

**AFPM & API  
ADVANCING  
PROCESS SAFETY**

**ANSI API RP-754  
Quarterly Webinar**

**September 13, 2016**

*Process Safety Performance  
Indicators for the Refining and  
Petrochemical Industries*



# Purpose of RP 754 Quarterly Webinars

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- To support broad adoption of RP-754 (2<sup>nd</sup> Edition) throughout the Refining and Petrochemical industries and other industry sectors where a loss of containment has the potential to cause harm
- To ensure consistency in Tier 1 and 2 indicators reporting in order to establish credibility and validity
- To share learning's regarding the effective implementation of Tier 1-4 lagging/leading indicators

# Today's Agenda

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## Tier 3 PSEs

- **De minimis releases as Tier 3 PSEs – Marty Martin (Dow)**
- **De Minimis Releases Other LOPC Examples – Felicia Miller (Delek)**
- **Demands on Safety System – Dan Wilczynski (Marathon)**
- **Safe Operating Limit Exceedance – Bill Ralph (BP)**

## Remaining 2016 Webinar Dates

- Backup – Safe Operating Limit Exceedance – Kelly Keim (ExxonMobil)

# De minimis releases as Tier 3 PSEs

By: Marty Martin

The Dow Chemical Company

# T3 LOPC Criteria in Dow

- LOPC from a relief system which exceeds a T1 or T2 TQ in 60 minutes or less, but qualifies for the “relief system exemption”.
- LOPC of a material where the T2 threshold quantity was released within a 24 hour period, but not in any 60 minute period.
- Quantity released in a 24 hour period:
  - Low-hazard liquid\* material:  $\geq 1000$  kg if NOT released to adequate secondary containment
  - All other materials which are not low hazard liquids\*, low hazard solids\* or exempted materials\*:  $\geq 500$  kg
- Any of the following which do not otherwise meet T1 or T2 criteria:
  - Known injury in the community resulting from or responding to a LOPC.
  - Warranted on-site shelter-in-place or evacuation as a result of a LOPC.
  - Any offsite property damage to non-Dow property, -OR- Any visible/measurable damage to crops, livestock, vegetation, wildlife or fish (on or off site).
  - Any LOPC which results in non-Dow media stories or broadcasts which are intended to alert the community while the event is in progress, as opposed to those which just inform the community after the fact.

\* = Dow internal definition

# Data Capture

SAP database called “Incident Management”

- Incident date, time
- Location (site, plant, business, equipment involved)
- Event description
- Release duration
- Material:
  - Composition
  - Release temperature
- Impacts against eight consequence criteria
- Potential severity (Dow internal criteria)
- Layer of protection failures

# Investigations / Prioritization

- There were approximately 75 T3 PSEs in Dow from January through July, 2016.
- This is a manageable number, and prioritization is not required.
- The expectation is that all T3 PSEs have a formal investigation (normally using the Apollo methodology) led by the plant leader or designee.
- RCI Data capture:
  - Causes
  - Management system failures
  - Actions to prevent recurrence

# Examples

- 1200 kg release of ethylene in less than 60 minutes to the atmosphere through an emergency depressurization system. No adverse (process safety) consequences.
  - Exceeded T1 TQ, but was released via a pressure relief system.
- 300 kg of 20% NaOH solution released outdoors from a transfer line over a four-hour period.
  - Exceeded T2 TQ, but not in any 60 minute period.
- 15 kg of anhydrous ammonia released over 30 minutes. Plant was evacuated
  - Quantity was below T2 TQ, but later dispersion modeling showed that the evacuation was warranted due to the proximity of workers to the release point.



