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

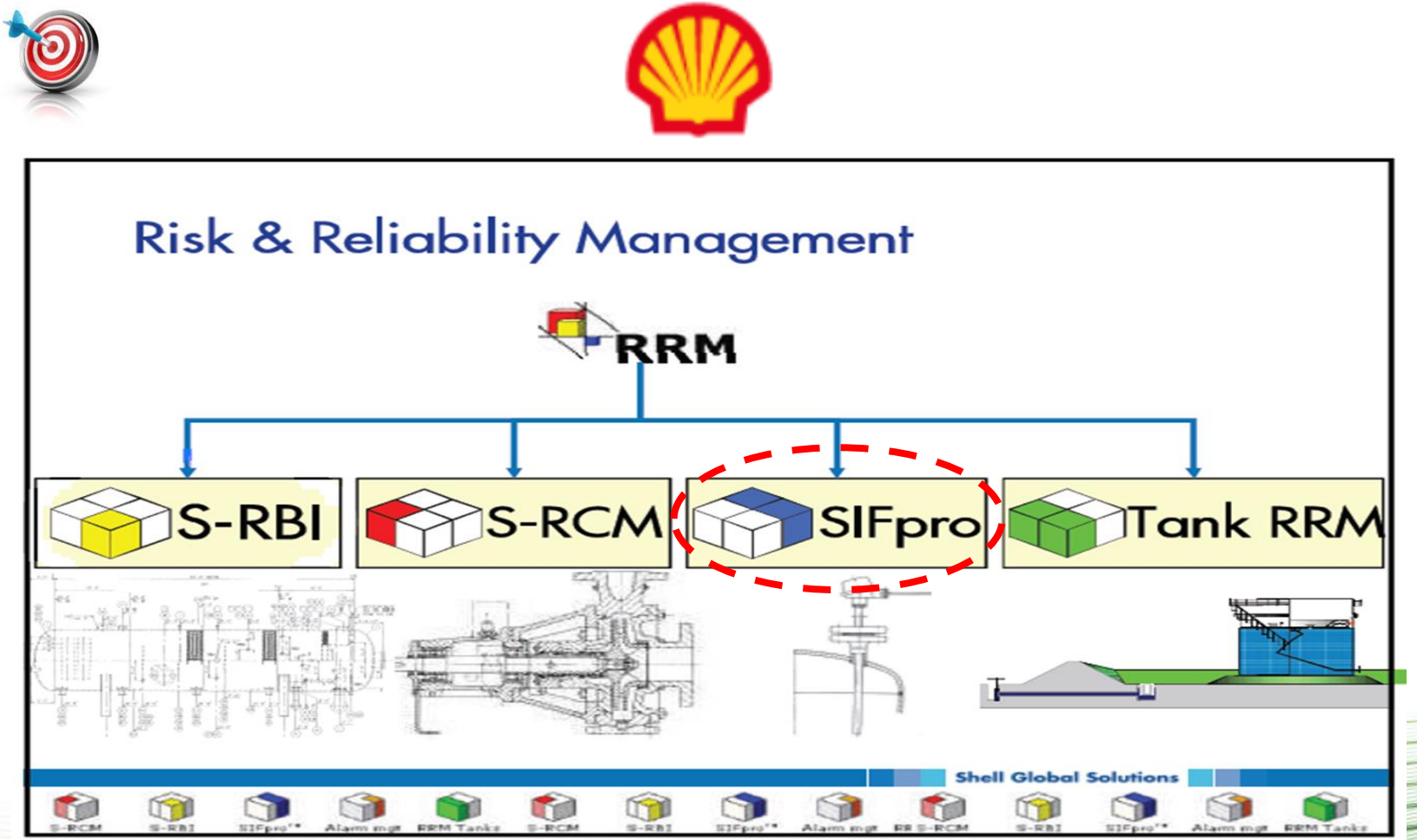
1980 1990 2000

## IRPC

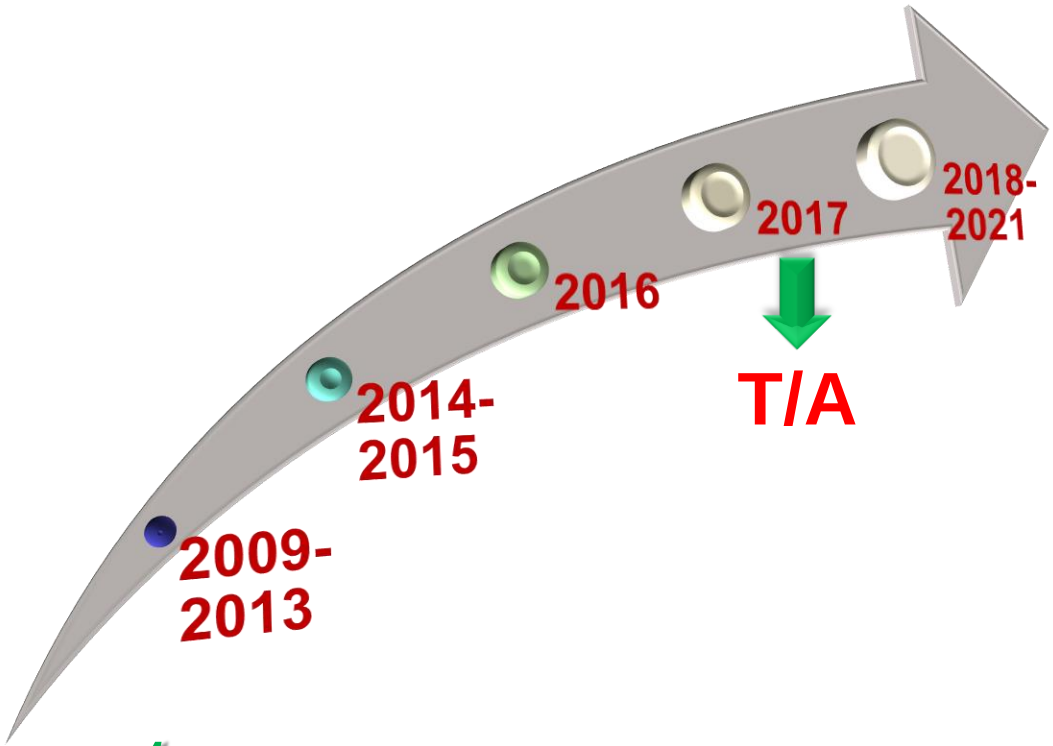
- On Jun. 2007, The "Rapid Business Improvement program (RaBIP)" with SGSi.
- On Nov. 2008, The "Plant Reliability Improvement program (PRIP)" (S-RCM, S-RBI, SIFpro)
- First Implement SIL Assessment at EBSM Plant with SGSi.

