

ANSI / API RP-754

Process Safety Performance Indicators for the Refining & Petrochemical Industries

Part 4: Implementation of RP-754

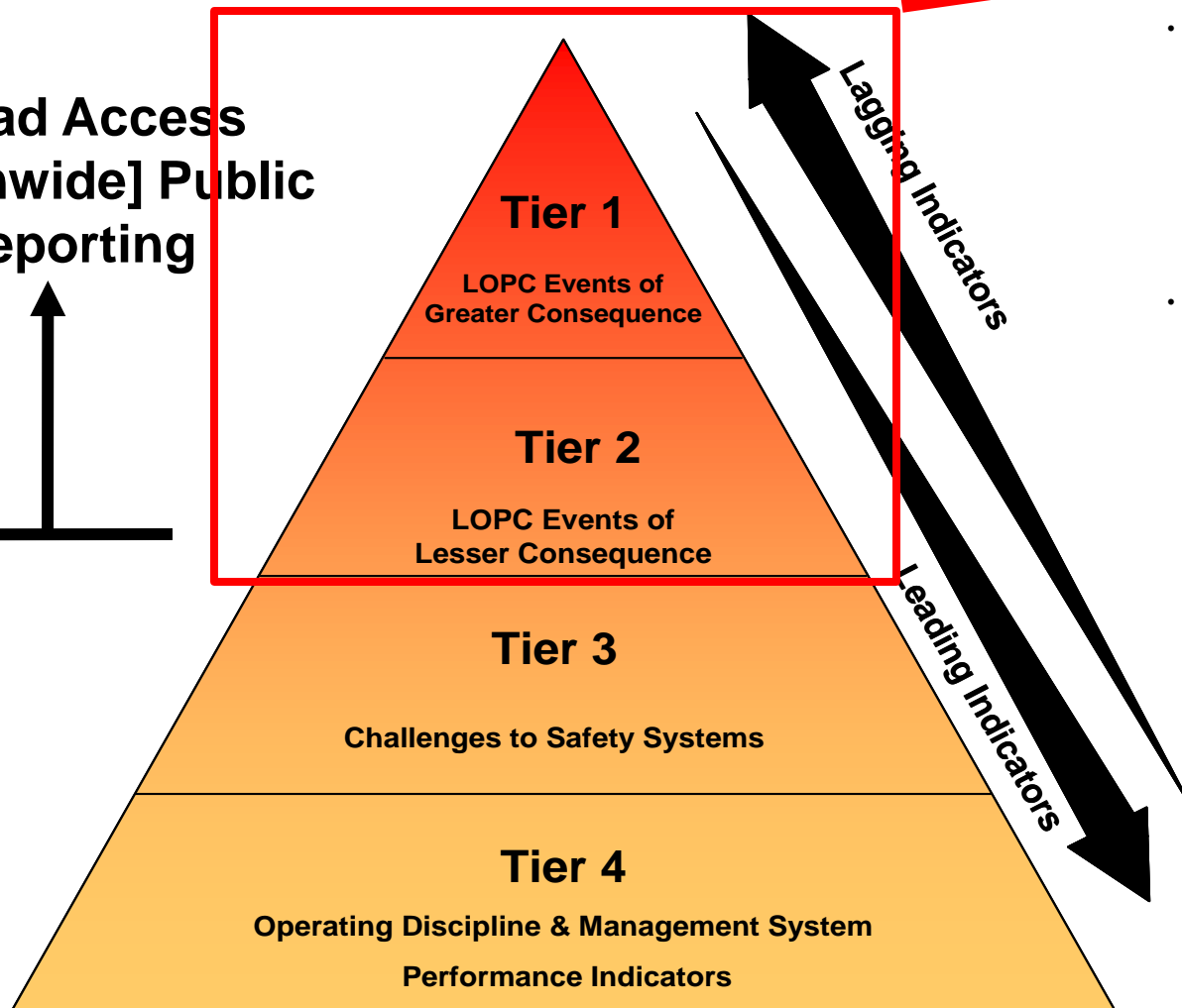
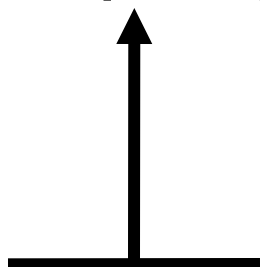
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Member API RP-754 Drafting Committee

Implementation of RP-754

- Background
- Implementation Process
- PSE Data Capture
- Introduction to Recordkeeping Spreadsheet
- Useful References & Examples
- Data Analysis Examples
- “What’s in it for me?”
- Where to go for help

Process Safety Indicator Pyramid

**Broad Access
[Nationwide] Public
Reporting**



- Tiers 1 & 2 are RP-754 standardized definitions
- Tiers 3 & 4 are company defined performance indicators

Critical First Step:

- Education & Awareness on the value of metrics as they apply to Process Safety
 - You can't track what you never hear about, monitor, or see

PSM Awareness SAFETY TALK

Topic: What are the PSM Event Categories?

Review: What is a PSM Event?
A PSM Event is a situation/incident which caused or could have potentially caused a catastrophic release of a highly hazardous chemical, major uncontrolled emission, fire, or explosion involving one or more highly hazardous chemical danger to employees in the workplace.

PSM Event Categories
PSM Events are broken down into 6 categories: **Fire, Release, Significant Mechanically Initiated, SLOs, and Safety Systems.** This allows us to group them and track potential danger to employees in the workplace.

Below are examples of events that fit into 3 of the 6 categories, showing the event's most severe.

EXAMPLES:

PSV Relief

Disb Tower PSV relief of LPG, resulting in a significant vapor cloud

PSV on Coker drum relieved to atmosphere, releasing 300 lbs. of H₂S

PSV lines to flare system during Unit Upset

EXAMPLES:

Excess Release

Excess release of H₂S

HR 3200 to procedure

EXAMPLES:

Safety Systems

Feed backflow system failed to operate, resulting in significant release from pump casing

Active Flame Line found frozen and blocked

Heater Stop due to low flow, with no 2nd order effects

PSM Awareness SAFETY TALK

Topic: Why is PSM Important?

Review: PSM stands for **Process Safety Management**. PSM is a Federal OSHA rule to prevent catastrophic releases of hazardous chemicals in areas where employees could be harmed.

The PSM Rule was created in response to a series of catastrophic events, involving major harm.

Before this rule, OSHA had little to no process safety requirements established as regulation. Each of the 14 parts/elements of the PSM rule is designed to act as a layer of protection against an incident causing an event. Eliminating gaps in those elements reduces the risk of an incident occurring.

