

Process Safety Metrics and Event Reporting Guide

REPORTING TIER 1 AND 2 EVENTS

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About Energy Safety Canada

Energy Safety Canada is the national safety association for Canada's energy industry. Our mission is to mobilize the industry to drive safe work performance through education, resources and engagement.

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Preface

PURPOSE

The purpose of this guide is to provide the information and instructions to classify and report process safety events (PSEs) at a corporate level and within the secure members-only Energy Safety Canada (ESC) Data Gateway. *This guideline does not supersede incident reporting requirements set by local or federal agencies regulatory reporting requirements.*

The framework and resources used within this guideline are developed from the American Petroleum Institute (API), the International Association of Oil and Gas Producers (IOGP) RP456 and the Canadian Standard Association (CSA) Z260:19. API focuses on downstream and chemical refining, and the use of IOGP's "Process Safety - Recommended Practice on Key Performance Indicators provides an overview tailored for oil and gas producers. The API Recommended Practice (RP) 754, identifies leading and lagging process safety indicators. CSA-Z260 focuses on a set of common safety metrics for pipeline systems along with the contributions of API.

These indicators are divided into four tiers that represent a leading and lagging continuum. Tiers 1 and 2 are suitable for organizational and nationwide reporting and Tiers 3 and 4 are generally intended for internal use. The collection of recommended Tier 1 and 2 key performance indicators (KPIs) provide consistent measures that deliver baseline data on industry and organization performance and facilitate trend analysis and benchmarking.

PSEs should be reported under this guide by organizations that are the lead operator of a facility or asset, for example, in joint ventures only the lead operator would report to avoid duplication of reporting.

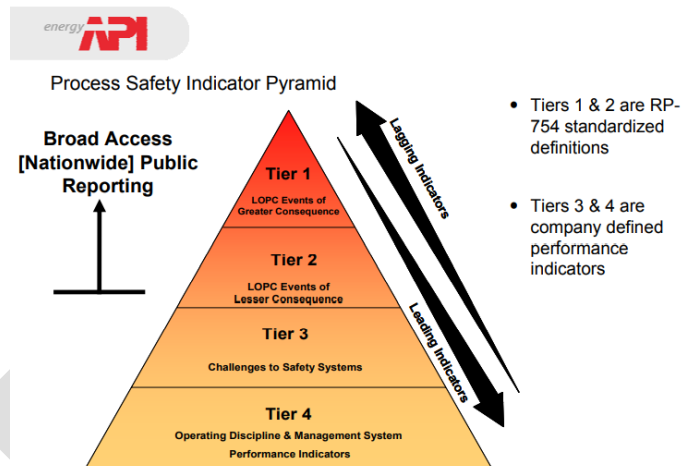


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1.0 Introduction

Oil and gas operations involve complex processes requiring risk management for hazards with potentially catastrophic events involving loss of life, harm to health and extensive environmental damage. 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.

Key performance indicators should drive process safety performance improvement and learning.

American Petroleum Institute

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. A loss of primary containment can occur when one or more layers of protection fail to operate as intended. These are known as process safety events (PSEs).

Safety management systems require that operating companies have an internal process of continual improvement that includes reporting, collecting, evaluating and trending of data related to PSEs, including near-misses and performance monitoring. The framework, definitions and thresholds contained within were adapted from API RP 754. A pragmatic approach on classifying incidents into various sectors (such as refining, processing, petrochemical and pipeline facilities) is used so that companies following this guideline can accurately compare performance. In addition to the value of benchmarking and comparative analysis, the alignment with API RP 754 reduces the potential for confusion or misinterpretation arising from multiple definitions for a pipeline system or process safety event.¹

When a Tier 1 or 2 PSE occurs, it presents an opportunity for companies to identify weaknesses in their barrier systems and rectify them. Even those Tier 1 and 2 events that are contained by secondary systems contain lessons important to the prevention of future incidents of equal or greater consequence.

Tier 1 and 2 indicators count LOPC incidents from a process. This also includes LOPC of non-toxic and non-flammable substances in circumstances where harm or damage could result.

- Tier 1 PSEs are incidents with greater consequence and represent the most lagging performance indicator within the four-tier approach.
- Tier 2 PSEs are *similar* incidents with lesser consequence.

1.1 SCOPE

This guide covers Tier 1 and 2 PSEs in the upstream and midstream oil and natural gas industry involving an LOPC during offshore and onshore operations such as 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. PSEs occurring in downstream industry are outside the scope of this guide. Tier 3 and 4 PSEs are not collected within the ESC Data Gateway.

