2nd Chemical Process Safety Sharing (CPSS)

Topic :

Safety Critical Elements

Present Name :

Anucha Pinyopornsawat

Position :

Section Manager

Company:

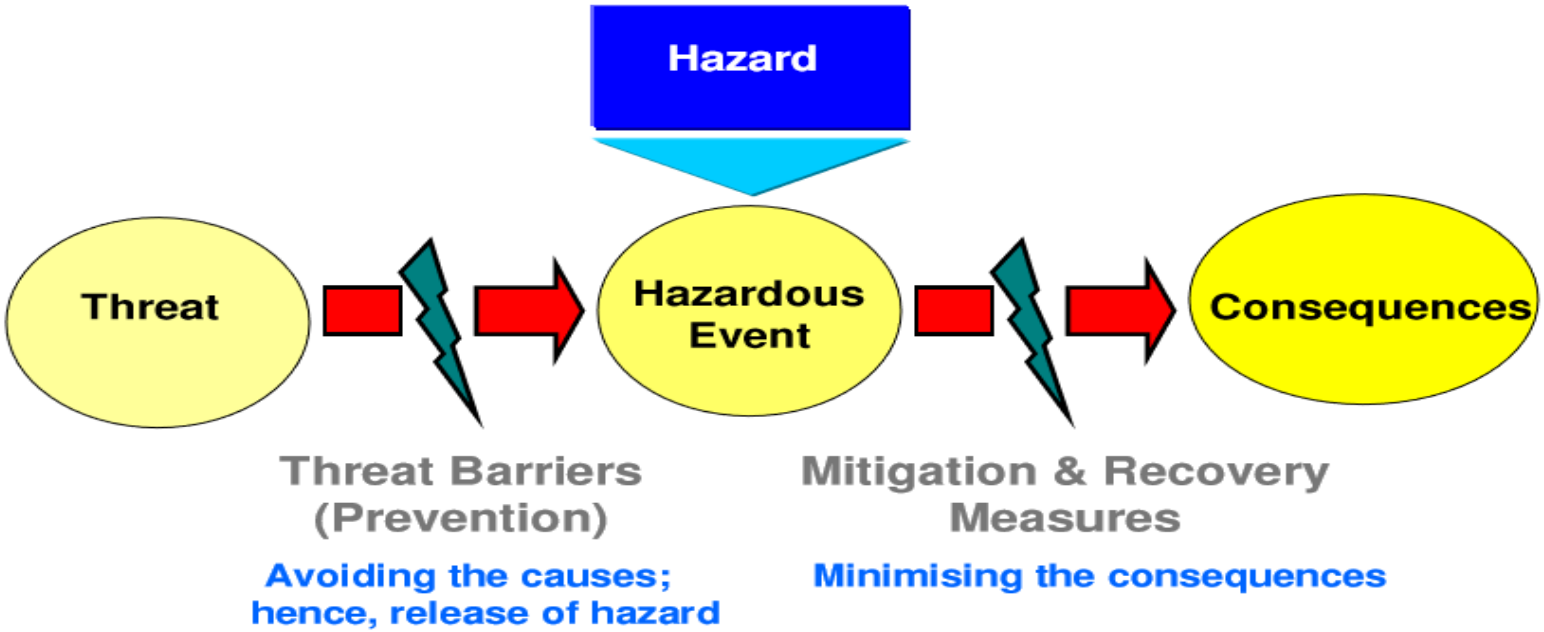
IRPC Public Company Limited.

Contents

- Background
- Brief Implement SCE at IRPC
- SCE Classification (Bow Tie)
- Implement SCE Outcome
- Development Program