Hazard

Gap

Elements of PSM Rule

→

PSM Procedures

Incident

Layers of Protection

Union Carbide Plant Bhopal, India 1984

• 2,000+ 3,000 Deaths

• 10,000+ injuries

Phillips Petrochemical Plant Pasadena, TX 1989

• 24 Deaths

• 130+ injuries

Aero Chemical Tank Channahow, TX 1990

• 17 deaths

PSM Awareness SAFETY TALK

Topic: PSM Event Classification- Exa

The best way to understand PSM Event criteria is to review real events. PSM Event classification, and the explanation:

Incident	PSM Classification/Category	Explanation
1/19/06: Coke found smoldering/burning on the side wall of the 23 unit slucy ramp.	PSM A Event (Fire)	This event fit within the PSM A Event criteria, "from a release of flammable process intermediate/utility as a result of PSM", which was
2/11/06: 5 gals. of spent acid leaked to containment from discharge flange on 350-90 due to plugged PSV discharge line	PSM B Event (Safety System)	Restriction found in suit fit within the PSM B C to activate or restrict section of flare line or
10/31/07: Tank S15 conservation vent lifted putting H ₂ S to atmosphere. The tank pressured up due to the control valve failing in the closed position.	PSM C Event (PSV and Release)	Significant release of release point, thereby criteria: "a 2 hour toxic atmosphere, or an area equal to or greater quantity"
2/3/08: Fire alarm activated in Main Control while cooking	NON-PSM Event	Because this event process event while the PSM did not incident was first within a process

Discussion Question:

What is the difference between Process Safety and Personal Safety? Personal Safety is potential to a single individual (acc. burn, fall). Process Safety focuses on impacts caused by an incident affecting more than one individual (explosion, release, fire). BOTH are important. If we can determine the impact more than one individual (explosion, release, fire) BOTH are important. If we can determine the impact more than one individual (explosion, release, fire) BOTH are important.

Why is it important to investigate Process Safety incidents? If we can determine the impact more than one individual (explosion, release, fire) BOTH are important. If we can determine the impact more than one individual (explosion, release, fire) BOTH are important.

PSM Incident from occurrence: For example, based on warnings from Texas City, we are filling our gap.

Check out the Pine Bend PSM Awareness Webpage (<https://psweb.healthandsafety.usm>)

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Process Safety Events

Vapors- Unknown Reason
Scaffold Board Fire
PSV Relief to Flare
SLO Exceeded
H2S Leak from Storage Tank
Bottom Loading Propane Release

25 Unit Fire

38 Unit Tubing Leak

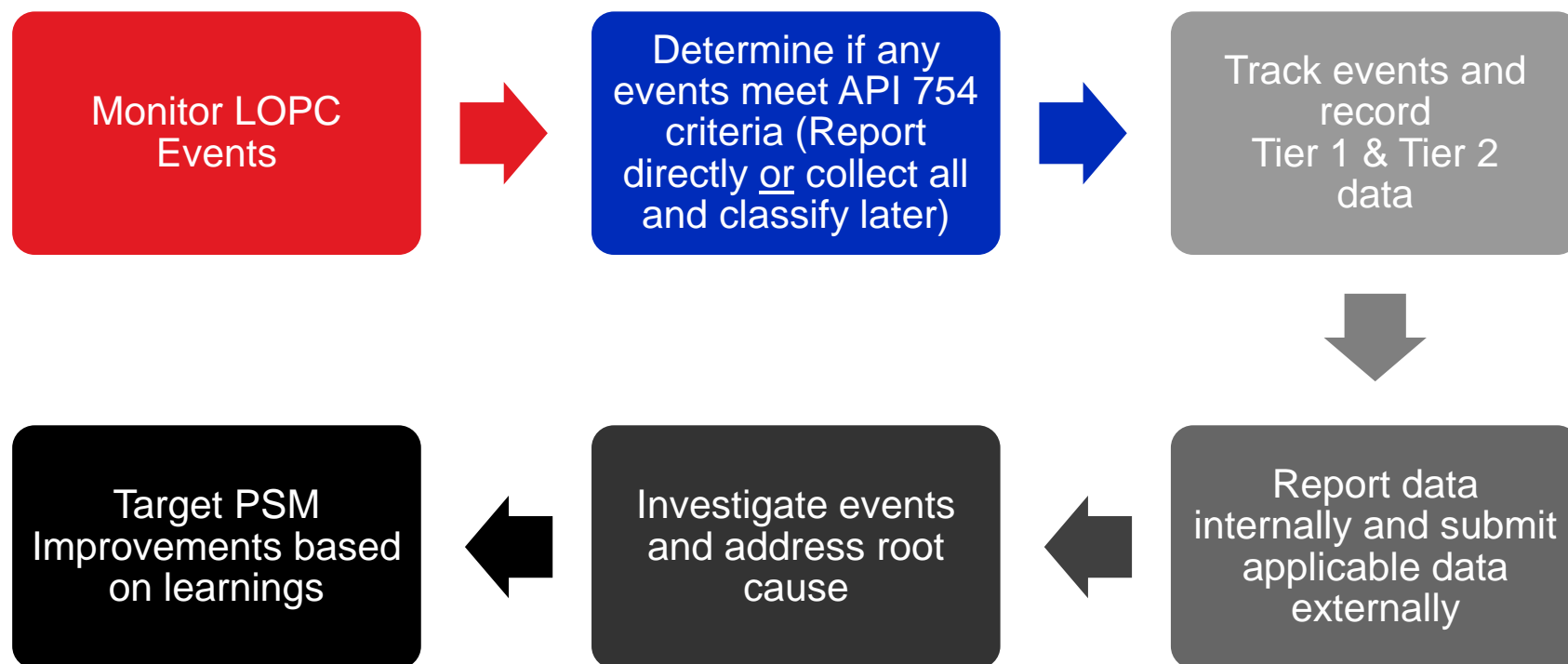
Tank 312

Texas City

Bhopal

Check out the Pine Bend PSM Awareness Webpage (<https://psweb.healthandsafety.usm>)