¹ CSA Standard Z260:19 Pipeline system safety metrics

2.0 Process Safety - Application for Oil and Gas Operations

2.1 DEFINING PROCESS SAFETY

Definitions of three terms published by IOGP are helpful for framing the scope of process safety management in the energy industry:

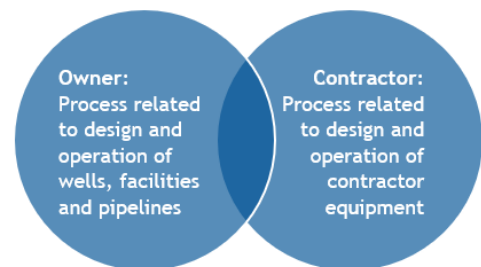
- 1) **Process Safety:** Process safety is a disciplined framework for managing the integrity of operating systems and processes handling hazardous substances. It is achieved by applying good design principles, engineering, operating, and maintenance practices. It deals with the prevention and control 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 results in multiple fatalities and/or serious damage, possibly beyond the asset itself. Typically initiated by a hazardous release, it may also result from structural failure or a loss of stability that caused serious damage to an asset.

2.2 HOW PROCESS SAFETY CONCEPTS APPLY

It is important to consider how process safety applies to industry and to determine full life cycle development considerations for each segment of the industry. It is equally important to consider the operations in both owner and contractor related operations.

The following operations are included:

1. **Well Operations: Drilling, Completions and Well Servicing.** Well operations include all exploration, appraisal and production drilling, wireline, completion, and workover activities as well as their administrative, engineering, construction, materials supply, and transportation aspects.
 - a. For drilling and completion operations, relevant PSEs include drilling; well workovers; wireline; and operations “in hole” when and there is a release of gas, oil, other drilling and well completion fluids or mud above ground or above seabed 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.
 - b. For completion and well servicing operations, relevant PSEs include release during the completions or well servicing work on production wells under pressure (i.e., snubbing).
2. **Pipeline Design and Operation including:**
 - a. Flowlines between wells and pipelines between facilities associated with field production operations.
 - b. Pipeline operations (including booster stations) that involve exploration, production or transmission business.

