



1st Chemical Process Safety Sharing (CPSS)

13 Jun. 2018, Thailand

SIL Assessment

Presenter Name: Anucha Pinyopornsawat
Section manager
iRPC

Background



STANDARD

1989
DIN
Germany

1989
ISA S84
USA

1999
IEC
61508

2003
IEC
61511

1980

1990

2000

2007

2008

2009

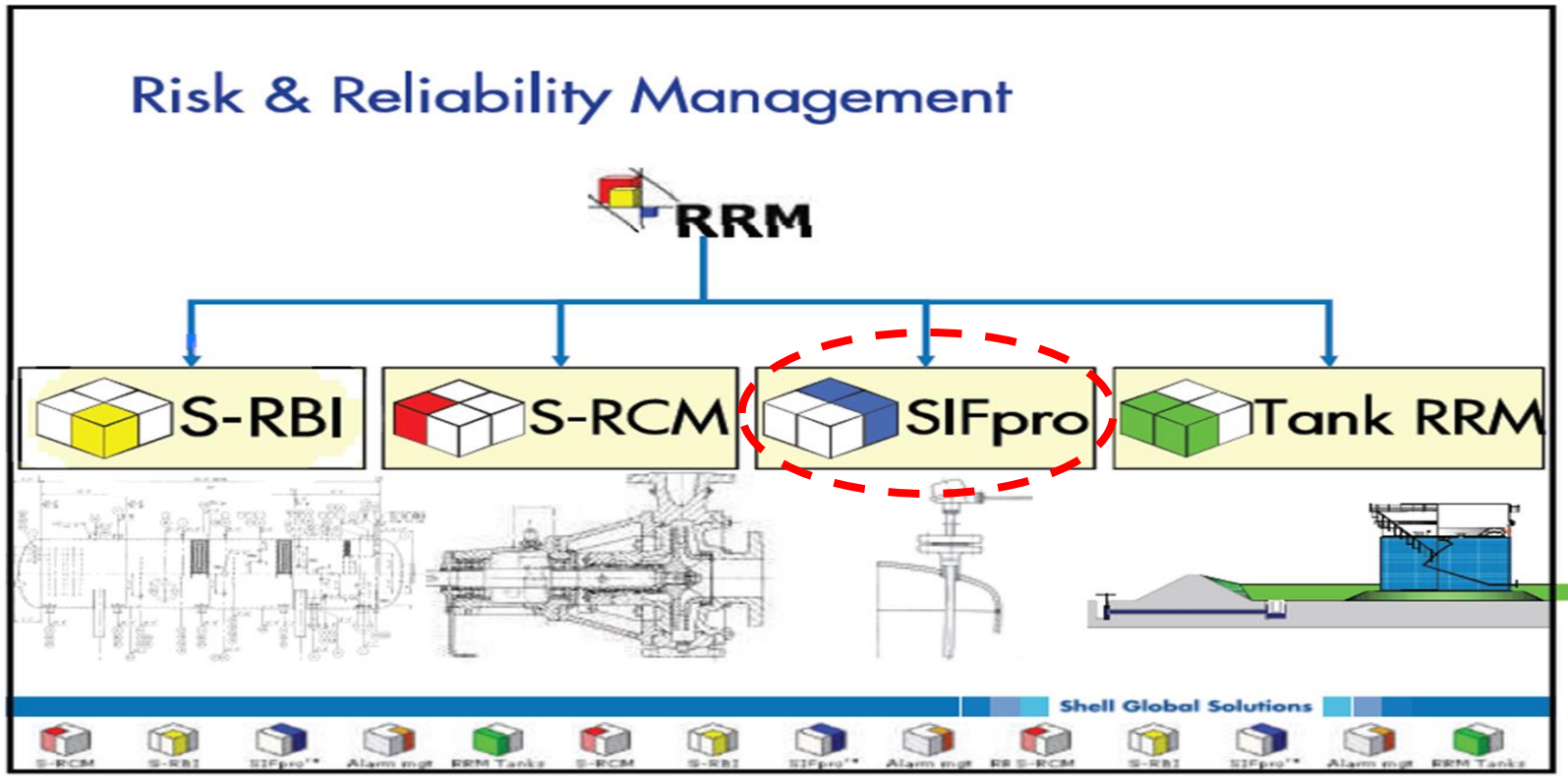
IRPC

On Jun. 2007,
The “Rapid
Business
Improvement
program
(RaBIP)” with
SGSi.

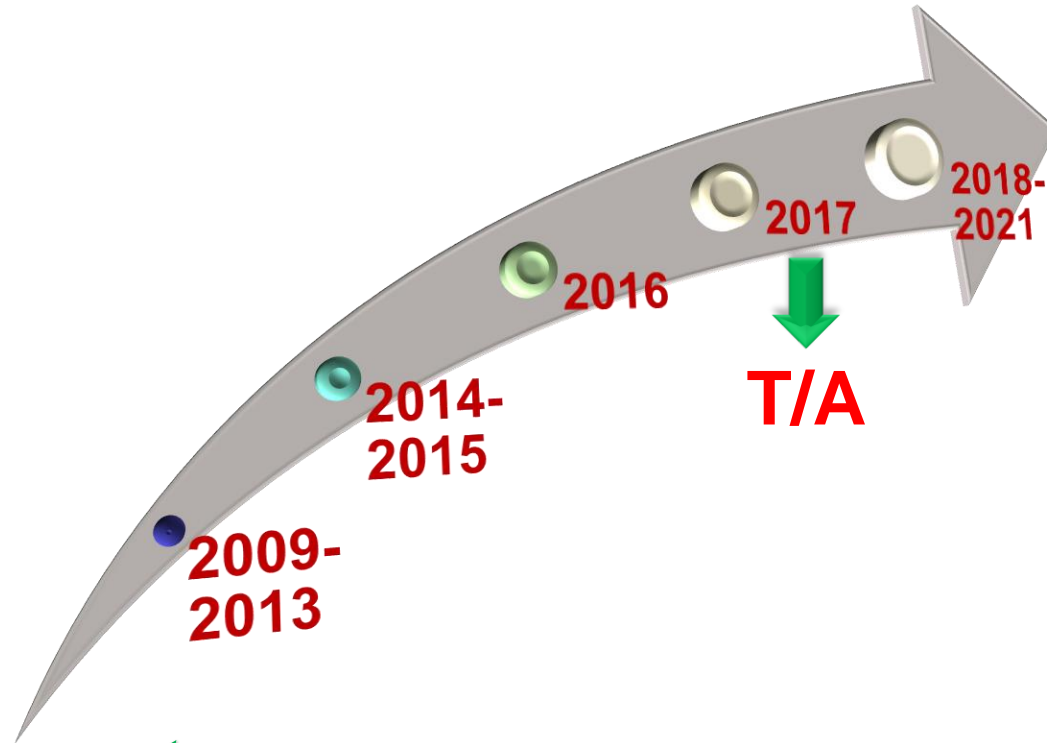
On Nov. 2008, The
“Plant Reliability
Improvement
program (PRIP)”
(S-RCM, S-RBI,
SIFpro)

First Implement
SIL Assessment
at EBSM Plant
with SGSi.

