ENERGY SAFETY CANADA

POTENTIALLY SERIOUS INCIDENT (PSI)

A Guideline on Identification and Reporting

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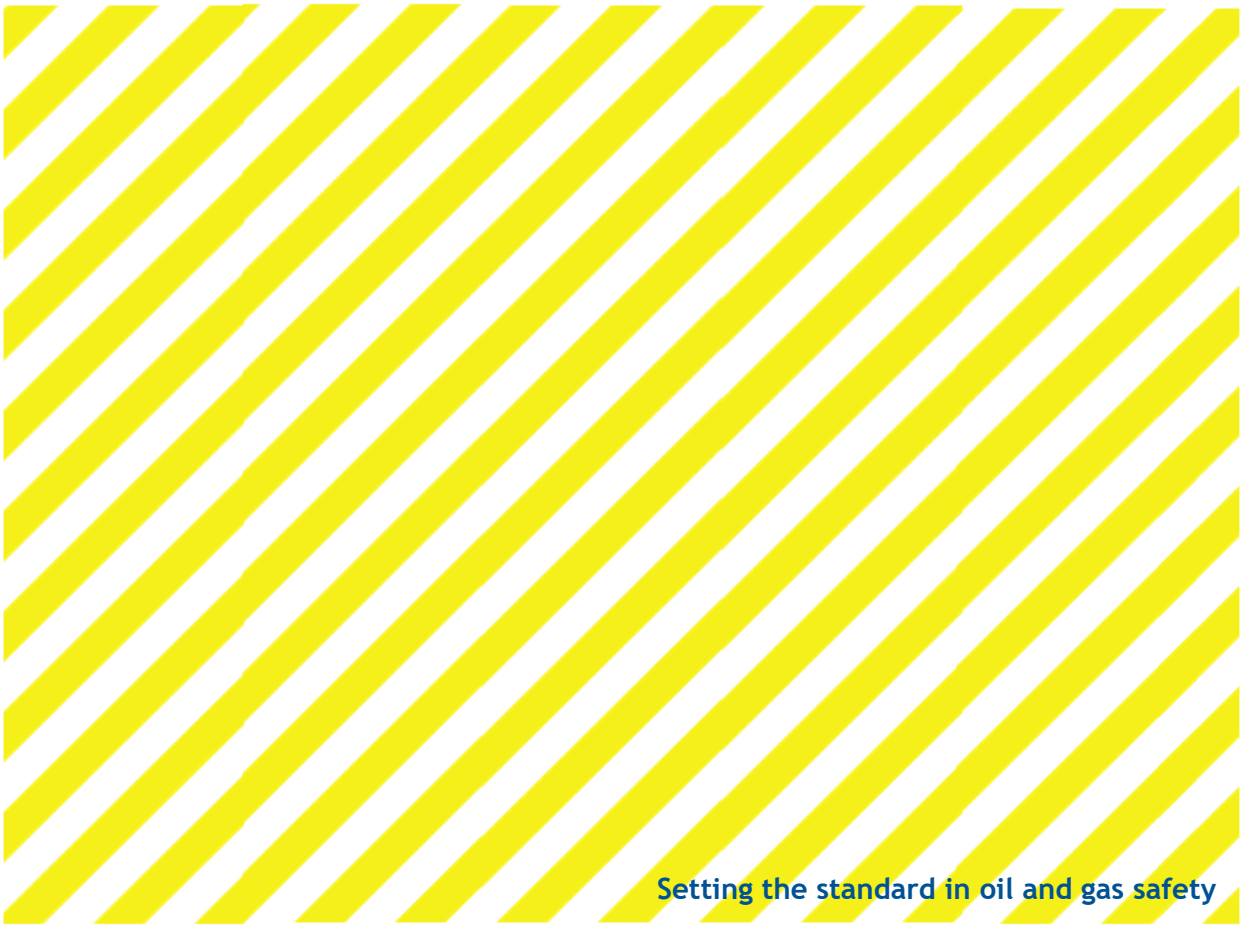

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ABOUT ENERGY SAFETY CANADA

Energy Safety Canada is the oil and gas industry's advocate and leading resource for the continuous improvement of safety performance. Our mission is to help companies achieve their safety goals by providing practices, assessment, training, support, metrics and communication.

