ANSI / API RP-754

Process Safety Performance Indicators for the Refining & Petrochemical Industries

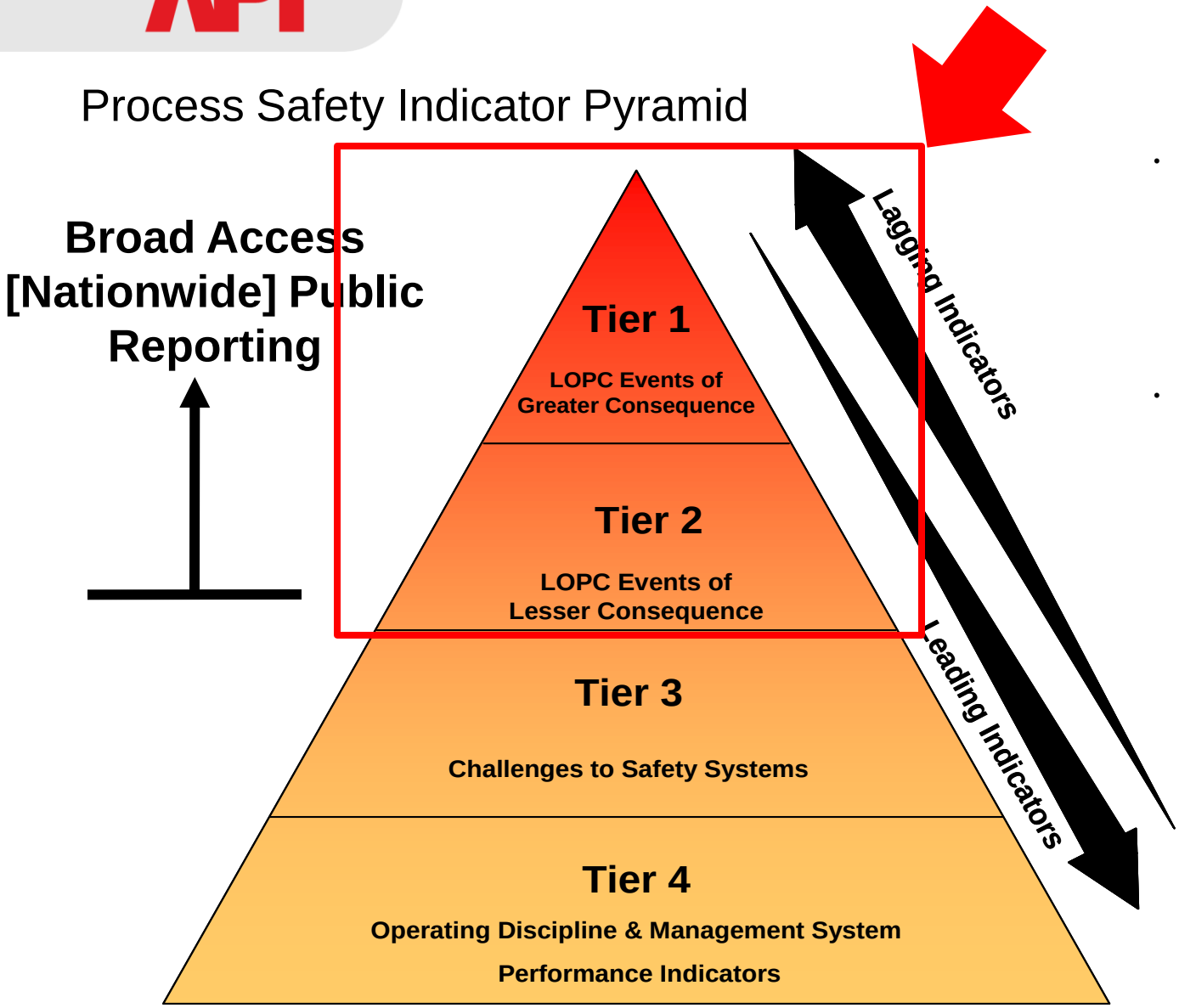
Part 4: Implementation of RP-754

Dawn Wurst
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

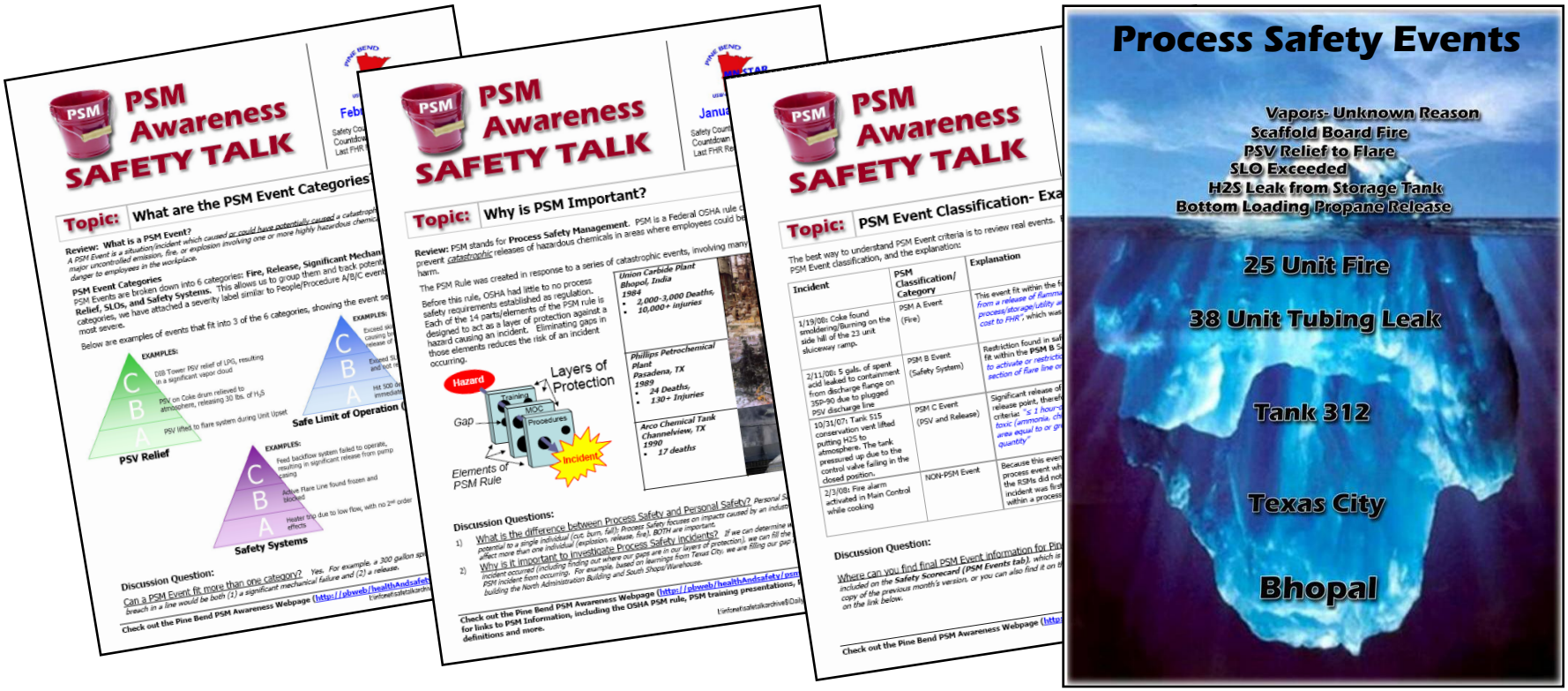
Emphasis for Data Collection & Reporting