2007 2008 2009

# Background


Risk & Reliability Management
RRM
S-RBI
S-RCM
SIFpro
Tank RRM
Shell Global Solutions

# Background




**SIL Assessment Road Map**

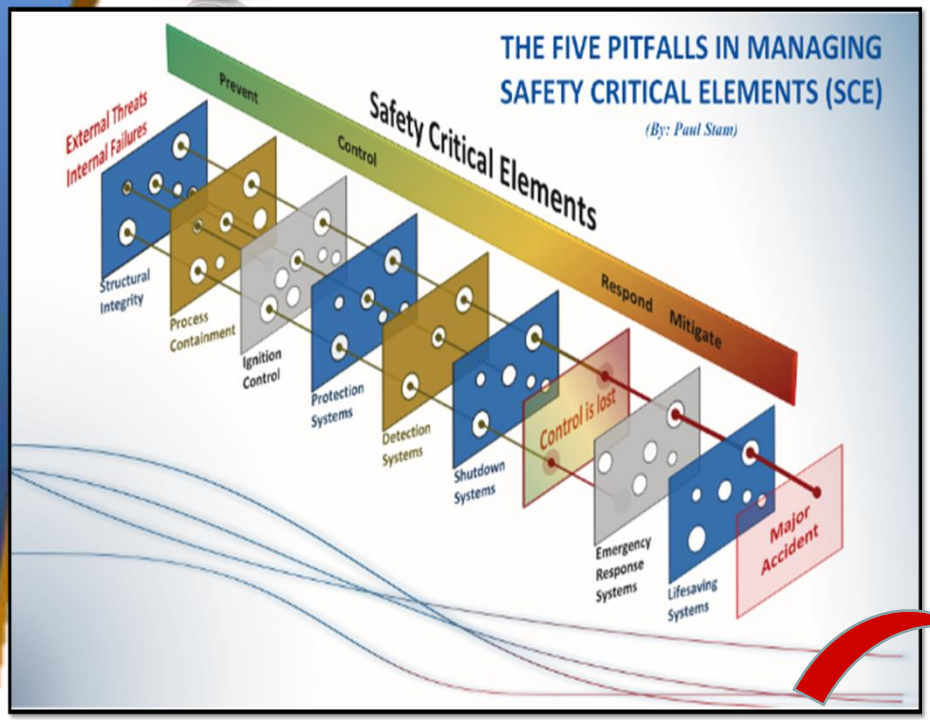
# Background

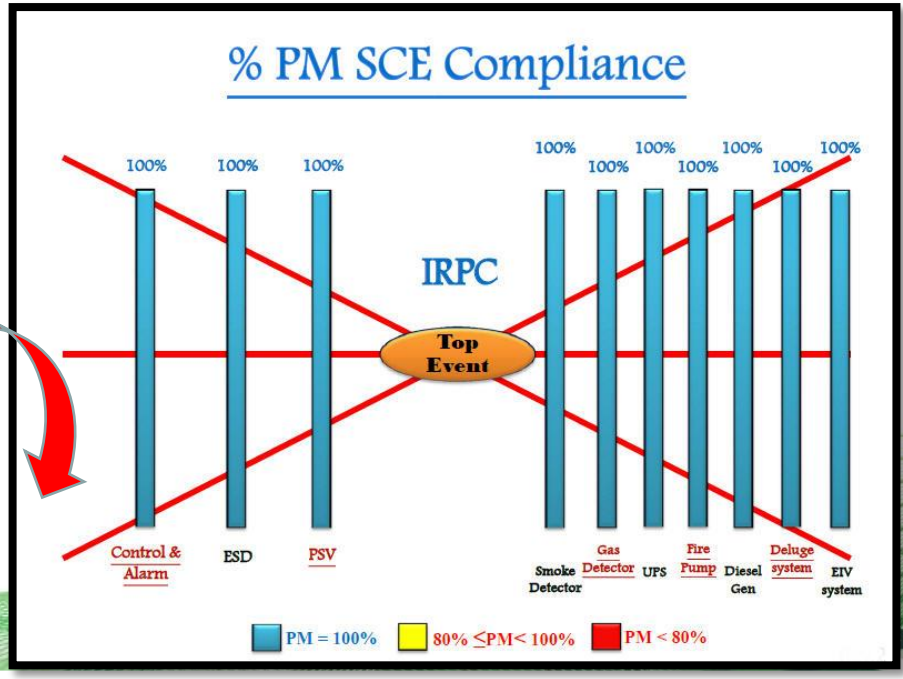
**Jack Welch (อดีตผู้บริหารสูงสุดของ General Electric ) เคยได้กล่าวไว้ว่า**