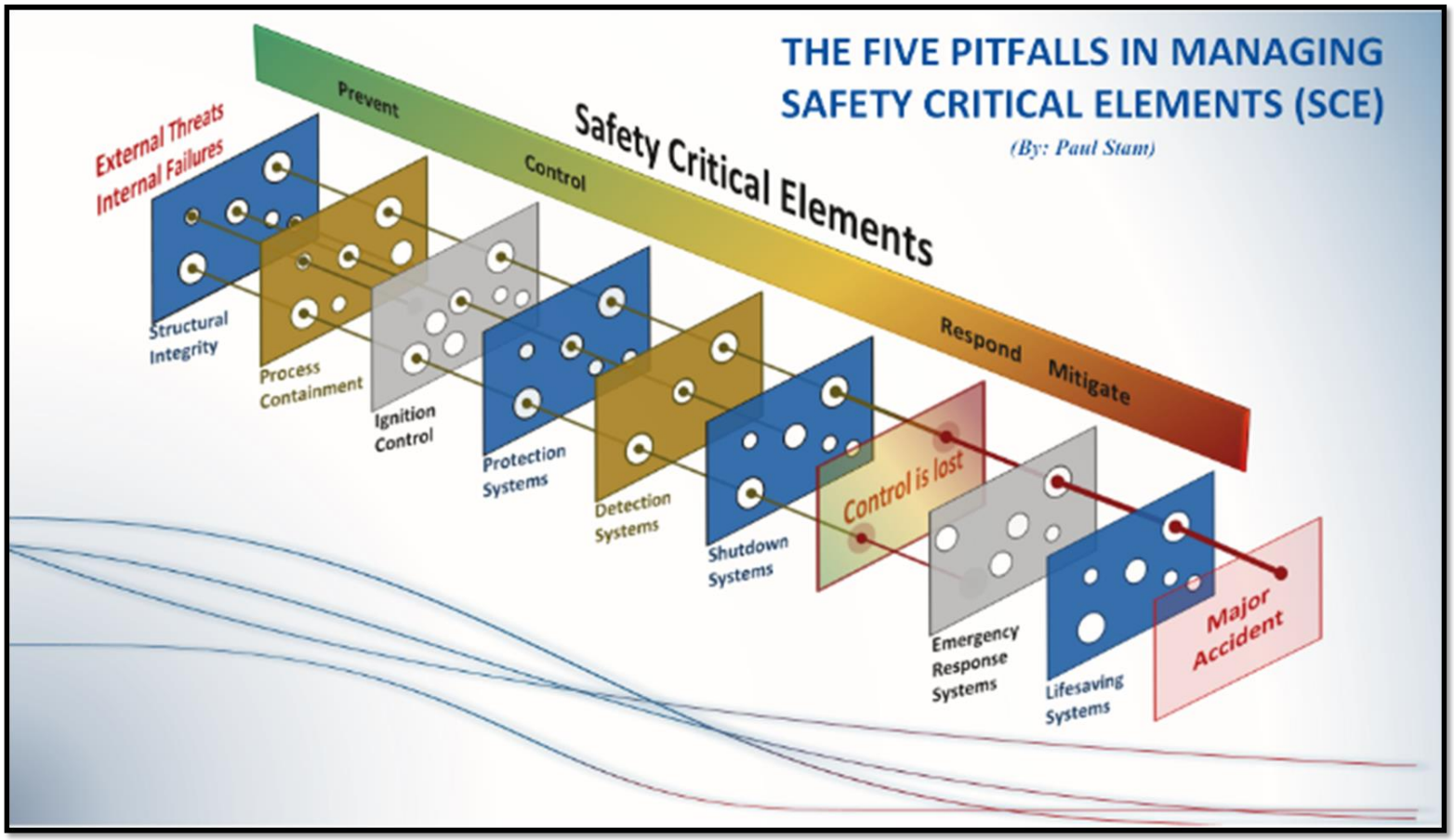
Introduction

Safety Critical Elements



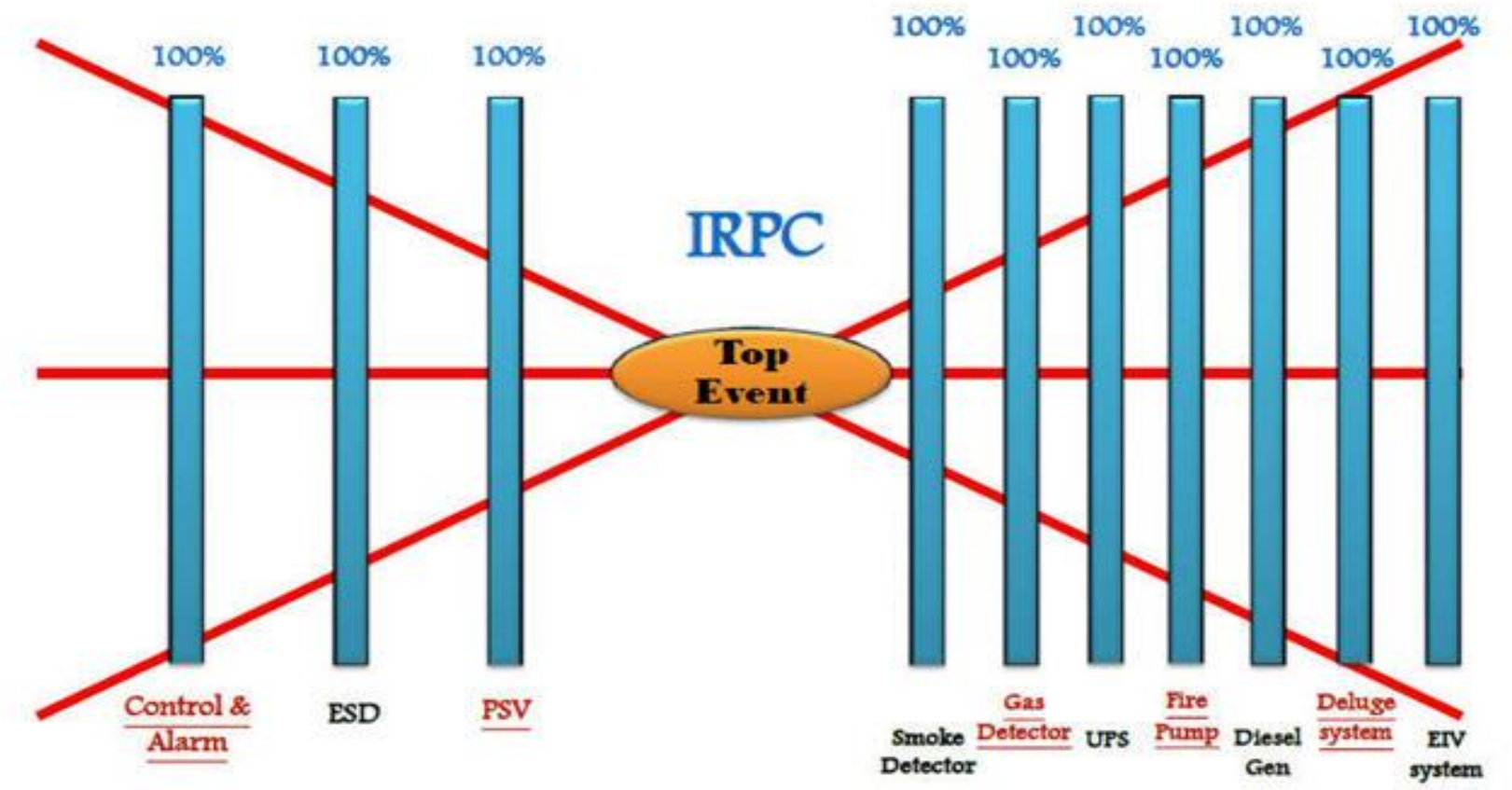
Introduction

Safety Critical Elements



Introduction

Safety Critical Elements



Safety Critical Elements

Back Ground

Operational Excellence Management system : (OEMS)

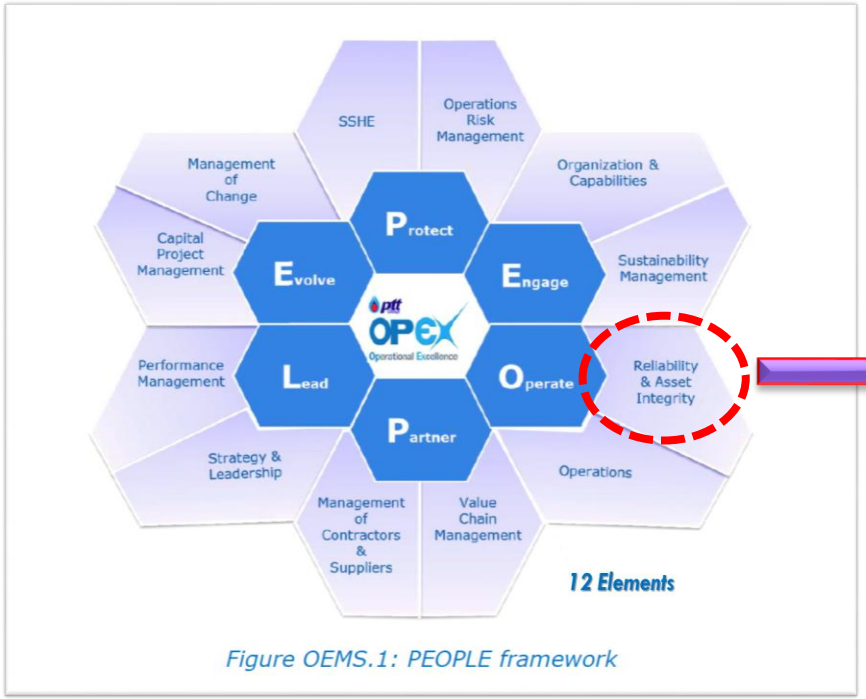


Figure OEMS.1: PEOPLE framework

5.2 Maintenance Approach

Select maintenance approach for each equipment according to its criticality to SSHE and operations performance. Asset registers form the core of the maintenance approach selection, and cover all equipment with particular emphasis on safety and production critical equipment.

Maintenance approach is selected in a three-step process *(cf. Figure 5.2a: Selection of maintenance approach)*

Identify	Analyze	Select
• Asset register • Equipment grouping	• Reactive - Problem solving analysis "... • Proactive -RBI -RCM -SIL "... • Statutory	• Condition Based monitoring • Time-based • Inspection & Functional Testing • Run-to-Failure • Replace or Retire • Redesign • Autonomous Maintenance

Figure 5.2a: Selection of maintenance approach

5.2.1 Equipment identification - This ensures:

- **Identification** of SSHE critical equipment by conducting a risk assessment (including likelihood and impact) on all equipment.
- **Comprehensive** coverage for maintenance planning.
- **Understanding** of logical relationships between equipment.
- **Optimization** of spare-parts inventory.

Safety Critical Elements

Back Ground

Operational Excellence Management system : (OEMS)

PTTEP

Safety Critical Elements

Brief Implement SCE at IRPC

Step to Implement Safety Critical Elements in IRPC

Classification SCE Equipment

Follow Up by Road Map

Test Per plan

Tracking Monthly Report "%PM SCE Compliance"

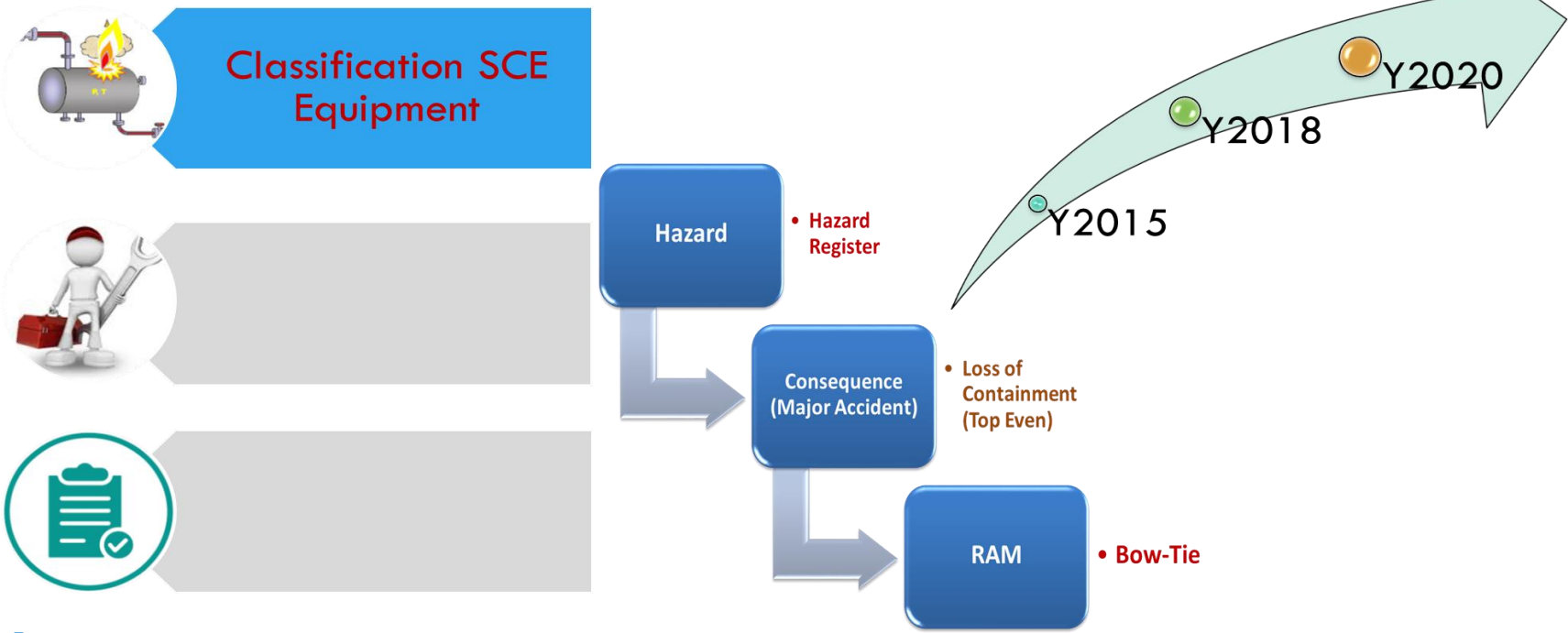
Perform as STD

Technical Data "Performance STD for SCE Equipment"

