd)	HFT	SC	SIL (arch)	MTTFS (y)
sensor	PT-6	2oo3	5,25E-05	4	1	3	2	3.866
sen_part	transmitter	--			--	3	--	--
sen_part	seal	--			--	3	--	--
logicsolver	ESD-1	1oo2D	1,73E-04	3	1	3	3	201
actuator	XV-6	1oo2	1,95E-03	2	1	3	2	66
act_part	valve	--			--	3	--	--
act_part	actuator	--			--	3	--	--
act_part	solenoid	--			--	3	--	--
act_part	isolator	--			--	3	--	--

Subsystem	Tags	Logic	Cpt	TI (y)	LT (y)	Beta	MTTRdd	Startup(h)
sensor	PT-6	2oo3	94%	1,0	15	5%	48	24
sen_part	transmitter	--						
sen_part	seal	--						
logicsolver	ESD-1	1oo2D	99%	4,0	15	2%	48	24
actuator	XV-6	1oo2	73%	1,0	15	10%	48	24
act_part	valve	--						
act_part	actuator	--						
act_part	solenoid	--						
act_part	isolator	--						

Subsystem	Tags	Logic	SD	SU	DD	DU	Type	SFF
sensor	PT-6	2oo3	279	94	0	87	B	81,1%
sen_part	transmitter	--	279	94	0	41	B	90,1%
sen_part	seal	--	0	0	0	46	A	0,0%
logicsolver	ESD-1	1oo2D	11852	136	3968	250	B	98,5%
actuator	XV-6	1oo2	0	916	0	829	A	52,5%
act_part	valve	--	0	0	0	442	A	0,0%
act_part	actuator	--	0	286	0	199	A	59,0%
act_part	solenoid	--	0	516	0	188	A	73,3%
act_part	isolator	--	0	114	0	0	A	100,0%

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**SIF: M5-FT-2312-30**

Required		Achieved
SIL-2	SIL	<b>SIL-2</b>
200	RRF	<b>244</b>
Route 1H	PFDavg	<b>4,11E-03</b>
10	MTTFS (y)	<b>28</b>

Achieved	
PFDavg	SIL-2
Arch. C.	SIL-2
SC	SIL-3

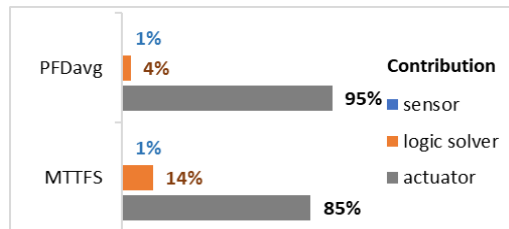
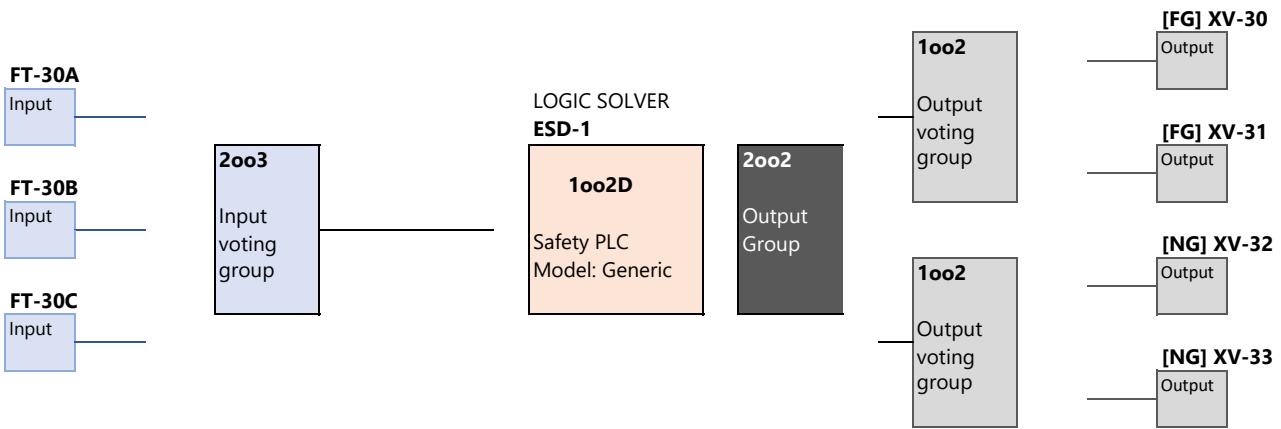
	Achieved	PFDavg	MTTFS (years)
sensor	SIL-3	2,54E-05	4176
logic solver	SIL-3	1,78E-04	197
actuator	SIL-2	3,90E-03	33
other	--	--	--