# **Tier 3 – De Minimis Releases Other LOPC Examples**

**Felicia Miller – Delek US**

## Example Tier 3 Metrics

1. **Other LOPC:** Includes the following subcategories (report total and by all subcategories that apply); does not apply to ancillary equipment or truck/rail operations not connected to the process.
  - a. **Corrosion Related LOPC:** Any LOPC that is the result of corrosion in piping or pressure vessels should be classified as a Tier 3 event. (Note that this is regardless of the amount of the leakage.)
  - b. **LPG LOPC:** Any “non-fugitive” leak of LPG that is not Tier 1 or Tier 2 (regardless of volume) shall be designated as a Tier 3 event.
  - c. **Heat Exchanger LOPC:** Any heat exchanger tube leak that is  $\geq$  a CERCLA or EPCRA Reportable Quantity RQ. Note that the leak still has to be evaluated to determine if it meets Tier 2 or 1 standards and may be OTHER LOPC due to Corrosion Related LOPC or LPG LOPC.
  - d. **Other Process Fires/Explosions:** Any “process” fire or explosion that does not meet Tier 1 or Tier 2 should be classified as a Tier 3 event. Includes hydrogen fires. Does not apply to trash fires, grass fires etc. unless the initiating event was a LOPC or other process safety event.
  - e. **Small Quantity Liquid LOPC:** Any LOPC of a liquid hydrocarbon from a process related operation that meets the following criteria:
    - i.  $\geq 5$  gallons released at  $\geq$  the flash point (Tier 2 criteria would be 1 bbl)
    - ii.  $\geq 1$  bbl released at  $<$  the flash point (Tier 2 criteria would be 10 bbl)
2. **Safety System Test Failure:** Failure of a safety system during testing. If a safety system fails testing, meaning it likely would not have functioned as required if called upon during an actual event, that will be recorded as a Tier 3 event. For example, a PRD that is found to have a relief pressure outside acceptable limits.
3. **Other PRD Activations.** (Does not include thermal relief valves.) Any known activation of a PRD (pressure relief device) not counted as Tier 1 or Tier 2 (includes those that discharge to atmosphere as well as those that discharge to downstream combustion devices).
4. **Piping/Vessel Remaining Thickness Below Acceptable Limits:** Piping segments or vessels at or below acceptable wall thickness at intended operating pressure/conditions. Piping segments and vessels with remaining thickness at or below acceptable replacement thickness where the pipe should be immediately replaced and/or where fitness for service calculations are required to keep the piping segment in service or where the equipment is de-rated to allow it to remain in service.
5. **Safe Operating Limit Excursions.**
6. **Demands on a Safety System.**

# Tier 3 - Information Recorded

Recorded on Investigation Summary Sheet that is reviewed monthly...

PROCESS SAFETY, API 754 TIER EVENTS

	Tier 1	Tier 2	Tier 3	Tier 4	Process Safety NM
Since Last Review	0	0	2	0	0
Total YTD <sup>2</sup>	0	0	2	0	0
YTD Rate <sup>1</sup>	0.00	0.00	16.94	0.00	0.00

TIER 3 SUMMARY

# of Reason 1: Other LOPC	# of Reason 2: Safety System Test Failure	# of Reason 3: Other PRD Activations	# of Reason 4: Piping/Vessel Remaining Thickness Below Acceptable Limits	# of Reason 5: Safe Operating Limit Excursions (COPs)	# of Reason 5: Safe Operating Limit Excursions (COPs)
2	0	0	0	0	0
2	0	0	0	0	0

Since Last Review  
Total YTD

<sup>1</sup> Rate = Number of Incidents/200,000 Work Hours (Employee + Contractor)  
<sup>2</sup> May not match the Process Safety totals on the Number of Incidents By Class Table if a Process Safety Event was also a Personnel Safety Event.

The following information is recorded...

No.	Incident Class (IC)	IC Cons. Type #	Date of Incident	Company/ Contractor	Category (Cause)	Title/Brief Description	Unit / Area	Craft Involved in Incident	Nature of the Task	Consequence							Type	Status	Date	
										Personnel Safety		Process Safety			Environmental					Incident
										Medical Provider	Outcome	Nature	API 754 Tier	API 754 Tier "Worst Case" Definition	Nature	Reporting				
1	IV	THREE	1/5/2016		Other	Technician tracing the wires in OCC, wire came loose from terminal strip and tripped #6 Penex recycle compressors	Area 1: NHT/Platformer, HTU/Isom, H2 Plant, WWTP/FGRU	E&I	Routine Maintenance	NA	NA	NA	NA	N/A	NA	NA	Informal	I		
2	III	FOUR	1/5/2016		Inattention	Driver loading 140/160 and overfilled truck. 3 BBLS spilled to ground	Area 5: Oil Movements, Off Site Env	Operations	Normal Operations	NA	NA	OD/MS	Tier 3	T3- 1.e.ii	Spill-Ground	NA	Informal	I		
3	III	EIGHT	1/9/2016		Inattention	Vac truck driver didn't have tank lowered and latched. Driver hit piping in rack when passing underneath	Area 1: NHT/Platformer, HTU/Isom, H2 Plant, WWTP/FGRU	Vehicle Operation	Normal Operations	NA	NA	NA	NA	T3-1.b T3-1.e.i T3-1.e.ii	NA	NA	Formal	I		
4	IV	TWO	1/11/2016		Unsafe Act	Maintenance employee suffered a contusion to right hand/wrist when harness clip was	Maintenance	Maintenance	Routine Maintenance	On-Site Clinic	First Aid	NA	NA	N/A	NA	NA	Informal	I		

# Tier 3 Events

Investigation is informal. Note however that Tier 3 events are discussed as part of a monthly “multiple refinery” Incident Review meeting.