Safety Critical Elements

Brief Implement SCE at IRPC

Step to Implement Safety Critical Elements in IRPC



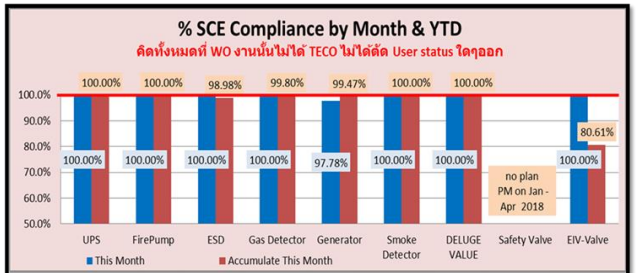
Safety Critical Elements

Brief Implement SCE at IRPC

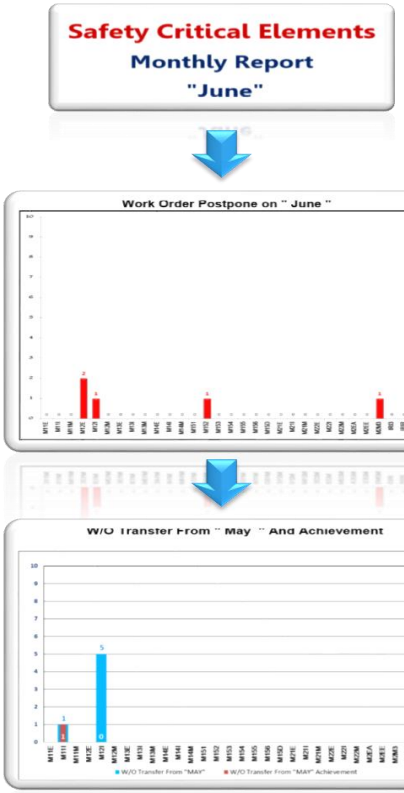
Step to Implement Safety Critical Elements in IRPC

Test Per plan

%SCE PM Compliance as of April & YTD Y2018



Maintenance	PM Postpone	PM Plan	PM Achieve as plan	PM Achieve with postpone	Postpone Out	% Acheivement as plan	Accumulate PM Plan	Accumulate PM Achievement	% Achievement with Postpone
UPS		16	16	16		100.00%	107	107	100.00%
M2		16	16	16		100.00%	107	107	100.00%
FirePump		32	32	32		100.00%	120	120	100.00%
IR		6	6	6		100.00%	24	24	100.00%
M1		26	26	26		100.00%	96	96	100.00%
ESD	3	32	32	32	3	100.00%	293	290	98.98%
M1	3	32	32	32	3	100.00%	149	146	97.99%
M2						0.00%	144	144	100.00%
Gas Detector	1	29	29	29	1	100.00%	495	494	99.80%
M2	1	29	29	29	1	100.00%	495	494	99.80%
Generator		45	44	44	1	97.78%	189	188	99.47%
M1		31	31	31		100.00%	133	133	100.00%
M2		14	13	13	1	92.86%	56	55	98.21%
SMOKE DETECTO	2	189	189	191		100.00%	932	932	100.00%
M1	2	180	180	182		100.00%	885	885	100.00%
M2		9	9	9		100.00%	47	47	100.00%
DELUGE VALUE	27	7	7	34		100.00%	108	108	100.00%
M1	27	7	7	34		100.00%	108	108	100.00%
EIV-Valve	62	28	28	58	32	100.00%	165	133	80.61%
M1	62	28	28	58	32	100.00%	165	133	80.61%
Grand Total	95	378	377	436	37	99.74%	2,409	2,372	98.46%

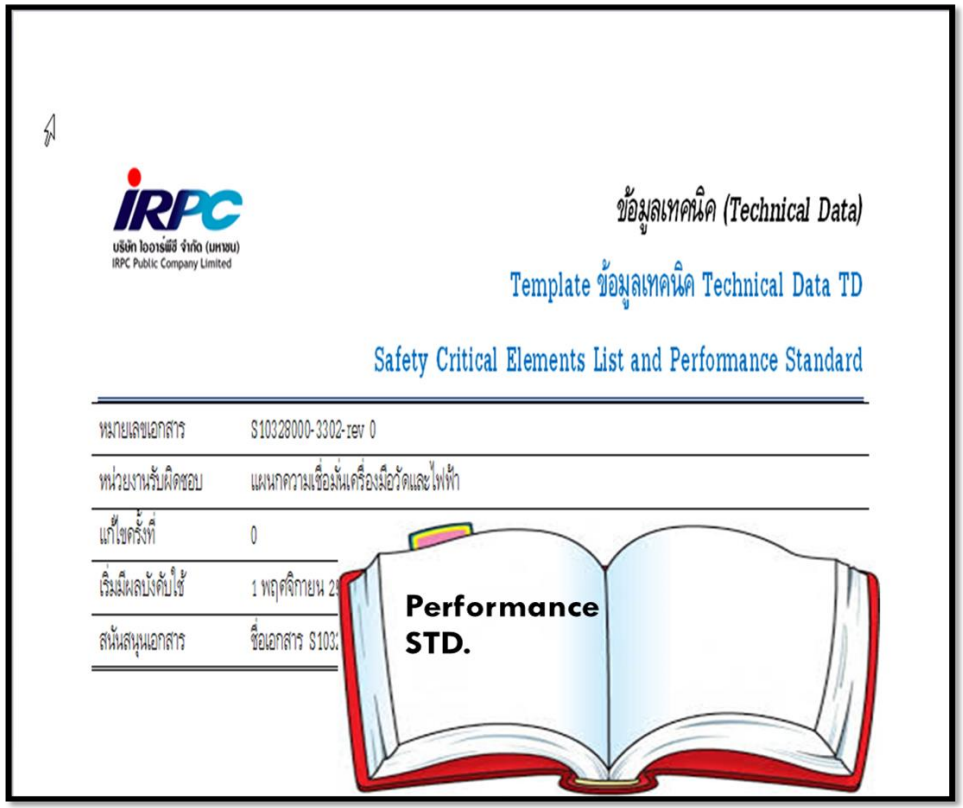


Safety Critical Elements

Brief Implement SCE at IRPC

Step to Implement Safety Critical Elements in IRPC

Perform as STD



Safety Critical Elements

SCE Classification (Bow Tie)

SCE Assessment

Safety Critical Element : SCE

Identification :

A SCE is classified as an equipment, structure or **system whose failure** could cause or contribute to a **major accident**, or whose purpose is to **prevent** or **mitigate** the effect of a major accident.

Safety Critical Elements

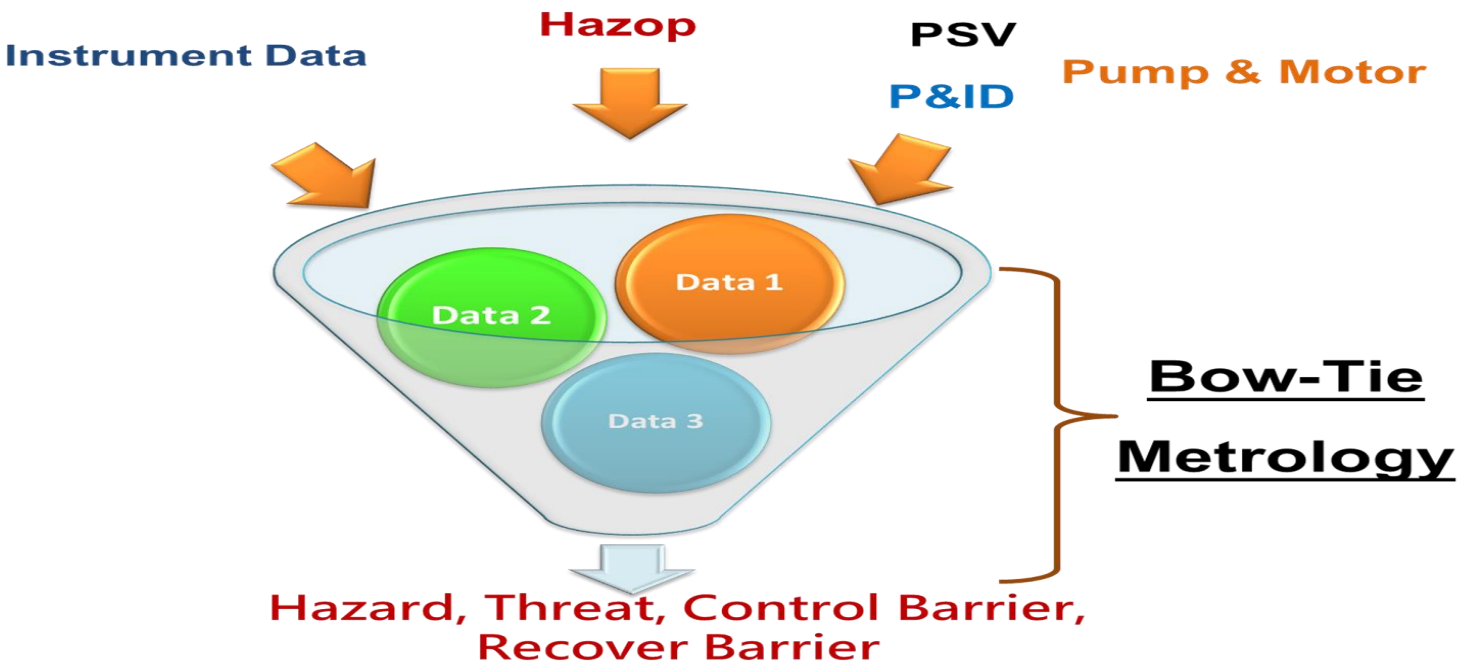
SCE Classification (Bow Tie)

