

Project: Refinery Expansion	Rev.1 by JB
SIL verification of Safety Instrumented Functions	

Sample: Detailed Report

Refinery Expansion SIL verification detailed Report

Annex I

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

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SIL verification of Safety Instrumented Functions	

SIF: SIF-2

Required	SIL	Achieved
SIL-1	SIL	SIL-1
20	RRF	373
Route 1H	PFDavg	2,68E-03
10	MTTFS (y)	51

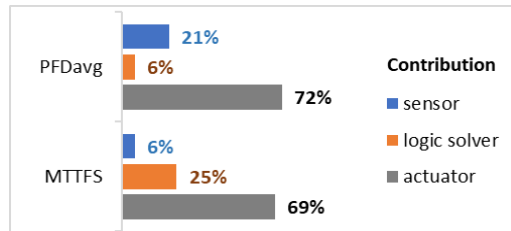
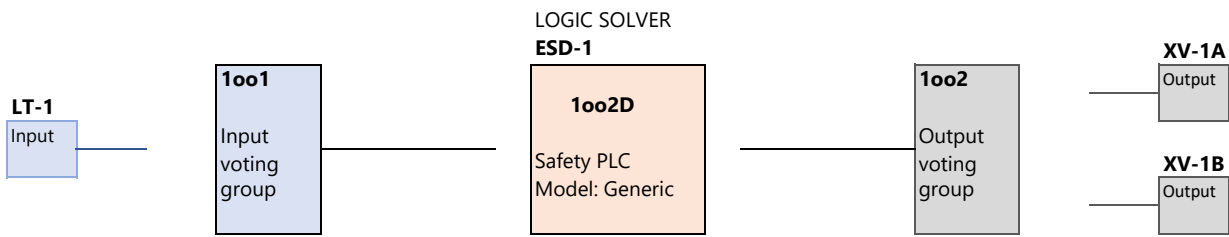
Achieved	
PFDavg	SIL-2
Arch. C.	SIL-1
SC	SIL-2

	Achieved	PFDavg	MTTFS (years)
sensor	SIL-1	5,77E-04	836
logic solver	SIL-3	1,67E-04	207
actuator	SIL-2	1,94E-03	74
other	--	--	--

High High Tank Level on LT-1 closes feed valves XV-1A/B [1oo2].

Out of range sensor diagnostics in PLC (see main document)

Factors for Maintenance Capability:
Cpt=1 TI=1



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SIF: SIF-2

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	1,67E-04	3	1	3	3	207
actuator	XV-1	1oo2	1,94E-03	2	1	3	2	74
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	1oo2	73%	1,0	15	10%	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	11756	130	3872	244	B	98,5%
actuator	XV-1	1oo2	0	808	0	819	A	49,7%
act_part	valve	--	0	0	0	442	A	0,0%
act_part	actuator	--	0	178	0	189	A	48,5%
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	SIL-2
200	RRF	462
Route 1H	PFDavg	2,16E-03
10	MTTFS (y)	54

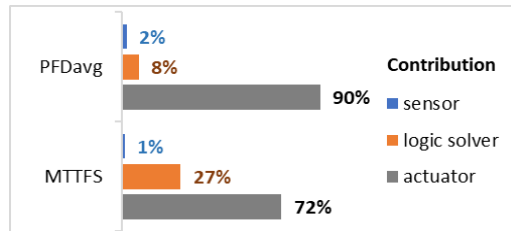
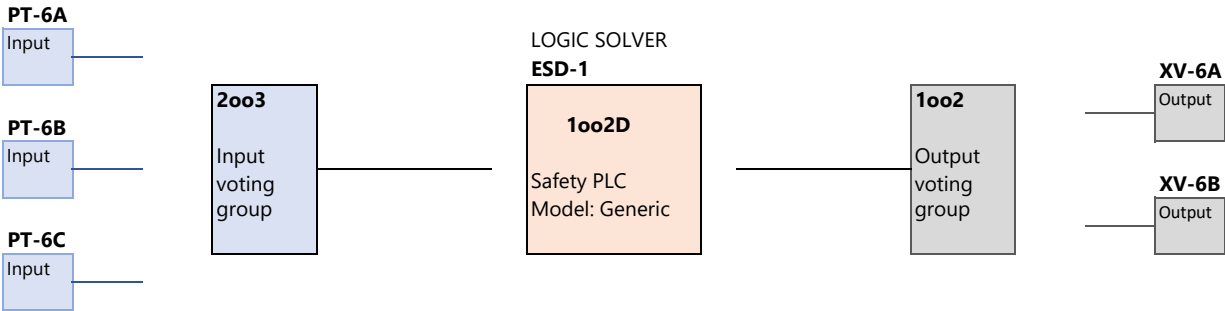
Achieved	
PFDavg	SIL-2
Arch. C.	SIL-2
SC	SIL-3

	Achieved	PFDavg	MTTFS (years)
sensor	SIL-2	5,25E-05	3866
logic solver	SIL-3	1,73E-04	201
actuator	SIL-2	1,94E-03	74
other	--	--	--

