CANADA'S OIL & NATURAL GAS PRODUCERS

Guide

Process Safety Event (PSE) Reporting

March 2019

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The Canadian Association of Petroleum Producers (CAPP) represents companies, large and small, that explore for, develop and produce natural gas and oil throughout Canada. CAPP's member companies produce about 80 per cent of Canada's natural gas and oil. CAPP's associate members provide a wide range of services that support the upstream oil and natural gas industry. Together CAPP's members and associate members are an important part of a national industry with revenues from oil and natural gas production of about $101 billion a year. CAPP's mission, on behalf of the Canadian upstream oil and natural gas industry, is to advocate for and enable economic competitiveness and safe, environmentally and socially responsible performance.

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Overview

CAPP is actively working on improving Process Safety Management (PSM) performance in the oil and gas industry. Learning from events using consistent metrics is an important element of PSM supporting prevention and improvement activities.

This Guide provides a framework for standardized measuring, recording and reporting of process safety performance metrics for petroleum industry operations managed by members to CAPP. The purpose of this guide is to provide CAPP members with the information and instructions needed to classify and report Process Safety Events (PSEs) using the CAPP Data Hub, and for internal use.

This framework is largely leveraged from *ANSI/API RP 754 – 2016* and IOGP Report 456.

This guide covers PSE events occurring in a joint venture or in areas under a Member Company's operating control. PSEs occurring in downstream oil and natural gas, chemicals, subsidiaries or to partnerships are not included.

The CAPP Data Hub provides members access to key components of CAPP's industry-leading data store, which includes cross-jurisdictional health, safety and other data from multiple sources including government, regulators and members. The Hub also includes powerful analysis tools, enabling independent and collaborative reporting and strategic decision-making.

Contents

1 Introduction

1.1 Background

Oil and gas operations involve complex processes with hazards that have the potential for catastrophic events involving loss of life, harm to health and extensive environmental damage that needs risk management.

The management of process safety is globally recognized as the primary approach for establishing the required level of safe operations needed to manage high hazard processes.

Process Safety is the discipline of preventing an unplanned or uncontrolled Loss Of Primary Containment (LOPC) of hazardous material from a process due to an unintended event or condition that could potentially result in a major event. This also includes LOPC of non-toxic and non-flammable substances in circumstances where harm or damage could result.

A number of associations and companies have established metrics that are being adopted by companies in oil and gas, petrochemical, and chemical sectors. There is general acceptance across the oil and gas industry of recently published metrics to record Process Safety Events (PSEs). Much of the industry is already tracking this information either through their own Process Safety Management (PSM) programs and/or through various regulatory reporting requirements that give industry licence to operate.

1.2 Purpose

The purpose of this guide is to provide CAPP members with the information and instructions needed to classify and report Process Safety Events (PSEs) to CAPP and for internal use.

The information will allow companies to assess their own performance and help to identify opportunities for improvement.

1.3 Scope

This CAPP Guide covers Tier 1 and 2 PSEs in the upstream and midstream oil and natural gas industry involving an LOPC during well drilling and completion, production and pipeline operations, heavy oil production where it is inseparable from upstream, in situ, and related oil and gas transportation activities (see Section 2.2 for a more detailed description). PSEs occurring in downstream industry are outside the scope of this guide. Tier 3 and 4 PSEs are not covered.

1.4 Resources Used and Terminology

In preparing this guideline, CAPP has relied on the efforts of American Petroleum Institute (API) and International Association of Oil and Gas Producers (IOGP) as noted in Section 5 – References and Resources. In particular, *ANSI/API RP 754 – 2016* provides an overview of LOPC events and their hierarchy. Since much of the work by API focuses on the downstream and chemical refining, this document also relies on IOGP's *Process Safety – Recommended Practice on Key Performance Indicators*. IOGP's product provides an overview on this subject tailored for oil and gas producers.

A glossary of relevant terms and acronyms is included in Appendix E.

2 Applying Process Safety to Oil and Gas Operations

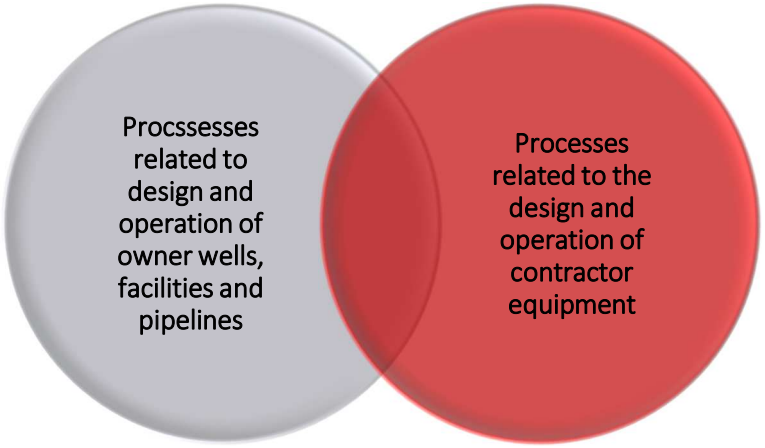
2.1 Defining Process Safety

Three definitions published by IOGP are helpful for framing the scope of process safety management in the oil and gas industry:

1) **Process Safety:** Process safety is a disciplined framework for managing the integrity of operating systems and processes handling hazardous substances. It is achieved by applying good design principles, engineering, operating, and maintenance practices. It deals with the prevention and control of events that have the potential to release hazardous materials and energy. Such events can result in toxic effects, fire or explosion, and other releases of energy that could result in serious consequences such as multiple fatalities, injuries, property damage, environmental damage, and lost production.
2) **Asset Integrity:** Asset integrity is related to the prevention of major events. It is an outcome of good design, construction and operating practice. It is achieved when facilities are structurally sound and perform the processes and produce the products for which they were designed. The emphasis is on preventing unplanned hydrocarbon releases that may, either directly or via escalation, result in a major event. Structural failures may also be initiating events that escalate into major events.
3) **Major Event:** An event that has resulted in multiple fatalities and/or serious damage, possibly beyond the asset itself. Typically initiated by a hazardous release, but may also result from structural failure or the loss of stability that has caused serious damage to an asset.

2.2 Applying Process Safety Concepts to Oil and Gas Operations

It is important to consider how process safety applies to oil and gas operations and full life-cycle development considerations for each segment of our industry. Equally important is the need to consider the operations of both the oil and gas producers and the contractors conducting related operations on their behalf.



Oil and gas industry includes the following (see Appendix D for summary):

1) **Well Operations: Drilling, Completions and Well Servicing**

Well operations includes all exploration, appraisal and production drilling, wireline, completion and workover activities as well as their administrative, engineering, construction, materials supply and transportation aspects.

- For drilling and completion operations, relevant PSEs include drilling, well workovers, wireline operations when “in hole” and there is a release of gas, oil, other drilling and well completion fluids or mud above ground or above sea-bed or onto the rig floor. This might occur during site preparation, rigging up, site restoration, etc., and loss of circulation, loss of drilling mud, well kick or underground blowout.
- For completion and well servicing operations, relevant process events include release during the completions or well servicing work on production wells under pressure (e.g., snubbing).