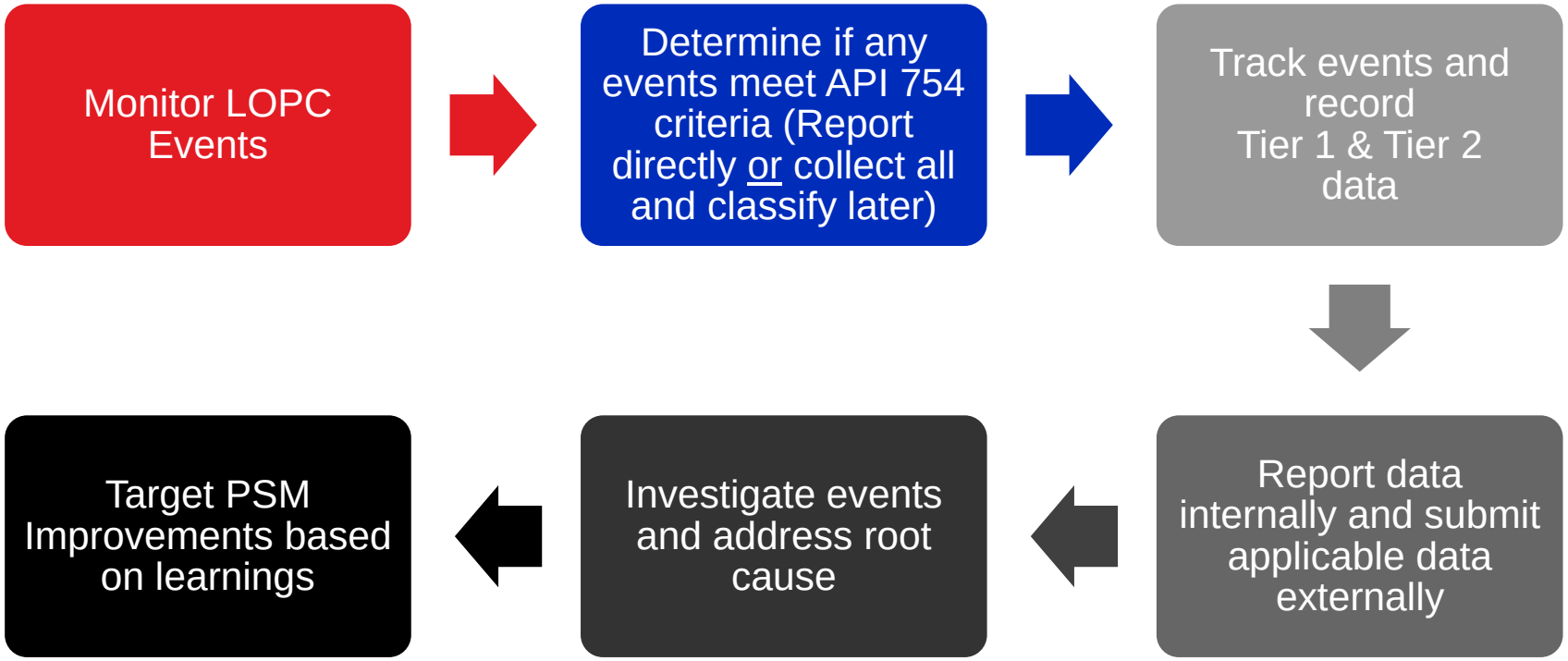
- Tiers 1 & 2 are RP-754 standardized definitions
- Tiers 3 & 4 are company defined performance indicators