No.	Incident Class (IC)	IC Cons. Type #	Date of Incident	Company/ Contractor	Category (Cause)	Title/Brief Description	Unit / Area	Craft Involved in Incident	Nature of the Task	Consequence						Incident			
										Personnel Safety		Process Safety		Environmental		Type	Status	Date	
										Medical Provider	Outcome	Nature	API 754 Tier	API 754 Tier "Worst Case" Definition	Nature				Reporting
5	III	FOUR	1/12/2016		Unsafe Act	Driver unloading n-Butane, disconnected 2" vent hose before blocking it in.	Area 5: Oil Movements, Off Site Ery	Operations	Normal Operations	NA	NA	OD/MS	Tier 3	T3- 1.b	Air	NA	Informal	C	
6	IV	TWO	1/20/2016	Delek	Unsafe Act	Maintenance employee making an line break to install blinds on #6 Isom compressor vent piping. When flanges were separated liquid splashed in his face and caused 1st degree chemical burns	Area 1: NHT/Platformer, HTU/Isom, H2 Plant, WWTP/FGRU	Maintenance	Planned Shutdown	On-Site Clinic	First Aid	NA	NA	T3- 1.b T3- 1.c T3- 1.d T3- 1.e.i T3- 1.e.ii T3- 2 T3- 3 T3- 4	NA	NA	Informal	I	

What have we learned thus far...

- Only been tracking Tier 3 events for the past year.
- It was important to define exactly what we considered to be Tier 3. (Took time to agree upon the De Minimis amounts.)
- Discussing the Tier 3 events in a group setting consisting of multiple refineries has been very eye-opening.

# **Tier 3 – Demands on Safety Systems**

Dan Wilczynski – Marathon Petroleum Company

# Demand on Safety System.

- Activation of a shutdown device or relief system,
- Failure of a shutdown device, Safety Instrumented System (SIS) or relief system to activate when called upon.

How do you handle failure during testing?

## Information collected for each PSE Tier 3:

- Title
- Incident Tracking Number (Common system across all plants)
- Date / Time
- Originator
- Facility / Area / Unit
- Detailed Description
- Immediate Corrective Actions
- Severity (Cat 0 to Cat 4)
- Contractor Involved?
- Draft report due date

# Review Process

- Reviewed each day by plant management team to determine Severity (i.e., level of investigation required).
- Tracked and reported monthly at plant and organizational level.
- Trends and deep-dives used to determine need for more focused improvement programs.





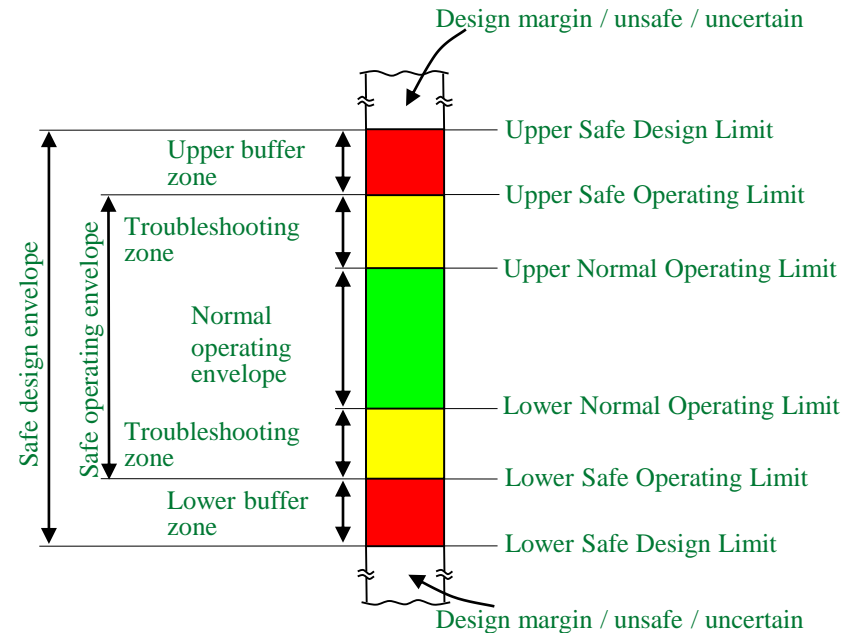
# API RP-754 Tier 3 Performance Indicator Safe Operating Limit Excursions