2) **Pipeline Design and Operation including:**

- Flow-lines between wells and pipelines between facilities associated with field production operations
- Pipeline operations (including booster stations) operated by company exploration and production business

3) **Facility Design and Operation including:**

Production for this guidance covers petroleum and natural gas production operations, including administrative and engineering aspects, repairs, maintenance and servicing, materials supply and transportation of personnel and equipment. It covers all mainstream production operations including:

- Oil (including condensates) and gas extraction and separation
- Heavy oil production where it is inseparable from upstream (e.g., steam assisted gravity drainage) production
- Oil processing (water separation, stabilization)
- Gas processing (liquids separation, compression, dehydration, sweetening, CO_2 removal)

Gas processing activities with the primary intent of producing gas liquids for sale including secondary liquid separation (e.g., gas compression, dehydration, liquids separation, sweetening, sulfur recovery, CO_2 removal, deep cut (C2/C3), and LNG).

Production storage facilities including oil, condensate, NGL, LPG, produced water, production waste streams. Also to be considered are Floating Storage Units (FSUs) and sub-sea storage units.

Processing for this guidance **excludes** mining processes associated with the extraction of heavy oil, heavy oil when separable from upstream operations, and secondary heavy oil processing such as upgrading and refining. Processing, for this guidance, also excludes large refinery facilities and offshore.

4) **Rail and Truck Transportation including:**
   - Oil & gas loading facilities, including land or marine vessels (trucks and rail) when connected to an oil or gas production process including the handling and transportation of oilfield wastes.

Useful examples of applicable PSE events are provided in *ANSI/API RP 754 – 2016*, Annex A, and in IOGP RP456.

3 PSE Reporting Criteria

Tier 1 and 2 PSEs are reportable to CAPP when they meet the criteria in Section 3.1 and 3.2 respectively. Tier 3 and 4 PSEs are not reportable to CAPP.

3.1 Overview of PSE Reporting Standards

An unplanned or uncontrolled Loss of Primary Containment (LOPC) is deemed to be a PSE when it results in one or more of the consequences in Table 3.1 below. To determine if the PSE is a Tier 1 or 2 PSE, review the severity of the harm or damage caused using Table 3.1, and review the amount of material released using Appendix B and Appendix C. The most severe result from any of these tables applies.

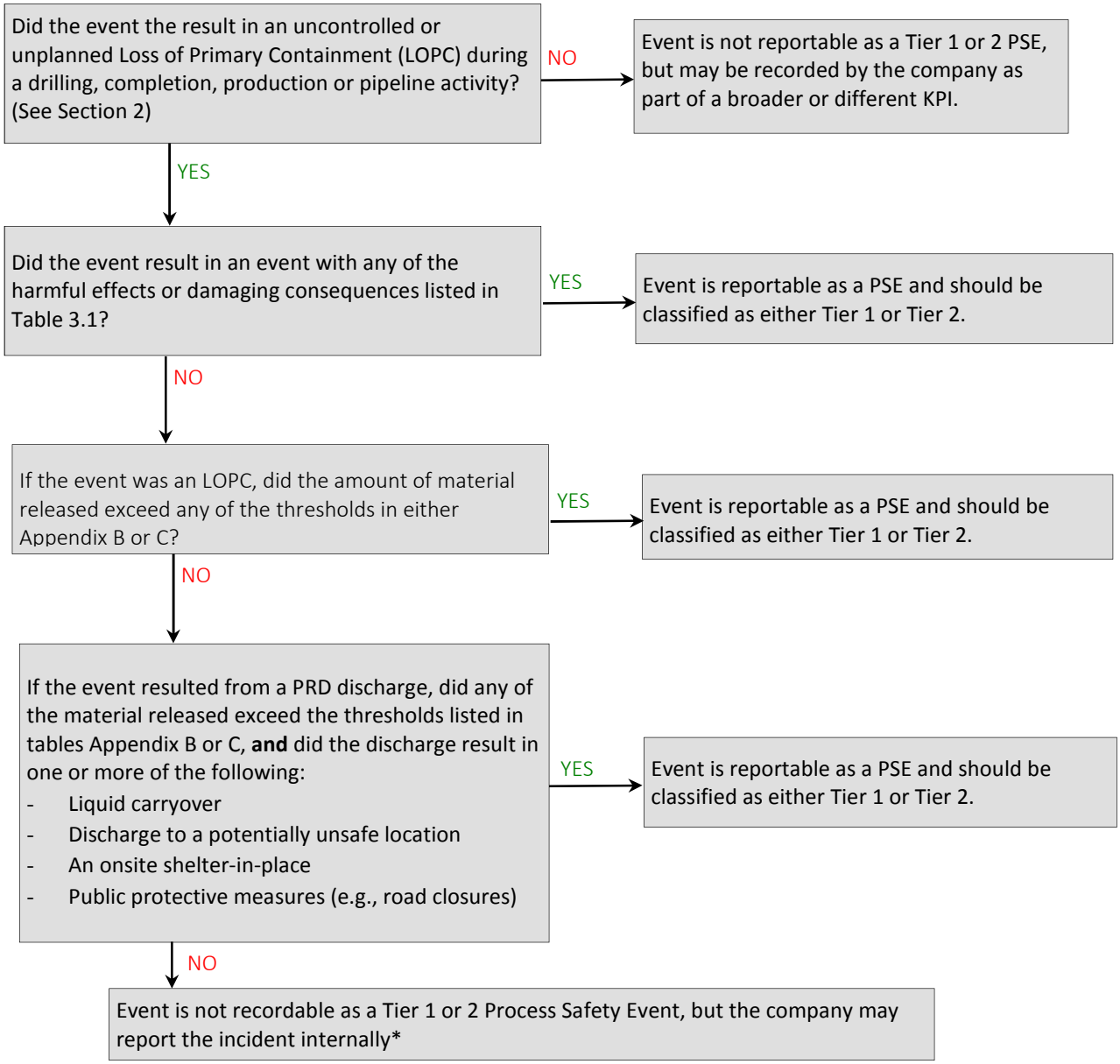
Table 3-1 Determining the PSE level by PSE's consequences

Process Safety Event Consequences	PSE Level	
	Tier 1	**Tier 2**
Injury to Employee or Contractor due to a loss of primary containment	Fatality and/or Lost Workday Case ('days away from work' or LTI)	Recordable occupational injury (restricted work case or medical treatment case)
Injury to the Public or a Third Party due to a loss of primary containment	Fatality, or injury/illness that results in a hospital admission	
Liquid release and spill due to a loss of primary containment	A release of material greater than the Tier 1 threshold quantities described in Appendix B/C in any one-hour period	A release of material greater than the Tier 2 threshold quantities described in Appendix B/C in any one-hour period
Gas release from a pressure relief device (PRD) due to a loss of primary containment	A release of material greater than the threshold quantities described in Appendix B/C in any one-hour period that ALSO resulted in any one or more of the following: • Liquid carryover • Discharge to a potentially unsafe location • An onsite shelter-in-place • Public protective measures (e.g., road closures	A release of material greater than the threshold quantities described in Appendix B/C in any one-hour period that ALSO resulted in any one or more of the following: • Liquid carryover • Discharge to a potentially unsafe location • An onsite shelter-in-place • Public protective measures (e.g., road closures

Process Safety Event Consequences	PSE Level	
	Tier 1	Tier 2
Impact to the Community due to a loss of primary containment	Officially declared community evacuation or community shelter-in-place	
Fire or explosion due to a loss of primary containment	Fire or explosion resulting in greater than or equal to $100,000 of direct cost to the Company	Fire or explosion resulting in greater than or equal to $2,500 of direct cost to the Company

3.2 PSE Reporting Decision Flowchart

The flowchart below provides a step-by-step process to determine if an event is a PSE using Table 3.1 and Appendices B and C.



*CAPP members are encouraged to track all events internally even when they are not reportable.