Background



Background



SIL Assessment Road Map

Background



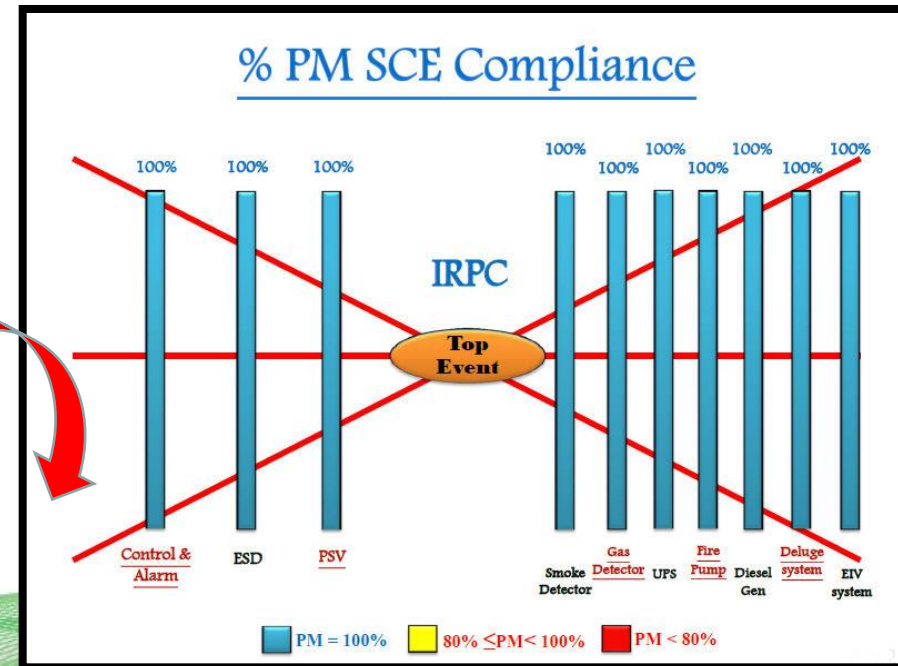
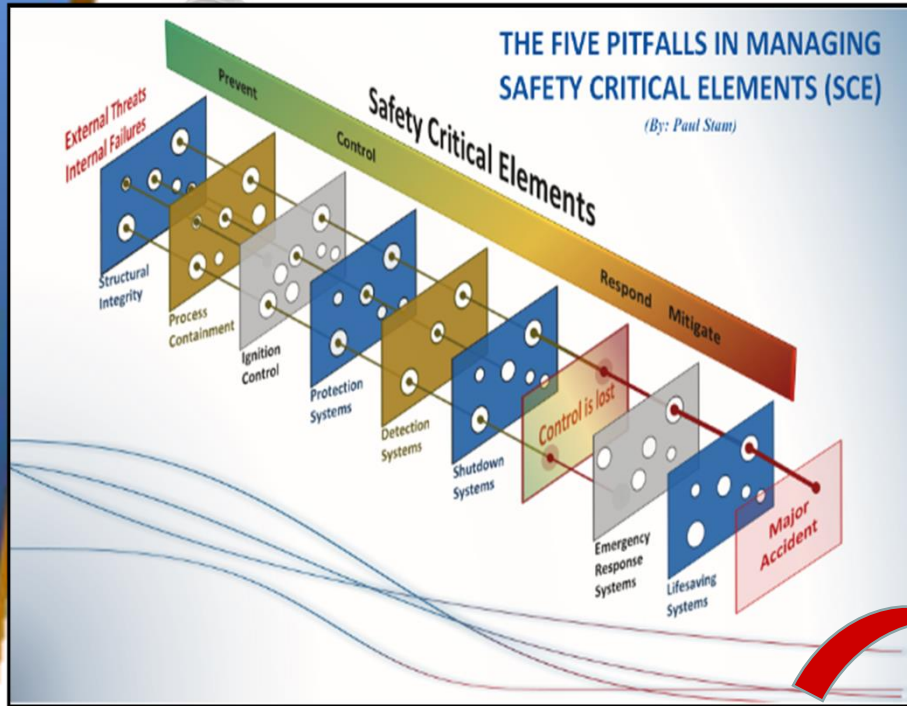
Jack Welch (อดีตผู้บริหารสูงสุดของ General Electric) เคยได้กล่าวไว้ว่า

“หากความเปลี่ยนแปลงภายนอก เป็นไปอย่างรวดเร็วกว่า
ความเปลี่ยนแปลงภายในองค์กร จุดจบก็คงอยู่ไม่ไกล”