**“หากความเปลี่ยนแปลงภายนอก เป็นไปอย่างรวดเร็วกว่าความเปลี่ยนแปลงภายในองค์กร จุดจบก็คงอยู่ไม่ไกล”**

# Background

## Safety Critical Elements (SCE)

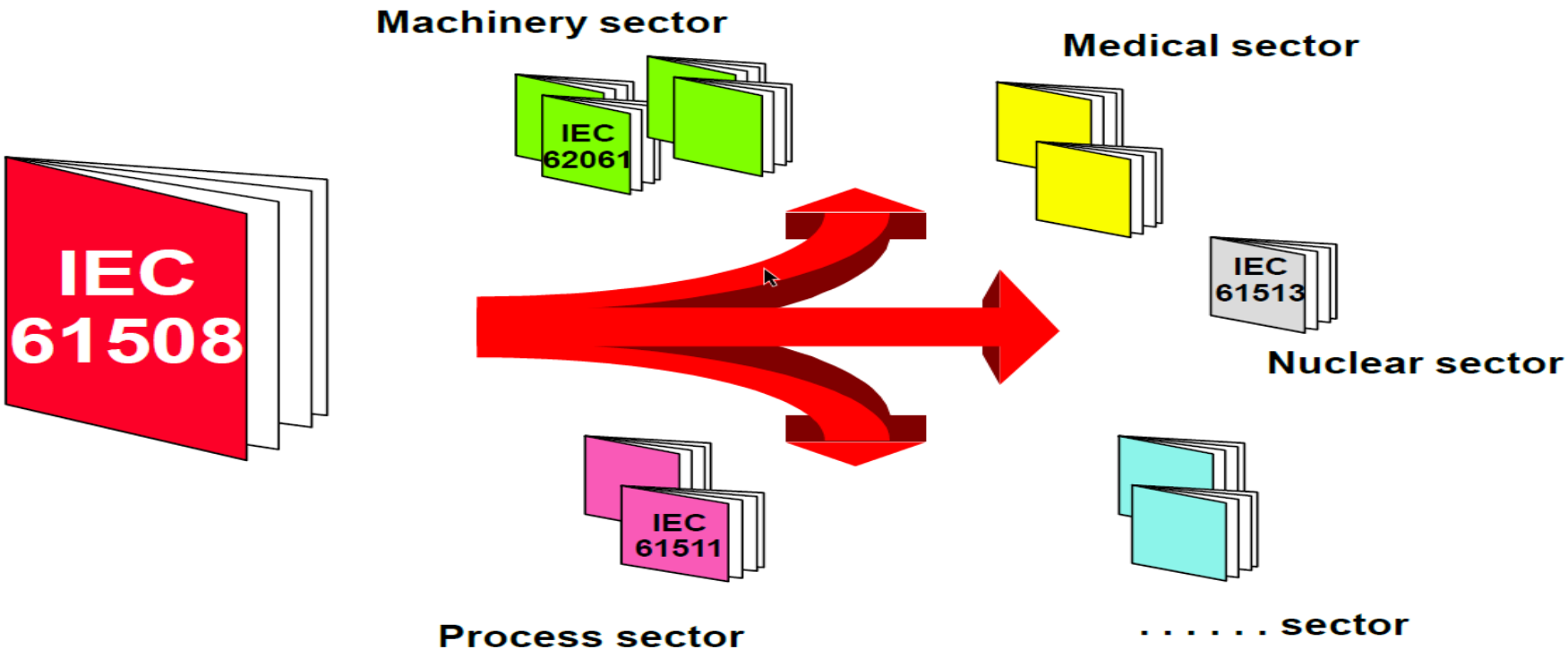


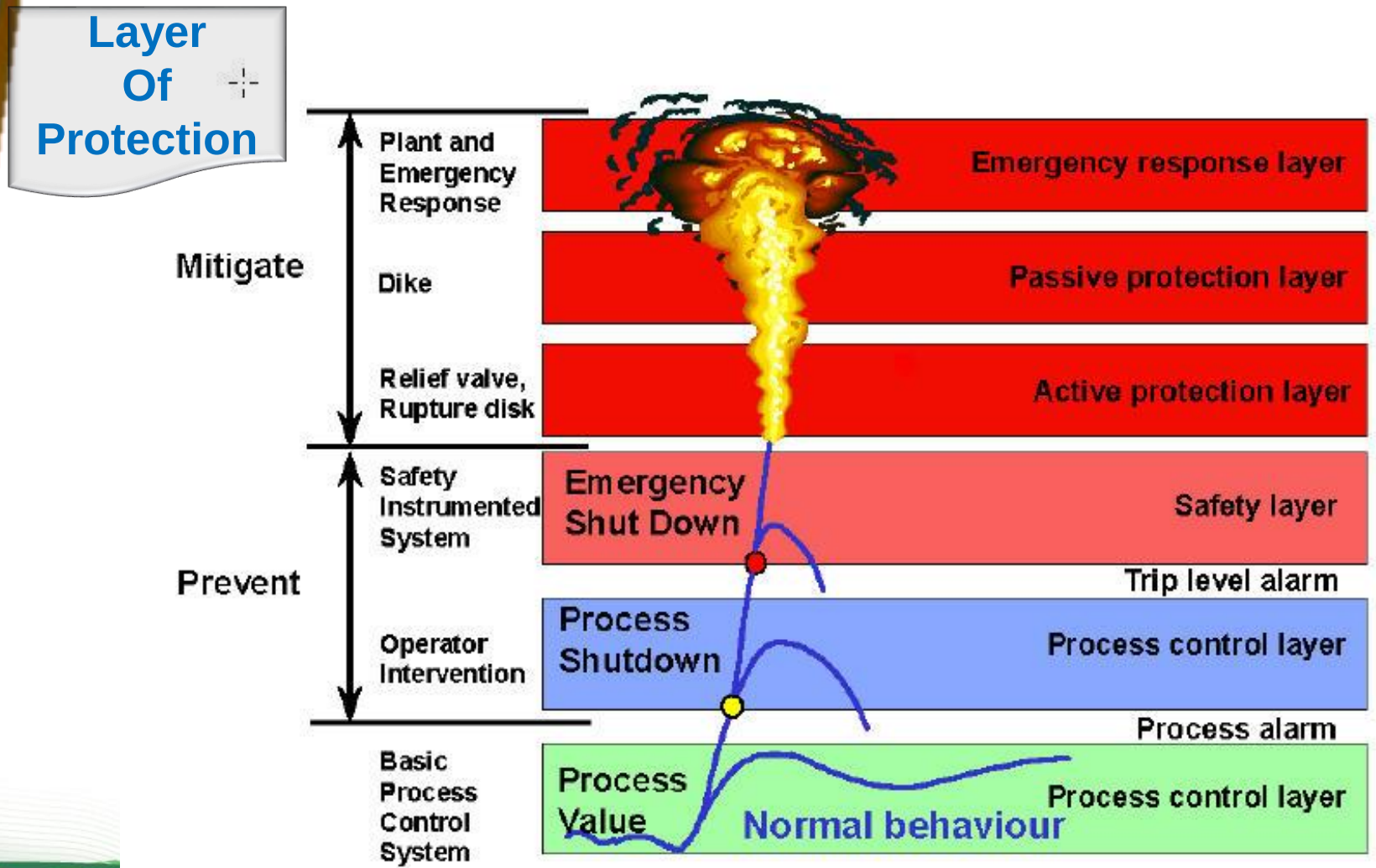
# Safety Integrity Level (SIL)