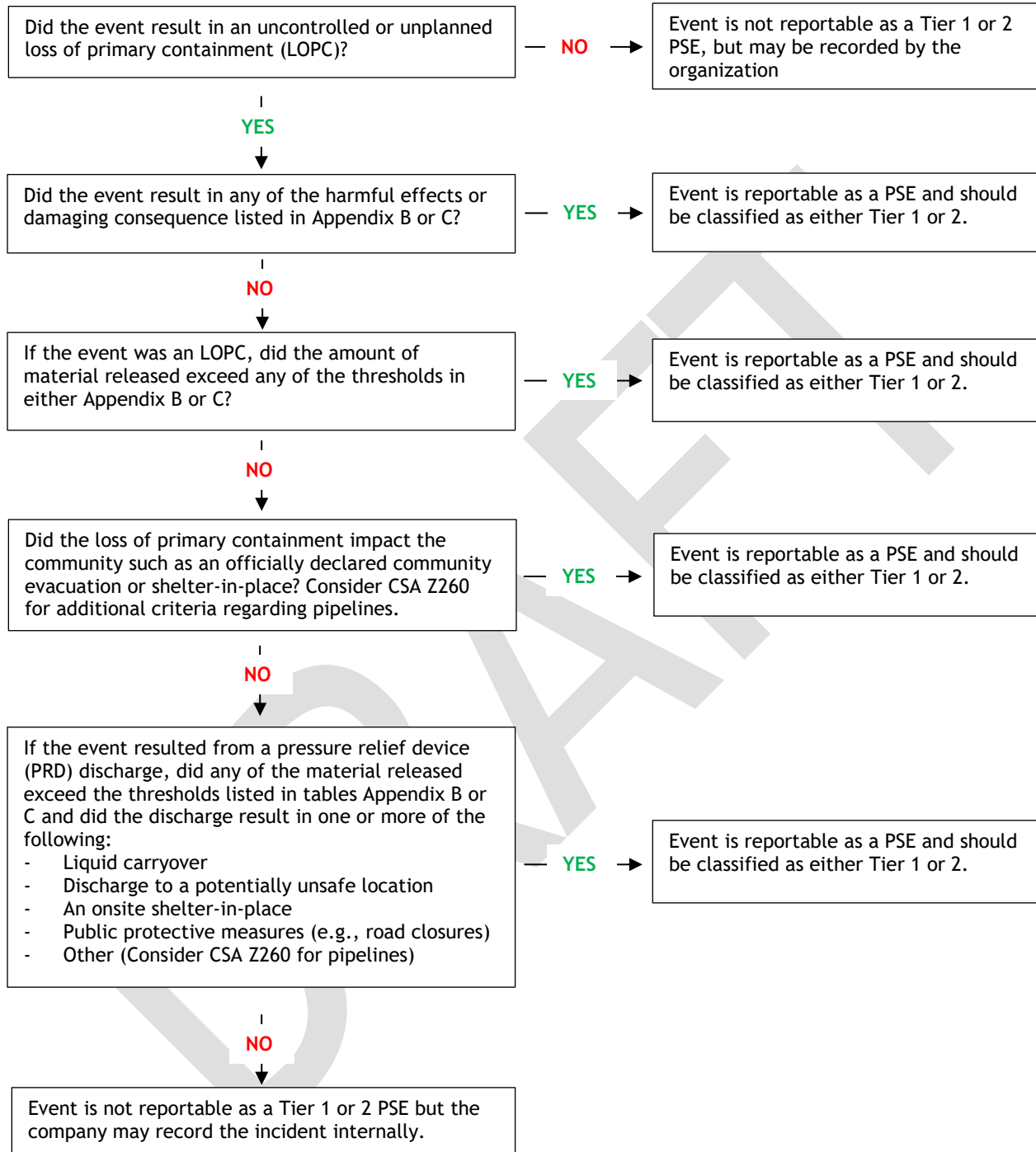


3. Facility Design and Operation including:
 - a. Petroleum and natural gas production operations, including administrative and engineering aspects, repairs, maintenance and servicing, materials supply and transportation of personnel and equipment. It covers all mainstream production operations including:
 - i. Oil (including condensates) and gas extraction and separation.
 - ii. Heavy oil production where it is inseparable from upstream (e.g., steam assisted gravity drainage) production.
 - iii. Oil processing (water separation, stabilization).
 - iv. Gas processing (liquids separation, compression, dehydration, sweetening, CO₂ removal).
 - v. 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, CO₂ removal, deep cut (C2/C3), and LNG).
 - vi. Production storage facilities including oil, condensate, NGL, LPG, produced water, and production waste streams. Also consider floating storage units (FSUs) and subsea storage units.
 - b. For this guide, processing excludes mining processes associated with the extraction of heavy oil and heavy oil when separable from upstream operations.
4. Rail and Truck Transportation including:
 - a. Oil and 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.

Other useful examples of applicable PSE events are provided in ANSI/API RP 754, CSA Z260-19, and in IOGP RP456.

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2.3 ESC REPORTING DECISION FLOWCHART



3.0 Reporting Tier 1 and 2 PSEs | ESC Data Gateway

The [ESC Data Gateway](#) is a members-only, secure, and confidential site to collect and benchmark process safety Tier 1 and 2 events. Companies must register and assign a representative before they can submit data online. For more information on the data fields in the ESC Data Gateway, please refer to Appendix A.

Most of the information is recorded as yes/no responses or multi-choice using drop-down menus, with some additional questions that request more detailed information about the nature and consequences of the event.

TABLE 3.1 DETERMINING THE PSE LEVEL BY PSEs CONSEQUENCES

PROCESS SAFETY EVENT CONSEQUENCE	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)	Reportable occupational injury (restricted work case or medical treatment case)
Injury to public or a third party due to a loss of primary containment	Fatality or injury/illness that results in a hospital admission	N/A
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 or C in any one-hour period	A release of material greater than the Tier 2 threshold quantities described in Appendix B or C in any one-hour period
Gas release from a pressure relief device (PRD) due to a loss of primary containment	<p>A release of material greater than the threshold quantities described in Appendix B or C in any one-hour period that ALSO resulted in any one or more of the following:</p> <ul style="list-style-type: none"> • Liquid carryover • Discharge to a potentially unsafe location • An onsite shelter-in-place • Public protective measure (e.g., road closures) • Other (Consider CSA Z260 for pipelines) 	<p>A release of material greater than the threshold quantities described in Appendix B or C in any one-hour period that ALSO resulted in any one or more of the following:</p> <ul style="list-style-type: none"> • Liquid carryover • Discharge to a potential unsafe location • An onsite shelter-in-place • Public protective measures (e.g., road closures) • Other (Consider CSA Z260 for pipelines)

Impact to the community due to a loss of primary containment

Officially declared community evacuation or community shelter-in-place

Note: Additional criteria may apply for pipelines as indicated in CSA Standard Z260.²

Note: Additional criteria may apply for pipelines as indicated in CSA Standard Z260.²

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

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² CSA Standard Z260:19 Pipeline system safety metrics

Appendix A | Data fields for Process Safety Events collection in the ESC Data Gateway

NOTE:

It is possible to submit more than one event of the same type in the same province and date.