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



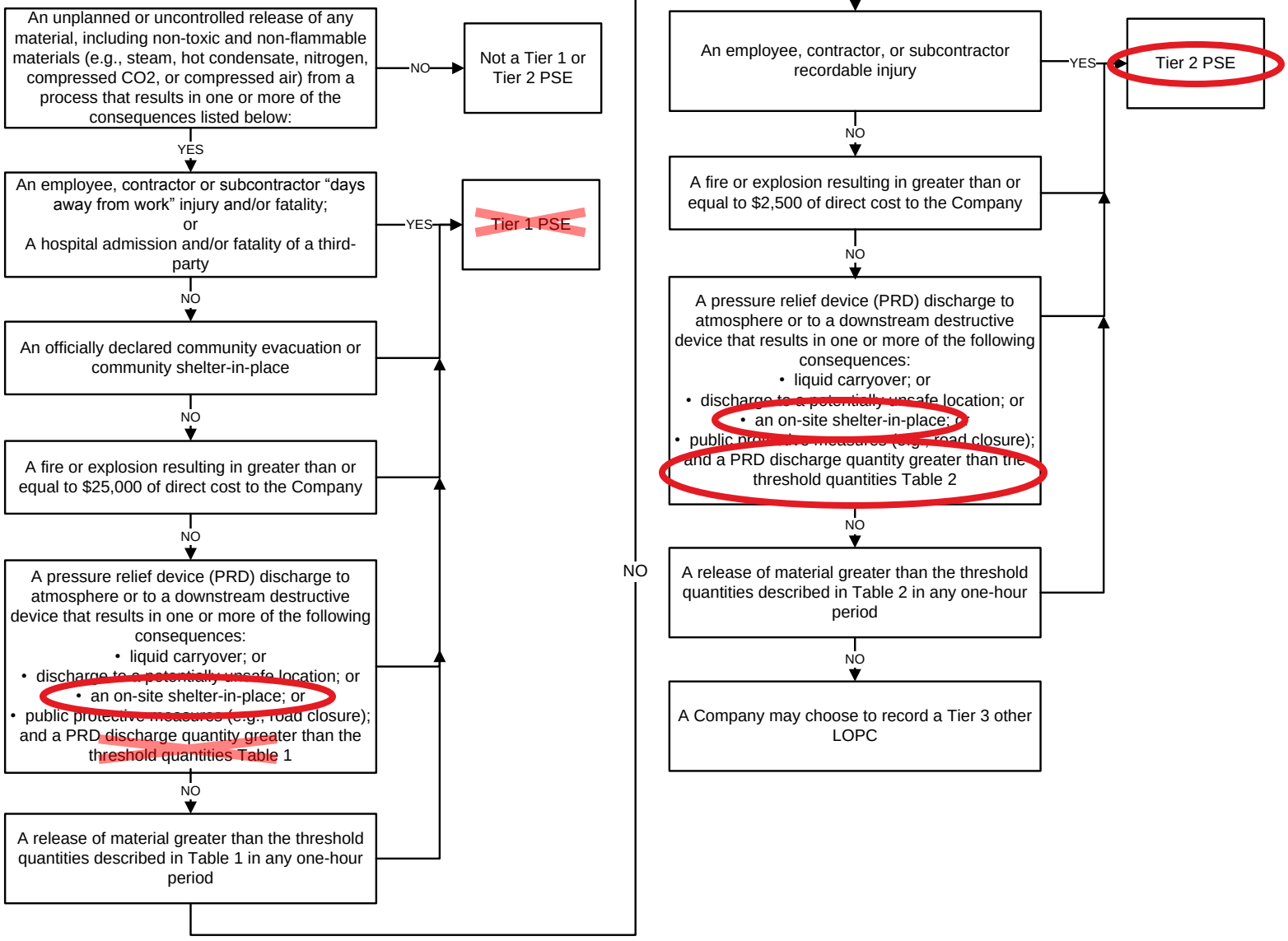
Process Safety Event Process Overview



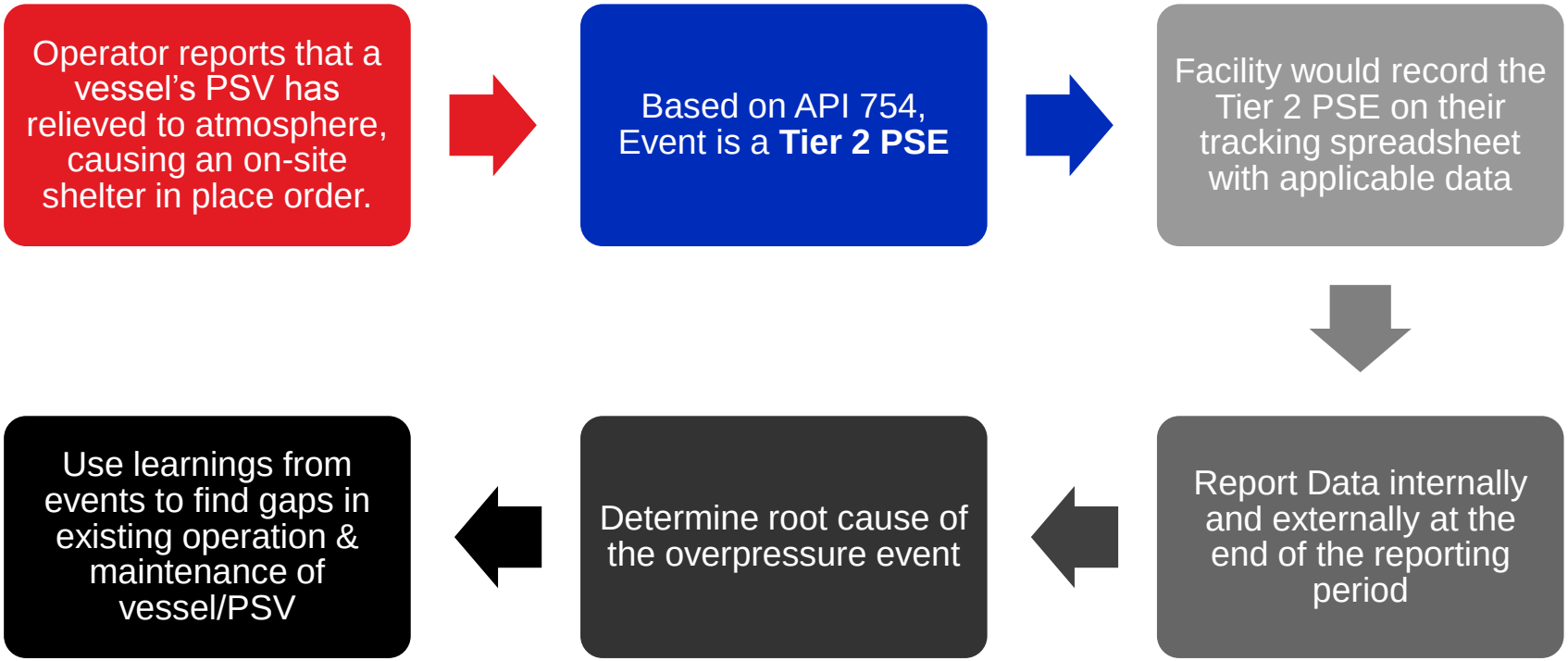
Example Event

- Process upset
- 40 lbs H_2S 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**



PSE Data Capture

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
  - Harm to people
  - An officially declared community evacuation or community shelter-in-place
  - A fire or explosion
  - A pressure relief device discharge to atmosphere whether directly or via a downstream destructive device
  - An acute release of flammable, toxic or corrosive chemicals

PSE Data Capture, Continued

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 <u>each facility</u> reporting data.