**Reference:**

## IEC61508 – A Basic Safety Standard



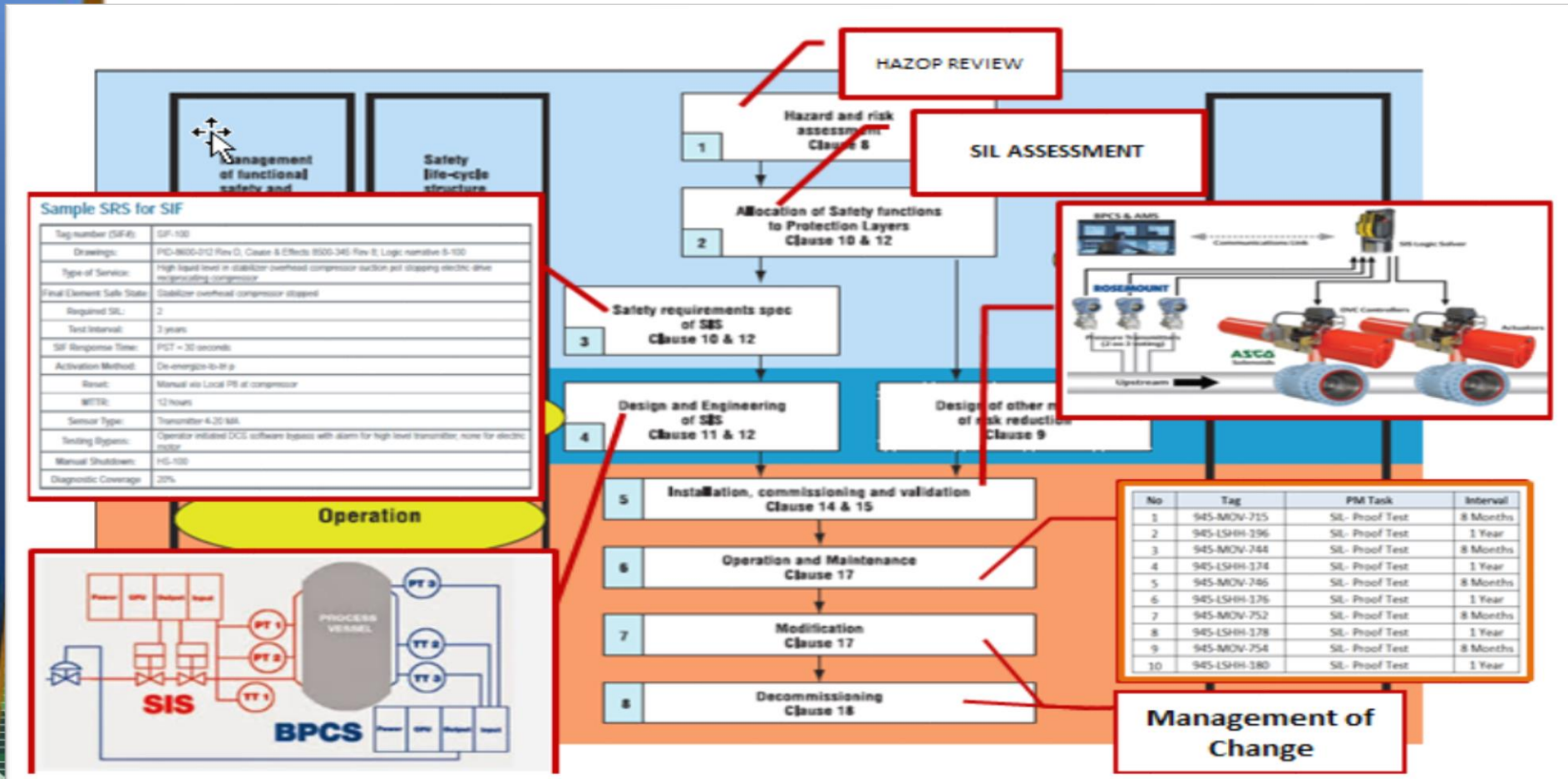
# Safety Integrity Level (SIL)



# Safety Integrity Level (SIL)

**Systematic**

## *Safety Lifecycle*




| No | Tag | PM Task | Interval |
|---|---|---|---|
| 1 | 945-MOV-715 | SIL- Proof Test | 8 Months |
| 2 | 945-LSHH-196 | SIL- Proof Test | 1 Year |
| 3 | 945-MOV-744 | SIL- Proof Test | 8 Months |
| 4 | 945-LSHH-174 | SIL- Proof Test | 1 Year |
| 5 | 945-MOV-746 | SIL- Proof Test | 8 Months |
| 6 | 945-LSHH-176 | SIL- Proof Test | 1 Year |
| 7 | 945-MOV-752 | SIL- Proof Test | 8 Months |
| 8 | 945-LSHH-178 | SIL- Proof Test | 1 Year |
| 9 | 945-MOV-754 | SIL- Proof Test | 8 Months |
| 10 | 945-LSHH-180 | SIL- Proof Test | 1 Year |