Figure 3-1 Determining Whether to Report a Process Safety Event

3.3 Tier 3 and Tier 4 PSEs (Leading Indicators)

While Tier 3 and 4 PSEs are not reportable to CAPP, recording them internally is valuable.

Tier 3 and 4 PSEs such as demands on safety systems, safe operating limit exceedances, pressure relief device activations, a spill/release below a Tier 2 threshold, or any other near misses that could have led to an LOPC are leading indicators and take place more frequently in industry than higher consequence Tier 1 and 2 PSEs. Leading indicators provide an opportunity to have insight into the integrity/performance of their operation. These events indicate barrier weaknesses that relate to operating discipline, management systems, and challenges to safety systems.

All aspects of process safety are important and it is strongly recommended that the oil and gas industry include Tier 3 and 4 metrics in their internal reporting. Descriptions of leading indicators are readily available in both *ANSI/API RP 754 – 2016* and *Process Safety Recommended Practice on Key Performance Indicators* at http://www.ogp.org.uk/pubs/456.pdf.

4 CAPP Process Safety Event Reporting

For CAPP's process safety event reporting, Tier 1 and Tier 2 PSEs are reportable. In addition to a total of the number of Tier 1, and the total number of Tier 2 events that occurred during the year, CAPP's reporting form asks for more detailed information about the nature and consequences of the event. Most of the additional information is recorded in the form of yes/no responses to questions, or multiple-choice responses using drop down menus. Section 4.2 provides a summary of the additional information required. Appendix D includes a listing of the categories for process safety metrics.

4.1 Accessing the Forms

Tier 1 and 2 PSE events are reported in an online data entry form through the CAPP data portal in the Data Hub section of MemberNet, CAPP's secure, members-only website. For each Tier 1 and 2 PSE, CAPP's reporting form will ask for related information. The requested information is shown below.

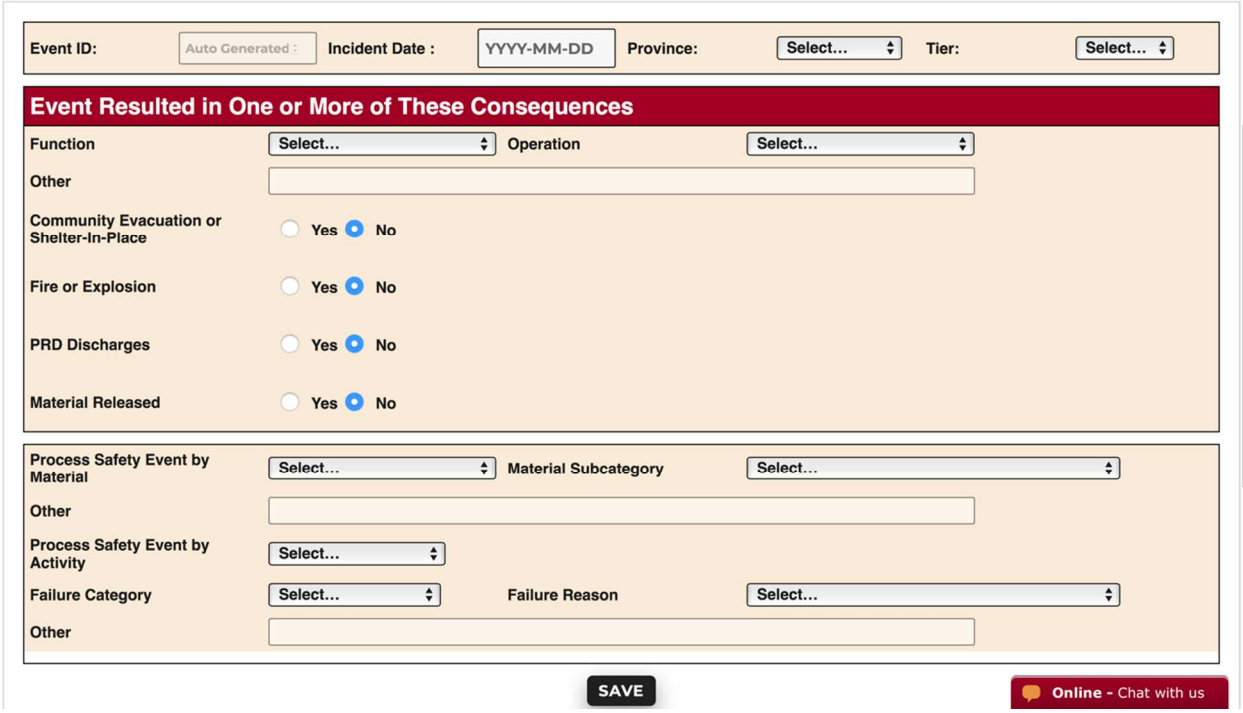


Figure 4-1 Process Safety New Event Form

4.2 Reporting Tier 1 and Tier 2 Events

When reporting, the following information will be required for each Tier 1 and Tier 2 PSE (See Figure 4.1):

- The date of the PSE.
- Location:
    - Using the drop down list, choose between Alberta, British Columbia, Manitoba, Newfoundland and Labrador offshore, Nova Scotia offshore, Northwest Territories, or Saskatchewan.
- Function:
    - Choose between Drilling and Completions, Gas Processing, Conventional Oil Processing, Non-Conventional Insitu Processing, Non-Conventional Heavy Oil Processing, Primary Production and Storage, Transportation, and Utilities and Offsites (see Appendix D).
    - Then choose the appropriate “Operation” (pick from drop down list).
    - **Note:** if you choose “Other” as one of the options in the “Operation” drop down list, you must then type something in the “Other” field located just below the “Operation” drop down list.

Note: Fill out the form for each Tier 1 or 2 PSE. If you enter two PSEs of the same tier, for the same province, and for the same day, the system will generate a popup window to confirm the entry. Click “yes” if you want to record more than one entry, with similar data. Click “no” otherwise.