NOTE: Each Site is a row of data

	Site Basics							
	Corporate Name	Company Name	Company Code	Site Name	Site Code	Site ID	Country	State/ Province
			Chosen by API-Stats		*Chosen by Company*	*Chosen by API-Stats*		*optional*
EXAMPLE	*Corporation ABC*	*ABC-Refining Division*	*1*	*NewCo Refinery*	*XXX-XXX*	*XXXXX*	*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
City	Facility Type	Facility Type	Employees' Hours	Contractors' Hours	Refining Capacity	Refining EDC	Normalizer spare 1
optional	*NAICS or Equivalent*	*refining/gas plant/other*			*BPD*		
Rosemount	*324110*	*Refinery*	*1,960,970*	*1,727,780*	*280,000*		

Site Data Tab

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

Site Data Tab

	Additional Information						
	History	Operated Full Year?	Included last Year?	Opened/ Closed?	Change of ownership?		
	Owned since 1969	*Yes*	*No*	*N/A*	*No*		

Event Data Tab

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

BASIC EVENT INFORMATION									An unplanned or uncontrolled release of any material, including nontoxic 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 su fatality, or hospital admission a employee, contractor, or subco		
										Injuries		
										Enter number		
Site Code	Date	Time	Type of process	Mode of operation	Point of release	Type of material	Incident Description	Comments:		employee fatalities	employee days away fro work cases	contractor fatalities
NOTE: Please list each Event on a separate row.												
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		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

Site Code	Date	Time	Type of process	Mode of operation	Point of release	Type of material
NOTE: Please list each Event on a separate row.						
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)*
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

<OPTIONAL> short description [100 character limit]	<OPTIONAL> free text provided for including useful justification, details, questions on interpretation, etc	An unplanned or uncontrolled releas nontoxic and nonflammable materials nitrogen, or compressed air) from a pr more of the consequenc	Injuries			
			Enter number of inj			
			employee fatalities	employee days away fro work cases	contractor fatalities	contractor days away fro 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		
uries 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 T2-2.i	T1-4.ii T2-2.ii	T1-5.a.i 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 r		
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

ontainment				
acute release - category 6	acute release - category 7	Indoor or Outdoor Release?	API 754 Resulting Classification and Event Type	
T1-6.vi T2-4.vi	T1-6.vii T2-4.vii		Tier	Type (Optional)
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 UNDGL Threshold Quantity)	
	Flammable Gas (flashpoint < 73 °F, boiling point < 95 °F)	**1100 lbs**	**Flammable Gas** (flashpoint < 73 °F, boiling point < 95 °F)	**100 lbs**
	Flammable Liquid UNDGL PG II (flashpoint < 73 °F, boiling point > 95 °F)	**7 bbls**	**Flammable Liquid UNDGL PG II** (flashpoint < 73 °F, boiling point > 95 °F)	**1 bbl**
	Flammable Liquid UNDGL PG III (flashpoint ≥ 73 °F and ≤ 140 °F) or **Combustible Liquid** (flashpoint > 140 °F) released above flashpoint	**14 bbls**	**Flammable Liquid UNDGL PG III** (flashpoint ≥ 73 °F and ≤ 140 °F) or **Combustible Liquid** (flashpoint > 140 °F) released above flashpoint	**1 bbl**
	Toxic Substances (See UNDG 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	**Various (see detail)**	**Toxic Substances (See UNDG 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	**Various (see detail)**
	Strong acids or bases (pH < 1 and > 12.5) *not otherwise classified	**14 bbls**	Moderate **acids or bases** (pH < 1 and > 12.5) *not otherwise classified **Combustible Liquid** (flashpoint > 140 °F) released below flashpoint	**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