# Safety Integrity Level (SIL)

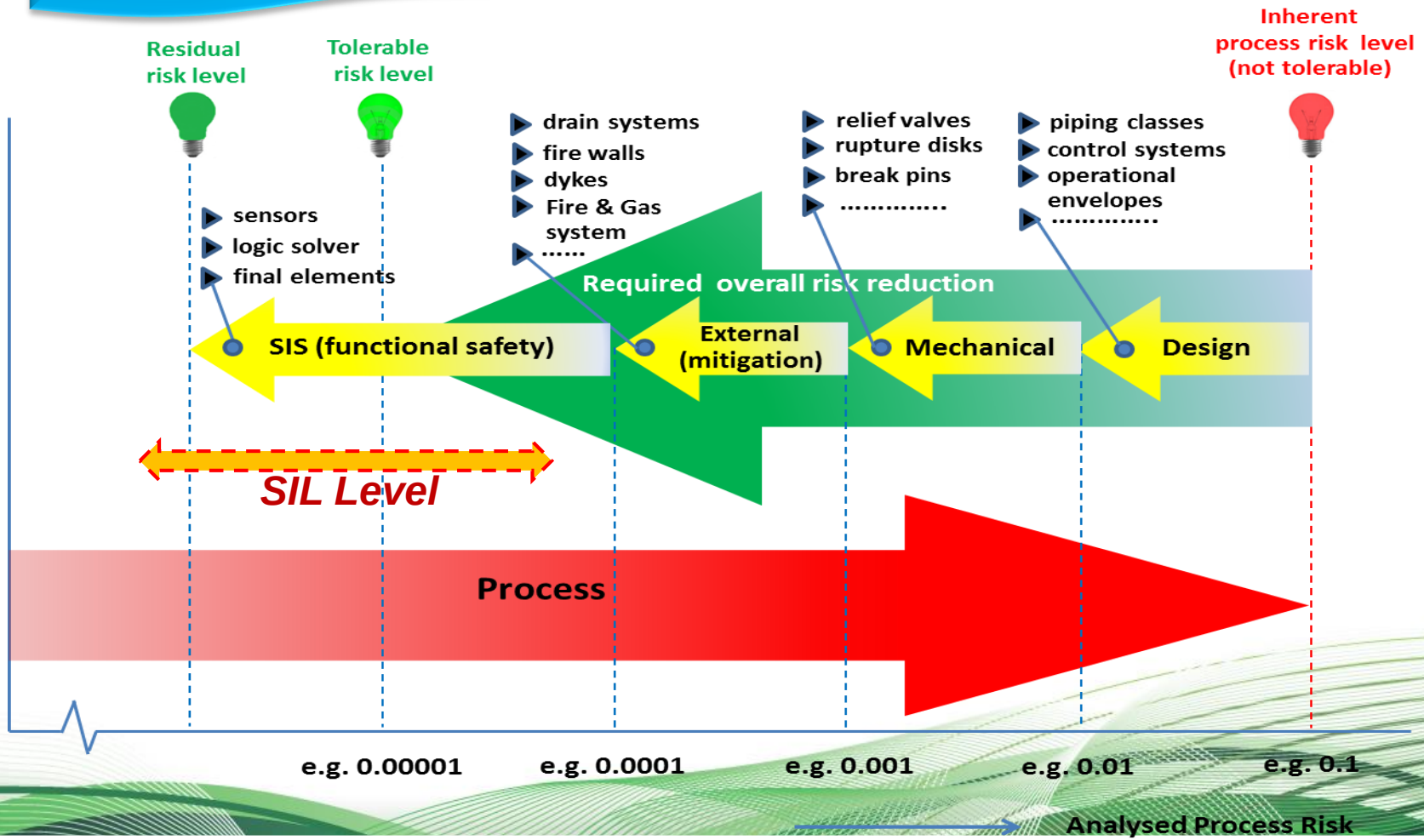
**Step**

Assessment Phase

Verification Phase

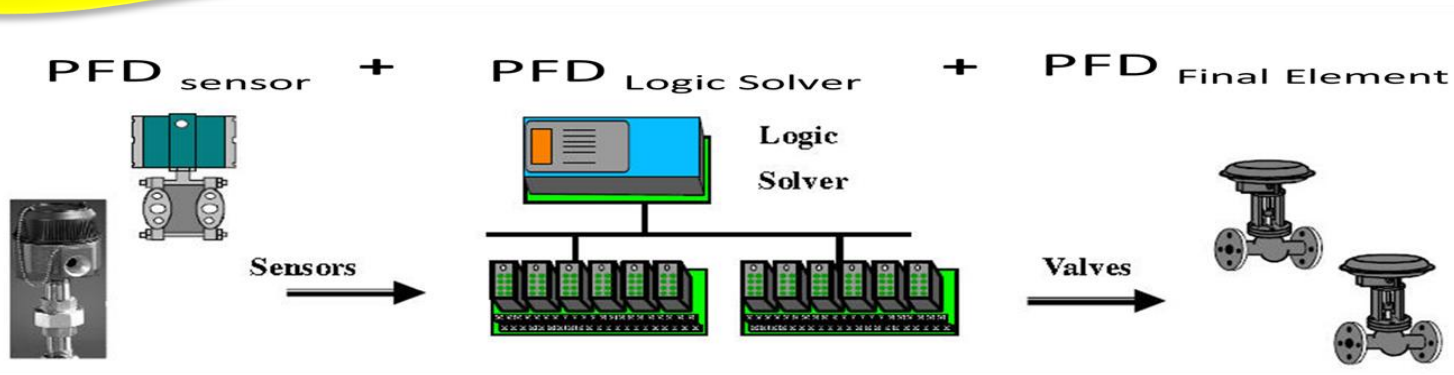
# Safety Integrity Level (SIL)