Background



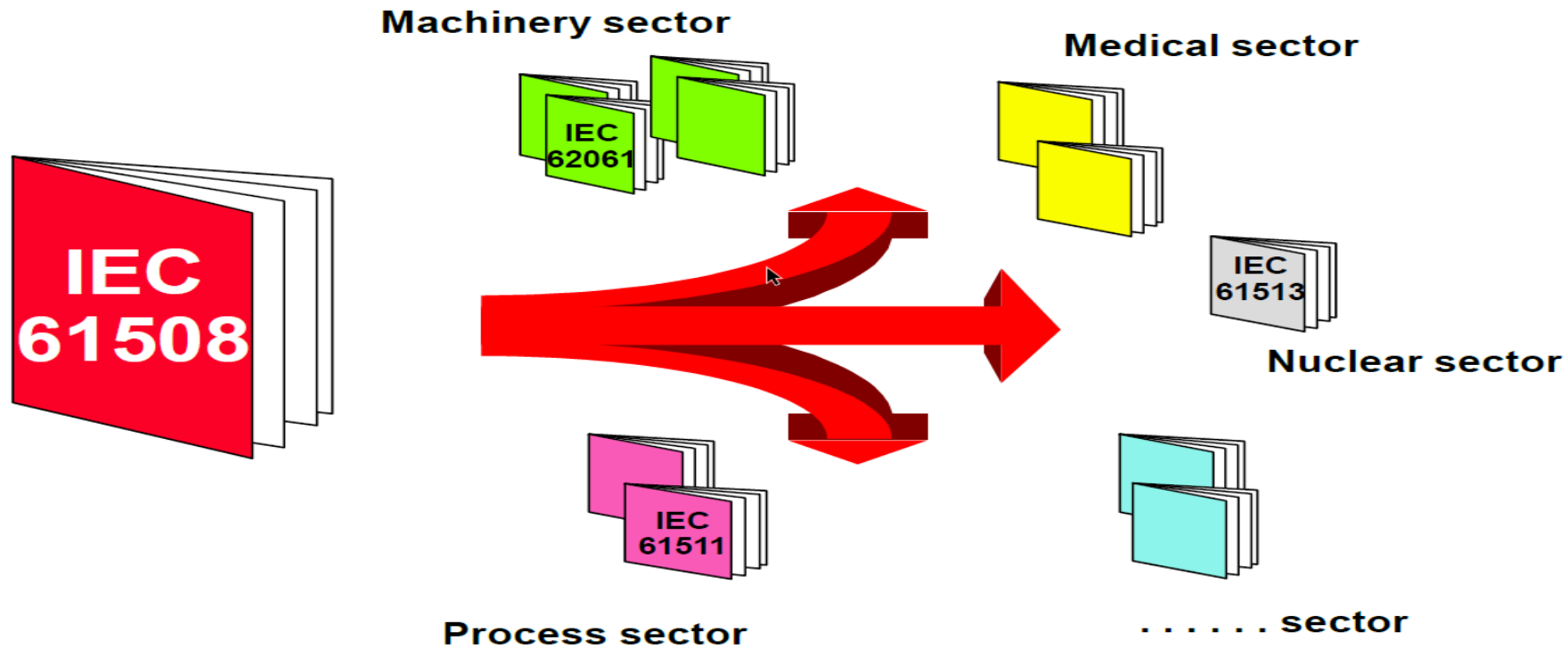
Safety Critical Elements (SCE)



Safety Integrity Level (SIL)

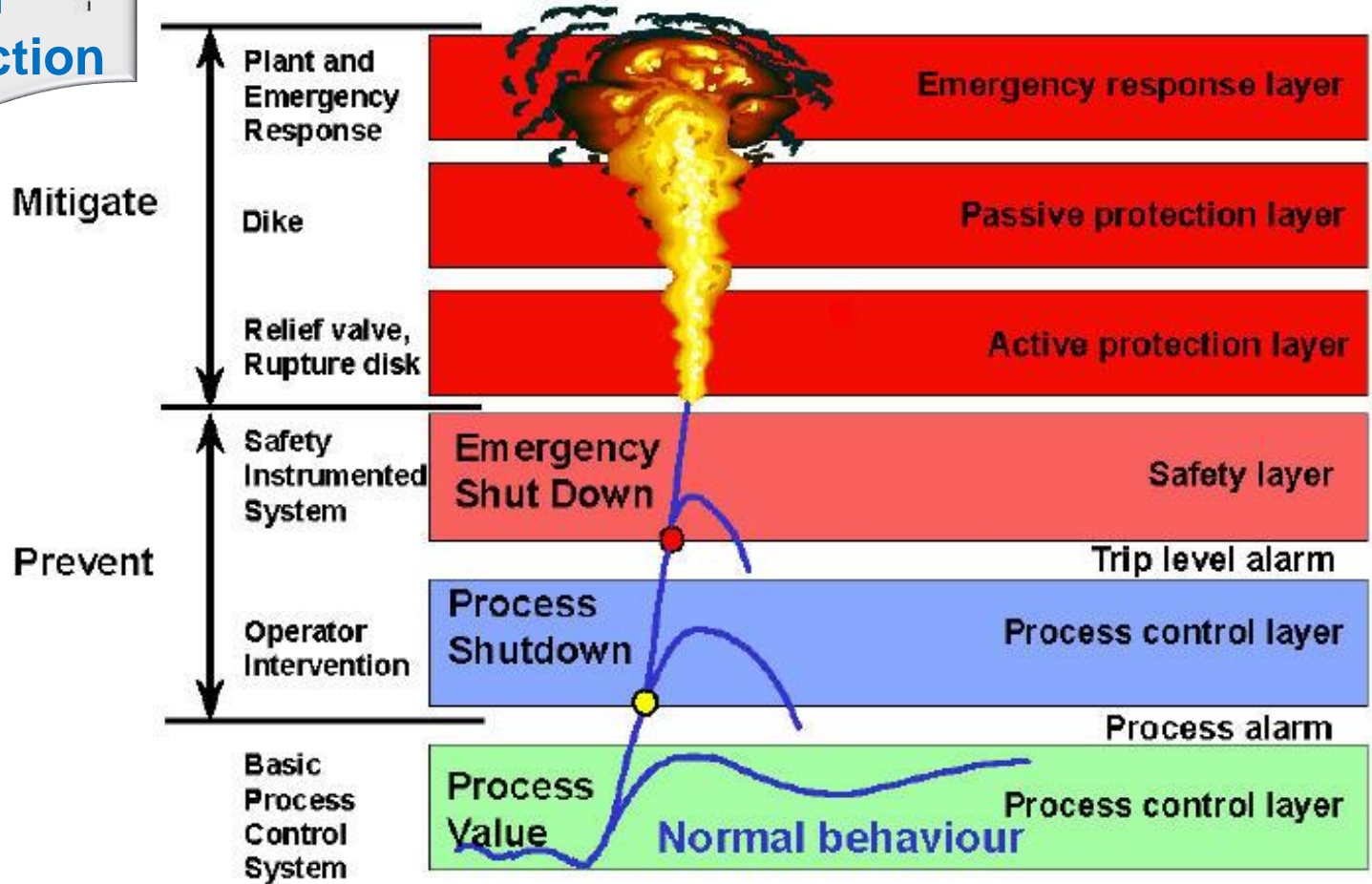
Reference:

IEC61508 – A Basic Safety Standard



Safety Integrity Level (SIL)