SCE Assessment

Safety Critical Elements

SCE Classification (Bow Tie)

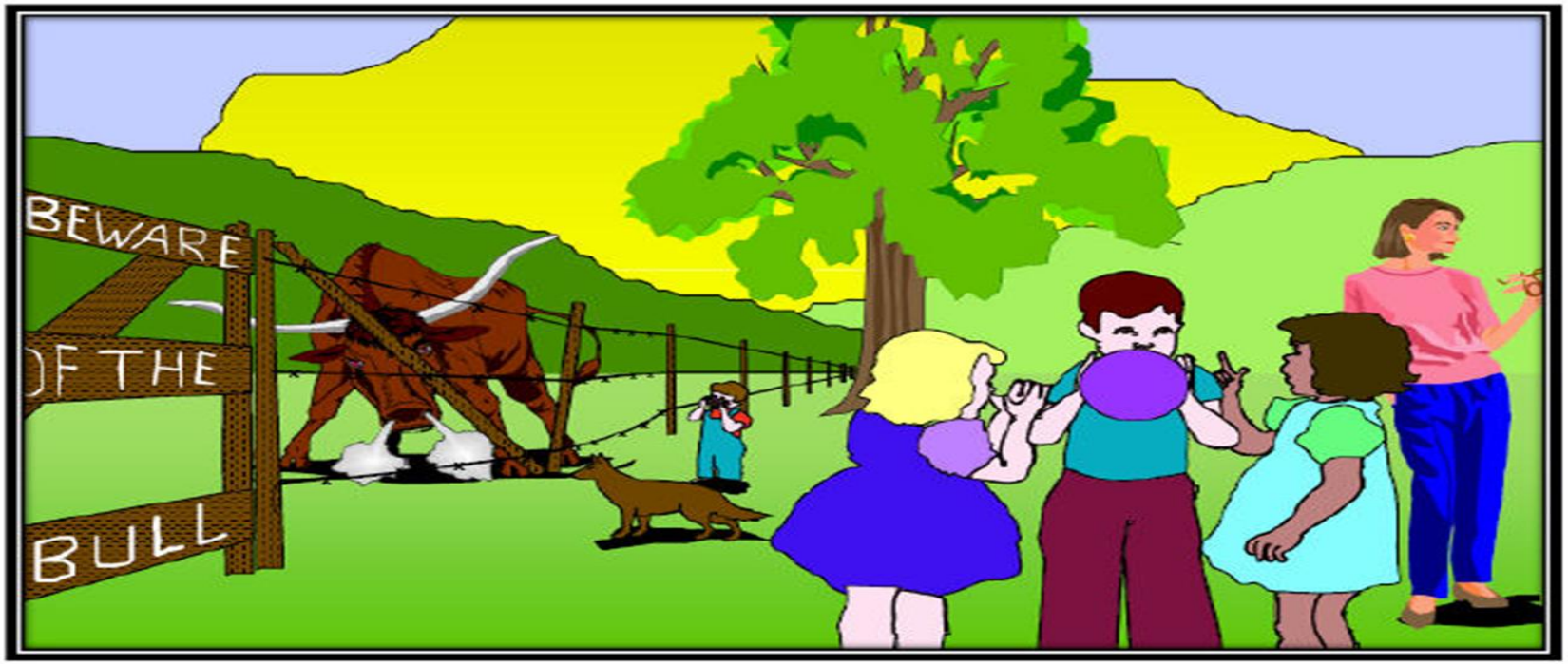
SCE Assessment



Safety Critical Elements

SCE Classification (Bow Tie)

SCE Assessment



Safety Critical Elements

SCE Classification (Bow Tie)

SCE Assessment

Hazard - - ?

Top Even - - ?

Threats - - ?

Consequence - - ?

Barrier - - ?

Safety Critical Elements

SCE Classification (Bow Tie)

SCE Assessment

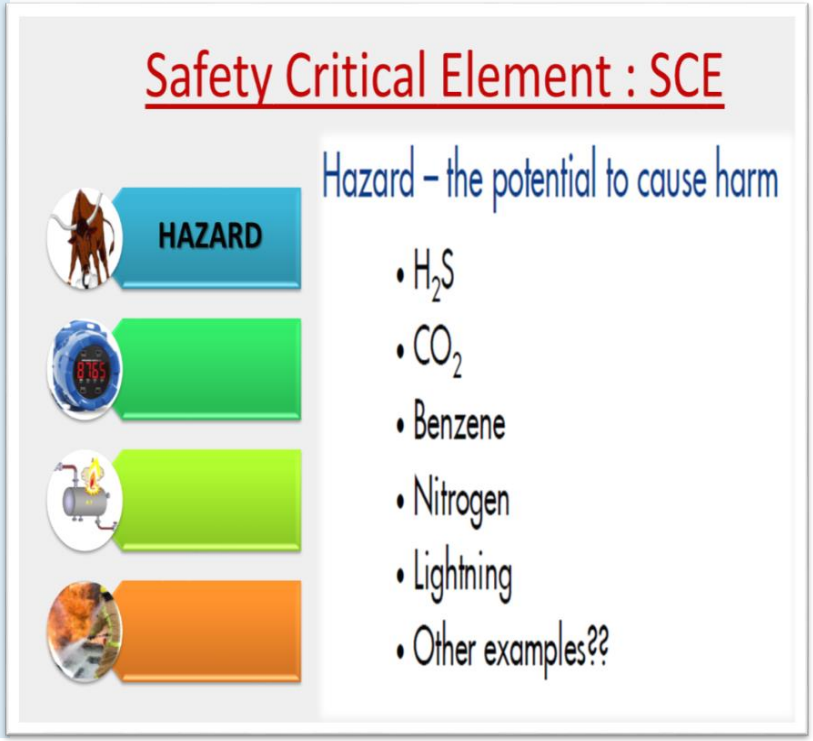
Hazard	Threats	Consequences	Top Even	Barrier
	• Gate left open • Corroded fence • Rotting posts • Bull jumps the fence	• Injury / fatality • Damage to assets	**- Bull go to out site**	**- Door, Fence**

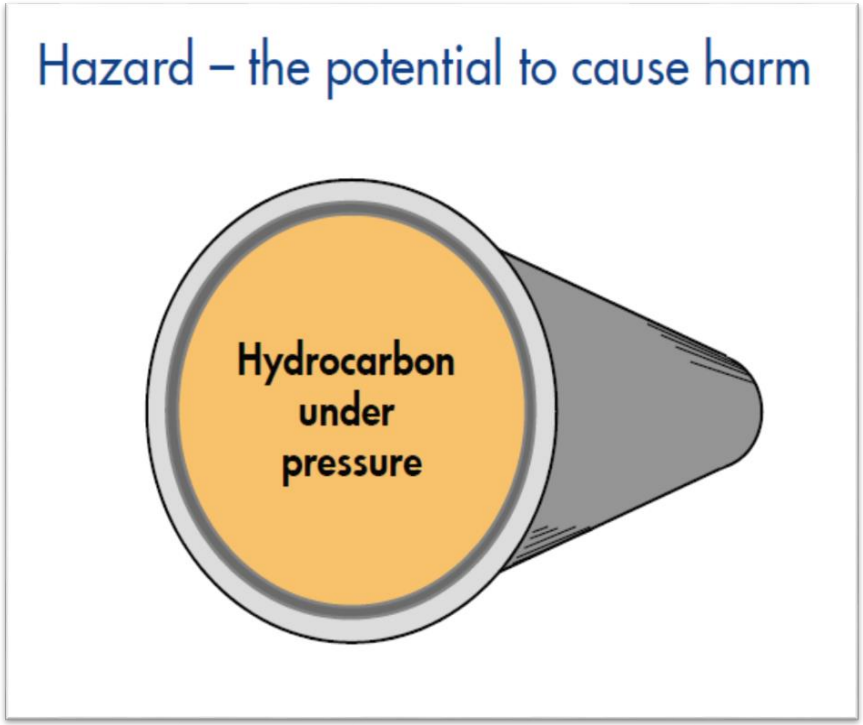
Safety Critical Elements

SCE Classification (Bow Tie)

SCE Assessment

HAZARD

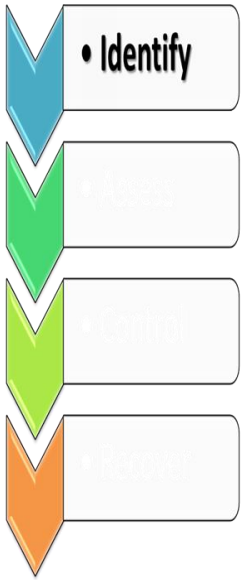




Safety Critical Elements

SCE Classification (Bow Tie)

SCE Assessment




THE SCOPE OF HAZARD IDENTIFICATION

The boundaries must be clearly defined. Overlaps are therefore avoided and focus is maintained on the discussion about what is within the boundary.