In the case of data under the category “other”, a response must be entered.

The information below is required for both Tier 1 and 2 events.

CONSEQUENCES QUESTIONS	LIST
Date of PSE	Use date of process safety event occurrence
Location	Drop down list: Alberta, British Columbia, Saskatchewan, Manitoba, Quebec, Ontario, Newfoundland and Labrador, Offshore, Nova Scotia offshore, Northwest Territories
Function Operation	Categories: Drilling and Completions, Gas Processing, Conventional Oil Processing, Non-Conventional In-situ Processing, Non-Conventional Heavy Oil Processing, Primary Production Storage, Pipelines, Transportation, Utilities and Offsite
Other	When using other, text must be included
Community shelter-in-place	Yes or No responses
Fire or explosion costs ≥ \$100,000	Yes or No responses
PRD discharge above Tier 1 threshold	Yes or No responses
Material released above Tier 1 threshold	Yes or No responses
Employee or contractor fatality or LWC	Provide numbers in box
PSE by material	Drop down list: Toxic, flammable and combustible, acid and base, or a release associated with injury or fatality. This section has a sub-category providing more granularity of materials.

Activity

Categories: start-up, normal operations, shutdown or other.

Failure type

Categories: Equipment failure, human error, procedural or external.

Failure reason

Drop down list: Design, equipment reliability, wrong material used, wrong part used, competency, fatigue, repetition, inexistent, complicated, not followed, sabotage, natural phenomena, other

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Appendix B | 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 Align With API/ANSI Standard 754)		Tier 2 (Categories Below Align With 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)
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)
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Appendix C | Toxic Material Release Threshold Quantities

Material hazard classification (with example materials)	Tier 1 (Categories below align with API/ANSI Standard 754)		Tier 2 (Categories below align with API/ANSI Standard 754)	
	Outdoor Release	Indoor Release	Outdoor Release	Indoor Release
Toxic Inhalation Hazard (TIH) 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 Zone B materials: hydrogen sulphide (H ₂ S), chlorine (Cl ₂)	≥ 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 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 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 k (110 lb) (Cat. T1-5)	≥ 50 kg (110 lb) (Cat. T2-5)	≥ 25 kg (55 lb) (Cat. T2-5)
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 III 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 sulphuric 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 dimethylamine (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)

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Appendix D | Glossary

The following terms and acronyms are referenced in this reporting guide. Many of the terms are adapted from API RP 754 and are integral to classifying Tier 1 and 2 PSE:

Term	
Asset Integrity	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.
Construction	Major construction, fabrication activities and 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 licensee, owner, or prime contractor of the worksite. Contractor, either individual or entities, who have entered into a verbal contract or written agreement. The definition of contractor includes any sub-contractor. Contractor employee, individual employed by contractor or sub-contractor involved into the prescribed work.
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.

Dehydration	Dehydration is part of a 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. Does not include indirect costs, such as a 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 costs also do not include the cost of the failed component leading to LOPC, if the component is not further damaged by 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., de-ethanizer, de-propanizer, de-butanizer, etc.
Drilling and 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 specification, 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.
Escalation	The process by which an initial, and 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, material 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 a rupture of equipment or piping.
Fire	Any combustion resulting from an LOPC, regardless of the presence of a flame. Includes smouldering, charring, smoking, singeing, scorching, carbonizing, or the evidence that any of these occurred.
First Aid	The first immediate assistance given to any worker suffering from an illness or injury during employment. It is often a one-time, short-term treatment. First aid cases are not classified as recordable unless they are used by organizations as criterion for Tier 3 event reporting.
Gas Compression	Compression is used to increase the pressure of gas.
Gas Processing	Raw gas from the reservoir goes through primary processing to purify raw natural gas by removal of contaminants such as water, carbon dioxide (CO ₂) and hydrogen sulphide (H ₂ S) 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.
Hospital Admission	Formal acceptance by hospital or inpatient health care facility for more than 24 hours. Treatment in an emergency room or overnight stay in emergency room is not classified as 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 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.
Incident	An event or chain of events that resulted in a recordable injury, illness or physical, asset or environmental damage.
Injection	An unconventional oil extraction technique used to enhance oil recovery. These include water and polymer flood techniques. Common approaches include water flood, polymer flood, steam (CSS/SAGD). Other approaches include solvents, 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. Technology to support in-situ oilsands recovery includes steam assisted gravity drainage (SAGD) and cyclic steam stimulation (CSS). There are other technologies including toe to heel air injection (THAI), reservoir adjusted solvent dewpoint (RASD-VAPEX) and other less familiar processes.