## Assessment Phase



# Safety Integrity Level (SIL)

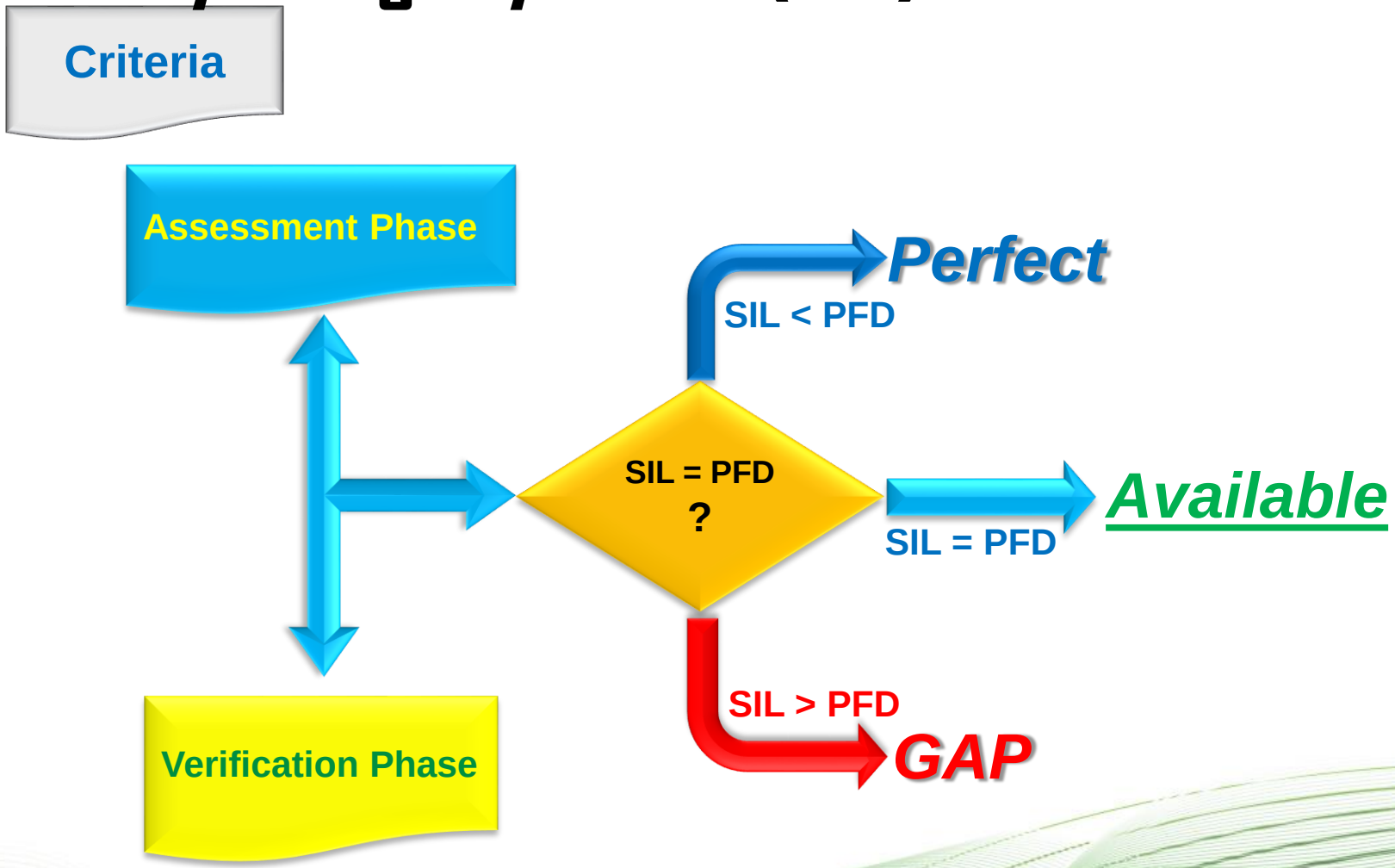
**Verification Phase** การคำนวณค่า PFD




**PFD : Probability of failure on demand**

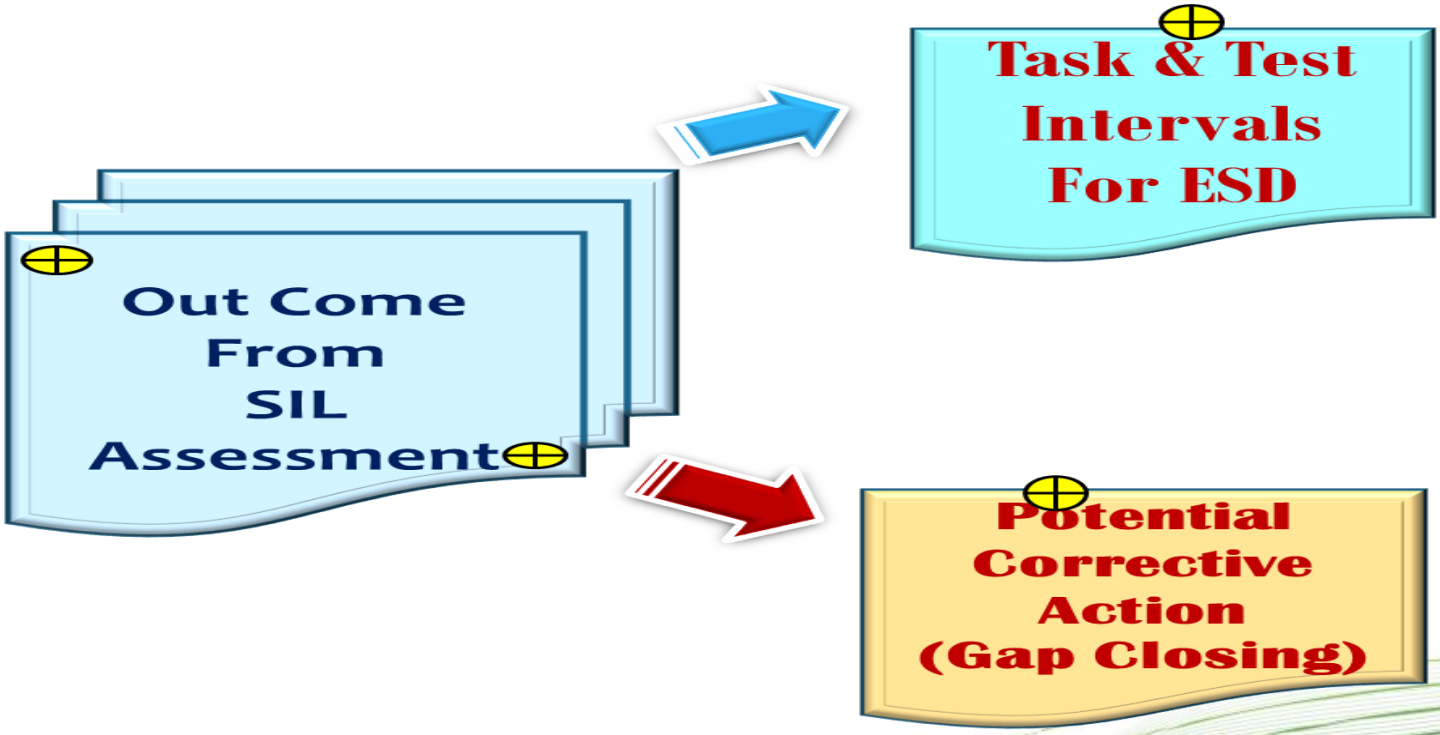
| Safety Integrity Level | $PFD_{AVG}$ : Average Probability of Failure on Demand (Demand Mode) |
|---|---|
| SIL 4 | $>=10^{-5}$ to $<10^{-4}$ |
| SIL 3 | $>=10^{-4}$ to $<10^{-3}$ |
| SIL 2 | $>=10^{-3}$ to $<10^{-2}$ |
| SIL 1 | $>=10^{-2}$ to $<10^{-1}$ |

# Safety Integrity Level (SIL)



# Safety Integrity Level (SIL)

## Outcome



# Safety Integrity Level (SIL)

**Outcome**

**Task & Test Intervals For ESD**

**Task up Load to SAP**

SAP Traditional Maintenance

# Safety Integrity Level (SIL)

## Outcome

List Edit Goto Environment Settings System Help

**Display Maintenance Item: Maintenance Item List**

Maintenance item | Maintenance plans | Cost estimate

| 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 |

IP18 | irpc41 | OVR

# Safety Integrity Level (SIL)

**Outcome**

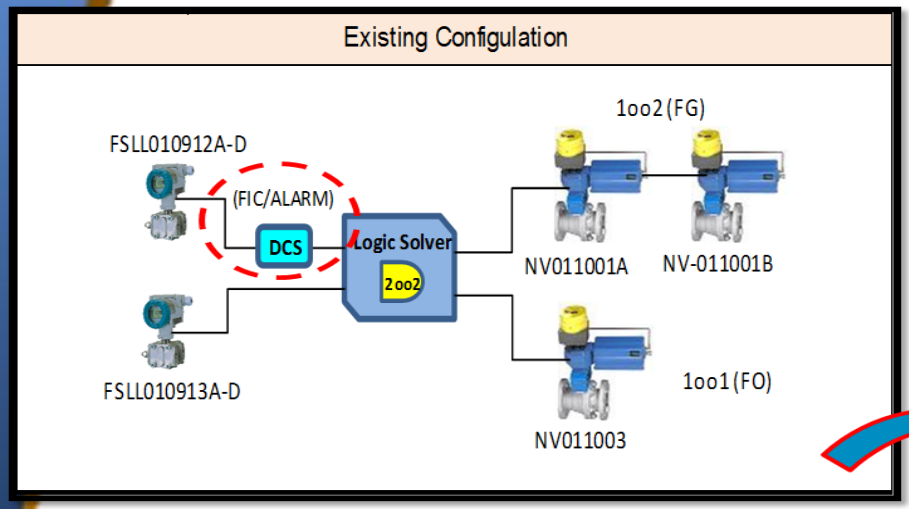
**Potential Corrective Action**

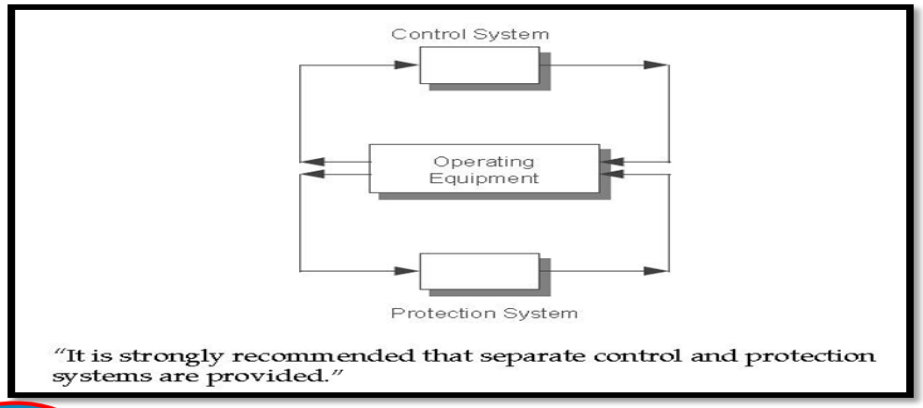
**Potential Corrective Action (Gap Closing)**