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1.0 Introduction

1.1 Purpose and Scope

This guideline is intended to assist the oil and gas industry in the identification and reporting of incidents or events with the potential to cause a serious injury, illness, or fatality to a person, herein referred to as potentially serious incidents (PSIs).

A PSI is any event where a reasonable and informed person would determine that under slightly different circumstances, there would be a high likelihood for serious injury, illness, or fatality to a person.

By adopting and using similar terminology and definitions, industry can share data and have more valuable conversations in the prevention of serious injuries, illnesses, and fatalities. This can only occur if incidents with the potential for serious injury can be sorted out from other incidents where that potential does not exist.

Serious injuries, illnesses and fatalities may have causal factors different than the causal factors for less serious injuries or illnesses, namely the degree of hazardous energy present. This differentiation often drives different prevention activities.

Most of the risks to workers within the industry are known. However, serious injuries, illnesses and fatalities continue to occur. Often, a failure to implement changes from lessons learned can contribute to ongoing incidents. Therefore, a disciplined approach to communicating these learnings is vital to the prevention of similar injuries, illnesses, or fatalities.

1.2 Regulatory Jurisdictions

Various jurisdictions across Canada have regulations that require either the investigation of potential serious incidents or the reporting of potentially serious incidents. Some jurisdictions refer to this as a dangerous occurrence. In general, most jurisdictions define a serious injury or illness similarly with varying degrees of detail. Jurisdictional examples are provided for reference below.

Please note, there may be unique regional expectations within any jurisdiction that result in slightly different interpretations. Companies must be aware of any such expectations and manage accordingly.

1.2.1 British Columbia Legislation

In British Columbia, the Workers Compensation Act requires incidents that had the potential for causing a serious injury to a worker to be investigated. WorkSafeBC defines serious injury in their Accident and Reporting and Investigation Guideline (G-D10-172-1 Guideline) as, “any injury that can reasonably be expected at the time of the incident to endanger life or cause permanent injury.

Serious injuries include both traumatic injuries that are life threatening or that result in a loss of consciousness, and incidents such as chemical exposures, heat stress, and cold stress which are likely to result in a life-threatening condition or cause permanent injury or significant physical impairment.”

This guideline also provides a detailed list of traumatic injuries.

1.2.2 Alberta Legislation

The requirement for reporting a PSI are in Section 33(5) of the OHS Act which states, “If an incident occurs where (a) the incident had the likelihood of causing a serious injury or illness, and (b) there is reasonable cause to believe that corrective action may need to be taken to prevent recurrence, the prime contractor or, if there is no prime contractor, the employer shall conduct an investigation…”.

A serious injury or illness is defined under Section 33 (2)(b) of the OHS Act as one where “there is reason to believe the worker has been or will be admitted to a hospital beyond treatment in an emergency room or urgent care.” In addition to this and other events such as an unplanned or uncontrolled explosion, serious incidents include “any worker exposure to radiation in excess of the maximum limits prescribed in the OHS Code.”

It is important to note that the Alberta definition is not limited to workers and includes other persons, such as the public, that may be impacted provided a worker could have experienced the same incident.

1.2.3 Saskatchewan Legislation

Section 2-2 of the Saskatchewan Occupational Health and Safety (OH&S) Regulations requires notification of accidents at the place of employment that cause or may cause the death of a worker or will require a worker to be admitted to a hospital as an inpatient for a period of 72 hours or more.

Section 2-3 of the Saskatchewan OH&S Regulations states that employers must give notice of a dangerous occurrence. A dangerous occurrence is defined as "any occurrence that does not result in, but could have resulted in, a condition or circumstance set out in subsection 2-2(1)," and includes such things as a structural failure, failure of a crane or hoist, failure of a suspended platform and other serious incidents as well as some unique requirements such as:

- Accidental contact with an energized electrical conductor.
- Bursting of a grinding wheel.
- Uncontrolled spill or escape of a toxic, corrosive or explosive substance.
- Failure of an atmosphere-supplying respirator.