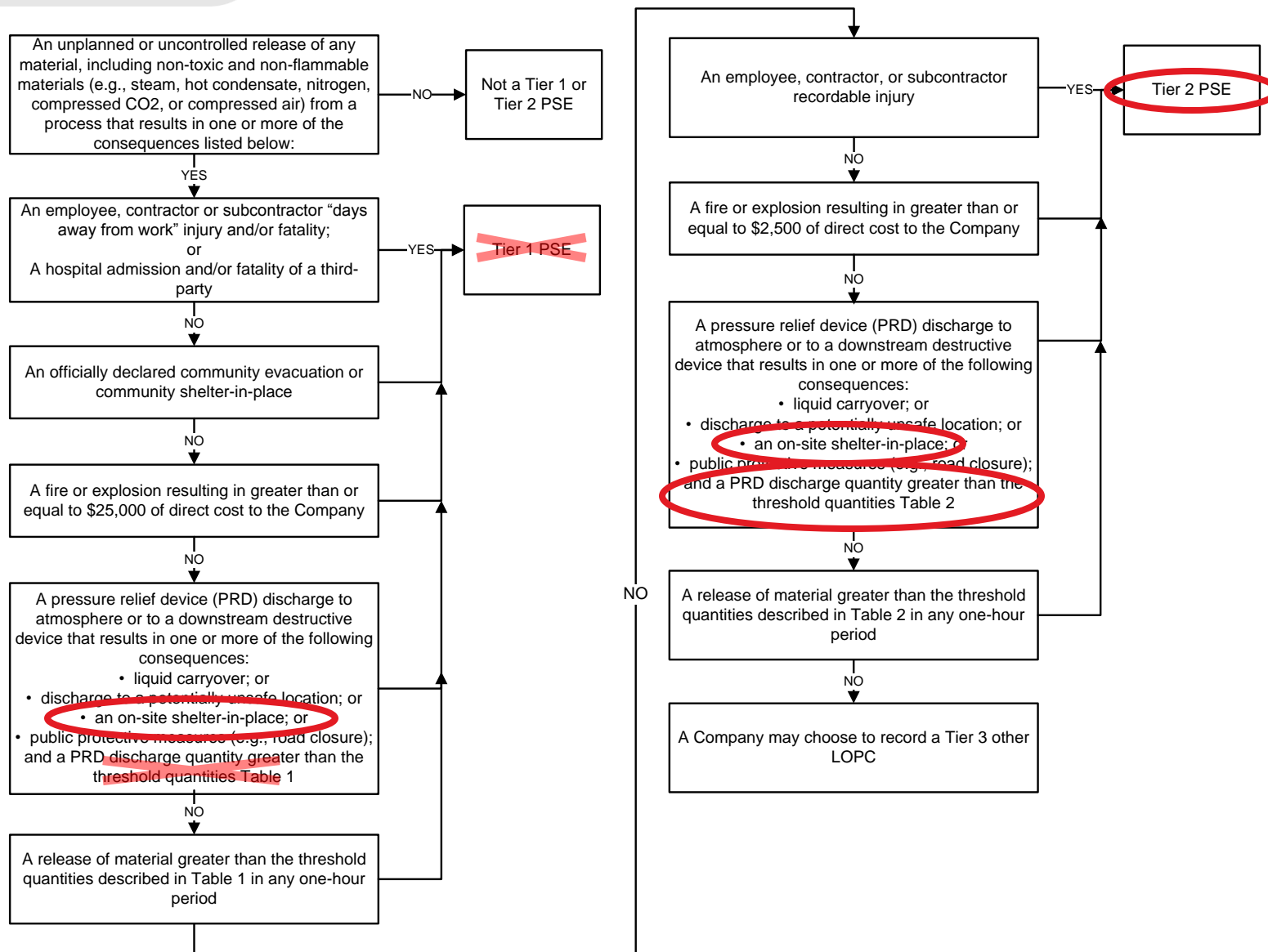
Process Safety Event Process Overview



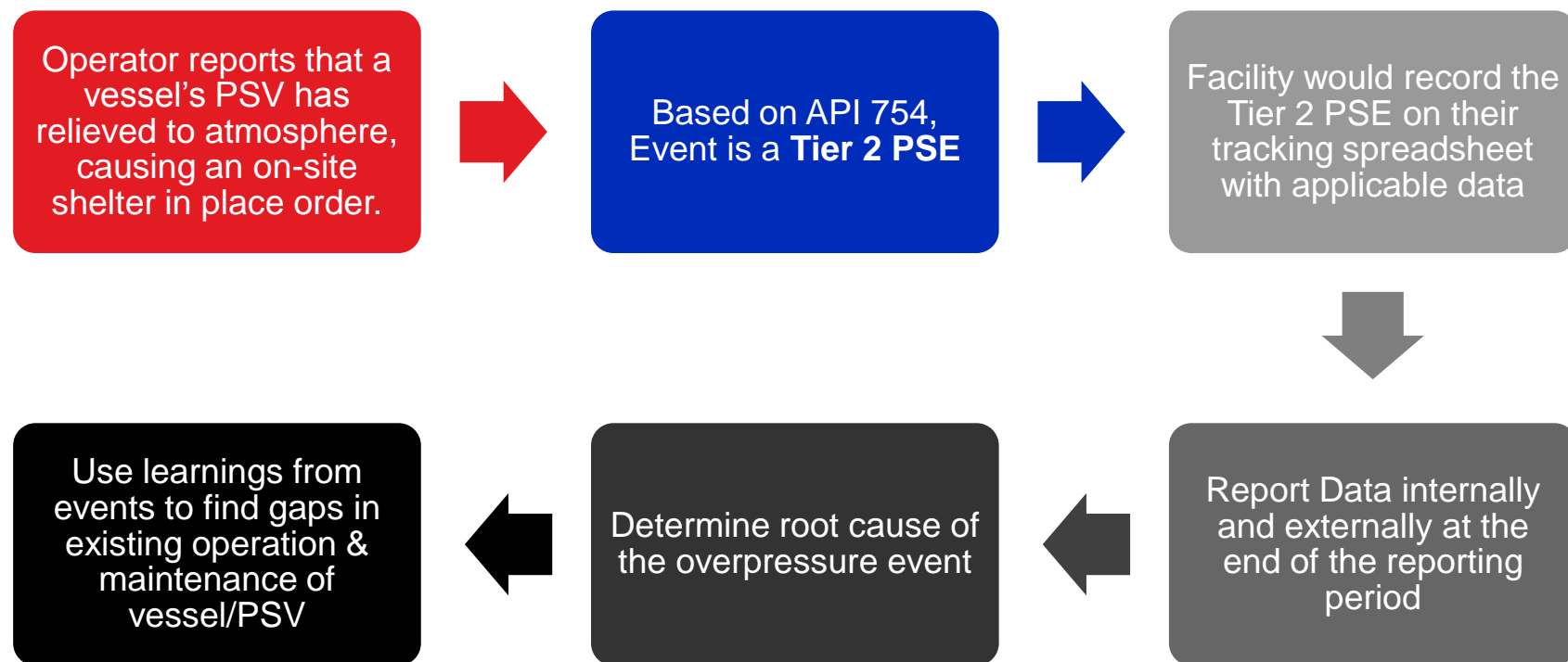
Example Event

- Process upset
- 40 lbs H₂S released through a pressure safety device (PRD/PSV) on a tank
- Release results in a shelter in place order within the facility
- No offsite impact
- Tier 2 event

API 754 Decision Logic Tree



Process Safety Event Process **Example**



Site Information

- Type of Facility (NAICS or equivalent international code)
- Corporate Name and Company Name (if different)
- Site Location/Name (country, state/province, city, site name)
- Site Identifier (unique number assigned by data collection group)
- Total work hours

Tier 1 or 2 PSE Information

- Site Identifier
- Identification of Tier 1 or 2 PSE Consequences / Triggers
 - o Harm to people
 - o An officially declared community evacuation or community shelter-in-place
 - o A fire or explosion
 - o A pressure relief device discharge to atmosphere whether directly or via a downstream destructive device
 - o An acute release of flammable, toxic or corrosive chemicals

PSE Related Information

- Type of Process
- Date & Time of Event
- Mode of Operation
- Point of Release
- Type of Material Released

API 754 Sample Tier 1 & 2 Data Reporting Format

- Data collection may be done a number of different ways
- A sample spreadsheet has been prepared to show data to be collected on Process Safety Events (PSEs)
- Spreadsheet includes:
 - Introduction/Instruction Tab
 - Site Data Tab
 - Event Recordkeeping Tab
 - Reference Tables Tab
 - Pick list Tab

Site Data Tab

- One line of data would be entered on the Site Data tab of the spreadsheet for each facility reporting data.