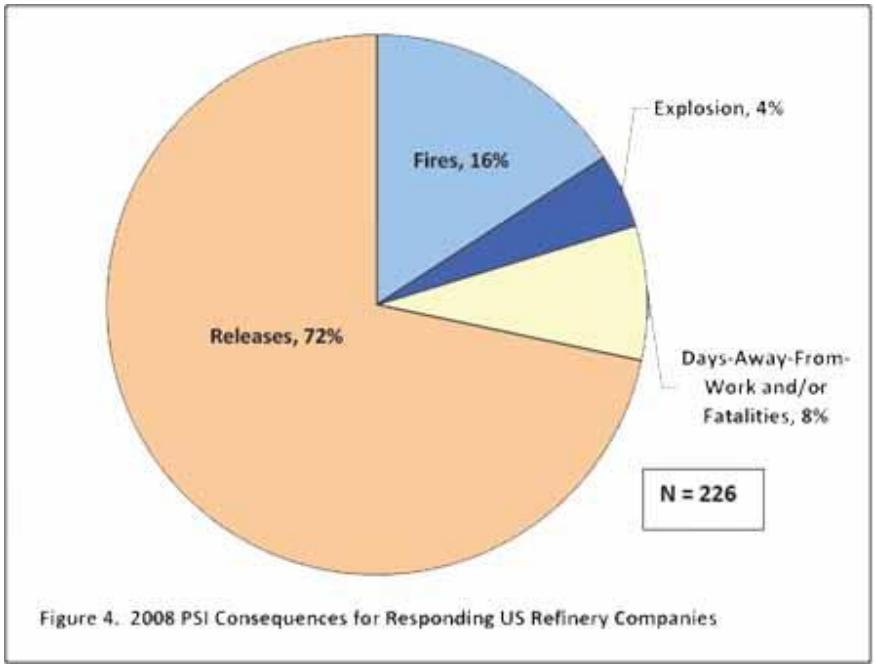


Figure 4. 2008 PSI Consequences for Responding US Refinery Companies

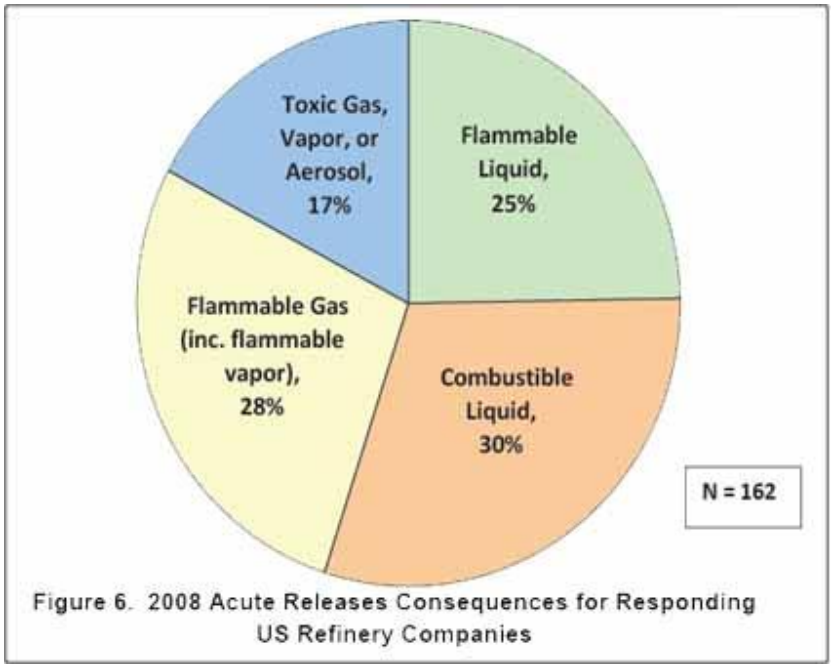
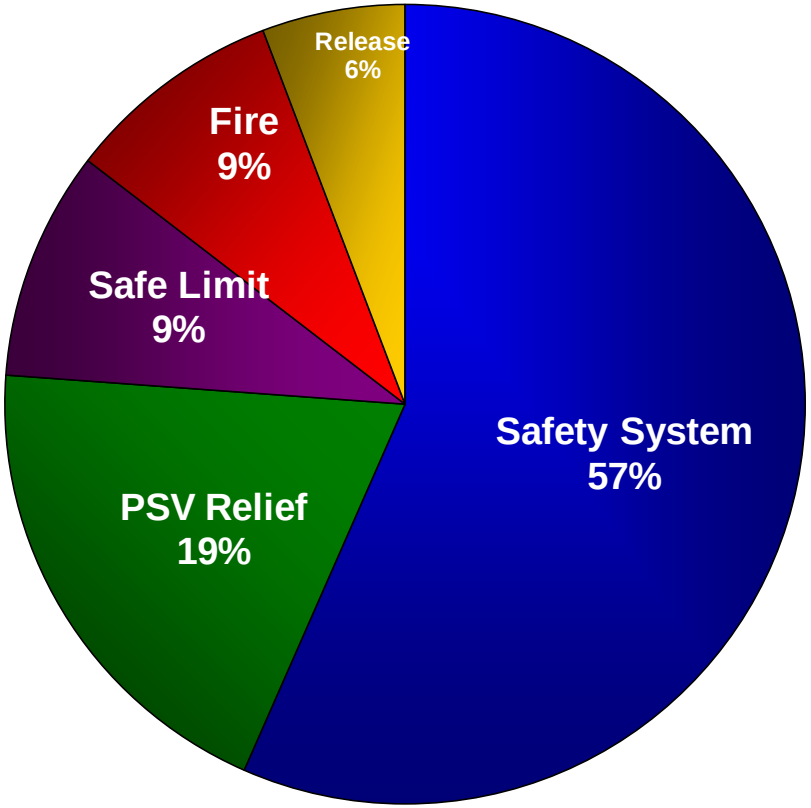