Section 3-18 details the requirements for investigating and preparing an investigation report that describes the occurrence and explains the causes and immediate and long-term action taken to prevent reoccurrence.

1.2.4 Manitoba Legislation

Manitoba's Workplace Safety and Health Act and Regulation defines serious incidents in Part 2.6 and the list of injuries includes medical treatment at a hospital. In addition, it lists a variety of incidents such as fires and explosions, collapses of structures and other serious incidents, as well as some unique requirements such as:

- An injury from electrical contact.
- An uncontrolled spill or escape of a hazardous substance.
- A failure of an atmosphere-supplying respirator.

Section 2.7(1) details the notification requirements while the investigations portion of the regulation in Section 2.9(1) indicates, "An employer must ensure that each of the following is investigated as soon as reasonably practicable after it occurs: (a) a serious incident; (b) an accident or other dangerous occurrence (i) that injures a person, and results in the person requiring medical treatment, or (ii) that had the potential to cause a serious incident."

1.2.5 East Coast Canada Offshore Oil and Gas Development

Nova Scotia and Newfoundland and Labrador's offshore oil and gas developments are regulated under the Atlantic Accord Implementation Acts and regulations made under it, which are in turn enforced by the Canada-Nova Scotia Offshore Petroleum Board (CNSOPB) and the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB). Their "Incident Reporting and Investigation Guideline" details near miss reporting and a variety of incident types where injury or illness was narrowly avoided.

In Section 6.20 Near Miss, the guideline indicates, “Any event that, under slightly different circumstances, would likely have caused harm to personnel…”. A major injury is defined by a detailed list of traumatic injuries and acute illness, as well as “any injury which places life in jeopardy or results in unconsciousness, substantial loss of blood, resuscitation or admittance to the hospital.”

The guide also states that “In making the determination of potential classification, operators and employers should take into consideration the severity of the incident in conjunction with which health, safety or environmentally critical barriers may have been missing or ineffective”.

Reportable near misses include:

- An event that had the potential for fatality or major injury (requires immediate verbal notification).
- An event with the potential for a lost/restricted workday injury or occupational illness, pollution, fire, explosion, loss of containment of any fluid from a from a well or posed an imminent threat to the safety of a person, etc. (requires written notification).

It is important to note that it refers to a person, not a worker, and that a more exhaustive list is provided in the guideline than is provided here.

A variety of near miss examples are provided in the guideline and a few are provided for reference below:

- Dropped objects.
- Use of defective or lack of use of personal protective equipment that is immediately dangerous to life and health.
- Free fall of an elevator, basket or other device for moving passengers or freight.

2.0 Identification

The various jurisdictions across Canada have criteria for what constitutes a reportable incident such as fatality, fire or explosion, building collapse, etc. and many have criteria for a PSI in one form or another. PSI includes injuries or illnesses that were not serious but had the potential to be serious, as well as incidents where persons (workers, members of the public, other) were not injured or ill but there was potential for serious injury or illness.

The impacted or potentially impacted person is not necessarily limited to a worker or the work site and, therefore, may include other employer’s workers, members of the public, etc. provided that a worker could have experienced the same incident.

Some examples are provided below:

- Injury Example: A person is struck on the head with a swinging drill pipe and receives a minor cut to the side of the head. The potential was there for that person to be killed by the strike to the head if the person did not get out of the way in time or had been standing a bit closer. This is a PSI.

- Near Miss Example: A person is almost struck on the head with a swinging drill pipe but steps out of the way in time and is not injured at all. This would be a PSI because a serious injury could have occurred with slight changes to the work site.

- Impacted Person Example: Building materials, such as a sheet of metal, are picked up by strong winds and moved through the air landing in an adjacent business's parking lot where members of the public are frequently present. This is a PSI even though members of the public, and not workers, were at risk, because a worker could have experienced the same incident.