**Plant Change Proposal (PCP)**

# Safety Integrity Level (SIL)

## Outcome

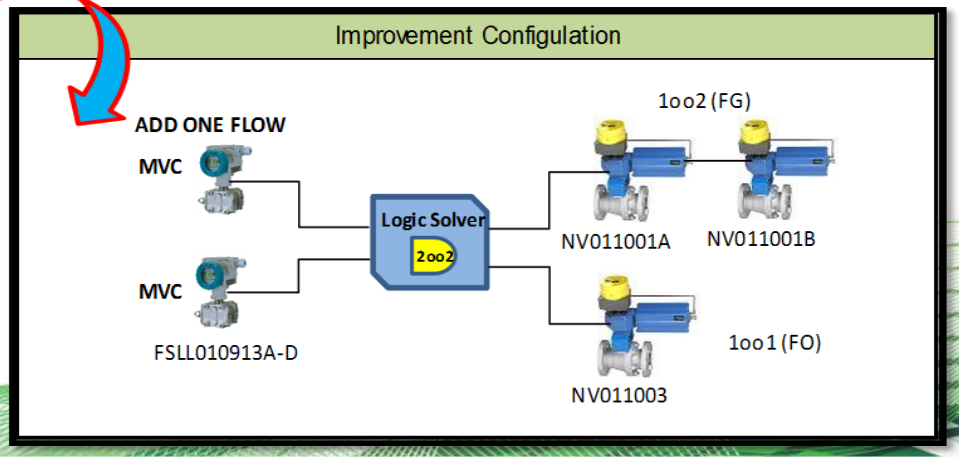



REF.

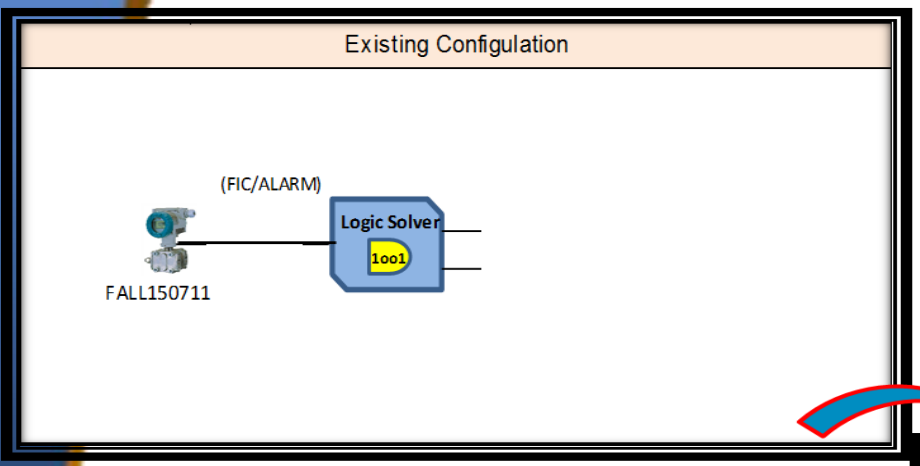
IEC 61508/11

Shell DEPs



# Safety Integrity Level (SIL)

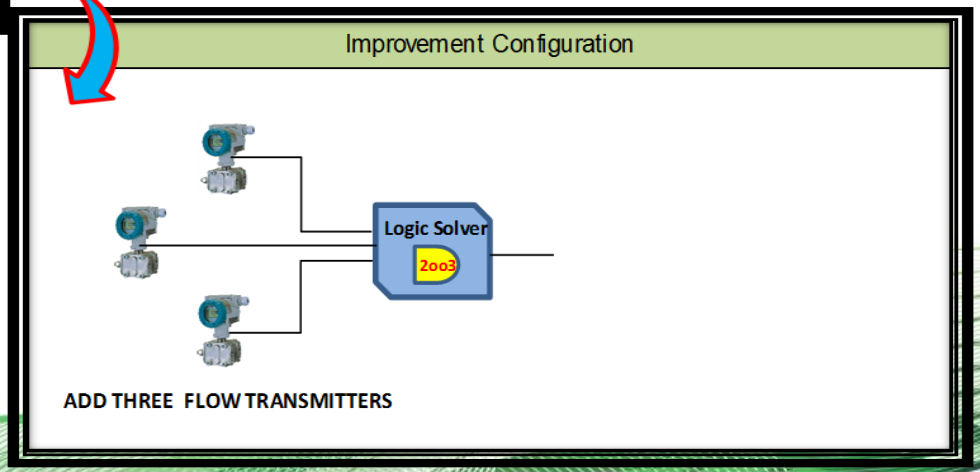
## Outcome




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

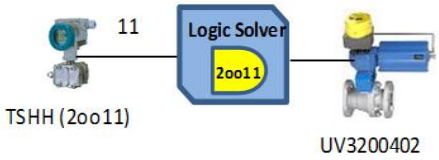
Shell DEPs



# Safety Integrity Level (SIL)

## Outcome

**Existing Configulation**



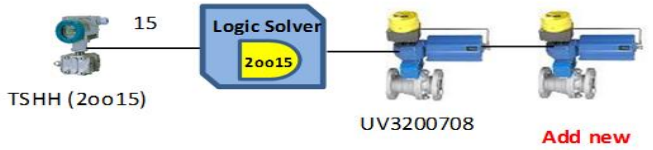

| SIL \ TSO | Control valve failure in demand scenario | | | |
|---|---|---|---|---|
| | Yes | | No | |
| | **not** required | required | **not** required | required |
| 1 | 1oo1 (0) excl. CV | 1oo1 TSO (0) excl. CV | 1oo1 (0) incl. CV | 1oo1 TSO (0) excl. CV |
| 2 | 1oo2 (1) incl. CV | 1oo2 TSO (1)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