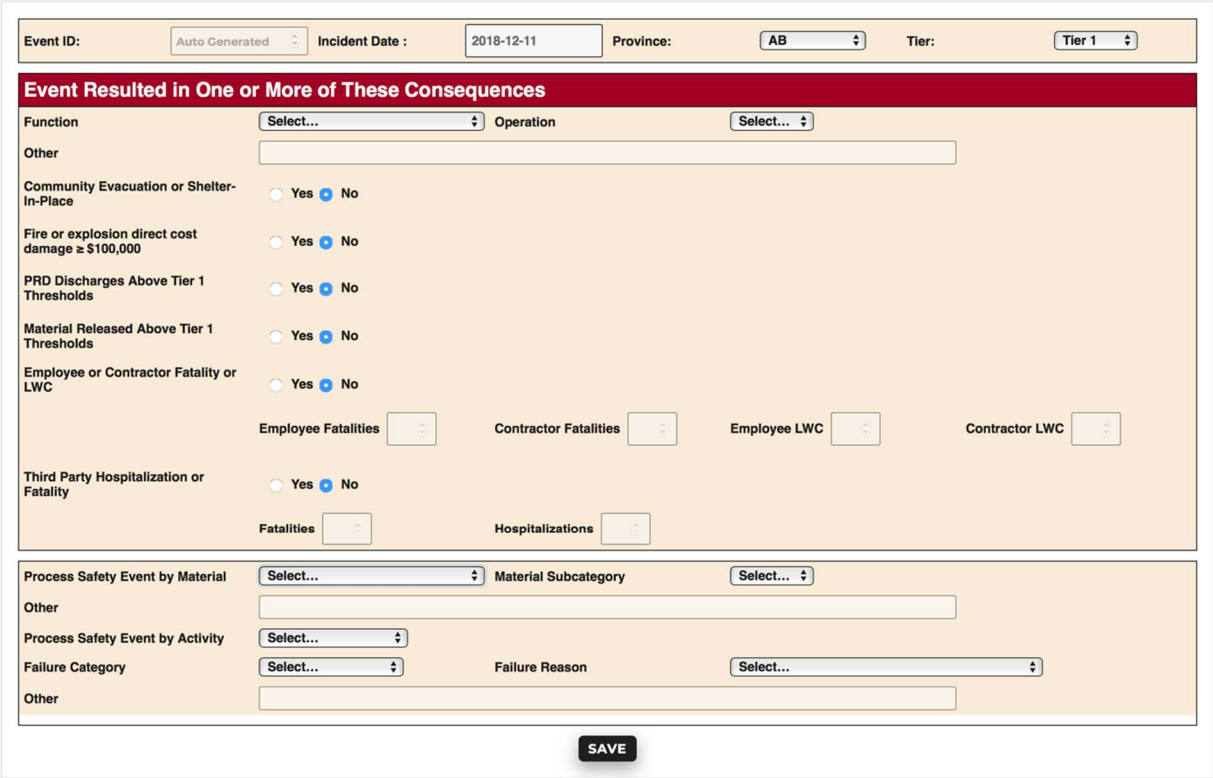


Figure 4-2 Tier 1 Form

- **If** you are reporting a **Tier 1** event (see Figure 4-2), provide yes or no response to the following questions:
    - Was a community evacuation or shelter-in-place required?
    - Did the event cause a fire or explosion resulting in $100,000 or more direct cost? (Choose yes/no)
    - Was the pressure relief device (PRD) discharge greater than Tier 1 thresholds?
    - Was the material released above Tier 1 Thresholds?
    - Was there an Employee or Contractor Fatality or LWC (provide numbers in the associated boxes)?
    - Was there any Third Party Hospitalization or Fatality? (provide numbers in the associated boxes)?

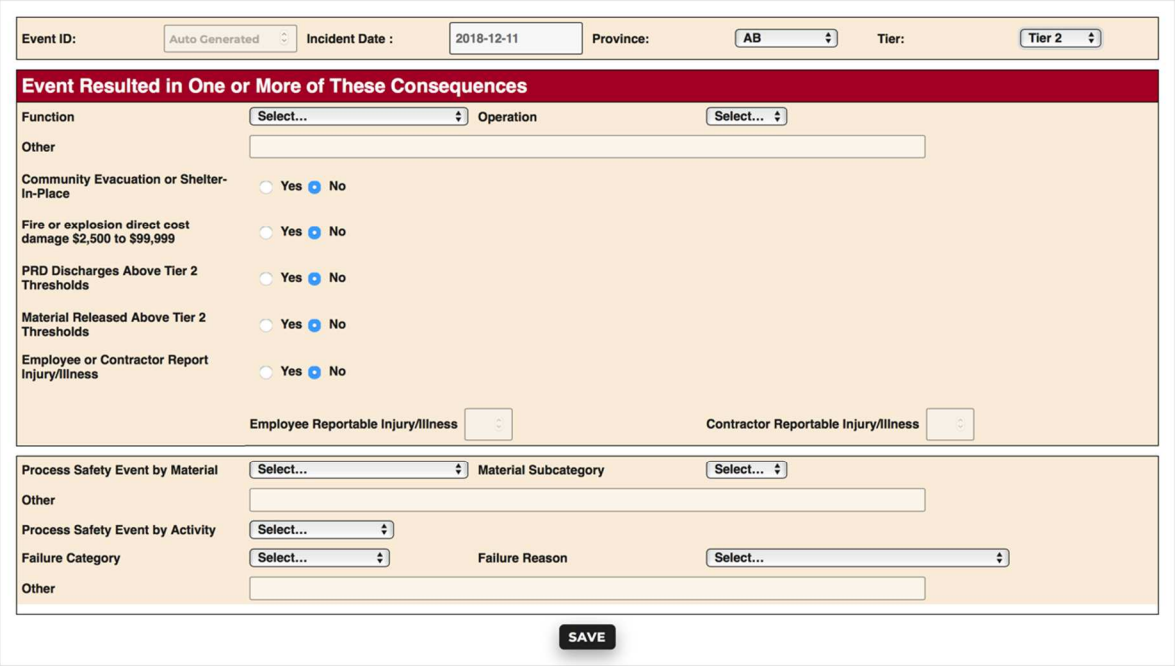


Figure 4-3 Tier 2 Form

- **If** you are reporting a **Tier 2** event (See Figure 4.3), provide yes or no response to the following questions:
    - Was a community evacuation or shelter-in-place required?
    - Did the event cause a fire or explosion resulting in $2,500 to $99,999 direct cost?
    - Were pressure relief device (PRD) discharge greater than Tier 2 thresholds?
    - Was the material Released Above Tier 2 Thresholds?
    - Was there an injury or illness to an employee or contractor (provide numbers in the associated boxes)?
- For **both** Tier 1 and Tier 2 events provide the following information:
    - Choose from the drop down list the type of material released (toxic, flammable and combustible, Acid and Base, or a Release Associated with Injury or Fatality). Also select the appropriate Material Subcategory from the dropdown list.
    - The type of activity (start-up, normal operations, shutdown or other).
    - The Failure Category (Equipment Failure, Human Error, Procedural, or External). Also select the appropriate Failure Reason from the dropdown list.

4.3 Data Analysis and Results Reporting

Process safety key performance indicators are new for CAPP's MemberNet secure, members-only website. These indicators will help members measure the strength of their process safety management systems and controls for preventing major incidents.

- Under the MemberNet PSE reporting program, members will collect and report their industry performance on the number of Tier 1 and Tier 2 process safety events and their consequence characteristics.
- With the use of international standards, CAPP member performance can be compared internationally.

5 References and Resources

The present CAPP Guide is aligned to the reporting standards and requirements in the following documents:

ANSI/API RP 754 – 2016. ANSI/API Recommended Practice 754: Process Safety Performance Indicators for the Refining and Petrochemical Industries. Second Edition, April 2016.

IOGP, Report No. 456. *Process Safety Recommended Practice on Key Performance Indicators*, November 2011 (Appendix B updated January 2017). Available from IOGP at: https://www.iogp.org/bookstore/product/process-safety-recommended-practice-on-key-performance-indicators/

IOGP, 2011. *Upstream PSE examples – Supplement to report 456*, November 2011. Available from IOGP at: https://www.iogp.org/bookstore/product/upstream-pse-examples-supplement-to-report-456/.

Appendix A. Defining Tier 1 & Tier 2 Process Safety Events

A.1. Defining Tier 1 & Tier 2 Process Safety Events

Tier 1 Process Safety Event

A Tier 1 process safety event is an incident with severe consequences. The following definition of a Tier 1 event comes from *ANSI/API RP 754 – 2016*. Any event that occurred during drilling, production, and processing activities and meets the definition below is recordable as a Tier 1 event.