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## Safe Operating Envelopes & Safe Operating Limits

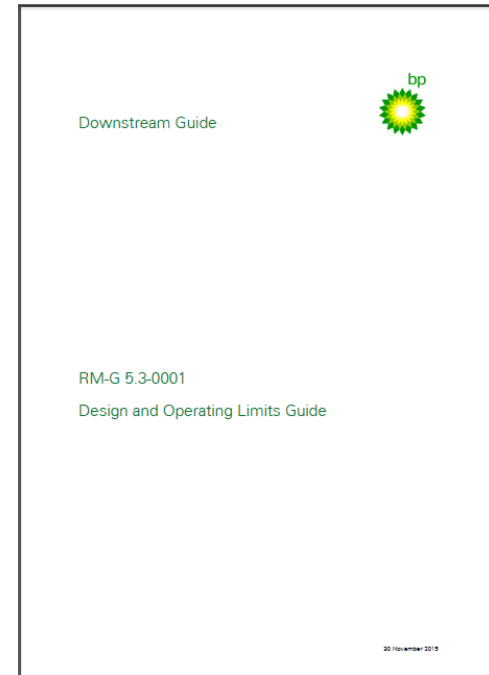
- Safe Design Envelope: beyond which is design margin, an unsafe condition, or uncertainty
- Safe Operating Envelope: beyond which troubleshooting ends and pre-determined action occurs to return the process to a safe state
- Normal Operating Envelope: the area of preferred operation





# Global Downstream Implementation

- To assure consistent implementation, BP developed a guide and program managed the implementation.
- The guide defines the facilities, process equipment, and process parameters of interest.
- Using input from subject matter experts, the guide defines generic limits for common process equipment and process technologies.
- The guide also describes the process for monitoring and reporting limit excursions.





## Monitoring, Reporting, and Investigating

- Not all measured excursions are valid for reporting.
  - measurement exceptions
  - process mode exceptions
  - engineering exceptions
- For each valid excursion, the peak value and the duration are reported along with a description of the initiating cause.
- Each safe design limit excursion and repeat or prolonged safe operating limit excursions are investigated with respect to the initiating cause and the barrier failure.



## Positive Performance Improvement

- BP is in Year-2 of a three-year assurance activity.
- Positive performance improvement examples:
  - Changes to operating procedures and operating targets have resulted in fewer furnace low oxygen excursions.
  - A high SOL excursion rate revealed an unusually high SIF demand rate, which was then investigated by the SIS Technical Authority.
  - An operator commented that safe limit documentation has proven to be an excellent training tool for new operators.
  - An operations manager commented that PSV lifts have been greatly reduced.

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**Questions? / Discussion!**

# Webinar Dates

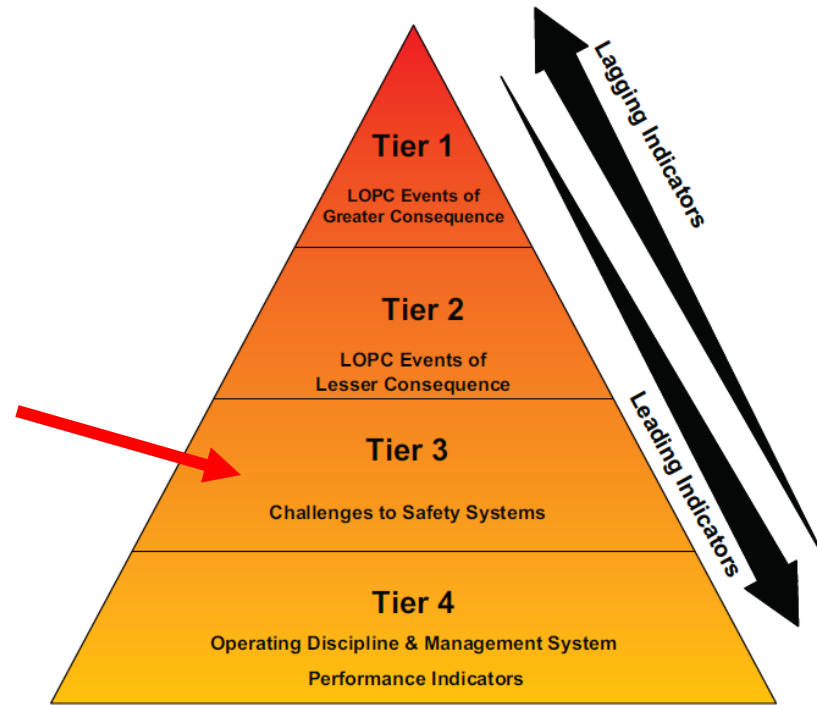
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- December 13 – 11:00 am Eastern