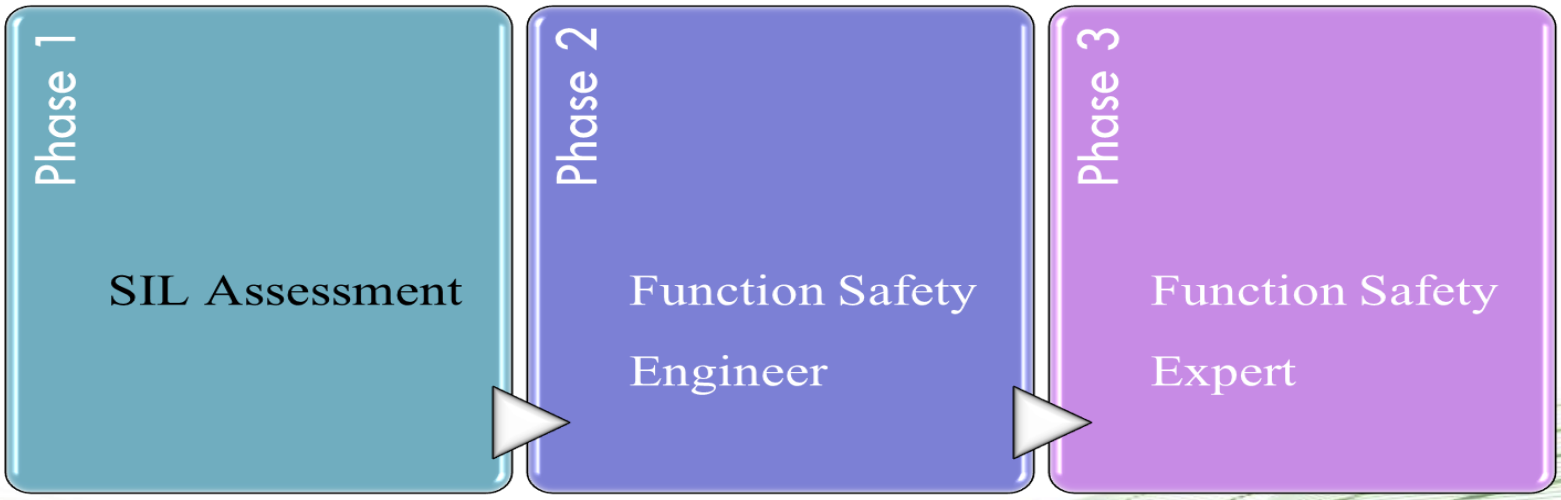
**Improvement Configulation**



# Safety Integrity Level (SIL)

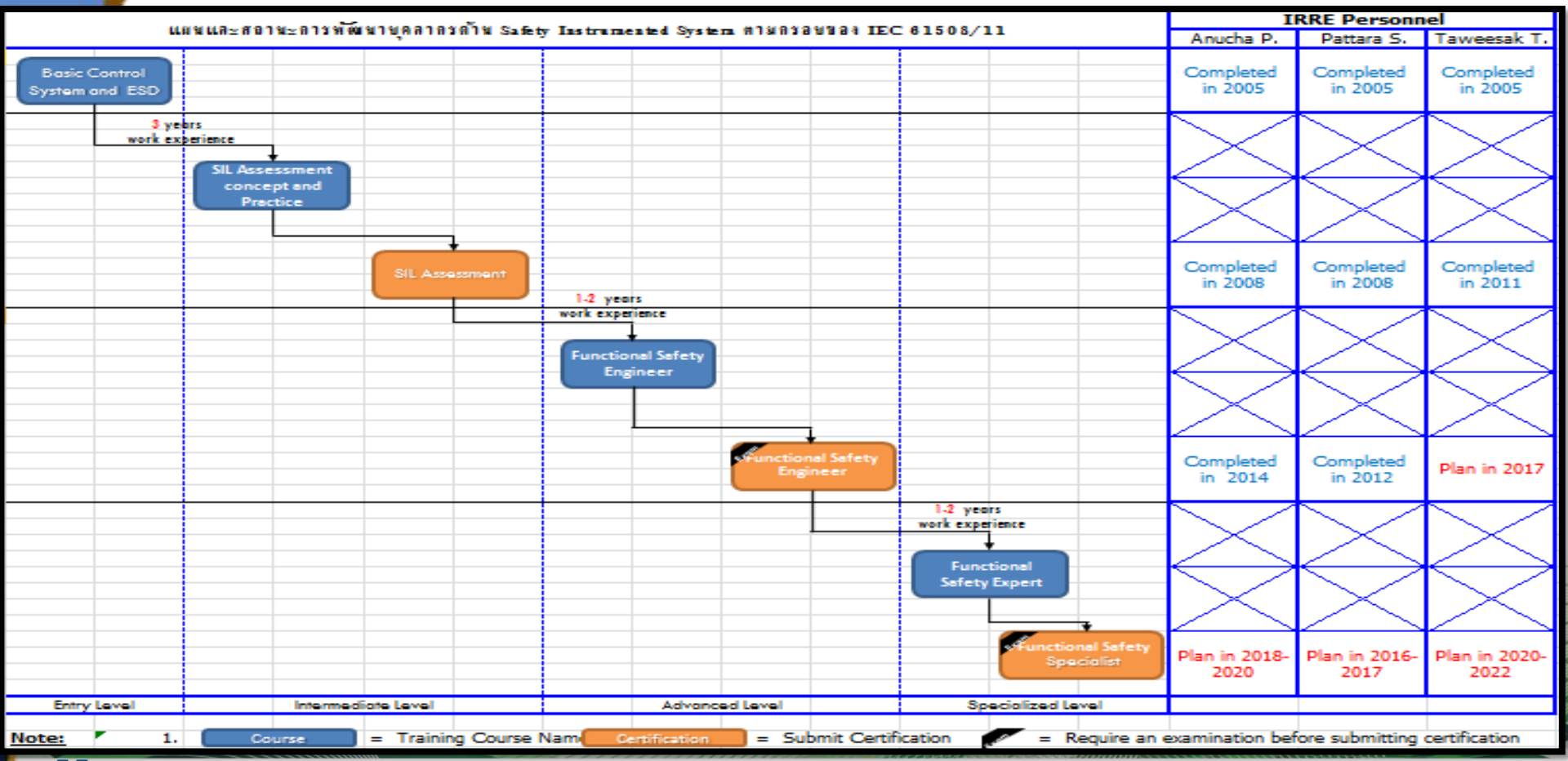
**Personnel**

## ROADMAP



# Safety Integrity Level (SIL)

## Personnel



# 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<br>Thailand |
| Course Provider | Yokogawa Europe B.V. |
| Training Contents | Process Safety Risk / Layers of Protection<br>International Safety Standards, Regulations, Enforcement<br>Safety Integrity Level (SIL) Assignment Methodologies<br>Safety Requirement Specifications (SRS) Development<br>Safety Integrity Level (SIL) Verification Methodologies<br>Management of Functional Safety<br>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

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

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Automation and Functional Safety
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51105 Cologne - Germany

www.tuvasi.com

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Precisely Right.

# Safety Integrity Level (SIL)

# Thank you

# Safety Integrity Level (SIL)

# Q&A