Tier 1 Definition

A Tier 1 Process Safety Event (PSE) is a loss of primary containment (LOPC) with the greatest consequence. A Tier 1 PSE is an unplanned or uncontrolled release of any material, including non-toxic and non-flammable materials (e.g. steam, hot condensate, nitrogen, compressed CO2 or compressed air), from a process that results in one or more of the consequences listed below:

- An employee, contractor or subcontractor 'days away from work' injury and/or fatality
- A hospital admission and/or fatality of a third-party
- An officially declared community evacuation or community shelter-in-place
- A fire or explosion resulting in greater than or equal to $100,000 of direct cost to the company
- A pressure relief device (PRD) discharge to atmosphere whether directly or via a downstream destructive device that results in one or more of the following four consequences:
    - liquid carryover
    - discharge to a potentially unsafe location
    - an onsite shelter-in-place
    - public protective measures (e.g., road closure)

  AND a PRD discharge quantity greater than the threshold quantities in Appendix B and Appendix C in any one-hour period
- A release of material greater than the threshold quantities described in Appendix B and Appendix C in any one-hour period

Tier 2 Process Safety Event

A Tier 2 process safety event is an incident with consequences that are significant but about an order of magnitude less severe than the consequences of a Tier 1 event. The following definition of a Tier 2 event comes from *ANSI/API RP 754 – 2016*. Any event that occurred during drilling, production, and processing activities and meets the definition below is recordable as a Tier 2 event.

Tier 2 Definition

A Tier 2 Process Safety Event (PSE) is an LOPC with lesser consequence. A Tier 2 PSE is an unplanned or uncontrolled release of any material, including non-toxic and non-flammable materials (e.g. steam, hot condensate, nitrogen, compressed CO2 or compressed air), from a process that results in one or more of the consequences listed below and is not reported in Tier 1:

- An employee, contractor or subcontractor recordable injury
- A fire or explosion resulting in greater than or equal to $2,500 of direct cost to the company
- A pressure relief device (PRD) discharge to atmosphere whether directly or via a downstream destructive device that results in one or more of the following four consequences:
    - liquid carryover
    - discharge to a potentially unsafe location
    - an onsite shelter-in-place
    - public protective measures (e.g., road closure)

  AND a PRD discharge quantity greater than the threshold quantities in Appendix B and Appendix C in any one-hour period
- A release of material greater than the threshold quantities described in Appendix B and Appendix C in any one-hour period

Material Release Thresholds

If an LOPC release of a gas or liquid exceeds the material release threshold quantities listed on the tables below in any one-hour period, the event is reportable as a PSE.

If the LOPC release exceeds the amount listed in the Tier 1 column of the table, the event is recordable as a Tier 1 PSE. If the LOPC release exceeds the amount listed in the Tier 2 column, the event is recordable as a Tier 2 PSE. When a PSE results in multiple thresholds exceeded, the PSE should be recorded at the highest Tier applicable to any one of the exceeded thresholds.

PRD discharges have identical material release thresholds as LOPCs when determining their tier, but they have additional requirements to determine whether they are recordable as PSEs (see Appendices B and C).

Important note: The release threshold applies only to acute releases. Acute releases are LOPCs which exceed the reporting threshold for a Tier 1 or Tier 2 PSE within any period of one hour during the event. LOPCs which occur over a prolonged period (such as fugitive emissions) and are unlikely to constitute a major event risk of a fire, explosion or toxic release are not reportable.

Pressure relief device (PRD) discharges to atmosphere

A PRD discharge event is reportable as a PSE if it caused serious harm or damage (Section 4.2), or exceeded the material release threshold quantities listed in Appendix B and Appendix C, **and** resulted in any of the following:

- **liquid carryover**
- **discharge to a potentially hazardous location**
- **on-site shelter in place**
- **public protective measures**

The Tier level of a PRD is determined by exactly the same threshold limits as an LOPC.

Appendix B. Non-toxic Material Release Threshold Quantities

B.1. Non-toxic Material Release Threshold Quantities

An LOPC is reportable as a PSE only when release is "acute" i.e. exceeds a threshold quantity in any one-hour period. PSE Tier is highest of all that apply.

Material hazard classification (with example materials)	Tier 1 (Categories below refer to API/ANSI Standard 754)		Tier 2 (Categories below refer API/ANSI Standard 754)	
	Outdoor Release	Indoor Release	Outdoor Release	Indoor Release
Flammable Gases – e.g. • methane, ethane, propane, butane • natural gas • ethyl mercaptan	≥ 500 kg (1,100 lb) (Cat.T1-5)	≥ 50 kg (110 lb) (Cat.T1-5)	≥ 50 kg (110 lb) (Cat.T2-5)	≥ 25 kg (55 lb) (Cat.T2-5)
Flammable Liquids with Boiling Point ≤ 35°C (95°F) and Flash Point < 23°C (73°F) – e.g. • liquefied petroleum gas (LPG) • liquefied natural gas (LNG) • isopentane	≥ 500 kg (1,100 lb) (Cat.T1-5)	≥ 50 kg (110 lb) (Cat.T1-5)	≥ 50 kg (110 lb) (Cat.T2-5)	≥ 25 kg (55 lb) (Cat.T2-5)
Flammable Liquids with Boiling Point > 35°C (95°F) and Flash Point < 23°C (73°F) – e.g. • gasoline/petrol, toluene, xylene • condensate • methanol • > 15 API Gravity crude oils (unless actual flashpoint available)	≥ 1,000 kg (2,200 lb) *or* ≥ 7 bbl (Cat.T1-6)	≥ 100 kg (220 lb) *or* ≥ 0.7 bbl (Cat.T1-6)	≥ 100 kg (220 lb) *or* ≥ 0.7 bbl (Cat.T2-6)	≥ 50 kg (110 lb) *or* ≥ 0.35 bbl (Cat.T2-6)
Combustible Liquids with Flash Point ≥ 23°C (73°F) and ≤ 60°C (140°F) – e.g. • diesel, most kerosenes, • < 15 API Gravity crude oils (unless actual flashpoint available)	≥ 2,000 kg (4,400 lb) *or* ≥ 14 bbl (Cat.T1-7)	≥ 200 kg (440 lb) *or* ≥ 1.4 bbl (Cat.T1-7)	≥ 200 kg (440 lb) *or* ≥ 1.4 bbl (Cat.T2-7)	≥ 100 kg (220 lb) *or* ≥ 0.7 bbl (Cat.T2-7)
Liquids with Flash Point > 60°C (140°F) released at a temperature at or above its flash point – e.g. • asphalts, molten sulphur • ethylene glycol, propylene glycol • lubricating oil	≥ 2,000 kg (4,400 lb) *or* ≥ 14 bbl (Cat.T1-7)	≥ 200 kg (440 lb) *or* ≥ 1.4 bbl (Cat.T1-7)	≥ 200 kg (440 lb) *or* ≥ 1.4 bbl (Cat.T2-7)	≥ 100 kg (220 lb) *or* ≥ 0.7 bbl (Cat.T2-7)
Liquids with Flash Point > 60°C (140°F) released at a temperature below its flash point – e.g. • asphalts, molten sulphur • ethylene glycol, propylene glycol • lubricating oil	Not applicable	Not applicable	≥ 1,000 kg (2,200 lb) *or* ≥ 7 bbl (Cat.T2-8)	≥ 500 kg (1,100 lb) *or* ≥ 3.5 bbl (Cat.T2-8)