NOTE: Each Site is a row of data

Site Basics					Site Bas		
<u>Corporate Name</u>	<u>Company Name</u>	<u>Company Code</u>	<u>Site Name</u>	<u>Site Code</u>	<u>Site ID</u>	<u>Country</u>	<u>State/Province</u>
		<i>Chosen by API-Stats</i>		<i>Chosen by Company</i>	<i>Chosen by API-Stats</i>		<i>optional</i>
EXAMPLE							
	Corporation ABC	ABC-Refining Division	1	NewCo Refinery	XXX-XXX	XXXXXX	USA TX
	NewEnergy Co.	NewEnergy Refining	366	XYZ Refinery	001-600	12485	USA MN

Site Data Tab

i c s			N o r m a l i z e r s				N o r m a l
<u>City</u>	<u>Facility Type</u>	<u>Facility Type</u>	<u>Employees'</u> <u>Hours</u>	<u>Contractors'</u> <u>Hours</u>	<u>Refining</u> <u>Capacity</u>	<u>Refining</u> <u>EDC</u>	<u>Normalizer</u> <u>spare 1</u>
<i>optional</i>	<i>NAICS or Equivalent</i>	<i>refining/gas plant/other</i>			<i>BPD</i>		
<i>Rosemount</i>	<i>324110</i>	<i>Refinery</i>	<i>1,960,970</i>	<i>1,727,780</i>	<i>280,000</i>		

Site Data Tab

Normalizers		Additional Information				
<u>Normalizer spare 2</u>	<u>Normalizer spare 3</u>	<u>Reporting Year</u>	<u>Submitting data to other groups?</u>	<u>Which Groups?</u>	<u>Basis of data this year</u>	
		<i>Year of the data</i>			<i>API754, CCPS, API 2008ed.</i>	
		<i>2010</i>	<i>Yes</i>	<i>NPRA, API</i>	<i>API 754</i>	

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Event Data Tab

- One line of data would be entered on the **Event Data** tab of the spreadsheet for each Process Safety Event that meets the Tier 1 or Tier 2 criteria.

BASIC EVENT INFORMATION									An unplanned or uncontrolled release of any material, including non-toxic and nonflammable materials (e.g. steam, hot condensate, nitrogen, or compressed air) from a process which results in one or more of the consequences listed below.	An employee, contractor, or subcontractor fatality, or hospital admission of an employee, contractor, or subcontractor		
Site Code	Date	Time	Type of process	Mode of operation	Point of release	Type of material	Incident Description	Comments:		Injuries		
NOTE: Please list each Event on a separate row.										Enter number		
Chosen by Company	mm/dd/yyyy	24-hour	drop-down list for each type of facility - for refining see # 1 below)	drop-down list # 2 (see below)	drop-down list # 3 (see below)	drop-down list # 4 (see below)	<OPTIONAL> short description [100 character limit]	<OPTIONAL> free text provided for including useful justification, details, questions on interpretation, etc		employee fatalities	employee days away from work cases	contractor fatalities
										T1-1.ii	T1-1.i	T1-1.iv
Ex. [001-001]	1/2/2009	04:50	Hydrogen	Normal	Heat exchanger	Flammable	Fire on exchanger in hydrogen plant that led to an emergency trip.	Unplanned LOPC causing fire with >\$2500 but less than		0	0	0
001-001	2/20/2010	16:25	Tank farm/offsites	Upset	Flare/relief system	Toxic	Process upset caused H2S plume from PSV- inducing in-plant shelter in place order.	Unplanned release of toxic material through pressure relief device; Cause Shelter in place in plant, but less than Tier 1 Threshold Quantity		0	0	0
001-002	3/2/2010	01:05	Utilities/steam plant/cogeneration	Normal	Piping system (piping, gaskets, site glasses, expansion joints, tubing, valves)	Utilities (e.g., air, water, steam, nitrogen, etc.)	Steam trap discharges at grade while Operator present taking sample, causing recordable burn.	Unplanned LOPC causes recordable injury.		0	0	0
001-003	3/15/2010	08:47	Hydrotreating/hydrocracking	Normal	Piping system (piping, gaskets, site glasses, expansion joints, tubing, valves)	Flammable	Forklift damaged bleeder valve in Naptha HT, causing a 9.5 bbl release, vapor cloud, and explosion.	Unplanned LOPC with release above Tier 1 TQ, as well as fire with more than \$25,000 direct cost.		0	0	0

Event Data Tab

<u>Site Code</u>	<u>Date</u>	<u>Time</u>	<u>Type of process</u>	<u>Mode of operation</u>	<u>Point of release</u>	<u>Type of material</u>
NOTE: Please list each Event on a separate row.						
<i>Chosen by Company</i>	<i>mm/dd/yyyy</i>	<i>24-hour</i>	<i>drop-down list for each type of facility - for refining see # 1 below)</i>	<i>drop-down list # 2 (see below)</i>	<i>drop-down list # 3 (see below)</i>	<i>drop-down list # 4 (see below)</i>
Ex. [001-001]	1/2/2009	04:50	Hydrogen	Normal	Heat exchanger	Flammable
001-001	2/20/2010	16:25	Tank farm/offsites	Upset	Flare/relief system	Toxic

Event Data Tab

<div><OPTIONAL> short description [100 character limit]</div> <div><OPTIONAL> free text provided for including useful justification, details, questions on interpretation, etc</div>		An unplanned or uncontrolled release of nontoxic and nonflammable materials (nitrogen, or compressed air) from a process vessel, or more of the consequences of such release.	Injuries			
			Enter number of injuries			
			employee fatalities	employee days away from work cases	contractor fatalities	contractor days away from work cases
			T1-1.ii	T1-1.i	T1-1.iv	T1-1.iii
Fire on exchanger in hydrogen plant that led to an emergency trip.	Unplanned LOPC causing fire with >\$2500 but less than		0	0	0	0
Process upset caused H2S plume from PSV- inducing in- plant shelter in place order.	Unplanned release of toxic material through pressure relief device; Cause Shelter in place in plant, but less than Tier 1 Threshold Quantity		0	0	0	0