High High Pressure on PT-6A/B/C [2oo3] closes feed valves XV-6A/B [1oo2]

Out of range sensor diagnostics in PLC (see main document)

Factors for Maintenance Capability:
Cpt=1 TI=1



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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	1,94E-03	2	1	3	2	74
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	808	0	819	A	49,7%
act_part	valve	--	0	0	0	442	A	0,0%
act_part	actuator	--	0	178	0	189	A	48,5%
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	SIL	Achieved
SIL-2	SIL	SIL-2
200	RRF	245
Route 1H	PFDavg	4,08E-03
10	MTTFS (y)	31

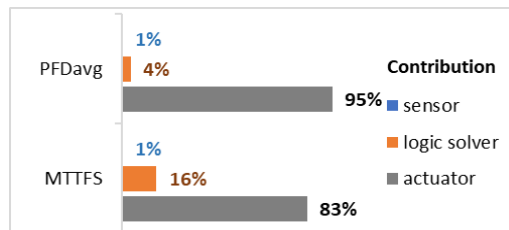
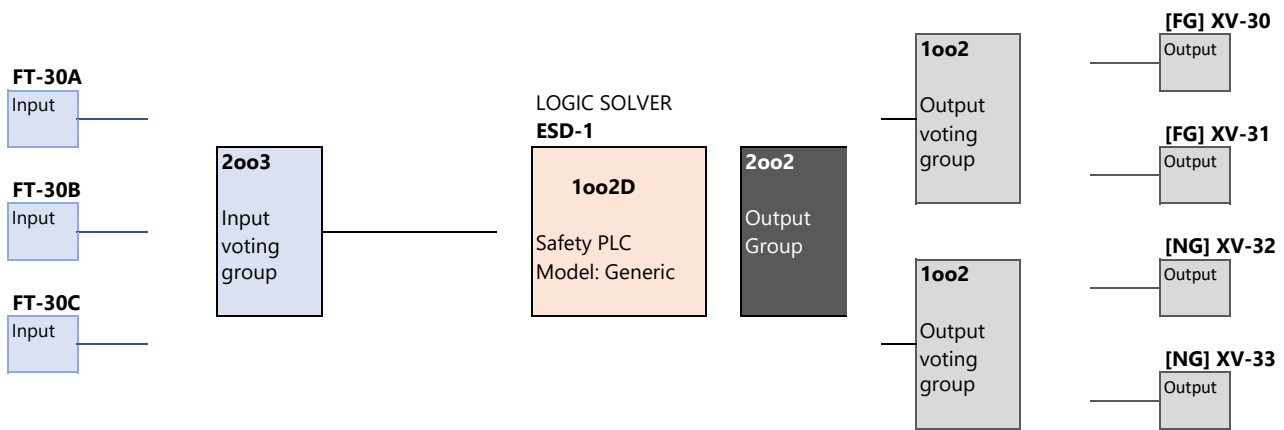
Achieved	
PFDavg	SIL-2
Arch. C.	SIL-2
SC	SIL-3

	Achieved	PFDavg	MTTFS (years)
sensor	SIL-3	2,54E-05	4176
logic solver	SIL-3	1,78E-04	197
actuator	SIL-2	3,88E-03	37
other	--	--	--

Low Low Air Flow on FT-30A/B/C [2oo2] closes Fuel Gas Valves (1oo2 XV-30/31) & Natural Gas Valves (1oo2 XV-32/33) [2oo2 of FG & NG]

Out of range sensor diagnostics in PLC (see main document)

Factors for Maintenance Capability:
Cpt=1 TI=1



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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	1,94E-03	2	1	3	2	74
actuator	[NG] XV-32/33	1oo2	1,94E-03	2	1	3	2	74

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	808	0	819	A	49,7%
actuator	[NG] XV-32/33	1oo2	0	808	0	819	A	49,7%

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

Subsystem	Tags	Logic	SD	SU	DD	DU	Type	SFF
actuator	[FG] XV-30/31	1oo2	0	808	0	819	A	49,7%
act_part	valve	--	0	0	0	442	A	0,0%
act_part	actuator	--	0	178	0	189	A	48,5%
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	808	0	819	A	49,7%
act_part	valve	--	0	0	0	442	A	0,0%
act_part	actuator	--	0	178	0	189	A	48,5%
act_part	solenoid	--	0	516	0	188	A	73,3%
act_part	relay	--	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	relay	--						

Subsystem	Tags	Logic	PFDavg	SIL (pfd)	HFT	SC	SIL (arch)	MTTFS (y)
actuator	[FG] XV-30/31	1oo2	1,94E-03	2	1	3	2	74
act_part	valve	--			--	3	--	--
act_part	actuator	--			--	3	--	--
act_part	solenoid	--			--	3	--	--
act_part	driver	--			--	3	--	--
actuator	[NG] XV-32/33	1oo2	1,94E-03	2	1	3	2	74
act_part	valve	--			--	3	--	--
act_part	actuator	--			--	3	--	--
act_part	solenoid	--			--	3	--	--
act_part	relay	--			--	3	--	--