Focus will be on using PSE Reporting tool for 2016 performance and event reporting.

# Backup





# Tier 3 – Safe Operating Limit Exceedance

Kelly Keim – ExxonMobil

## Four types of Tier 3 PSEs

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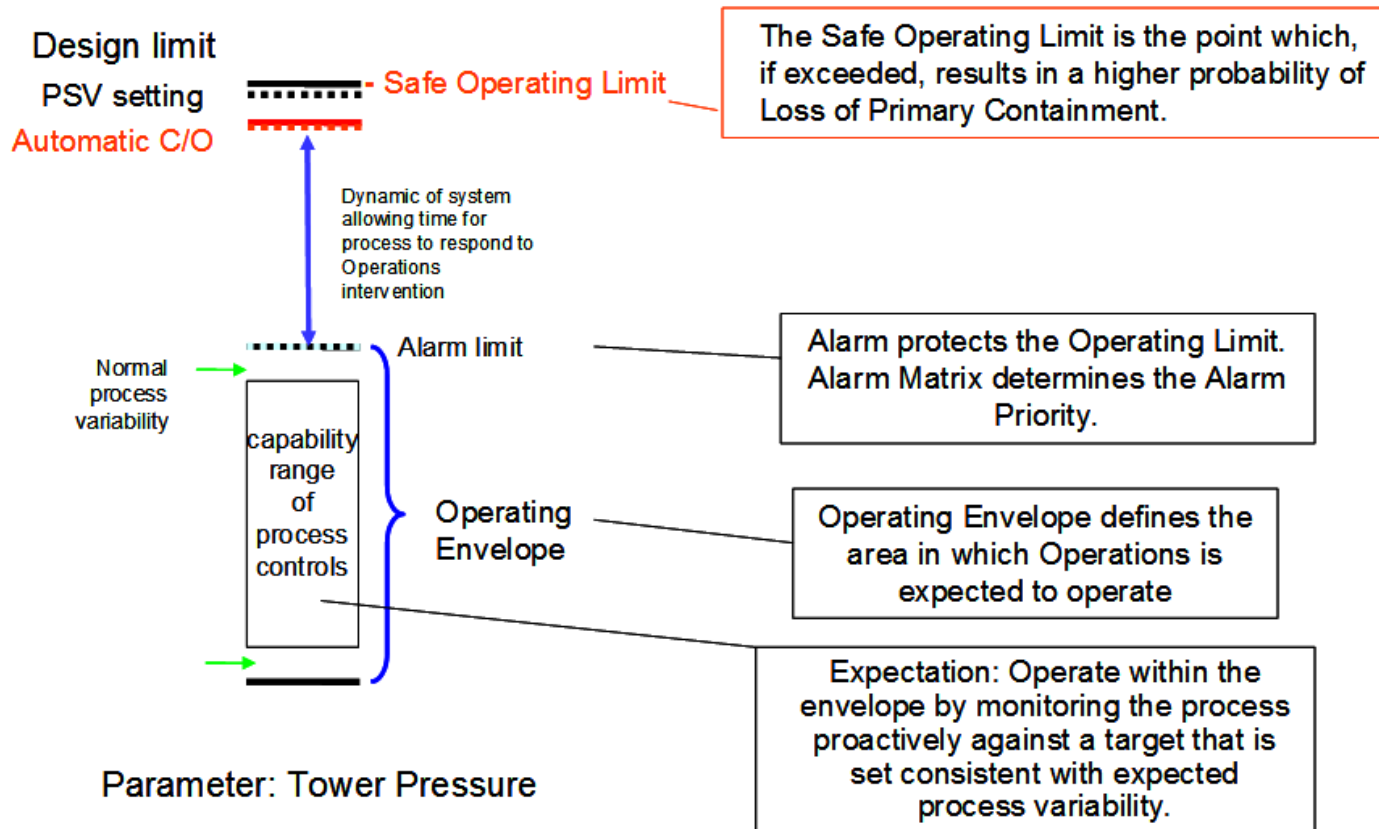
### **Four types of Process Safety Events are categorized as Tier 3. They are:**