Event Data Tab

Injuries				Evac?	Fire / Explosion		
Injuries that result in:				Yes/No	Yes/No-Direct Cost		
third party fatalities	third party hospital admissions	employee recordable injuries	contractor recordable injuries	officially declared community evacuation	fire - direct cost	explosion - direct cost	PRD directly to atmosphere or via downstream destructive device
T1-2.ii	T1-2.i	T2-1.i	T2-1.ii	T1-3	T1-4.i	T1-4.ii	T1-5.a.i
					T2-2.i	T2-2.ii	T2-3.a.i
0	0	0	0	No	Yes - \$2500 to \$25,000 direct cost damage	None	Not Applicable
0	0	0	0	No	None	None	Table 2 volume 'to atmosphere' from Malfunctioning PRD

Event Data Tab

Malfunctioning PRD discharge				An acute release		
Exceed Table 1 [Tier 2 - Table 2]						
contains liquid carryover	discharge to unsafe location	on-site shelter-in-place	public protective measure	acute release - category 1	acute release - category 2	acute release - category 3
T1-5.b.i	T1-5.b.ii	T1-5.b.iii	T1-5.b.iv	T1-6.i	T1-6.ii	T1-6.iii
T2-3.b.i	T2-3.b.ii	T2-3.b.iii	T2-3.b.iv	T2-4.i	T2-4.ii	T2-4.iii
Not Applicable	Not Applicable	Not Applicable	Not Applicable	No	No	No
Not Applicable	Not Applicable	Table 2 volume 'to atmosphere' from Malfunctioning PRD	Not Applicable	No	Yes - Tier 2 level	No

Event Data Tab

Containment				
acute release - category 6	acute release - category 7	Indoor or Outdoor Release?	API 754 Resulting Classification and Event Type	
			Tier	Type (Optional)
T1-6.vi	T1-6.vii			
T2-4.vi	T2-4.vii			
No	No	Outdoor	Tier 2	Fire
No	No	Outdoor	Tier 2	PRD Discharge

References

- It is useful to create a common list of substances involved at your facility that could be released
- Include the Threshold Release Category (i.e. TIH Zone), Threshold and Quantity

Classification	Tier 1 - Higher consequence		Tier 2 - Lower consequence	
Acute Release [Meets threshold quantity during any one-hour duration]	Threshold quantities:		Threshold quantities: (Approx. 10% of UNLGL Threshold Quantity)	
	Flammable Gas (flashpoint < 73 °F, boiling point < 95 °F) Flammable Liquid UNLGL PG II (flashpoint < 73 °F, boiling point > 95 °F) Flammable Liquid UNLGL PG III (flashpoint ≥ 73 °F and ≤ 140 °F) or Combustible Liquid (flashpoint > 140 °F) released above flashpoint Toxic Substances (See UNLGL list for full list): Ammonia, Anhydrous TIH D - 440 lbs Ammonia, Aqueous (10-35% solution) PG III - 4400 lbs Chlorine TIH B - 55 lbs Hydrogen Sulfide TIH B - 55 lbs Hydrogen Fluoride, Anhydrous TIH C - 220 lbs Hydrofluoric Acid, > 60% solution PG I - 1100 lbs Hydrofluoric Acid, < 60% solution PG II - 2200 lbs Sodium Hydroxide (caustic - fresh) PG II - 2200 lbs (124 gallons) Sodium Hydroxide (caustic - spent) PG II - 2200 lbs (220 gallons) Sulfuric Acid (spent and fresh) PG II - 2200 lbs (144 gallons) Sulfur Dioxide TIH C - 220 lbs Strong acids or bases (pH < 1 and > 12.5) *not otherwise classified	1100 lbs 7 bbls 14 bbls Various (see detail) 14 bbls	Flammable Gas (flashpoint < 73 °F, boiling point < 95 °F) Flammable Liquid UNLGL PG II (flashpoint < 73 °F, boiling point > 95 °F) Flammable Liquid UNLGL PG III (flashpoint ≥ 73 °F and ≤ 140 °F) or Combustible Liquid (flashpoint > 140 °F) released above flashpoint Toxic Substances (See UNLGL list for full list): Ammonia, Anhydrous TIH D - 5 lbs Ammonia, Aqueous (10-35% solution) PG III - 220 lbs Chlorine TIH B - 5 lbs Hydrogen Sulfide TIH B - 5 lbs Hydrogen Fluoride, Anhydrous TIH C - 5 lbs Hydrofluoric Acid, > 60% solution PG I - 100 lbs Hydrofluoric Acid, < 60% solution PG II - 220 lbs Sodium Hydroxide (caustic - fresh) PG II - 220 lbs (12 gallons) Sodium Hydroxide (caustic - spent) PG II - 220 lbs (22 gallons) Sulfuric Acid (spent and fresh) PG II - 220 lbs (14 gallons) Sulfur Dioxide TIH C - 5 lbs Moderate acids or bases (pH < 1 and > 12.5) *not otherwise classified Combustible Liquid (flashpoint > 140 °F) released below flashpoint	100 lbs 1 bbl 1 bbl Various (see detail) 10 bbls

References

- Another example of a release threshold table (site-specific):

Example Release Thresholds for Refining Process Safety Events

Acute Release = Exceeds threshold in ≤ 1 hour		Tier I			Tier 2 (10%)		
Chemical Name	Hazard Classification	Threshold (lb)	Barrels	Gallons	Threshold (lb)	Barrels	Gallons
#1 Fuel Oil	Combustible Liquid	4400	14.99	629	440	1.50	63
#2 Fuel Oil	Combustible Liquid	4400	14.06	591	440	1.41	59
Anhydrous ammonia	Toxic Inhalation Hazard	440	2.03	85	44	0.20	9
Butane	Flammable Gas	1100			110		
Chlorine	Toxic Inhalation Hazard	55			5.5		
Clarified Oil	Combustible Liquid	4400	11.37	478	440	1.14	48
Crude Oil	Flammable Liquid	2200	6.90	290	220	0.69	29
FRC Gasoline	Flammable Liquid	2200	8.28	348	220	0.83	35
Gas Oil	Combustible Liquid	4400	13.88	583	440	1.39	58
Heavy Alkylate	Flammable Liquid	2200	8.95	376	220	0.90	38
Heavy Cycle Oil	Combustible Liquid	4400	11.37	478	440	1.14	48
Heavy Vacuum Gas Oil	Combustible Liquid	4400	13.28	558	440	1.33	56
Hydrogen	Flammable Gas	1100			110		
Hydrogen Sulfide	Toxic Inhalation Hazard	55			5.5		
Light Coker Gas Oil	Flammable Liquid	2200	7.16	301	220	0.72	30
Light Cycle Oil	Combustible Liquid	4400	12.55	527	440	1.25	53
Light Vacuum Gas Oil	Combustible Liquid	4400	13.69	575	440	1.37	58
MDEA	Combustible Liquid	4400	12.56	528	440	1.26	53
MEA	Combustible Liquid	4400	12.56	528	440	1.26	53
Propane	Flammable Gas	1100			110		
Sulfur Dioxide	Toxic Inhalation Hazard	220			22		