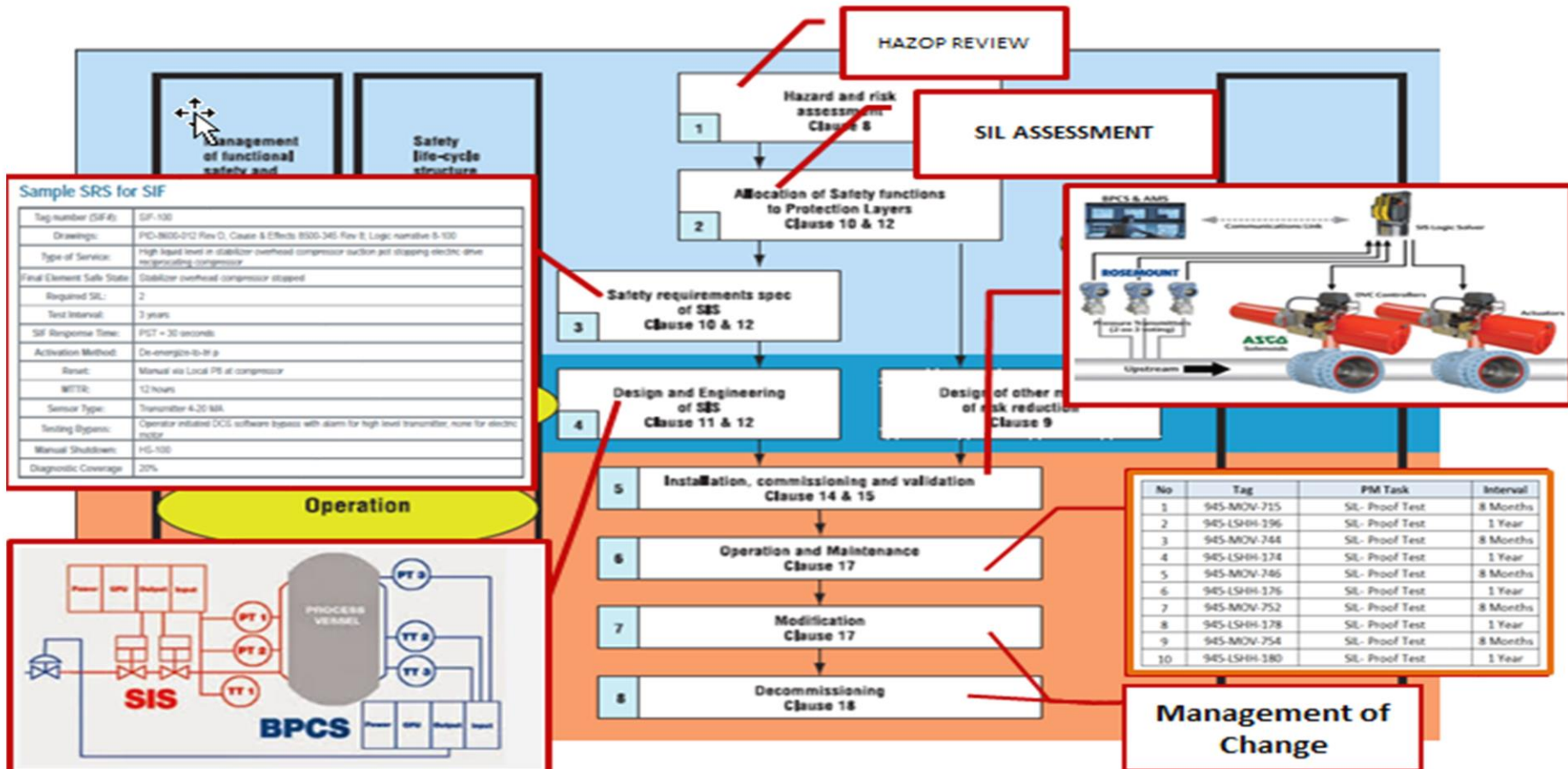
Layer
Of
Protection



Safety Integrity Level (SIL)

Systematic

Safety Lifecycle



Safety Integrity Level (SIL)

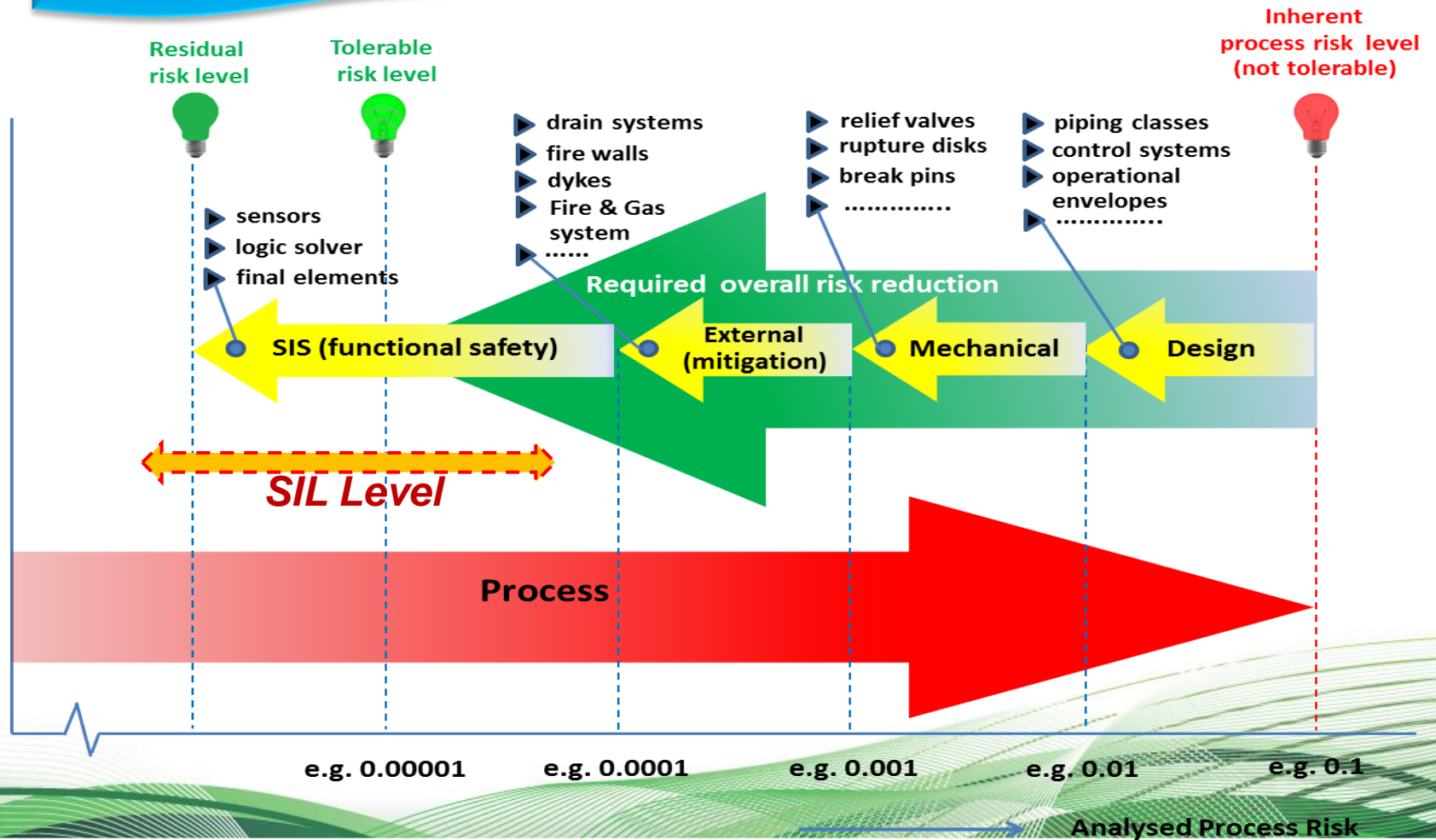
Step

Assessment Phase

Verification Phase

Safety Integrity Level (SIL)