- De minimis LOPC Events
- Other Process Unit Fires
- Demands on Safety Systems
- **Safe Operating Limit Exceedances**

Note that there are Process Safety Near Misses other than those specified above as Tier 3 Events. Those Process Safety Near Misses should be reported and investigated according to site procedures. These other Process Safety Near Misses include dropping of loads within range of equipment handling flammable or toxic materials, problems with equipment clearing and isolation for mechanical work, severe vibration and other instances of unexpected equipment degradation.

# Safe Operating Limit Exceedances

Incidents of operation outside the design parameter(s) which, if exceeded, results in a higher probability of Loss of Primary Containment. Outside the Safe Operating Limit, LOPC becomes a credible outcome. Safe Operating Limits often reflect parameters set by Engineering Codes and Standards. Safe Operating Limits are to be established for each piece of equipment where LOPC could result in harmful consequences.



# Safe Operating Limit Exceedances - SOLEs

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## Types of SOLEs:

- **SOLs protected by an engineered system, the SOLE shall be recorded as a Demand on Safety System (DOSS)**
- **SOLs Protected by Operator Response to Safety Critical Alarms**
- **SOLs Protected by Response to Inspection**
  - A single SOLE is recorded for each pressure containing vessel or piece of equipment regardless of the number of inspection points identifying thickness below the FFS value; or
  - A single SOLE is recorded for each pipe segment or section operated outside its FFS value regardless of the number of inspection points identifying thickness below the FFS value so long as it is the same line, constructed of the same material and carrying the same service.
  - A single SOLE is recorded for each atmospheric vessel operated above a level determined by its FFS value using the most recent wall thickness inspection measurements regardless of the number of inspection points identifying thickness below the FFS value.
- **SOLs Protected by Response to Periodic Sampling**

# **Use of Supervisory Computers to Identify and Categorize SOLEs**

The type of Tier 3 PSE recorded for each Operating Limit exceedance is established by providing the Operating Limit with an identification code. The Operating Limit identification codes in the table below are used for categorization.

<b>Operating Limit Description (Safe Operating Limit protected by)</b>	<b>Tier 3 PSE Code</b>
<b>Safe Operating Limit - No engineered protection system (i.e. Operator intervention only). Alarm with process value monitoring to SOL value</b>	<b>SOLE</b>
<b>Safety Critical Alarm - No engineered protection system (i.e. Operator intervention only) - Digital (On/Off) Alarm without process value monitoring to SOL value</b>	<b>DOSS - SCA</b>
<b>Pressure Relief Device - PRD</b>	<b>DOSS - PRD</b>
<b>Safety Instrumented System (SIS)</b>	<b>DOSS - SIS</b>
<b>Both SIS and PRD</b>	<b>DOSS - 2</b>
<b>Mechanical Trip System</b>	<b>DOSS - MTS</b>

# Tier 3 PSE Data Reporting - IMPACT

All Process Safety events and near misses are investigated. Incident Risk Analysis Tool is used to determine investigation level / method used.

Item #	Minimum Essential Fields
1	Responsible Department
2	Date / Time
3	Location (Process Unit)
4	Executive Summary (In English if Corporate Reportable)
5	Activity
6	Job Task
7	Dominant Incident Type
8	Incident Flags
9	Barriers Less Than Adequate
10	Phase of Operation

# Tier 3 PSE Data Reporting - Continued

Item #	Minimum Essential Fields
11	Incident (Sub-Types)
12	IRAT Actual Consequence
13	IRAT Potential Consequence
14	IRAT Potential Consequence Comments
15	IRAT Barriers to Potential Consequences
16	Equipment Involved
17	Direct Cause
18	Causal Factors based on Investigation Method (CFWT, RCAF/LPS)
19	Management System (OIMS)