Examples Section of API 754

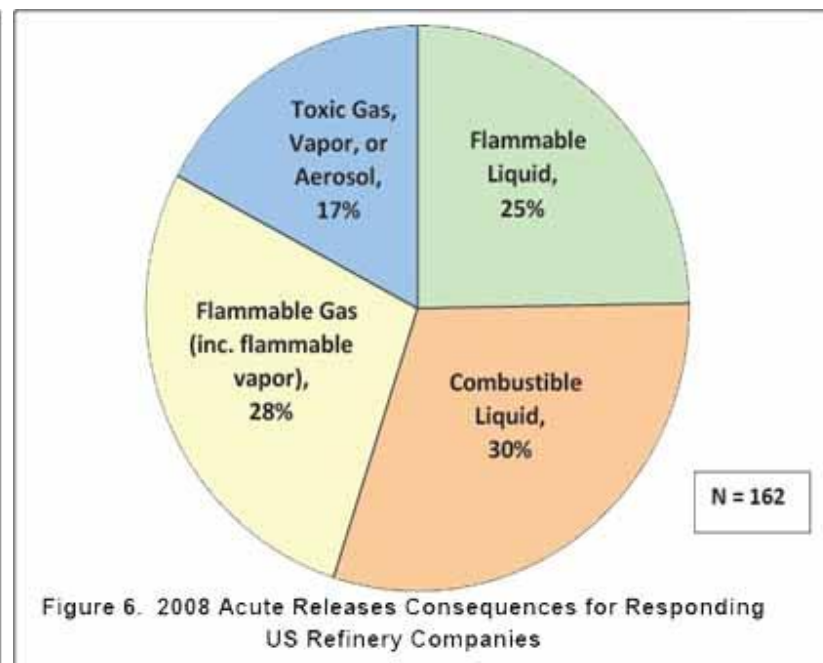
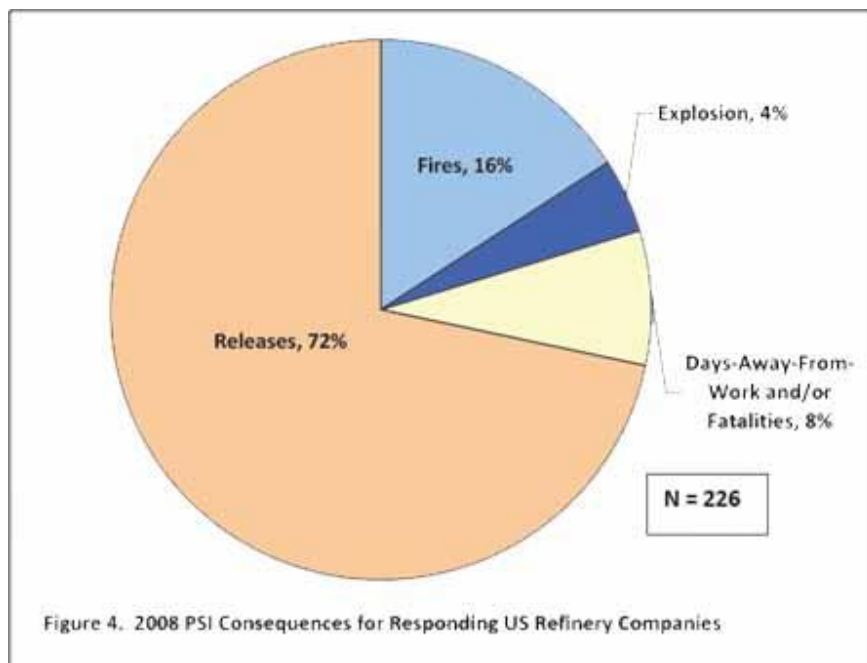
- Annex A contains multiple examples of events and their correct classification using API 754
- Annex A is organized by event type, and includes a determination for each example of what the resulting classification would be based on the event described

Loss of Primary Containment (LOPC)	19) An operator opens a quality control sample point to collect a routine sample of product and material splashes on him. The operator runs to a safety shower leaving the sample point open and a Tier 2 threshold quantity is released. This is a Tier 2 PSE since the release of a threshold quantity was unplanned or uncontrolled.	Tier 2 §6.2, Tier 2 Definition
	Same as above, however, the operator catches the sample, blocks in the sample point and later drops and breaks the sample container resulting in exposure and injury from the sample contents. This is not a PSE because the LOPC is from a piece of ancillary equipment not connected to a process.	Not a PSE §1.2, Applicability
	20) A bleeder valve is left open after a plant turnaround. On start-up, an estimated 15 bbl of fuel oil, a liquid with a flashpoint above 60 °C (140 °F), is released at 38 °C (100 °F) (below its flashpoint) onto the ground within an hour and into the plant's drainage system before the bleeder is found and closed. This is a Tier 2 PSE.	Tier 2 §6.2, Table 2
	Same as above, except the release temperature is above the flashpoint; thus, it would be a Tier 1 PSE.	Tier 1 §5.1, Table 1
	21) There is a loss of burner flame in a fired heater resulting in a fuel-rich environment and	Tier 1

Extending API 754 Data into Industry, Company & Site Analysis

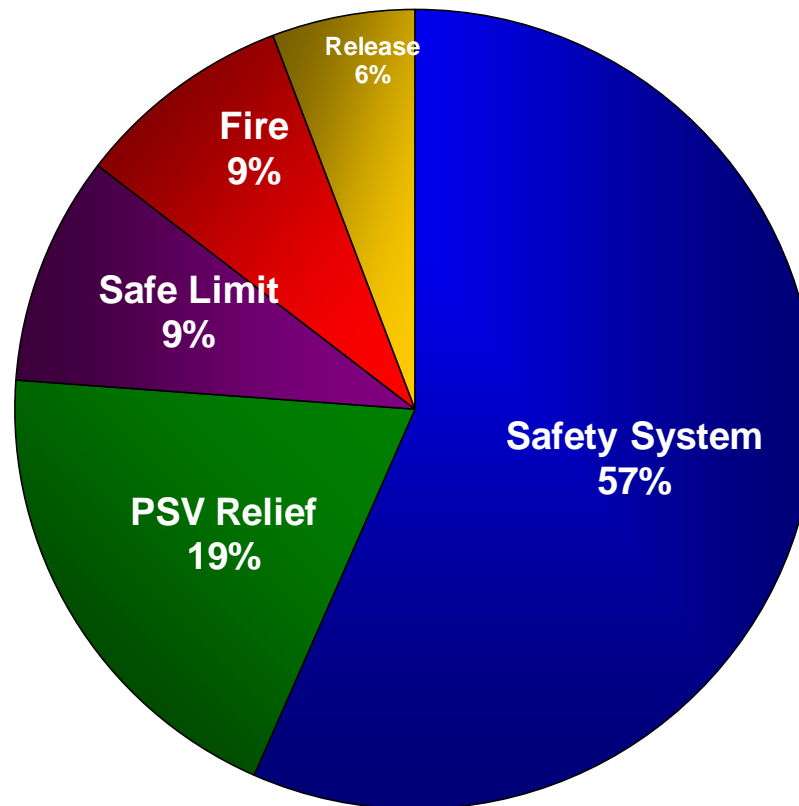
- It is a natural extension of API 754 data collection to develop trends, breakdowns, and pareto charts by industry-type, company and by site
- The following slides contain examples of what can be done with API 754 data once it is collected.