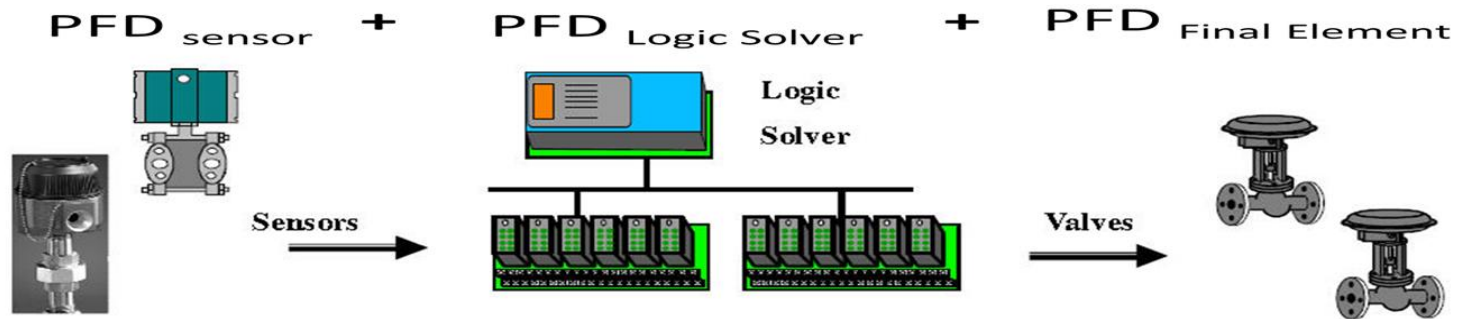
Assessment Phase



Safety Integrity Level (SIL)

Verification Phase

การคำนวณค่า PFD

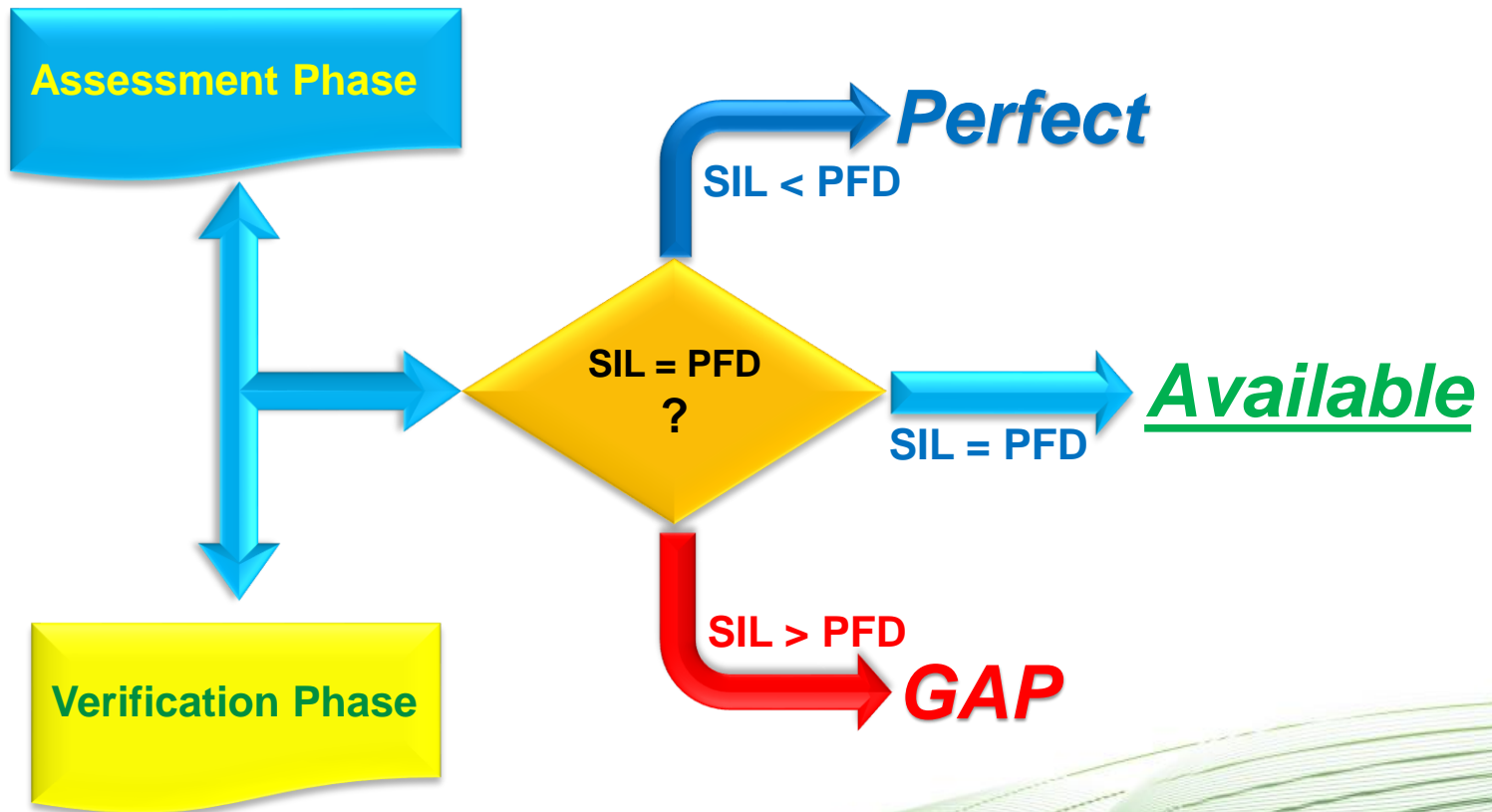


PFD : Probability of failure on demand

Safety Integrity Level	PFD _{AVG} : Average Probability of Failure on Demand (Demand Mode)
SIL 4	$\geq 10^{-5}$ to $< 10^{-4}$
SIL 3	$\geq 10^{-4}$ to $< 10^{-3}$
SIL 2	$\geq 10^{-3}$ to $< 10^{-2}$
SIL 1	$\geq 10^{-2}$ to $< 10^{-1}$