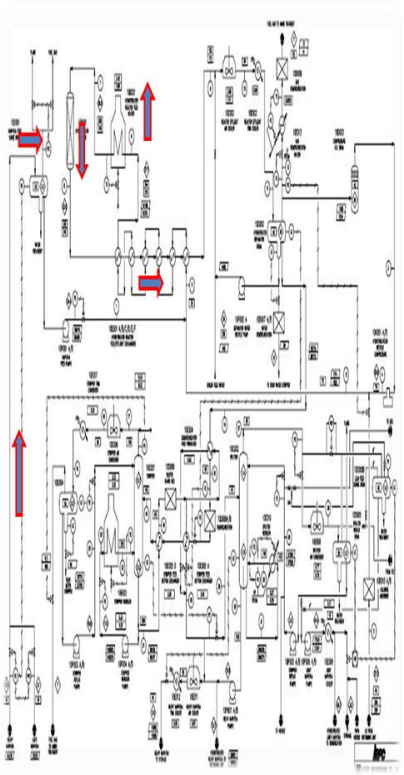
Hazards

Process Unit or Work Activity

Bulk Storage

Blending Packaging Warehouse

- Where does the hazard occur?
- Identify the process flow or business workflow and separate the flow into logical blocks or 'nodes' (see the example above).
- Group similar conditions.
- Carry out a hazard identification on each block (in some cases, hazards may be relevant to multiple blocks and may have to be analysed separately in these blocks).



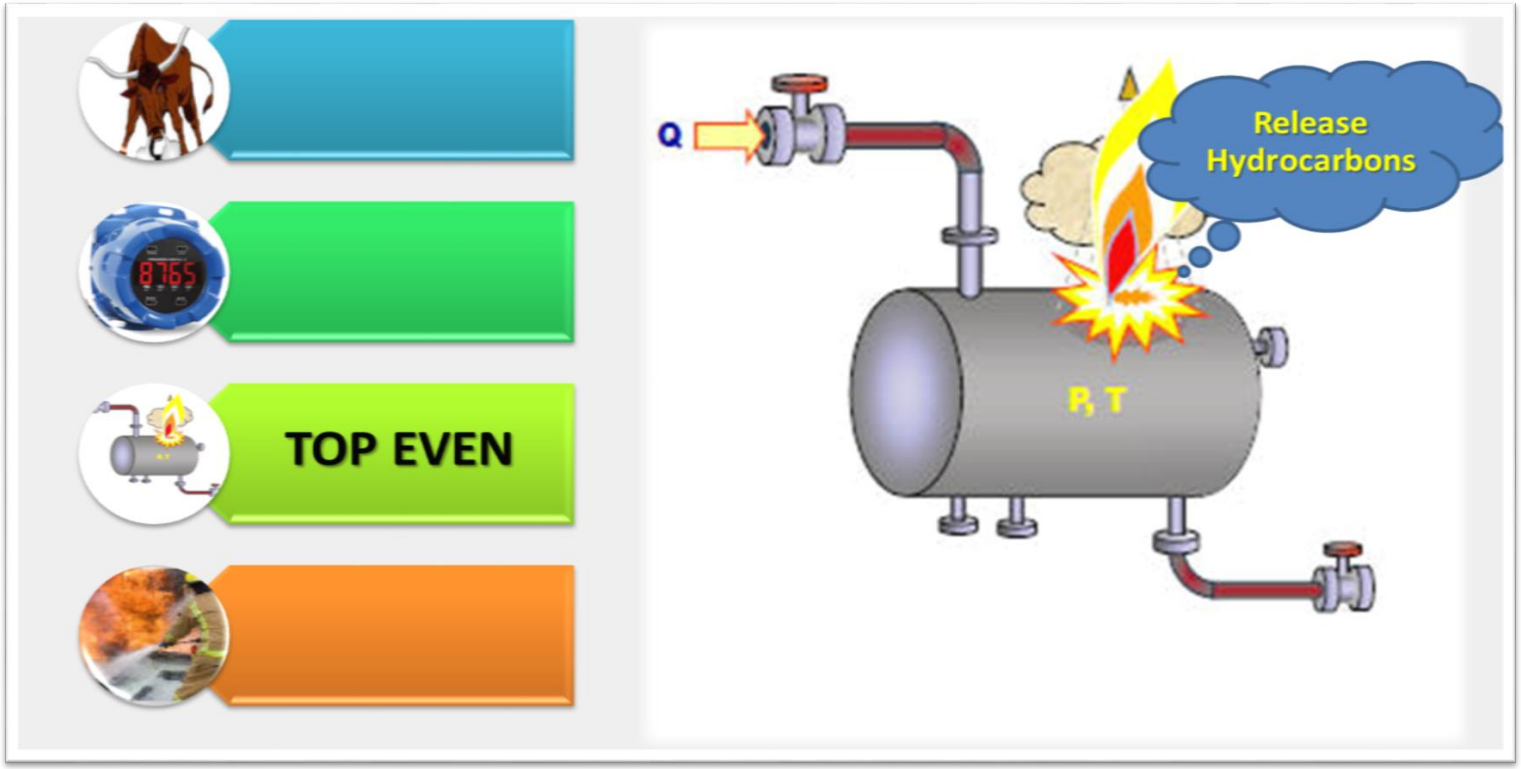
Hazard	Phase	Location
Naphtha	Liquid	10D001, 10P001A/B, 10C002, 10E008, 10B002, 10E005A/B, 10P003, 10P004A/B, 10D009, 10P005/6/7, 10E009, 10E011, 10E012, 12F001
H2 + HCl (5ppm)	Vapour	10D010
Naphtha + H2	Mixed	10E001A-F, 10B001
Naphtha+H2 +H2S (>1000ppm)	Mixed	10R001, 10E001A-F, 10C001, 10D002
Naphtha+H2 +H2S (>1000ppm)	Mixed	10R001, 10E001A-F, 10C001, 10D002
Naphtha+Fuel gas	Vapour	10E006, 10E007, 10D004
DMDS (use only during start up)	Liquid	10T002
Fuel gas	Vapour	2D008, 12D009, 10B001, 10B002, 10D001, 12B001
Fuel oil	Liquid	10B001, 10B002, 12B001-5
High pressure steam (25 bars)		10E010, 10B001, 10B002, 12B001-005, 11E003, 11E006, 11E009
Hot & high pressure boiler feed water (115C, 30bars)	Liquid	10E001, 10E002
H2 + H2S ((>1000ppm)	Vapour	10K001, 10D003
Treated Light Naphtha	Liquid	11A001A/B
Isomerate	Liquid	11A001A/B, 11A002A/B, 11D001, 11P001A/B, 11C001, 11E006, 11E007, 11E008, 11E009, 11B001, 11E010, 11E011

Safety Critical Elements

SCE Classification (Bow Tie)

SCE Assessment

TOP EVEN



Safety Critical Elements

SCE Classification (Bow Tie)