Examples of Industry Data Analysis



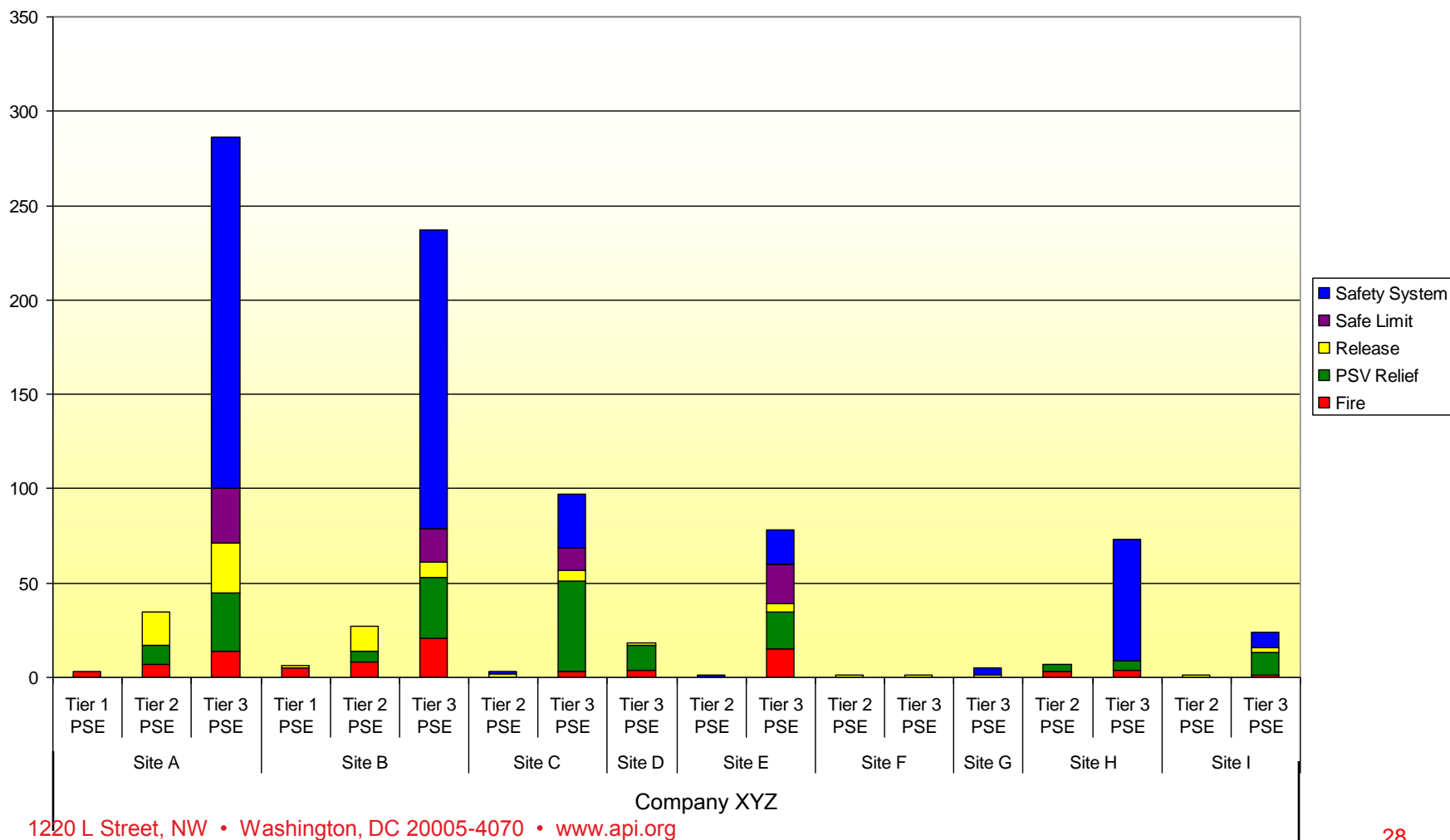
Data Analysis Examples:

Single Site

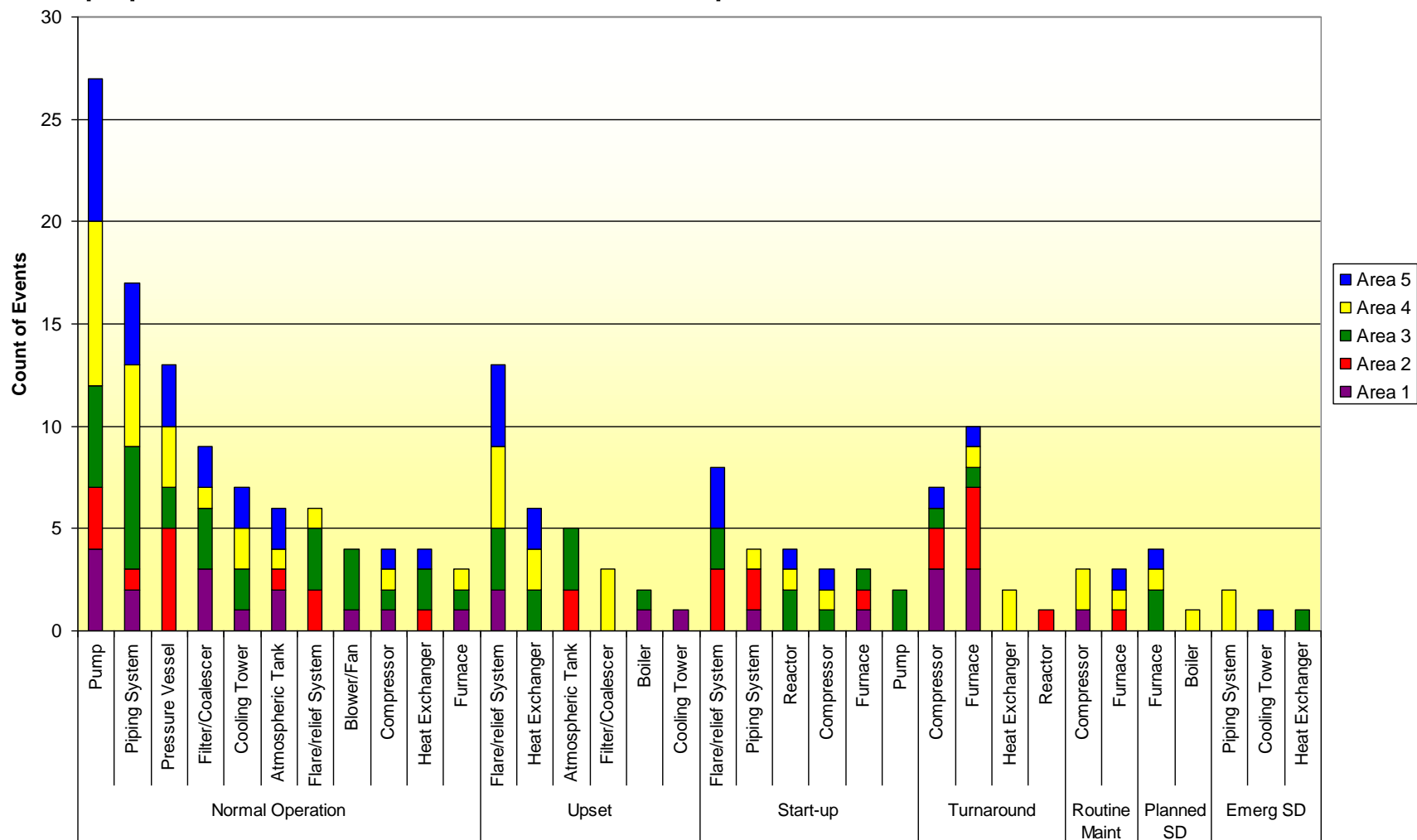


Data Analysis Examples:

Multi Site



Data Analysis Examples: Equipment Involved vs. Mode of Operation



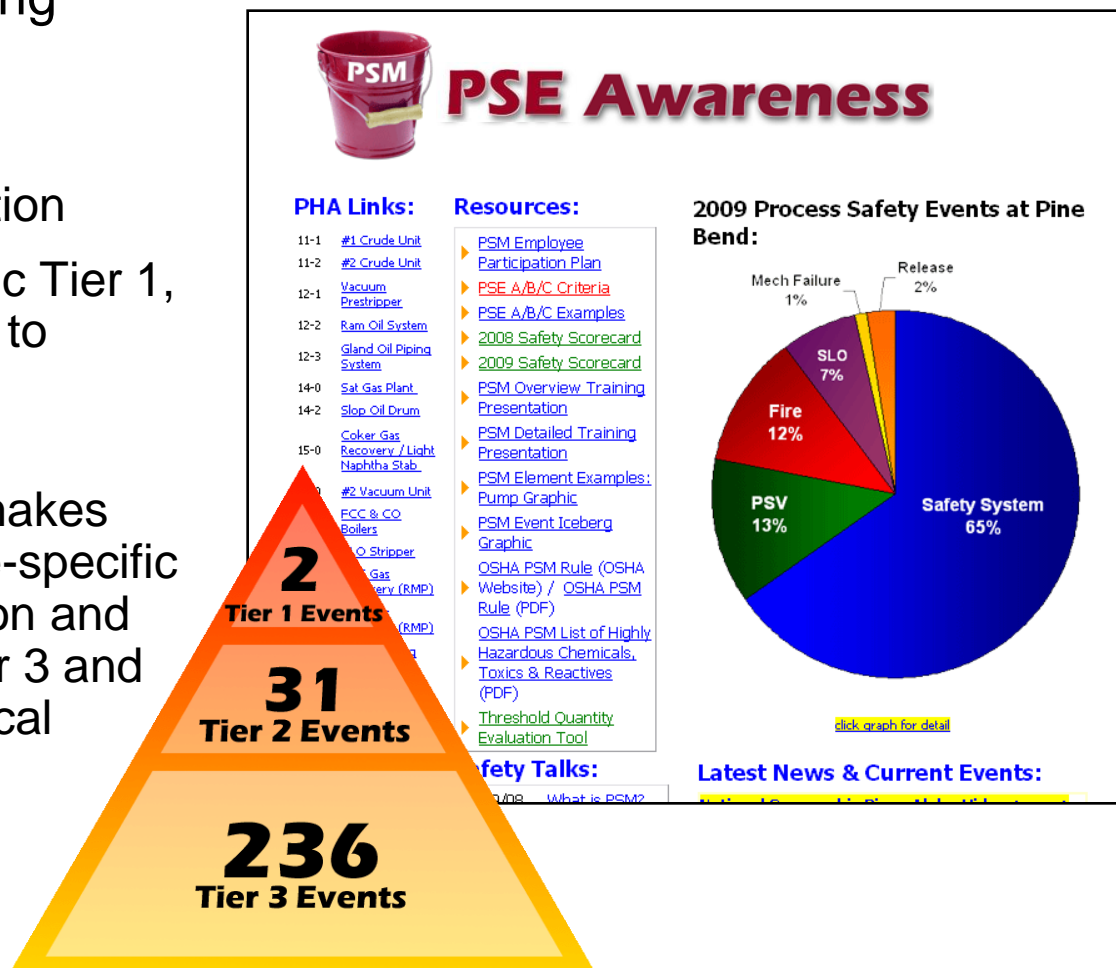
“What’s in it for me?”

- Classification and communication of facility events as Process Safety Events is a powerful catalyst for Process Safety awareness
- Data collected on events can be used to:
 - Draw attention to areas of process safety that employees are not aware of
 - Focus in-depth investigations on specific ‘repeat offenders’
 - Pareto the highest frequency of events to better allocate resources and equipment
 - Assist with prioritizing project resources for equipment improvements
 - Categorization and prioritization of events is an excellent learning tool for facility personnel on critical areas of process safety
 - Trigger actions which become a ‘what have I done for you lately’ list of specific process safety improvements
 - Show improvement over time, which should be communicated both internally and externally



Local [Site] Public Reporting

- Each site determines the appropriate methods to communicate PSE information
- Annual report of site-specific Tier 1, 2, 3 and 4 PSE information to employees and employee representatives
- Annually, each Company makes available a summary of site-specific Tier 1 and 2 PSE information and may report site-specific Tier 3 and 4 PSE information to the local community and emergency management officials



Where to go for Help

- **API website:** <http://api.org/standards/psstandards>
 - Access to API 754 Recommended Practice
 - Sample Data Spreadsheet
 - Webinar Presentations
 - Contact Information for API personnel if questions arise
 - Benchmark information for member companies who participate in data collection
- **CCPS website :** <http://www.aiche.org/ccps/>
 - [Full list](#) of materials cross-referenced to the UN Dangerous Goods definitions
 - Guidelines for Process Safety Metrics: <http://www.wiley.com/WileyCDA/WileyTitle/productCd-0470572124.html>
- **NPRA website:** <http://www.npra.org/>
 - Many resources for member companies
- **DOT Resources:**
 - Hazardous Materials Table (172.101)
<http://ecfr.gpoaccess.gov/cgi/t/text/textidx?c=ecfr&rgn=div8&view=text&node=49:2.1.1.3.7.2.25.1&idno=49>

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Electronic Download of RP-754

<http://api.org/standards/psstandards>

Questions