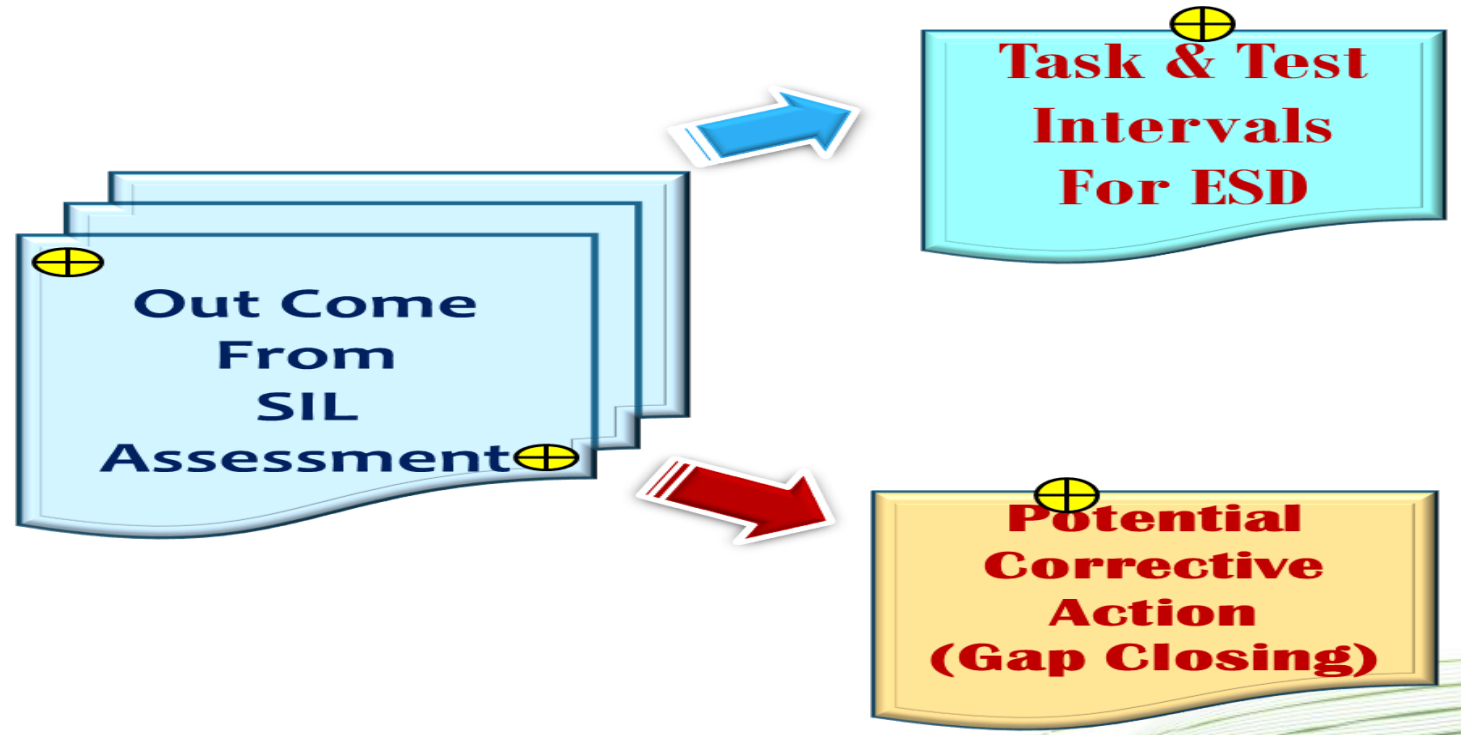
Safety Integrity Level (SIL)

Criteria



Safety Integrity Level (SIL)

Outcome



Safety Integrity Level (SIL)

Outcome

**Task & Test Intervals
For ESD**

Task up Load
to SAP



Safety Integrity Level (SIL)