When determining whether an incident is a PSI, the following factors should be considered:

- Similar incidents that have occurred within the employer or prime contractor's operations in the recent past (e.g. last two years) that resulted in a serious injury or illness.
- Actual circumstances of the incident (person, place, time, work practices being followed).
- Hazards present at the time of the incident.
- Slightly different circumstances (timing, distance, body position, etc.) that may have resulted in a serious injury or illness.
- Whether appropriate controls were in place at the time of the incident.
- Whether corrective actions are required to prevent a recurrence.

2.1 Decision Tree

A decision tree is presented below to assist in the identification of PSIs (Figure 1) followed by an explanation of the various factors that should be considered.

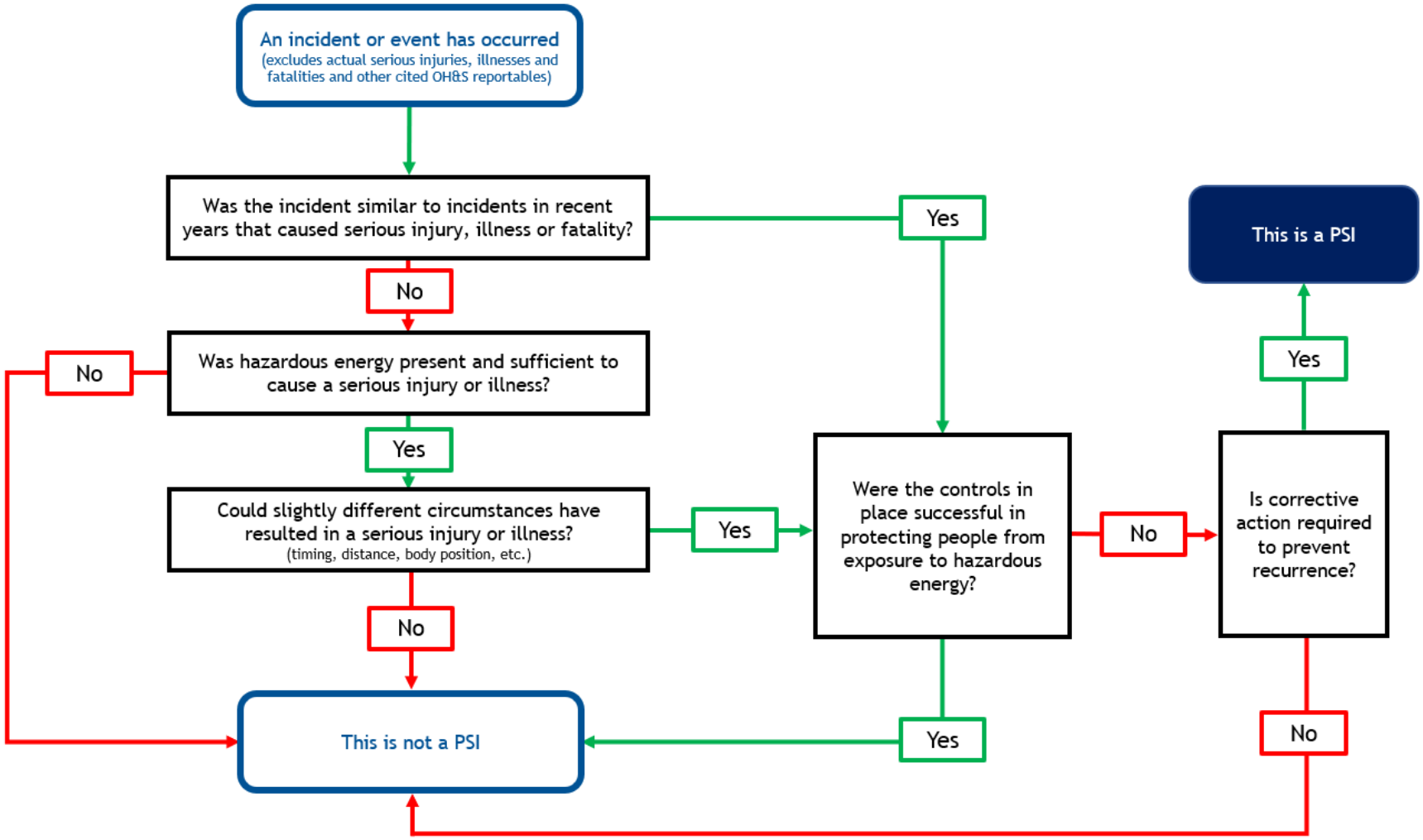

Figure 1. PSI Identification Decision Tree*

*Jurisdictional variation may apply

2.2 Similar Incidents

If an incident occurs that is like a previous incident which resulted in a serious injury, illness or fatality in recent years and the controls in place were not sufficient to protect persons from the hazardous energy, this is a PSI. This is an indication that no controls were instituted or that the controls put in place after the initial serious injury or illness were ineffective in mitigating future incidents.

2.3 Actual Circumstances

Actual circumstances at the time of the incident are important because the incident needs to be assessed in a reasonable context. It is easy to become caught up in "what-if scenarios" that are not applicable to what happened or what could have happened.

2.4 Hazards Present

For an event to be a PSI, it must be evaluated in relation to the hazards present at the time of the incident. Therefore, this evaluation should occur relative to what hazardous energy was present and not what hazardous energy could have been present.

Hazardous energy may include the following:

- Chemical
- Thermal
- Gravitational
- Mechanical
- Pneumatic
- Hydraulic
- Electrical
- Nuclear (Radiation)
- Biological
- Any energy that could cause injury or illness

For additional guidance on hazardous energy, please refer to the Energy Wheel example located in Appendix C.

Additional guidance is provided below to determine the worst credible outcome on several types of hazardous energy or events such as:

- Chemical exposures
- Flammability
- Oxygen deficiency
- Dropped objects
- Motor vehicle collisions
- Process safety events
- Life Saving Rule infractions

2.4.1 Chemical Exposures

Immediately Dangerous to Life and Health Concentrations for Workers