Appendix C. Toxic Material Release Threshold Quantities

C.1. Toxic Material Release Threshold Quantities

Material hazard classification (with example materials)	Tier 1 (Categories below refer to API/ANSI Standard 754)		Tier 2 (Categories below refer API/ANSI Standard 754)	
	Outdoor Release	Indoor Release	Outdoor Release	Indoor Release
TIH Hazard Zone A materials: • acrolein (stabilized) • bromine	≥ 5 kg (11 lb) (Cat.T1-1)	≥ 0.5 kg (1.1 lb) (Cat.T1-1)	≥ 0.5 kg (1.1 lb) (Cat.T2-1)	≥ 0.25 kg (0.5 lb) (Cat.T2-1)
TIH Hazard Zone B materials : • hydrogen sulphide (H2S), • chlorine (Cl2)	≥ 25 kg (55 lb) (Cat.T1-2)	≥ 2.5 kg (5.5 lb) (Cat.T1-22)	≥ 2.5 kg (5.5 lb) (Cat.T2-2)	≥ 1.3 kg (2.8 lb) (Cat.T2-2)
TIH Hazard Zone C materials: • sulphur dioxide (SO_2) • hydrogen chloride (HCl)	≥ 100 kg (220 lb) (Cat.T1-3)	≥ 10 kg (22 lb) (Cat.T1-3)	≥ 20 kg (44 lb) (Cat.T2-3)	≥ 5 kg (11 lb) (Cat.T2-3)
TIH Hazard Zone D materials: • ammonia (NH_3) • carbon monoxide (CO)	≥ 200 kg (440 lb) (Cat.T1-4)	≥ 20 kg (44 lb) (Cat.T1-4)	≥ 20 kg (44 lb) (Cat.T2-4)	≥ 10 kg (22 lb) (Cat.T2-4)
Other Packing Group I Materials: • aluminum alkyls • some liquid amines • sodium cyanide • sodium peroxide • hydrofluoric acid (>60% solution)	≥ 500 kg (1,100 lb) (Cat.T1-5)	≥ 50 kg (110 lb) (Cat.T1-5)	≥ 50 kg (110 lb) (Cat.T2-5)	≥ 25 kg (55 lb) (Cat.T2-5)

Material hazard classification (with example materials)	Tier 1 (Categories below refer to IOGP RP457)	Tier 2 (Categories below refer to IOGP RP457)	Material hazard classification (with example materials)	Tier 1 (Categories below refer to IOGP RP457)
	Outdoor Release	Indoor Release	Outdoor Release	Indoor Release
Other Packing Group II Materials : • aluminum chloride • phenol • calcium carbide • carbon tetrachloride • some organic peroxides • hydrofluoric acid (<60% solution)	≥ 1,000 kg (2,200 lb) *or* 7 bbl (Cat.T1-6)	≥ 100 kg (220 lb) *or* 0.7 bbl (Cat.T1-6)	≥ 100 kg (220 lb) *or* 0.7 bbl (Cat.T2-6)	≥50 kg (110 lb) *or* 0.35 bbl (Cat.T2-6)
Other Packing Group Ill materials: • sulphur • lean amine • calcium oxide • activated carbon • chloroform • some organic peroxides • sodium fluoride • sodium nitrate	≥2,000 kg (4,400 lb) *or* 14 bbl (Cat.T1-7)	≥200 kg (440 lb) *or* 1.4 bbl (Cat.T1-7)	≥200 kg (440 lb) *or* 1.4 bbl (Cat.T2-7)	≥100 kg (220 lb) *or* 0.7 bbl (Cat.T2-7)
Strong Acids or Bases — includes: • suplhuric acid, hydrochloric acid • sodium hydroxide (caustic) • calcium hydroxide (lime)	≥2,000 kg (4,400 lb) *or* 14 bbl (Cat.T1-7)	≥200 kg (440 lb) *or* 1.4 bbl (Cat.T1-7)	≥200 kg (440 lb) *or* 1.4 bbl (Cat.T2-7)	≥100 kg (220 lb) *or* 0.7 bbl (Cat.T2-7)
Moderate Acids or Bases — includes: • diethylamine (corrosion inhibitor)	None	None	≥1,000 kg (2,200 lb) *or* 7 bbl (Cat.T2-8)	≥500 kg (1,100 lb) *or* 3.5 bbl (Cat.T2-8)

This table is taken from IOGP 456 Appendix B.

Appendix D. Categories for Process Safety Metrics

Asset / Activity Classification		
Category 1	**Subcategory 1**	**Reference**
Drilling and Completions	Conventional Hydraulic Fracturing In-Situ Other	OGP
Gas Processing	Gas Compression Dehydration Liquids Separation Sweetening Sulfur Recovery CO2 removal Deep Cut (C2/C3) LNG Other	API / OGP
Conventional Oil Processing	Water Separation Stabilization Vapour Recovery Upgrading Other	API
Non-Conventional Insitu Processing	Insitu – Water/Solvent recovery Insitu – Oil Production Other	
Non-Conventional Heavy Oil Processing	Coking Froth Treatment Sweetening Hydrotreating / Hydrocracking Hydrogen Production Sulfur Recovery Vapor Recovery Other	

Asset / Activity Classification		
Category 1	**Subcategory 1**	**Reference**
Primary Production and Storage	Well Integrity Caverns Injection Other	OGP
Transportation	Pump Stations Compressor Stations Loading / Unloading Facilities Truck Tanker – only when connected to the process Rail Tanker – only when connected to the process Pipelines, Primary Pipeline, Gathering Other	OGP / API
Utilities and Offsites	Tank Farm Plant Utility / Steam Plant / Co-generation Wastewater Flare Other	OGP / API

*Other = is an open field for a description of the process

Hazardous Material Classification		
Category 2	**Subcategory 2**	**note**
Toxic	Acrolein Bromine H2S Cl2 SO2 NH3 CO Aluminum alkyls Liquid Amine Sodium Cyanide Sodium Peroxide Aluminum Chloride Phenol Calcium Carbide Carbon Tetrachloride Organic Peroxide Nitrogen Other	The data base needs to be robust enough that commodities can be added if needed and deleted if not used.
Flammable and Combustible	Natural Gas Ethyl Mercaptan LPG Isopentane Gasoline Condensate Methanol >15 API crude oil Diesel < 15 API crude oil Glycols Lube oil Other	The data base needs to be robust enough that commodities can be added if needed and deleted if not used.
Acid and Base	HCl HF H2SO4 NaOH Other	
Releases associated with injury or fatality (if not captured above)	Steam Air Water Other	

Appendix E. Glossary and Acronyms

E.1. Glossary

The following terms and acronyms are referenced in this reporting guide:

Asset Integrity

Asset integrity is related to the prevention of major events. It is an outcome of good design, construction and operating practice. It is achieved when facilities are structurally sound and perform the processes and produce the products for which they were designed. The emphasis is on preventing unplanned hydrocarbon releases that may, either directly or via escalation, result in a major event. Structural failures may also be initiating events that escalate into major events.

Caverns

Underground salt caverns are used for the storage of natural gas, hydrocarbons or for the disposal of oil processing waste.

CO_2 Removal

Amine treating, membrane systems or other technology used to remove CO_2 typically to meet pipeline quality specifications. CO_2 in gas tends to reduce

Construction

Major construction, fabrication activities and also disassembly, removal and disposal (decommissioning) at the end of the facility life. Includes construction of process plant, yard construction of structures, offshore installation, hook-up and commissioning, and removal of redundant process facilities.

Contractor

An individual or organization performing work for the reporting company, following verbal or written agreement. 'Sub-contractor' is synonymous with 'Contractor'.

Contractor Employee

Any person employed by a Contractor or Contractor's Sub-Contractor(s) who is directly involved in execution of prescribed work under a contract with the reporting company.