SCE Assessment

CONSEQUENCE

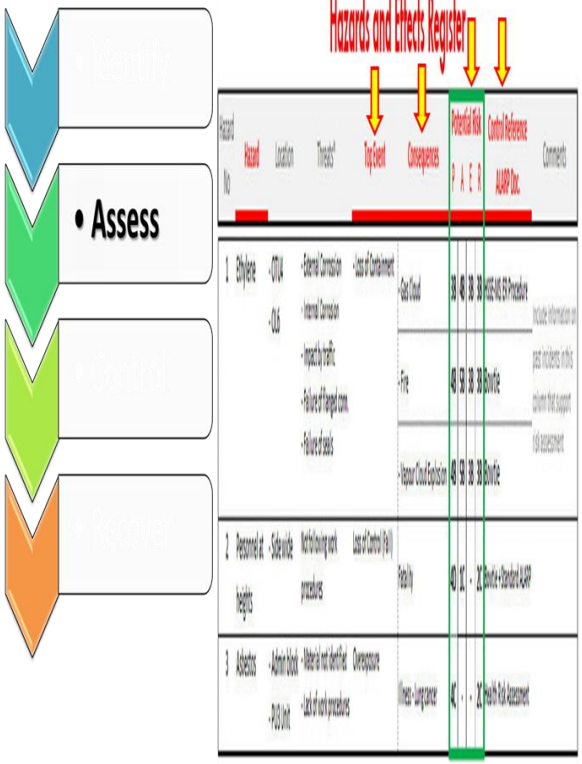
Typical Major Hazards

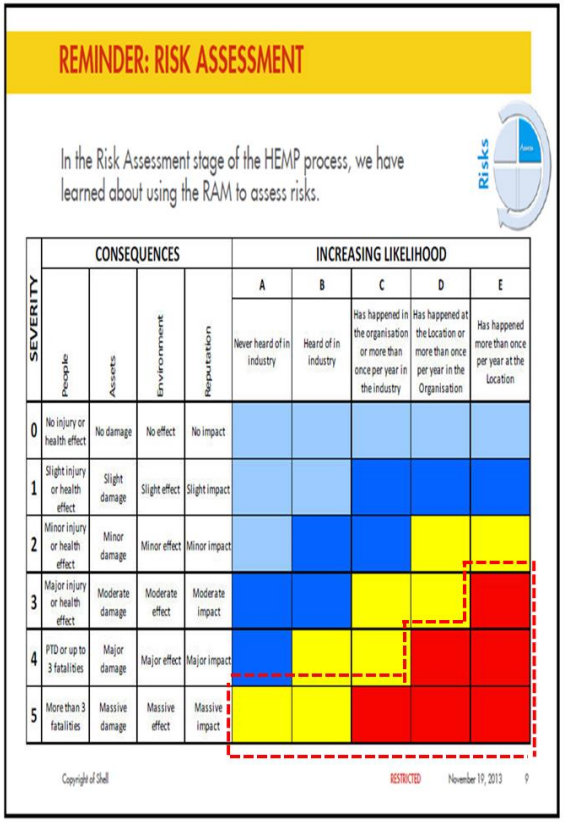
- Hydrocarbons – fires/explosions/blowouts/oil spills
- Toxic materials – toxic releases
- Air/marine/land transport – helicopter/boat/road accidents
- Shipping activities – marine collision

Safety Critical Elements

SCE Classification (Bow Tie)

SCE Assessment





Top Event	Consequences	Risk Potential P	A	E	R	ALARP determination
Loss of containment (LOC)	Fire/explosion	4B	4B	3B	4B	
LOC	Fire/explosion	5C	5C	3C	4C	Bow Tie
LOC	Fire/explosion	5C	5C	3C	4C	Bow Tie
LOC	Fire/explosion	5C	5C	3C	4C	Bow Tie
LOC	Injury/fatality	4C	0C	2C	3C	
LOC	Fire/explosion	4C	4C	3C	4C	
LOC	Spill to water/land	0C	0C	3C	1C	
LOC	Fire/explosion	4C	4C	3C	4C	
LOC	Spill to water and/or land leading to minor impact on environment and reputation. Toxic to aquatic organisms.	0C	2C	2C	2C	
LOC	Injury/fatality	4C	2C	0C	1C	
LOC	Injury/fatality	4C	2C	0C	1C	
LOC	Fire/explosion	4C	5C	2C	3C	Bow Tie
	Injury/fatality	4C	0C	2C	3C	
LOC	Fire/explosion	4B	4B	3B	4B	
LOC	Vapour Cloud Explosion, BLEVE	4B	4B	3B	4B	

Safety Critical Elements

SCE Classification (Bow Tie)

SCE Assessment

THREAT

Threat

- The pathway or mechanism which enables or releases the hazard to cause harm

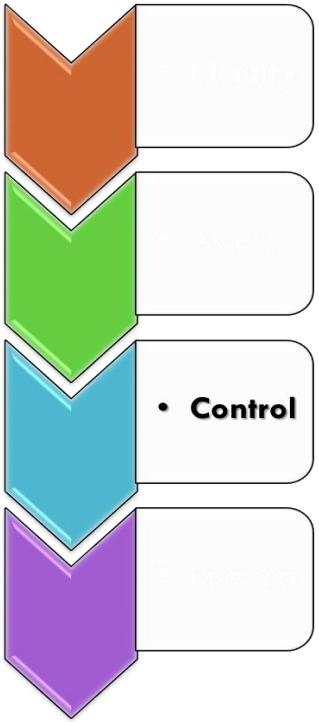
Threat – that which enables / releases the hazard

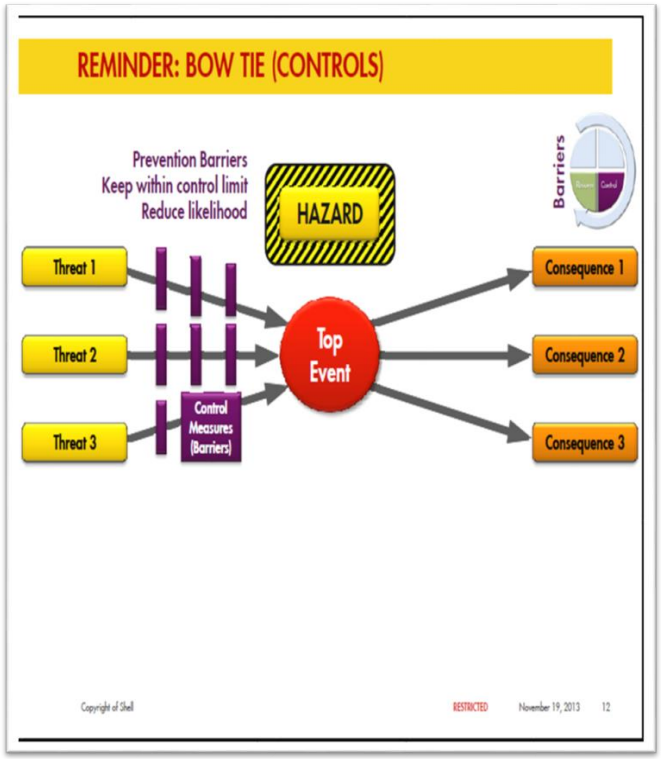
- External Impact
- Overpressure
- High Temperature
- Runaway reaction
- Human Factors
- Other examples?

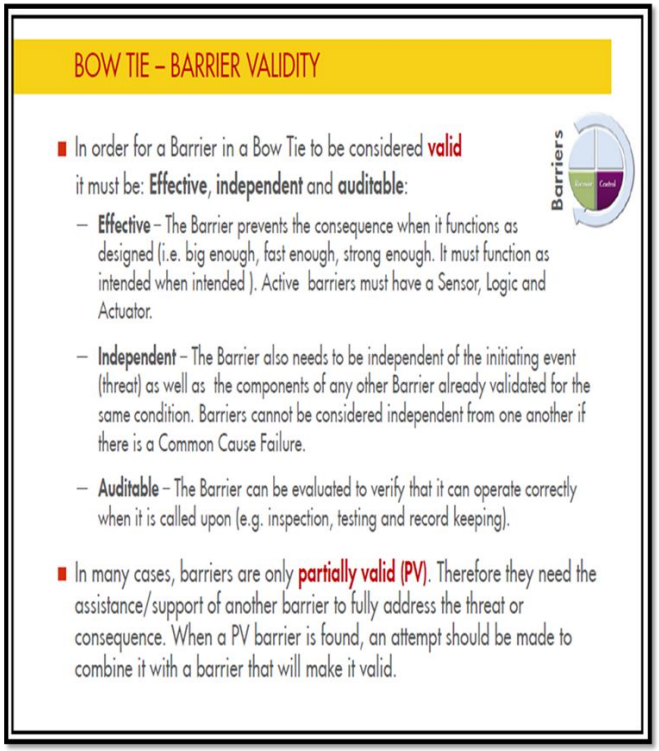
Safety Critical Elements

SCE Classification (Bow Tie)

SCE Assessment



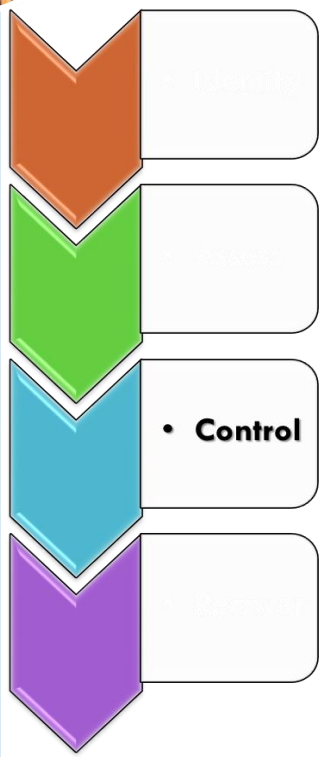




Safety Critical Elements

SCE Classification (Bow Tie)

SCE Assessment



BARRIER VALIDITY – EFFECTIVENESS

- In order for a Barrier to be considered **valid**, it must be **effective:**
- The Barrier prevents the consequence when it functions as designed:
  - big enough,
  - fast enough,
  - strong enough.
- A barrier must be protected from the consequences of the release of another hazard and perform as intended when impacted by another threat condition.