The Immediately Dangerous to Life and Health (IDLH) concentrations as defined by the National Institute of Occupational Safety and Health (NIOSH) are atmospheres containing harmful substances such as chemicals and other hazardous materials.

Exceeding IDLH concentrations represents an immediate threat to life, may affect health irreversibly, may have future adverse effects to health, or may interfere with a worker's ability to escape from a dangerous atmosphere. As a result, IDLH aligns with the definitions of a serious injury in Section 1.2 of this guideline. IDLH concentrations apply to workers and not the general population.

IDLH concentrations are notably different than occupational exposure limits (OEL), because OELs vary in the type of health and safety consequences they are trying to prevent, such as irritation, organ system toxicity, carcinogenicity, etc.

PSI only applies to IDLH concentrations when a worker exceeds or is reasonably likely to exceed these concentrations in the absence of the proper use and function of approved respiratory protective equipment, such as supplied-air or self-contained breathing apparatus (SCBA).

An IDLH concentration often familiar to oil and gas workers is hydrogen sulphide (H_2S), which is 100 parts per million (ppm). If a worker was exposed to over 100 ppm of H_2S without proper respiratory protection, this would constitute a PSI.

It is worth noting that several IDLH concentrations relevant to oil and gas activities — such as butane, propane, petroleum distillates etc. — are based on flammability (10% LEL), and therefore reference to these IDLHs should be conducted considering a company's flammability criterion for a PSI as well.

Acute Exposure Guideline Levels for the Non-Workers

IDLH concentrations are only applicable to workers and not exposures to non-workers. The Acute Exposure Guideline Levels (AEGLs) created by the National Advisory Council in the United States describe levels more applicable to the general population, including infants and children.

2.4.2 Flammability

Persons present in flammable work environments without appropriate controls represent a potential for serious injury. Flammable work environments are defined as environments at or above the lower explosive limit (LEL) for a flammable substance such as a gas, vapour or combustible dust.

Flammable work environments could be indicated by a properly calibrated combustible gas monitor such as one worn in the worker's breathing zone, which indicates a percentage of the lower explosive limit (LEL) for the flammable substance or mixtures of flammable substances present. Companies need to set their criterion for a PSI in relation to flammability — such as 10% LEL, 20% LEL or 100% LEL — depending on the work environments, risk tolerance and other factors.