Outcome

Display Maintenance Item: Maintenance Item List

S	Maintenance item	MntPlan	Strat.	Maintenance item description	Group	G	Sort field	Functional Location	Equipment	Mn.wk.ctr	PG	S	Cost
	151570	122508		NV012704C-FULL Fn. TEST SHUT-OFF VALVE	F9201901	9E	ADU1-NV0...	ADU1-01 -01B001B -INST -NV012704C	30016807	13I-ADU1	13I	P	1023
	151571	122509		NV012704C-OVERH AND TEST SHUT-OFF VALVE	H92019...	9E	ADU1-NV0...	ADU1-01 -01B001B -INST -NV012704C	30016807	13I-ADU1	13I	P	1023
	151572	122510		NV012705-FULL Fn. TEST SHUT-OFF VALVE	F9201901	9E	ADU1-NV0...	ADU1-01 -01B001B -INST -NV012705	30016808	13I-ADU1	13I	P	1023
	151573	122511		NV012705-OVERH AND TEST SHUT-OFF VALVE	H92019...	9E	ADU1-NV0...	ADU1-01 -01B001B -INST -NV012705	30016808	13I-ADU1	13I	P	1023
	151574	122512		NV012706-FULL Fn. TEST SHUT-OFF VALVE	F9201901	9E	ADU1-NV0...	ADU1-01 -01B001B -INST -NV012706	30016809	13I-ADU1	13I	P	1023
	151575	122513		NV012706-OVERH AND TEST SHUT-OFF VALVE	H92019...	9E	ADU1-NV0...	ADU1-01 -01B001B -INST -NV012706	30016809	13I-ADU1	13I	P	1023
	151576	122514		TT012644-FULL Fn. TEST TEMP TRANS&PROBE	F8206901	9E	ADU1-TT0...	ADU1-01 -01B001B -INST -TT012644	30018379	13I-ADU1	13I	P	1023
	151577	122515		TT012652-FULL Fn. TEST TEMP TRANS&PROBE	F8206901	9E	ADU1-TT0...	ADU1-01 -01B001B -INST -TT012652	30018402	13I-ADU1	13I	P	1023
	151578	122516		TT012653-FULL Fn. TEST TEMP TRANS&PROBE	F8206901	9E	ADU1-TT0...	ADU1-01 -01B001B -INST -TT012653	30018403	13I-ADU1	13I	P	1023
	151579	122517		LSL010403-FULL Fn. TEST LEV. DISP SW	F8004901	9E	ADU1-LSL0...	ADU1-01 -01D001 -INST -LSL010403	30017271	13I-ADU1	13I	P	1023
	151580	122518		LSL010403-OVERH AND TEST LEV. DISP SW	H80049...	9E	ADU1-LSL0...	ADU1-01 -01D001 -INST -LSL010403	30017271	13I-ADU1	13I	P	1023
	151581	122519		LSL012211-FULL Fn. TEST LEV. DISP SW	F8004901	9E	ADU1-LSL0...	ADU1-01 -01D002 -INST -LSL012211	30017273	13I-ADU1	13I	P	1023
	151582	122520		LSL012211-OVERH AND TEST LEV. DISP SW	H80049...	9E	ADU1-LSL0...	ADU1-01 -01D002 -INST -LSL012211	30017273	13I-ADU1	13I	P	1023
	151583	122521		LSH011006-FULL Fn. TEST LEV. DISP SW	F8004901	9E	ADU1-LSH...	ADU1-01 -01D004 -INST -LSH011006	30017316	13I-ADU1	13I	P	1023
	151584	122522		LSH011006-OVERH AND TEST LEV. DISP SW	H80049...	9E	ADU1-LSH...	ADU1-01 -01D004 -INST -LSH011006	30017316	13I-ADU1	13I	P	1023
	151585	122523		LSH012716-FULL Fn. TEST LEV. DISP SW	F8004901	9E	ADU1-LSH...	ADU1-01 -01D008 -INST -LSH012716	30017274	13I-ADU1	13I	P	1023
	151586	122524		LSH012716-OVERH AND TEST LEV. DISP SW	H80049...	9E	ADU1-LSH...	ADU1-01 -01D008 -INST -LSH012716	30017274	13I-ADU1	13I	P	1023
	151587	122525		FT010912A-FULL Fn. TEST FLOW TRANS.	F7918901	9E	ADU1-FT0...	ADU1-01 -FLOW -010912-FT010912A	30017129	13I-ADU1	13I	P	1023
	151588	122526		FT010912A-OVERH AND TEST FLOW TRANS.	H79189...	9E	ADU1-FT0...	ADU1-01 -FLOW -010912-FT010912A	30017129	13I-ADU1	13I	P	1023
	151589	122527		FT010912B-FULL Fn. TEST FLOW TRANS.	F7918901	9E	ADU1-FT0...	ADU1-01 -FLOW -010912-FT010912B	30017130	13I-ADU1	13I	P	1023
	151590	122528		FT010912B-OVERH AND TEST FLOW TRANS.	H79189...	9E	ADU1-FT0...	ADU1-01 -FLOW -010912-FT010912B	30017130	13I-ADU1	13I	P	1023
	151591	122529		FT010912C-FULL Fn. TEST FLOW TRANS.	F7918901	9E	ADU1-FT0...	ADU1-01 -FLOW -010912-FT010912C	30017131	13I-ADU1	13I	P	1023
	151592	122530		FT010912C-OVERH AND TEST FLOW TRANS.	H79189...	9E	ADU1-FT0...	ADU1-01 -FLOW -010912-FT010912C	30017131	13I-ADU1	13I	P	1023
	151593	122531		FT010912D-FULL Fn. TEST FLOW TRANS.	F7918901	9E	ADU1-FT0...	ADU1-01 -FLOW -010912-FT010912D	30017132	13I-ADU1	13I	P	1023
	151594	122532		FT010912D-OVERH AND TEST FLOW TRANS.	H79189...	9E	ADU1-FT0...	ADU1-01 -FLOW -010912-FT010912D	30017132	13I-ADU1	13I	P	1023
	151595	122533		FT010912A-FULL Fn. TEST FLOW TRANS.	F7918901	9E	ADU1-FT0...	ADU1-01 -FLOW -010912-FT010912A	30017129	13I-ADU1	13I	P	1023

SAP

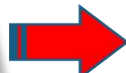
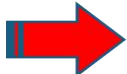
IP18 | ipc41 | OVR

Safety Integrity Level (SIL)

Outcome

Potential Corrective Action

Potential Corrective Action (Gap Closing)

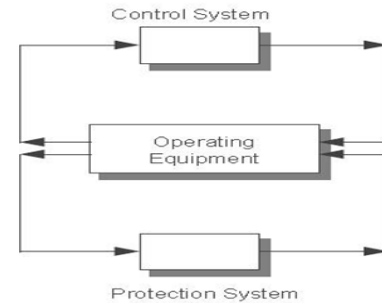
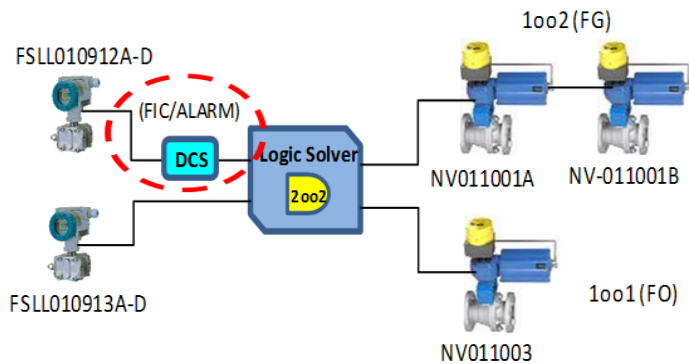


Plant Change Proposal (PCP)

Safety Integrity Level (SIL)

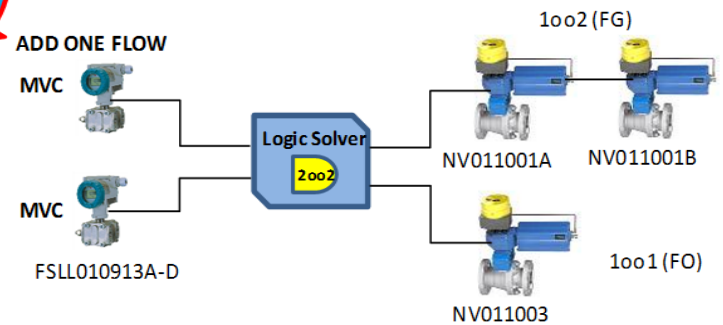
Outcome

Existing Configuration



"It is strongly recommended that separate control and protection systems are provided."

Improvement Configuration



REF.

IEC 61508/11

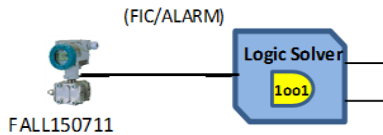


Shell DEPs

Safety Integrity Level (SIL)

Outcome

Existing Configuration



In the case of a SIL 1 or 2 IPF where dangerous fault tolerant sensors are applied (1oo2). In that case one of the sensors may be a sensor also used for control, even if a dangerous failure of this control sensor may lead to a demand on the function.