Key Performance Indicator (KPI) Information or data that provides evidence of an organization'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.

Leading Indicators: process-oriented metrics that indicate the performance of the key work processes, operating discipline, or protective barriers that prevent incidents; they are designed to give an indication of the potential problems or deterioration in key safety systems early enough that corrective action can be taken.

Lagging Indicators: metrics deemed to be reflective of an actual or past performance of an attribute, system, procedure, or process.

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

Lost Workday Case (LWDC) Any occupational injury or illness, other than a fatal injury, which results in a worker being unfit for work on any day after the day of the occurrence of the injury. Any day refers to rest days, weekend days, leave days, holidays or days after ceasing employment. An LWDC is a recordable event.

Loss of Primary Containment (LOPC) An unplanned or uncontrolled release of any material from primary containment, includes non-toxic and non-flammable materials. 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 is released under normal operating conditions.

Major Event A hazardous event that has resulted in multiple fatalities and/or serious damage, severe environmental damage, loss of natural resource, structural failure or loss of stability that has caused serious damages possibly beyond the asset itself.

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 either as a Tier 1 or Tier 2 PSE. Further details and descriptions are available in API RP 754.
Mitigation Barrier	A barrier which reduces or limits consequences of an LOPC.
Near Miss (Near Hit)	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.
Offshore Work	All activities and operations that take place at sea, including activities in bays, in major inland seas, or in inland seas directly connected to oceans. Event involving transportation of people or equipment from shore to the offshore location, either by vessel or helicopter, should be recorded as “offshore”.
Pipeline	Those items through which oil or gas industry fluids are conveyed, including pipe, components, and any appurtenances attached thereto, up to and including isolating valves used at stations and other facilities (adapted from CAN/CSA-Z662).
Pipeline System	Pipelines, stations, and other facilities required for the measurement, processing, storage, gathering and transportation of oil or gas industry fluids or gases (adapted from CAN/CSA-Z662).
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 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)	An unplanned or uncontrolled release of any material including non-toxic and non-flammable materials (e.g., steam, hot water, nitrogen, compressed CO ₂ or compressed air) from a process, or an undesired event or condition, that under slightly different circumstances, could have resulted in a release of material and/or much more severe outcomes.
Recordable/Reportable	A recordable event is a type of event, including an LOPC or an occupational injury or illness, or other outcome that meets or exceeds definitions, criteria or thresholds for inclusion and classification as per ANSI/API RP 754. The broader term “reportable” is used in this guide to indicate the key performance indicator data collected by Energy Safety Canada.
Secondary Containment	An impermeable physical barrier specifically designed to prevent release of materials into the environment that have already breached primary containment (i.e., a 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.
Sweetening	A process used to remove hydrogen sulfide (H ₂ S) 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.
Tank Farm	A collection of tanks that typically store crude oil and other petroleum products within a common area. Tank farms may include the storage of consumables or intermediate processing products.
Tier 1 Indicator	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. Any event that occurred during drilling, production and processing activities and meets the definition below is recordable as a Tier 1 event.

A Tier 1 PSE is an unplanned or uncontrolled release of any material (an LOPC), including non-toxic and non-flammable materials (e.g., steam, hot water, 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 including precautionary community evacuation or community shelter-in-place
- A fire or explosion damage greater than or equal to \$100,000 of direct cost
- An engineered pressure relief (e.g., use of PRD, safety instrumented system (SIS), or manually initiated emergency depressure) discharge, or a quantity greater than or equal to the threshold quantities in Appendix B and C in any one-hour period, whether directly to the atmosphere, or via a downstream destructive device that results in one or more of the consequences:
 - Liquid carryover
 - Discharge to a potentially unsafe location
 - An onsite shelter-in-place or onsite evacuation excluding precautionary onsite shelter-in-place or onsite evacuation
 - Public protective measures (e.g., road closures) including precautionary public protective measures
 - A PRD discharge quantity greater than the threshold quantities in Appendix B and C in any one-hour period
- A release of material greater than or equal to the threshold quantities described in Appendix B and C in any one-hour period.
- Additional criteria that may apply to pipelines include a release of liquid hydrocarbon to open water or potable aquifer, death of a species at risk or destruction of cultural/historical resource.³