Conventional

A reservoir in which buoyant forces keep hydrocarbons in place below a sealing caprock. Reservoir and fluid characteristics of conventional reservoirs typically permit oil or natural gas to flow readily into wellbores. The term is used to make a distinction from shale and other unconventional reservoirs, in which gas might be distributed throughout the reservoir at the basin scale, and in which buoyant forces or the influence of a water column on the location of hydrocarbons within the reservoir are not significant (Ref 1).

Dehydration

Dehydration is part of gas conditioning to remove water vapour from gas streams to prevent the formation of hydrates and corrosion in pipelines. Various processes

accomplish dehydration including hydrate suppression with a chemical, absorption with glycol, absorption with a deliquescent salt, adsorption with dry desiccant, or refrigeration.

Destructive Device

A flare, scrubber, incinerator, quench drum, or other similar device used to mitigate the potential consequences of a PRD release.

Direct Cost

Cost of repairs or replacement, cleanup, material disposal, environmental remediation and emergency response.

Direct cost does not include indirect costs, such as business opportunity, business interruption and feedstock/ product losses, loss of profits due to equipment outages, costs of obtaining or operating temporary facilities, or costs of obtaining replacement products to meet customer demand. Direct cost does not include the cost of the failed component leading to LOPC, if the component is not further damaged by the fire or explosion.

Distillation

Separation of natural gas stream into their base components using fractionation. This works based on the different boiling points of the different hydrocarbons in the NGL stream, e.g. deethanizer, depropanizer, debutanizer, etc.

Drilling & Completions

Drilling is the process of boring into the earth for the purpose of extracting oil or natural gas. The drilling process includes the placement of casing in the borehole. Completion is the process of making a well ready for production. This involves preparing the bottom of the hole to the required specifications, running-in the production tubing and its' associated down hole tools, perforating and stimulating

as required, and running-in and cementing the casing. Drilling and completions operations include water wells, boreholes, auger rigs, and coring operations (Ref 2).

Escalation

The process by which an initial – sometimes small – event triggers a further – sometimes larger event that may be classified as a near miss or an event

Event

An unplanned or uncontrolled outcome of a business operation or activity that has or could have contributed to an injury, illness or physical damage or environmental damage.

Exploration

Geophysical, seismographic and geological operations, including their administrative and engineering aspects, construction, maintenance, materials supply, and transportation of personnel and equipment; excludes drilling.

Explosion

A release of energy resulting from an LOPC that causes a pressure discontinuity or blast wave (e.g., detonations, deflagrations, and rapid releases of high pressure caused by rupture of equipment or piping).

Fire

Is any combustion resulting from an LOPC - regardless of the presence of flame. This includes smouldering, charring, smoking, singeing, scorching, carbonizing, or the evidence that any of these have occurred.

First Aid

A consequence of an event that required medical attention, often consisting of one-time, short-term treatment and requiring little technology or training to administer. First aid can include cleaning minor cuts, scrapes, or scratches; treating a minor burn; applying bandages and dressings; the use of non-prescription medicine; draining blisters; removing debris from the eyes; massage; and drinking fluids to relieve heat stress. A full list of 14 first aid treatments is provided by OGP in Reference 18. First aid cases are not classified as recordable events for the purpose of reporting to OGP but may be used by companies as a criterion for reporting of events as Tier 3 KPIs.

Gas Compression

Gas compression is used to increase the pressure of the gas (Ref 3).

Gas Processing

Raw gas from the reservoir goes through primary processing to purify raw natural gas by removal of contaminates such as water, carbon dioxide (CO2) and hydrogen sulphide (H2S) in order to produce pipeline quality natural gas.

Gas to Liquids (GTL)

A process that combines the carbon and hydrogen elements in natural gas molecules to make synthetic liquid petroleum products, such as diesel fuels, naphtha and lubricants (Ref. 4 modified).

Hospital Admission

Formal acceptance by a hospital or other inpatient health care facility of a patient who is to be provided with room, board, and medical service in an area of the hospital or facility where patients generally reside at least overnight.

Treatment in the hospital emergency room or an overnight stay in the emergency room would not by itself qualify as a ‘hospital admission’.

Hydraulic Fracturing

A stimulation treatment routinely performed on oil and gas wells in low-permeability reservoirs. Specially engineered fluids are pumped at high pressure and rate into the reservoir interval to be treated, causing a vertical fracture to open. The wings of the fracture extend away from the wellbore in opposing directions according to the natural stresses within the formation. Proppant, such as grains of sand of a particular size, is mixed with the treatment fluid to keep the fracture open when the treatment is complete. Hydraulic fracturing creates high-conductivity communication with a large area of formation and bypasses any damage that may exist in the near-wellbore area. (Ref. 1)

Incident

An event or chain of events that has resulted in recordable injury, illness or physical damage or environmental damage.

Injection

An unconventional oil extraction technique used to enhance oil recovery. These include water flood and polymer flood techniques.

Common approaches include water flood, polymer flood, steam (CSS/SAGD). Other non-proven approaches include solvent toe to heel air injection (THAI) and VAPEX.

In-situ

Directional drill technology is used to install a well or multiple wells to recover heavy oil from deep oil sand formations in place without mining. Proven technology to support in-situ oil sands recovery includes Steam Assisted Gravity Drainage (SAGD) and Cyclic Steam Stimulation (CSS). There are other technologies not in wide use including Toe to Heel Air Injection (THAI), Reservoir Adjusted Solvent Dewpoint (RASD-Vapex), and other unproven processes.

Key Performance Indicator (KPI)

Information or data that provides evidence of a company's performance in managing its key risks, which in this guide are those risks related to asset integrity and process safety. KPIs may also be referred to as performance metrics.

Liquids Separation

Knockout of liquids from a rich/wet gas stream simply by a drop of pressure as gas enters the separator.

Lost Work Day Case (LWDC)

Any occupational injury or illness, other than a fatal injury, which results in a person being unfit for work on any day after the day of occurrence of the occupational injury. 'Any day' includes rest days, weekend days, leave days, public holidays or days after ceasing employment. A LWDC is a recordable event.

Loss of Primary Containment (LOPC)

An unplanned or uncontrolled release of any material from primary containment, including non-toxic and non-flammable materials (e.g., steam, hot condensate, nitrogen, compressed CO_2 operations, any unplanned or uncontrolled release to the surface (seabed or ground level) should be included. LOPC is a type of event. An unplanned or uncontrolled release is an LOPC irrespective of whether the material is released into the environment, or into secondary containment, or into other primary containment not intended to contain the material released under normal operating conditions).

Major Event

An event that has resulted in multiple fatalities and/ or serious damage, possibly beyond the asset itself. Typically, a major event is initiated by an LOPC event, but may also result from major structural failure or loss of stability that has caused serious damage to an asset.

Material Release Threshold Quantity

The weight of gas, liquid, or solid material released from an LOPC which, if exceeded, results in the event being recordable as either a Tier 1 or Tier 2 PSE. The threshold quantities are described more fully in API/ ANSI standard RP 754 and follow the UNDG classification system.

Mitigation

A barrier which limits consequences, generally by limiting escalation, but which does not prevent the initial event.

Near Miss

An event or chain of events that has not resulted in a recordable injury, illness or physical damage or environmental damage but had the potential to do so in other circumstances.

Offsites

Supporting facilities which are not primary production and process or utility, e.g. tankage and storage (atmospheric, pressurized and refrigerated), flare, loading/unloading facilities, firewater pump house and such.

Number of Employees

Average number of full-time and part-time employees involved in exploration and production, calculated on a full-time basis, during the reporting year.

Number of Fatalities

The total number of Company's employees and/or Con- tractor's employees who died as a result of an event. 'Delayed' deaths that occur after the event are to be included if the deaths were a direct result of the event. For example, if a fire killed one person outright, and a second died three weeks later from lung damage caused by the fire, both are reported.