  For instance, a boundary isolation valve must be protected from fires and explosion either by its location or by a protective enclosur

BARRIER VALIDITY – AUDITABILITY (EXAMPLES)

- In order for a Barrier to be considered **valid**, it must be **auditable**:
  - Level Float – normally runs to failure and is then repaired. This does not meet the requirements of auditable.
  - Level Float – is tested on a yearly (or other set frequency) basis, then determine if it meets the required reliability criteria*. This does meet the requirements of auditable – test records for the instrument are maintained in a system.

BARRIER VALIDITY – INDEPENDENCE

- In order for a Barrier to be considered **valid**, it must be **independent:**
  - The Barrier is independent of the initiating event of the threat as well as the components of any other Barrier already validated for the same condition.

    Example: Tank inventory management is not a valid barrier when the threat is overfill due to mistakes in the dipping of the tank.
  - The Barriers cannot be considered independent from one another if there is a Common Cause Failure.

    Example: The high level alarm and the high-high level alarm are on the same transmitter, therefore they are not independent.

Note:
Loss of Power, Loss of Steam, Loss of Air don't affect independence as they usually result in total shutdown of plant equipment. There may be exceptions to this however (e.g. Ship-shore or pipeline transfer operations)

Safety Critical Elements

SCE Classification (Bow Tie)

SCE Assessment

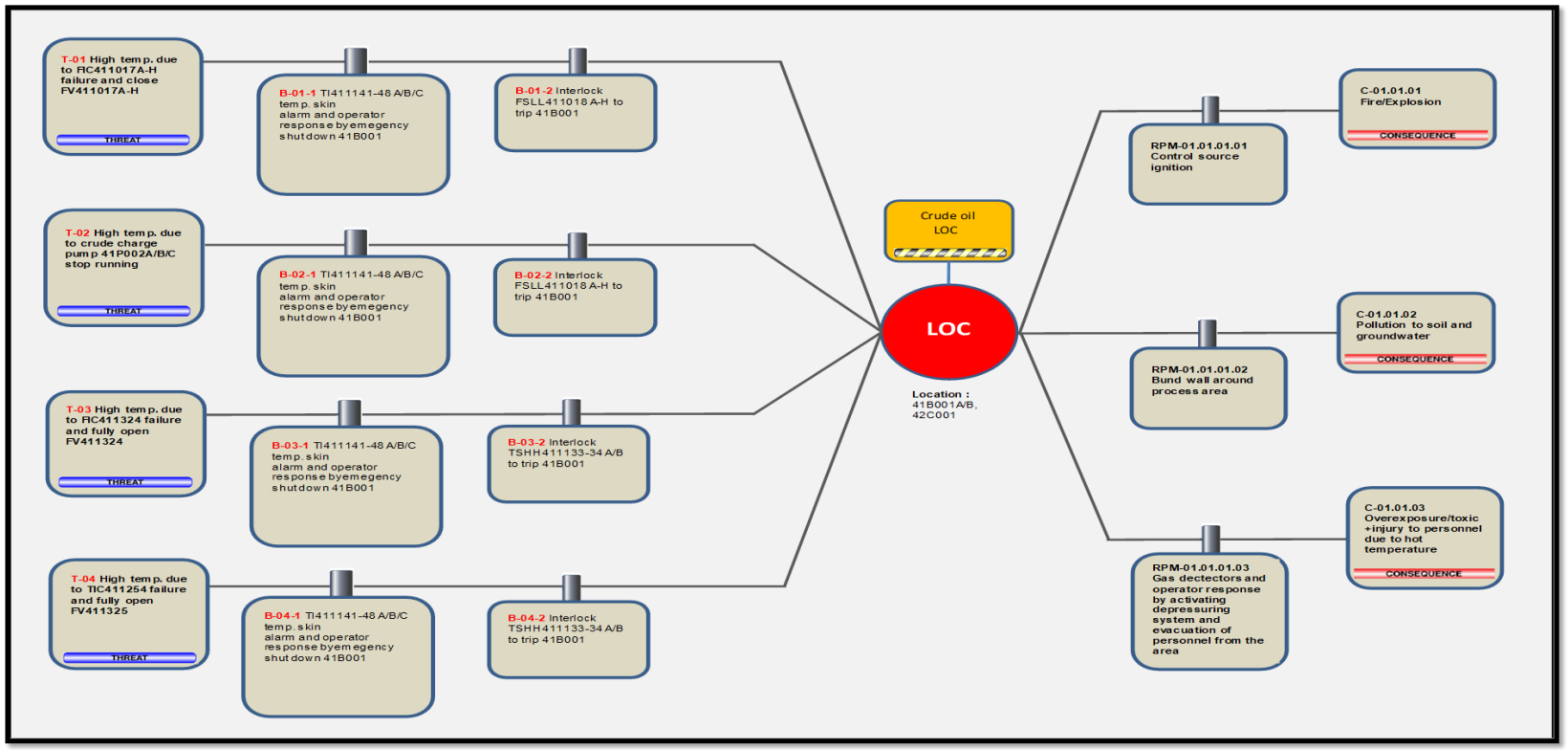
- Identify
- Assess
- Control
- **Recover**

- Fire Pump
- UPS
- Fire & Gas System
- Diesel Gen
- Deluge system
- EIV System

Safety Critical Elements

SCE Classification (Bow Tie)

SCE Assessment



Safety Critical Elements

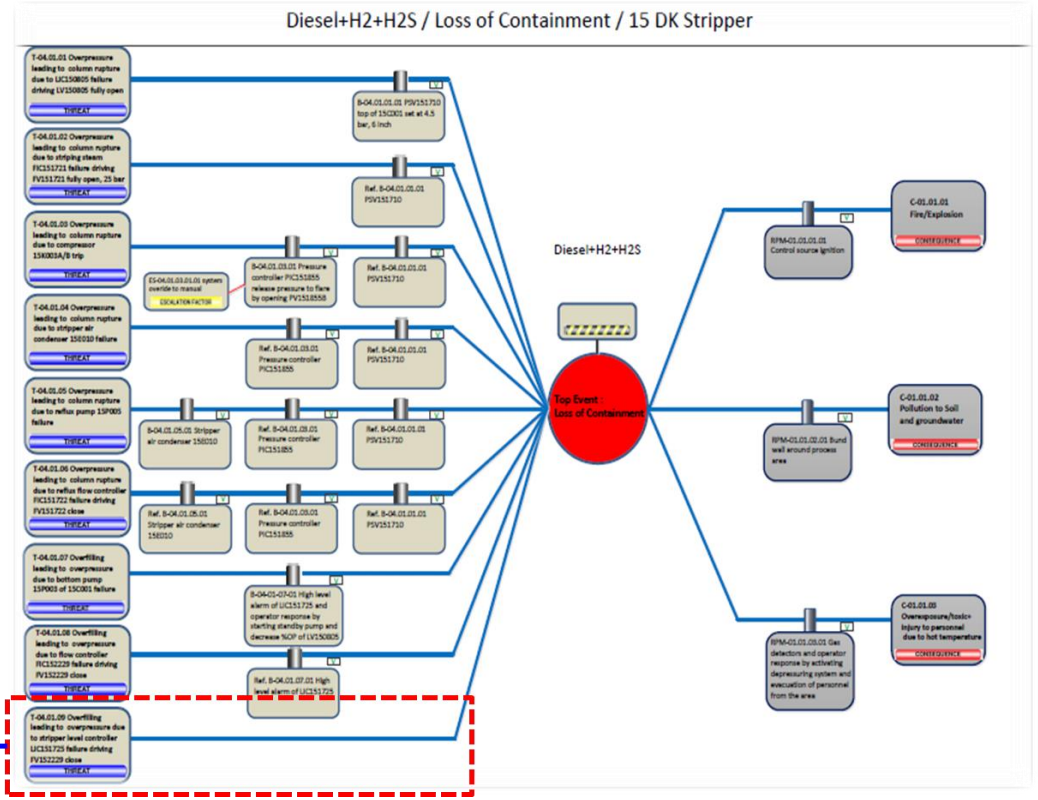
Implement SCE Outcome

SCE Gap Closing

SCE Gap:

– Add Equipment ???