Tier 2 Indicator

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 one or more 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
-

³ CSA Standard Z260:19 Pipeline system safety metrics

- Additional criteria that may apply to pipelines include a release of liquid hydrocarbon into wetland or non-potable aquifer and the death of livestock or wildlife.⁴
- PRD discharge to atmosphere whether directly or via a downstream destructive device that results in one or more the following consequences:
 - Liquid carryover
 - Discharge to a potentially unsafe location
 - An onsite shelter-in-place
 - Public protective measures (e.g., road closure)
 - A PRD discharge quantity greater than the threshold quantities in Appendix B and C in any one-hour period
- A release of material greater than the threshold quantities described in Appendix B and C in any one-hour period.

Tier 3 (or 4) Indicators

Operation situation, typically considered a “near miss”, which has challenged the safety system by progressing through one or more barrier weaknesses to result in an event or condition with:

- Consequence that does not meet the criteria for a reportable Tier 1 or Tier 2 event; or
- No actual consequences, but the recognition that in other circumstances further barriers could have been breached and a Tier 1 or Tier 2 event could have happened.

Utilities

Air, cooling, fuel systems, power and steam generation, water system (BFW, utility water, potable, and fire water, etc.) and other such supports for the primary or secondary plant processes.

Vapour Recovery

Primary oil production typically has both free and entrained gas that is recovered throughout the inlet and cleaning processes. Regulations may also require vapour recovery systems off storage and blanket gas systems.

Wastewater

Water extracted from geological formations, or mixed with chemicals during exploration, completions or workovers, well drilling and production of oil and gas.

⁴ CSA Standard Z260:19 Pipeline system safety metrics

Appendix E | 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
AFPM	American Fuel and Petrochemical Manufacturers
AIChE	American Institute of Chemical Engineers
API	American Petroleum Institute
CAPP	Canadian Association of Petroleum Producers
CEPA	Canadian Environmental Protection Act
CER	Canadian Energy Regulator
CCPS	Center for Chemical Process Safety
CSA	Canadian Standards Association
DACC	Drilling and Completion Committee
IOGP	International Association of Oil and Gas Producers (formerly OGP)
OGC	British Columbia Oil and Gas Commission
OSHA	US Occupational Safety and Health Administration
SER	Saskatchewan Energy and Resources
TDG	Transportation of Dangerous Goods
TIH	Toxic Inhalation Hazard
TSB	Transportation Safety Board of Canada
TSBC	Technical Safety British Columbia
TSASK	Technical Safety Authority of Saskatchewan

Appendix F | References

ANSI/API RP 754 - Process Safety Performance Indicators for the Refining and Petrochemical Industries

IOPG Report 456-2018 - Process safety - Recommended practice on Key Performance Indicators

CSA Z260-2019 - Pipeline system safety metrics

NOTES:

- (1) *The use of singular does not exclude the plural when the sense allows.*
- (2) *Although the primary application of the guideline is stated in its scope, it is important to note that it remains the responsibility of the users to judge its suitability to their particular purpose.*

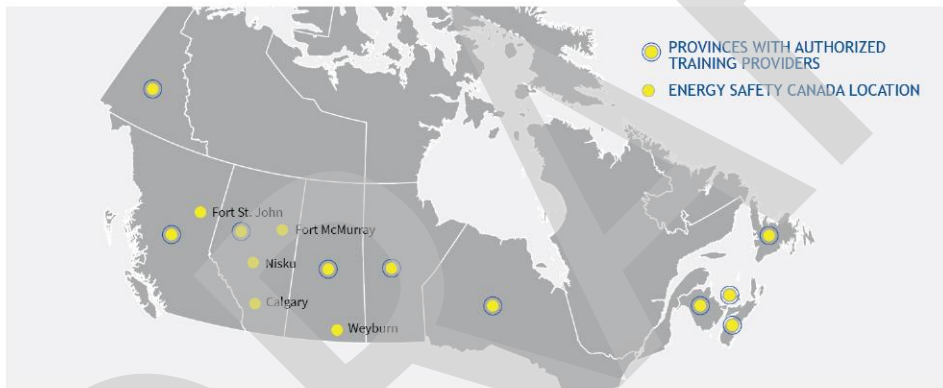
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