2.4.3 Oxygen Deficiency

In the majority of jurisdictions across Canada, oxygen deficient atmospheres are defined as atmospheres with oxygen levels below 19.5% at standard temperature and pressure. Oil and gas activities where reduced oxygen environments may be encountered include confined spaces that are known to be subject to rapid changes in atmospheric conditions. As such, workers breathing air that contains less than 19.5% oxygen are at risk for serious injury and, as such, this is defined as a PSI in the absence of adequate controls such as supplied-air breathing equipment.

2.4.4 Dropped Objects

A significant amount of work has been conducted on the potential for dropped objects to cause a serious injury or fatality. This work is captured in the Electronic Drops Calculator, which uses the weight of the object combined with the distance that object falls to calculate a force and the resulting severity of potential injury.

2.4.5 Motor Vehicle Collisions

Vehicle speed is a good indicator of the potential for serious injury or fatality with respect to vehicle collisions with other vehicles and pedestrians. Approximate critical impact speeds for common crash types are cited in the research paper, "Exploration of vehicle impact speed – injury severity relationships for application in safer road design" published in ScienceDirect in 2016. This information, combined with whether there was a vehicle rollover, can be used to guide an understanding of the potential for serious injury or fatality.

2.4.6 Process Safety Events

Process safety events involve the unintentional release or loss of containment of hazardous materials or energy that may lead to catastrophic consequences. Process safety events are classified into tiers based on criteria defined in the American Petroleum Institute's (API) Recommended Practice 754.

For more information on Process Safety, please see Energy Safety Canada's free Process Safety Online Awareness training.

2.4.7 Life Saving Rule Infractions

Many non-compliances of Life Saving Rules are PSIs because the majority of Life Saving Rules focus on hazardous energy. However, not all PSIs involve Life Saving Rule non-compliances and not all Life Saving Rule non-compliances are PSIs. Any non-compliance of a Life Saving Rule should be assessed to determine if it is a PSI (i.e. involves the release or exposure to hazardous energy with potential impact to a person and/or if an injury has occurred). Please refer to Energy Safety Canada's Life Saving Rules for more information.

2.5 Slightly Different Circumstances

Slightly different circumstances, such as timing, distance, body position, etc., need to be considered. Sometimes these different circumstances are referred to as luck and may illicit a visceral response or gut feeling.

To help determine if an event is a PSI, ask the following:

- Would the consequence have been a severe injury, illness or fatality if the event had occurred on a different day or at a different hour or minute than it did?
- Would the consequence have been a severe injury, illness or fatality if some distance, angle or other parameter was slightly different at the time of the event?
- Would the consequence have been a severe injury, illness or fatality if the person was crouched over, kneeling, standing up, or standing in a slightly different spot at the time of the event?

If the answer to any of these questions is yes, then controls need to be evaluated as the final step in determining whether this incident was a PSI.

2.6 Appropriate Controls

The use of adequate controls is an important element in the identification of a PSI. If adequate controls to protect the person from hazardous energy were not in place, this is a PSI. Some examples are provided below:

- Example 1: A worker is wearing a self-contained breathing apparatus (SCBA) when exposed to a harmful substance in concentrations above IDLH concentrations. This is an adequate control, as work in an IDLH atmosphere requires the use of SCBA. Therefore, this is not a PSI.

- Example 2: A suspended load falls and hits the ground within the exclusion zone. No workers are present because everyone is aware of the exclusion zone, adheres to the exclusion zone and the exclusion zone is enforced. This is not a PSI.

Additionally, there must be reasonable cause to believe that corrective action is required to prevent recurrence. If this is not the case, then this is not a PSI. This aspect of identifying a PSI may be beneficial for extremely remote events that are unlikely to reoccur.

3.0 Investigation

Alberta and other jurisdictions require an investigation of PSIs. How companies do this is at their discretion, but it is recommended they have a consequence and complexity-based approach where the type of investigation, level of training of the investigators, and formalized nature of the report are based on the potential or actual severity of the incident as well as complexity.