Figure 6. 2008 Acute Releases Consequences for Responding US Refinery Companies

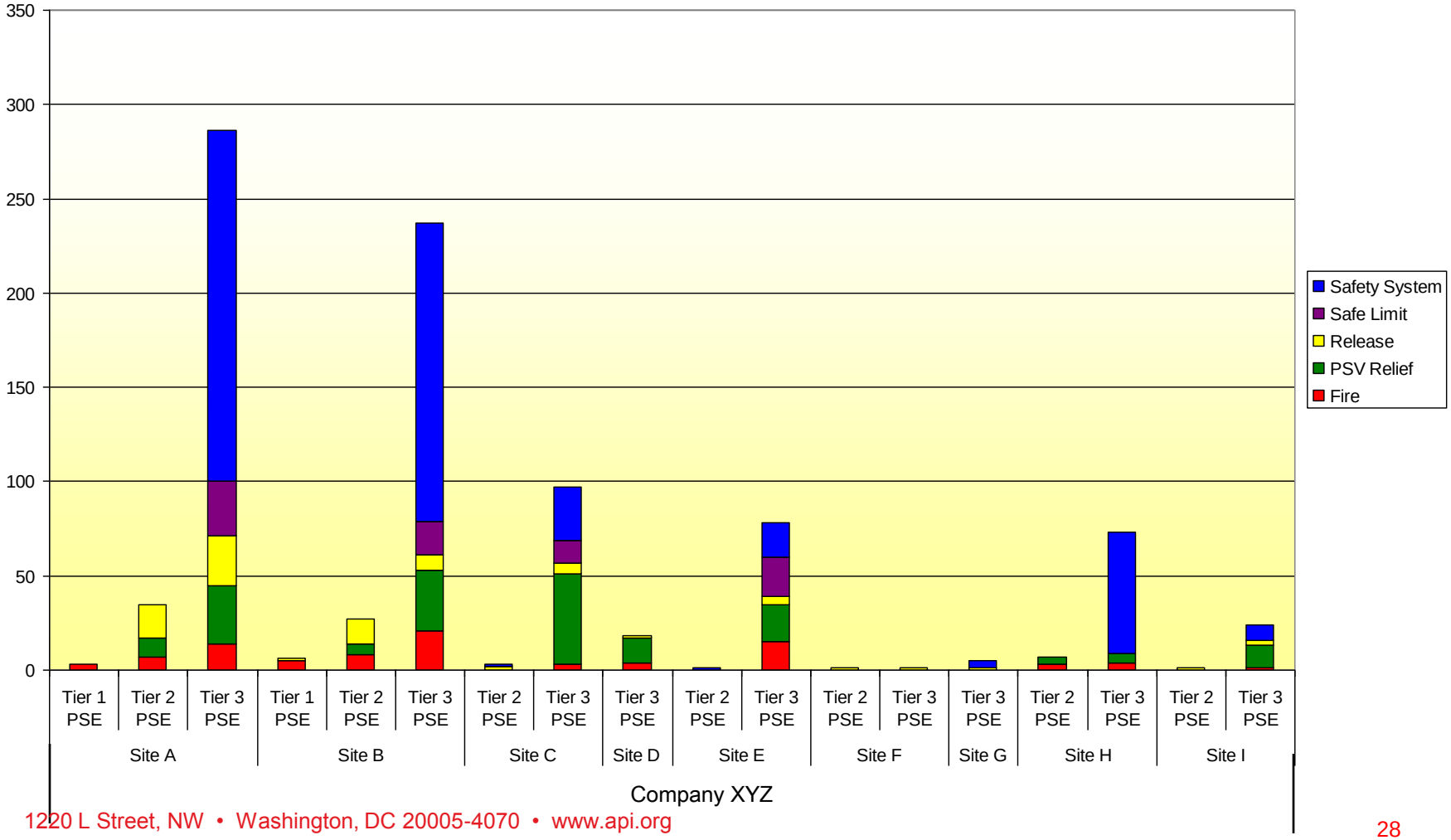
Data Analysis Examples:

Single Site



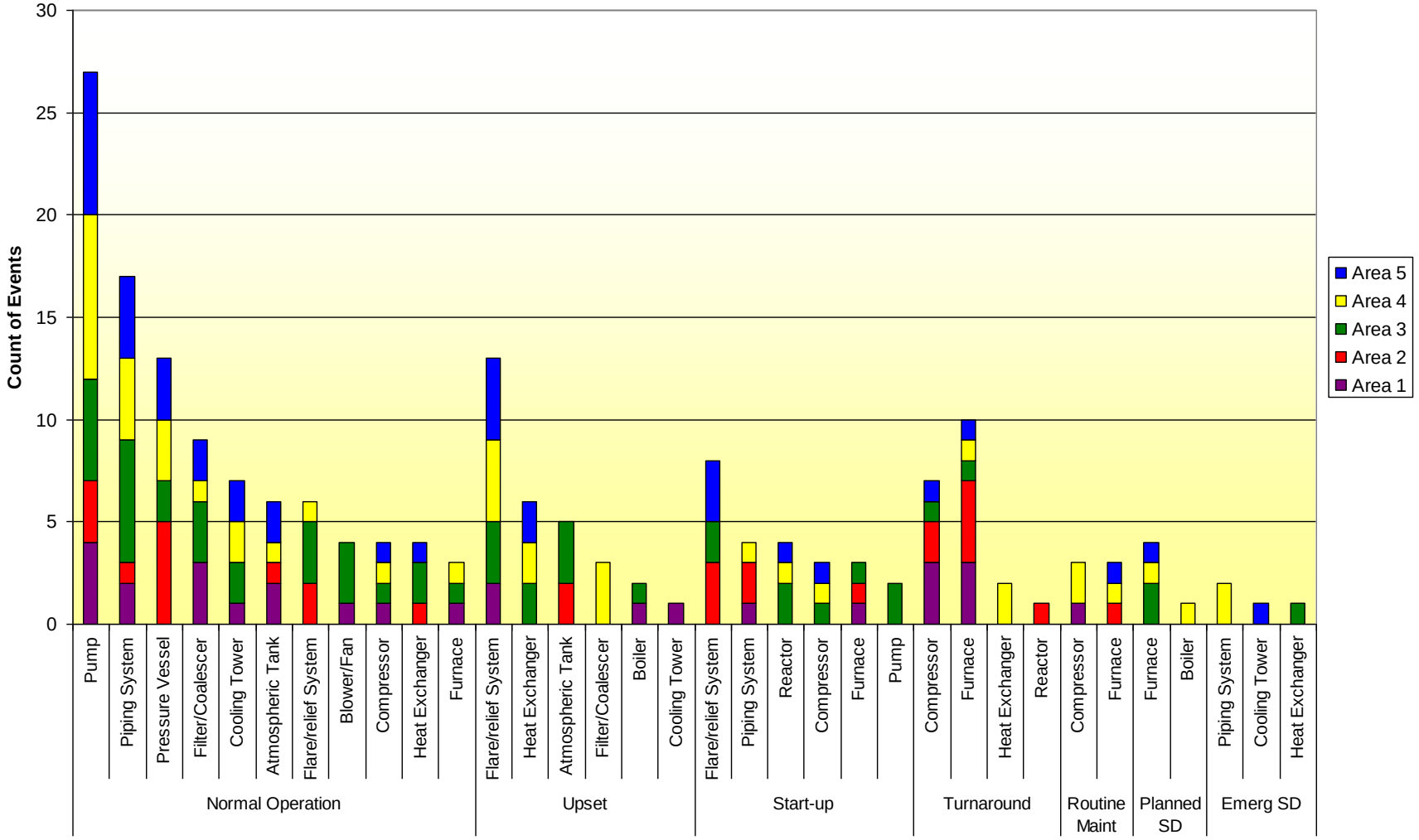
Data Analysis Examples:

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

Contact Information

Karen Haase, API Staff
API
1220 L Street, NW
Washington, DC 20005
202-682-8478
haasek@api.org

Electronic Download of RP-754

http://api.org/standards/psstandards

Questions