Occupational Injury

Any injury such as a cut, fracture, sprain, amputation, etc. which results from a work-related activity or from an exposure involving a single event in the work environment, such as deafness from explosion, one-time chemical exposure, back disorder from a slip/trip, insect or snake bite.\

Officially Declared

A declaration by a recognized community official (e.g., fire, police, civil defence, emergency management) or delegate (e.g., Company official) authorized to order the community action (e.g., shelter-in-place, evacuation).

Pressure Relief Device (PRD)

A device designed to open and relieve excess pressure (e.g., safety valve, thermal relief, rupture disk, rupture pin, deflagration vent, pressure/vacuum vents).

Primary Containment

A tank, vessel, pipe, truck, rail car, or other equipment designed to keep a material within it, typically for purposes of storage, separation, processing or transfer of gases or liquids. The terms vessel and pipe are taken to include containment of reservoir fluids within the casing and wellhead valving to the surface. Note that primary containment for a specified material may comprise a vessel or pipe that is inside another vessel that is also designed as primary containment for a different material; for example, a heating tube is primary containment for fuel gas or fuel oil, even though the tubes may be inside a firebox which is in turn within an oil-water separator.

Process

Facilities used in drilling and production operations in the oil & gas industry. This includes rigs and process equipment (e.g., vessels, piping, valves, boilers, generators, pumps, compressors, exchangers, refrigeration systems) and includes storage tanks, ancillary support areas (e.g., boiler houses and waste water treatment plants), on-site remediation facilities, and distribution piping under control of the Company.

Process safety

Process safety is a disciplined framework for managing the integrity of operating systems and processes handling hazardous substances by applying good design principles, engineering, and operating and maintenance practices. It deals with the prevention and control of events with the potential to release hazardous materials and energy. Such releases can result in toxic effects, fire, explosion, and could ultimately result in serious events including fatalities, injuries, property damage, lost production and environmental damage.

Process Safety Event (PSE)

A Loss of Primary Containment (LOPC) from a process that meets the Tier 1 or Tier 2 definitions in this guide. A PSE is a Key Performance Indicator (KPI) and is reportable. For the purpose of reporting a PSE:

Drilling facilities are considered to be part of a process when operations are 'in-hole'.

Land or marine vessels (trucks and ships) are considered to be part of a process when physically connected to a production facility.

Production

Production covers petroleum and natural gas production operations, including administrative and engineering aspects, repairs, maintenance and servicing, materials supply and transportation of personnel and equipment. Refer to the discussion on page 2-3 for additional details.

Recordable/Reportable

A recordable event is a type of event or event, including an LOPC or an occupational injury or illness, or other outcome which has been determined to meet or exceed definitions, criteria or thresholds for inclusion and classification in data provided to OGP (or other agencies or stakeholders). The broader term 'reportable' is used in this guide to indicate then key performance indicator data collected by CAPP.

Secondary Containment

An impermeable physical barrier specifically designed to prevent release of materials into the environment that have already breached primary containment (i.e., an LOPC). Secondary containment systems include, but are not limited to: tank dykes, curbing around process equipment, drainage collection systems into segregated oily drain systems, the outer wall of double walled tanks, etc.

Secondary Liquids Separation

Separation of gas into light end components (propane, butane and such) for sales using processes like turbo expansion, absorption towers and similar.

Stabilization

Reduce vapour pressure of produced oil/condensate for purposes of tank storage and transport.

Sweetening

A process used to remove hydrogen sulfide [H_2S] and carbon dioxide [CO_2] from a gas stream. These components are removed because they can form acidic solutions when they contact water, which will cause corrosion problems in gas pipelines. In a sweetening process, different types of ethanolamine can be used, including monoethanolamine (MEA), diethanolamine (DEA), diglycolamine (DGA) and methyldiethanolamine (MDEA). Hydrogen sulfide and carbon dioxide are absorbed by the ethanolamine and sweet gas leaves at the top of the absorber. The ethanolamine is heated and acid gas (hydrogen sulfide and carbon dioxide gases) and water vapor are obtained. The water is removed while the acid gas can be flared or further treated in a sulfur recovery unit to separate out elemental sulfur. Finally, the lean ethanolamine is returned to the absorber

Tank Farm

A Tank Farm is a collection of tanks that typically store crude oil and petroleum products within a common area at the edge of a plant typically used as surge volume before entering a pipeline or other transportation method. The tank farm area can also be used to store consumables or intermediate processing products.

Tier

One of the four levels of the OGP framework for asset integrity KPIs as described in this report, which is in turn based on the API/ANSI standard RP 754.

Third party

A person with no business relation with the company or contractor.

United Nations Dangerous Goods (UNDG)

A classification system used to evaluate the potential hazards of various materials when released, which is used by most international countries as part of the product labelling or shipping information.

Unsafe location

An atmospheric pressure relief device discharge point or downstream destructive device (e.g., flare, scrubber) discharge point that results in a potential hazard, such as the formation of flammable, toxic or corrosive mixtures at grade level or on elevated work structures, or ignition of relief streams at the point of emission.

Utilities

Air systems, cooling systems, fuel systems, power generation, steam generation, water systems (BFW, Utility Water, potable water, fire water, etc.) and such that supports the primary or secondary plant processes.

Vapour Recovery

Primary oil production typically has both free gas and entrained gas that is recovered throughout the inlet and cleaning processes. Environmental regulations typically also require vapour recovery off the storage tanks and blanket gas system.

Wastewater

The industry generates wastewater from the water extracted from the geological formations and from chemicals used during exploration, well drilling and production of oil and gas.

Water Separation

Processes that remove water from oil including inlet separator, free water knockout drum, treaters and tanks (using residence time) or other process equipment.

Well Integrity

Well integrity refers to well servicing operations in an effort to optimize production of the well and maintenance to extend the life of the well.

Work-Related Injury

See occupational injury.

References

1) Schlumberger Oilfield Glossary, (http://www.glossary.oilfield.slb.com).
2) CAPP Guide Health and Safety Performance Metrics Reporting, November 2013
3) Online engineering encyclopedia, (http://www.enggcyclopedia.com/2011/05/gas-compression)
4) Online education, (http//www.eia.gov/kids)
5) Society of Petroleum Engineers (SPE) E&P Petrowiki online taxonomy, (http://petrowiki.org/Taxonomy)

E.2. Acronyms

Many of the following acronyms are used in this reporting guideline as well as those frequently used when discussing process safety.

- ABSA Alberta Boiler Safety Association
- AER Alberta Energy Regulator (Formerly EUB and ERCB)
- AFPM American Fuel & Petrochemical Manufacturers
- AIChE American Institute of Chemical Engineers
- API American Petroleum Institute
- BCSA British Columbia Safety Authority
- CAPP Canadian Association of Petroleum Producers
- CEPA Canadian Environmental Protection Act
- CCPS Center for Chemical Process Safety
- CSA Canadian Standards Association
- DACC Drilling and Completion Committee
- IOGP International Association of Oil & Gas Producers (formerly OGP)
- LOPC Loss of Primary Containment
- OGC British Columbia Oil and Gas Commission
- OSHA US Occupational Safety and Health Administration
- PRD Pressure Relief Device
- PSM Process Safety Management
- SER Saskatchewan Energy and Resources
- TDG Transportation of Dangerous Goods
- TSB Transportation Safety Board of Canada
- TSASK Technical Safety Authority of Saskatchewan