A more formalized root cause investigation approach is recommended for PSIs such as: TapRoot®, 5 Whys, DNV Systematic Cause Analysis Technique (SCAT®), Failure Modes and Effects, Fault Tree Analysis, etc. These examples are provided for reference only and may not be appropriate for all PSIs. Every company needs to build their program and select their investigation processes accordingly.

4.0 Reporting and Preventative Actions

All PSIs must be investigated, and a report prepared that identifies the circumstances of the incident and corrective actions to prevent reoccurrence. This report should be provided to applicable regulators, the Health and Safety Committee or Health and Safety Representative and be made available to workers.

Various jurisdictions have their own reporting processes. For Alberta, an online reporting tool for PSIs can be accessed here: https://psi.labour.alberta.ca/.

5.0 Communication and Learnings

It is recognized that reportable incidents such as PSIs may result in "selective sharing" of information to manage other risks. This is particularly true for actual serious injuries and fatalities where a company's legal department is involved. While this need is recognized and necessary, it is equally important to recognize the need to share these incidents both company- and industry-wide to prevent reoccurrence. Companies and industry should take a balanced approach to ensure relevant learnings are shared and prevent reoccurrences.

Management should be mindful of how PSIs are communicated within a company; how they respond to the identification of PSIs; how reporting is actively encouraged; and how learnings are translated into preventative action.

Energy Safety Canada encourages companies to share PSIs with industry, and for regulators who mandate reporting of PSIs to share that data with industry safety associations so serious injury, illnesses and fatalities can be prevented throughout all industries and jurisdictions across Canada.

6.0 Summary

For companies to successfully prevent serious injuries, illnesses and fatalities, everyone must be committed to keeping themselves and others safe from serious injuries, illnesses, and fatalities.

The identification, management and reporting of PSIs can be part of an effective strategy to prevent and learn from incidents that have the potential for serious injury, illness, or fatality. By identifying incidents in a manner consistent with this guideline, companies can comply with regulatory requirements in their jurisdiction, maintain due diligence, and help advance their company's and industry's prevention efforts.

Appendix A – Glossary

Term	Definition
Hazardous Energy	Pneumatic, nuclear, thermal, mechanical, hydraulic, gravitational, electrical, chemical, biological or any other type of energy that may result in injury. For additional information on hazardous energy please refer to Alberta OH&S Code's definition of hazardous energy and the CSA Standard, Z460-13 Control of Hazardous Energy.
Immediately Dangerous to Life and Health (IDLH)	Immediately Dangerous to Life and Health as defined by National Institute of Occupational Safety and Health (NIOSH). IDLH values can be found here: https://www.cdc.gov/niosh/idlh/intridl4.html
Incident	An event or occurrence, often involving the release of hazardous energy, that endangers or is likely to endanger the health, well-being or life of a person.
Lower Explosive Limit (LEL)	The lower value of the range of concentrations of a substance, in a mixture with air, at which the substance may ignite (Alberta OH&S Code).
Near Miss (Near Hit)	An incident that did not result in an injury, but where there was potential for it to do so. Sometimes referred to as a near hit. It must involve the release or exposure to hazardous energy.
Process Safety Event	A process safety event involves the unintentional release or loss of containment of hazardous materials or energy that may lead to catastrophic consequences.
PSI	Potentially serious incident that could seriously injure or kill a person.
SCBA	Self-contained breathing apparatus
Security Incident	Security incidents involve threats of or actual criminal activity such as workplace violence, robbery, theft, alcohol and drug abuse or possession, terrorism, etc.

Appendix B – Examples

A series of PSI and non-PSI examples are provided in Table 2. These examples are provided for context only and should not be viewed as a list of all possible situations that may or may not be a PSI.