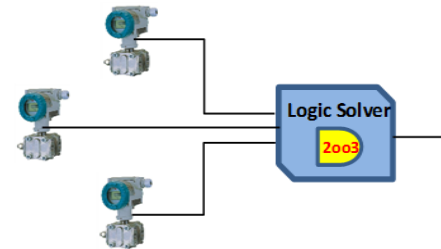
REF.

IEC 61508/11



Shell DEPs

Improvement Configuration

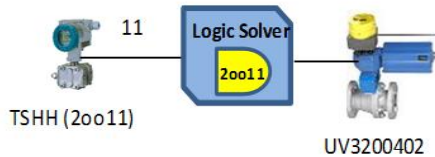


ADD THREE FLOW TRANSMITTERS

Safety Integrity Level (SIL)

Outcome

Existing Configuration



SIL	TSO	Control valve failure in demand scenario			
		Yes		No	
		not required	required	not required	required
1		1oo1 (0) excl. CV	1oo1 TSO (0) excl. CV	1oo1 (0) incl. CV	1oo1 TSO (0) excl. CV
2		1oo2 (1) incl. CV	1oo2 TSO (1) excl. CV (1)	1oo2 (1) incl. CV	1oo2 TSO (1) excl. CV
3		1oo2 (1) excl. CV	1oo2 TSO (1) excl. CV	1oo2 (1) incl. CV	1oo2 TSO (1) excl. CV

“Excl. CV” means that the Control Valve (if any) cannot (be part of) the final element
 “Incl. CV” means that the Control Valve (if any) can (be part of) the final element. If the control valve is used as (one of) the final element(s) it shall be via a SOV between positioner and actuator.
 (0) and (1) denote the achieved degrees of dangerous fault tolerance.

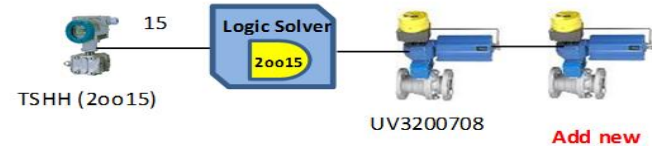
REF.

IEC 61508/11



Shell DEPs

Improvement Configuration



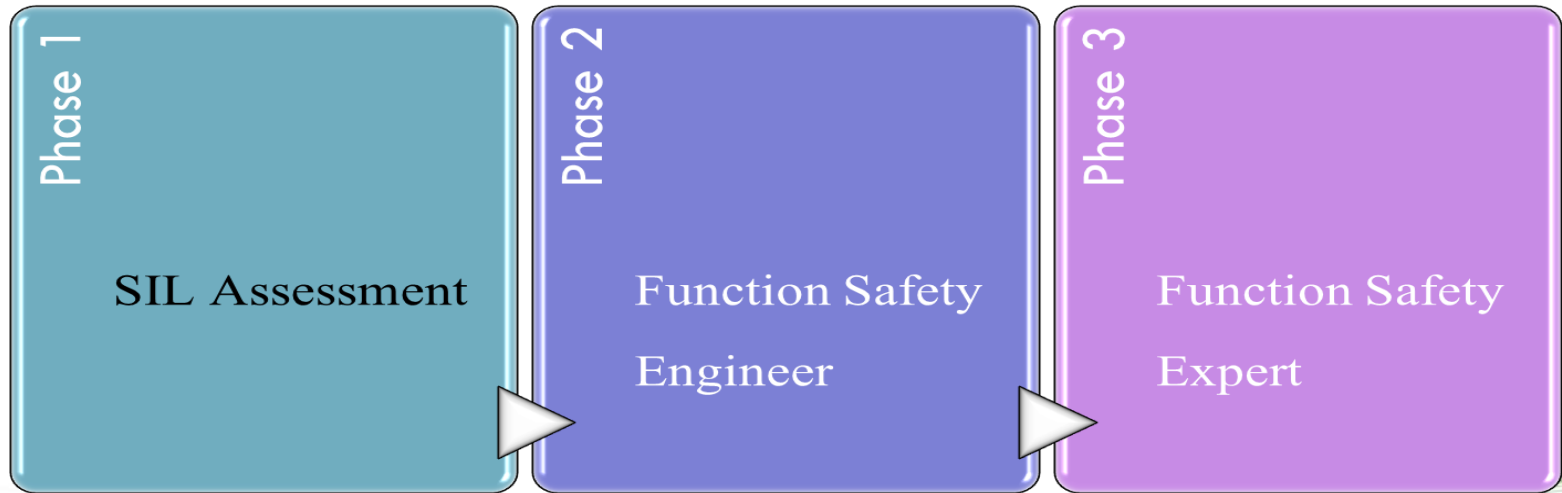
1st Chemical Process Safety Sharing (CPSS)

13 Jun. 2018, Thailand

Safety Integrity Level (SIL)

Personnel

ROADMAP



Safety Integrity Level (SIL)

Personnel

Safety Instrumented System IEC 61508/11				IRRE Personnel		
				Anucha P.	Pattara S.	Taweesak T.
Basic Control System and ESD				Completed in 2005	Completed in 2005	Completed in 2005
3 years work experience						
SIL Assessment concept and Practice						
	SIL Assessment			Completed in 2008	Completed in 2008	Completed in 2011
1-2 years work experience						
		Functional Safety Engineer				
			Functional Safety Engineer	Completed in 2014	Completed in 2012	Plan in 2017
1-2 years work experience						
			Functional Safety Expert			
				Plan in 2018-2020	Plan in 2016-2017	Plan in 2020-2022
Entry Level	Intermediate Level	Advanced Level	Specialized Level			

Note: 1. Course = Training Course Name Certification = Submit Certification = Require an examination before submitting certification

Safety Integrity Level (SIL)

Personnel

Certificate

FS Eng (TÜV Rheinland)
Functional Safety Engineer (TÜV Rheinland)

Application Area	Safety Instrumented Systems
ID-No.	# 9619/ 14
Certificate Owner	Anucha Pinyopornsawat Thailand
Course Provider	Yokogawa Europe B.V.
Training Contents	Process Safety Risk / Layers of Protection International Safety Standards, Regulations, Enforcement Safety Integrity Level (SIL) Assignment Methodologies Safety Requirement Specifications (SRS) Development Safety Integrity Level (SIL) Verification Methodologies Management of Functional Safety SIS Design and Good Engineering Practices
Issue Date	December 2014
Expiry Date	December 2019
Validity	This certificate is valid for 5 years.

Cologne, December 2014

H. Gall
Dipl.-Ing. Heinz Gall
Head of TÜV Rheinland Functional Safety Program

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Precisely Right.

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Thank you

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Q&A