- Hazop
  - SIL Assessment
  - Other



Safety Critical Elements

Implement SCE Outcome

Task and Test interval

List of Safety Critical Equipments and Critical Human Interventions

Location: 02C001, 02E001A/B, 02D001, 02E002A/B, 02D002, 03D001

Bow Tie Reference	Threat Detail	Barrier	SCE Tag Numbers	Escalation Factor	Critical Human Intervention
T-07.01.01	Overpressure due to FIC020106 failure to close FV020610	B-07.01.01.01 High pressure alarm of PT020103 at 1.25 barg and operator response by opening reflux valve FV020610 (NV)	PT020103		
		B-07.01.01.02 Pressure controller PIC020732 at SP 0.55 barg by open PV020732A releasing pressure to flare	PIC020732	E-07.01.01.02.01 System overide to manual	
		B-07.01.01.03 PSV020101 and PSV020121 Top of 02C001 set at 4.4 bar, 10x8 inch and 10x6 inch, PSV020102 and PSV020122 Top of 02C001 set at 4.5 bar and 4.7 bar, 10x6 inch and 10x8 inch.	PSV020101 10x8 inch PSV020121 10x6 inch PSV020102 10x6 inch PSV020122 10x8 inch		

Task

SOP

Safety Critical Elements

Implement SCE Outcome

SCE Gap Closing

Location : 41E001A/B, 41E002-7, 41E008A/B, 41D001/2, 41E009, 41D007, 41P002A-C, 41E010-12, 41E013A/B, 41E023, 41E024A/B, 41E014A/B/E/F

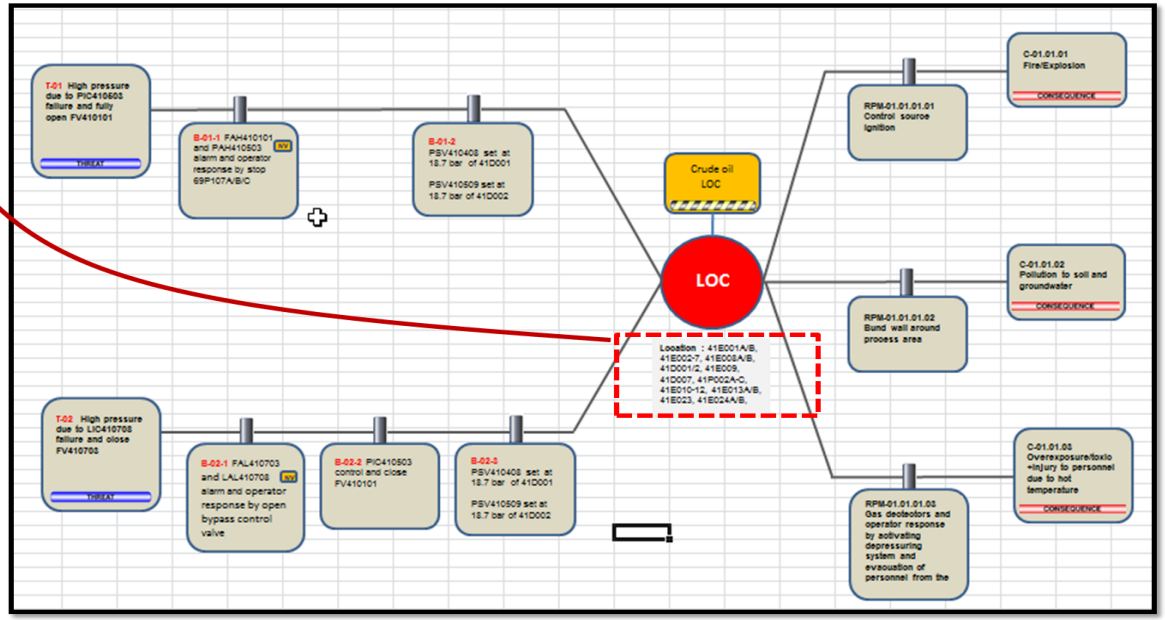
RBI TEAM

SCE ⇔ Corrosion (High)

Failure Mode

Bow - Tie

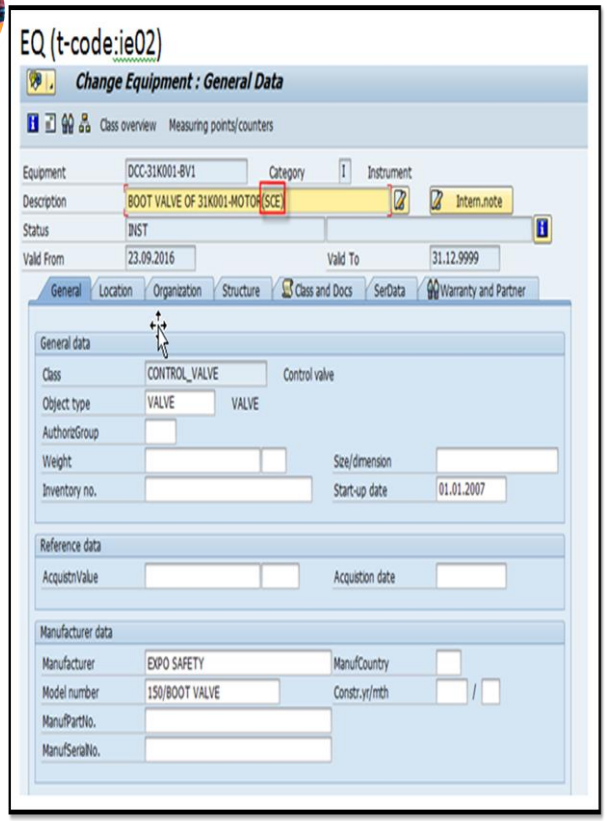
Implement SCE + Corrosion (RBI)

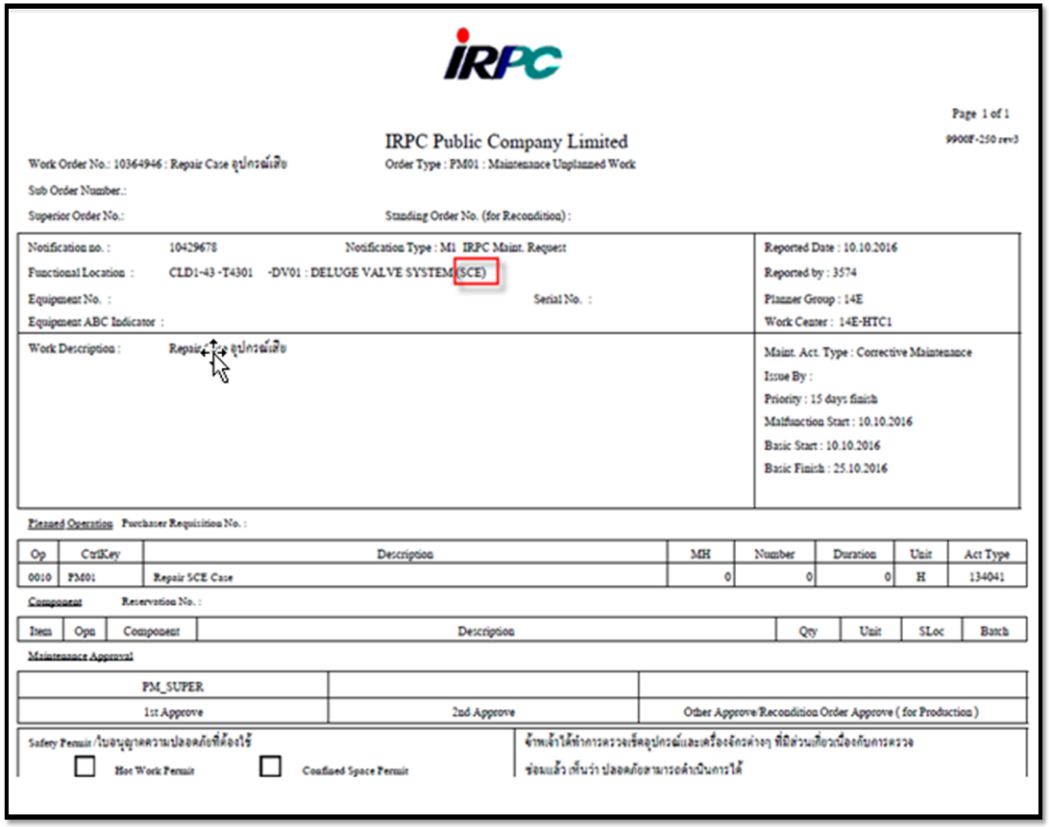


Safety Critical Elements

Implement SCE Outcome

Implement on SAP





Safety Critical Elements

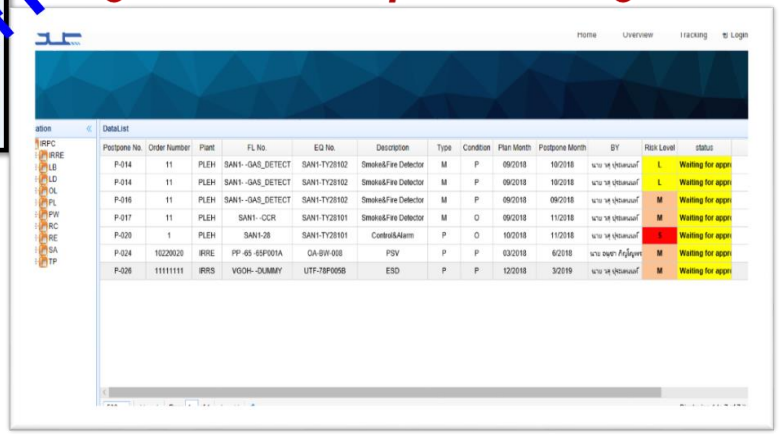
SCE Development Program

Program Development

Program Bow Tie Management

Development Program

Program SCE Postpone Management



Chemical Process Safety Sharing

Thank you for your attention