Table 1. PSI and Non-PSI Examples

PSI	Non-PSI
A worker is working inside a confined space when her personal gas monitor alarms, indicating 100 ppm H_2S, the IDLH for H_2S. The worker is not using SCBA.	A worker's gas monitor alarms, indicating 5 ppm of H_2S when she walks past a vent connected to a process that has up to 10 ppm of H_2S.
A worker is inspecting a piece of equipment and positions himself so he can see inside a piece of pipe. Unknown to him, another worker energizes the equipment and a steel rod is ejected just seconds after the worker moves his head out of the way.	A worker is inspecting a piece of equipment and positions himself so that he can see inside a piece of pipe. Unknown to him, another worker tries to energize the equipment, but the equipment is locked-out and cannot be energized.
Workers at a camp are exposed to an individual who is later identified as having a highly contagious disease that could have serious consequences requiring hospitalization.	A camp cook has a cold and cooks and serves food for the camp workers potentially exposing them to the cold virus.
A worker partially enters an inlet separator by placing his head and upper chest in the vessel so he can see if all the liquid has been sucked from the vessel's boot. His personal gas monitor reads 100% LEL.	A worker partially enters an inlet separator by placing his head and upper chest in the vessel so he can see if all the liquid has been sucked from the vessel's boot. There is no safety watch present, the vessel has been ventilated and gas detection indicates a safe atmosphere.
A worker's gas monitor reads 19% oxygen when process equipment is depressured to atmosphere in the immediate vicinity of the worker. The worker is not using SCBA.	A worker's gas monitor reads 19% oxygen when working outside on a very cold day in an open field when there is no reason for an oxygen deficient atmosphere.
A worker is struck on the side of the head with a swinging section of drill pipe and receives only a minor cut.	A worker drops a pneumatic tool on his steel-toed boot that results in a bruise on the upper part of his foot.

PSI	Non-PSI
A worker is driving to a well site when his floor mat becomes stuck on the accelerator pedal and his vehicle collides with a bridge pier. The vehicle hits the pier at 50 km/h but glances off and the driver is not hurt.	A vehicle's park break fails, and the vehicle rolls three feet into a parking lot guard rail scratching the front head light.
A suspended load of pipe is being lifted. The load shifts and the pipe falls to the ground narrowly missing a worker who briefly went under the barricade tape to observe the load.	During a lift the load shifts and is observed rocking back and forth. The lift is stopped and the load is lowered to the ground to be reconfigured.
A worker climbs outside a protected area on an elevated platform and then falls but manages to grab part of the railing, stopping his fall. The worker tears some arm ligaments.	A worker slips on an icy sidewalk and pulls muscles in her back resulting in a missed day of work.
A disgruntled former worker pushes through the security gate and fights with security personnel. When the individual is taken into custody, a loaded gun is found in his coat pocket.	A worker who recently was on a hunting trip forgets that his hunting knife was still located in his duffle bag and unintentionally brings the bag containing the knife into the camp where it is noticed by cleaning staff.
A release of a harmful substance occurs at a work site. The substance travels in the air off site and the toxic cloud narrowly misses the adjacent town.	An event occurs at a work site and a non-toxic odour travels off site just missing the adjacent town.
A worker is located inside the guard fence of a beam pump (pump jack) that is not locked out when the counterweight strikes and knocks off his hard hat.	Slack in the chain used to lockout the beam pump counterweights results in the counterweights moving an inch when a worker is standing outside the guard fence.

Appendix C – Energy Wheel Example

Mechanical Rotating equipment, drive belts, conveyors, motors or compressed springs.	**Electrical** Power lines, transformers, generators, wiring, batteries, static charges and lightning.
Pressure Piping, vessels, tanks, hoses, compressed cylinders and pneumatic and hydraulic equipment.	**Temperature** Ignition sources, hot or cold surfaces or materials, steam, friction and weather.
Chemical Flammable vapours and gases, combustibles, pyrophorics, toxic compounds, corrosives, oxygen-deficient atmospheres, welding fumes and dusts.	**Biological** Bacteria, viruses, fungi, parasites, insects, poisonous plants and animals.
Radiation Lighting issues, solar rays, welding arcs, microwaves, lasers, x-rays and NORM.	**Sound** Equipment noise, vibration, high-pressure releases and the impact of noise to communication.
Gravity Enables objects to fall, roofs to collapse and people to trip and fall.	**Motion** The movement of vehicles, equipment or materials, water, wind or a person's body or part of body such as arm.

Appendix D – Resources

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