On Low Low Air Combustion Flow (FT-30A/B/C) [2oo3] in Incinerator 100-2312 closes Fuel Gas Valves (1oo2 XV-30/31) & Natural Gas Valves (1oo2 XV-32/33) [2oo2 of FG & NG]

Used Tables of IEC61508 for all SIFs (Route 1H)

Factors for Maintenance Capability:  
Cpt=1 TI=1

Out of range diagnostic: ON      Sensor Fault: --      Channel Trip: Yes



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SIF: M5-FT-2312-30

Subsystem	Tags	Logic	PFDavg	SIL (pfd)	HFT	SC	SIL (arch)	MTTFS (y)
sensor	FT-30	2oo3	2,54E-05	4	1	3	3	4.176
sen_part	transmitter	--			--	3	--	--
sen_part	process	--			--		--	--
logicsolver	ESD-1	1oo2D	1,78E-04	3	1	3	3	197
actuator	[FG] XV-30/31	1oo2	1,95E-03	2	1	3	2	66
actuator	[NG] XV-32/33	1oo2	1,95E-03	2	1	3	2	66

Subsystem	Tags	Logic	Cpt	TI (y)	LT (y)	Beta	MTTRdd	Startup(h)
sensor	FT-30	2oo3	90%	1,0	15	5%	48	24
sen_part	transmitter	--						
sen_part	process	--						
logicsolver	ESD-1	1oo2D	99%	4,0	15	2%	48	24
actuator	[FG] XV-30/31	1oo2	73%	1,0	15	10%	48	24
actuator	[NG] XV-32/33	1oo2	73%	1,0	15	10%	48	24

Subsystem	Tags	Logic	SD	SU	DD	DU	Type	SFF
sensor	FT-30	2oo3	258	84	0	32	B	91,4%
sen_part	transmitter	--	258	84	0	32	B	91,4%
sen_part	process	--	0	0	0	0	A	0,0%
logicsolver	ESD-1	1oo2D	12130	138	4082	256	B	98,5%
actuator	[FG] XV-30/31	1oo2	0	916	0	829	A	52,5%
actuator	[NG] XV-32/33	1oo2	0	916	0	829	A	52,5%

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## Groups: [Fuel-Gas] XV-30/31 &amp; [N.Gas] XV-32/33

Subsystem	Tags	Logic	SD	SU	DD	DU	Type	SFF
actuator	[FG] XV-30/31	1oo2	0	916	0	829	A	52,5%
act_part	valve	--	0	0	0	442	A	0,0%
act_part	actuator	--	0	286	0	199	A	59,0%
act_part	solenoid	--	0	516	0	188	A	73,3%
act_part	driver	--	0	114	0	0	A	100,0%
actuator	[NG] XV-32/33	1oo2	0	916	0	829	A	52,5%
act_part	valve	--	0	0	0	442	A	0,0%
act_part	actuator	--	0	286	0	199	A	59,0%
act_part	solenoid	--	0	516	0	188	A	73,3%
act_part	driver	--	0	114	0	0	A	100,0%

Subsystem	Tags	Logic	Cpt	TI (y)	LT (y)	Beta	MTTRdd	Startup(h)
actuator	[FG] XV-30/31	1oo2	73%	1,0	15	10%	48	24
act_part	valve	--						
act_part	actuator	--						
act_part	solenoid	--						
act_part	driver	--						
actuator	[NG] XV-32/33	1oo2	73%	1,0	15	10%	48	24
act_part	valve	--						
act_part	actuator	--						
act_part	solenoid	--						
act_part	driver	--						

Subsystem	Tags	Logic	PFDavg	SIL (pfd)	HFT	SC	SIL (arch)	MTTFS (y)
actuator	[FG] XV-30/31	1oo2	1,95E-03	2	1	3	2	66
act_part	valve	--			--	3	--	--
act_part	actuator	--			--	3	--	--
act_part	solenoid	--			--	3	--	--
act_part	driver	--			--	3	--	--
actuator	[NG] XV-32/33	1oo2	1,95E-03	2	1	3	2	66
act_part	valve	--			--	3	--	--
act_part	actuator	--			--	3	--	--
act_part	solenoid	--			--	3	--	--
act_part	driver	--			--	3	--	--