Guideline for Classification of Process Safety Incidents

STAY LIVE
Electrical Industry Health & Safety Group

StayLive Electrical Industry Health and Safety Group

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Contents

1 Purpose

This document provides guidance on classification of Process Safety incidents within the New Zealand electricity generation and distribution industry. It is intended to enable companies in the electricity sector to establish effective and consistent reporting of process safety incidents.

This guideline:

- sets out the reasons for separately classifying Process Safety incidents
- recognises how Process Safety incident identification can be used as part of a broader Process Safety awareness and improvement process
- identifies the guiding principles to be used in defining the classification process
- provides an example flowchart and associated guidance for adaptation by individual organisations.

2 Background

The American Petroleum Institute (API) has developed a recommended approach (RP) to the identification and classification of Process Safety incidents[1], and contains detailed and specific references to thresholds and limits referred to in this document. However, the API guideline is for refining and petrochemical industries. The StayLive Process Safety Working Group has used the API guideline as a foundation and adapted it to meet the needs of the New Zealand electricity industry.

3 Electricity Industry Alignment

By definition, a Process Safety incident is typically a low probability, high consequence event that is likely to be serious if not catastrophic. Because the occurrence within an individual organisation is low, there are limited opportunities for recognising trends and learning lessons from actual events or near misses. Sharing information across the industry increases exposure to learnings from the collective experiences of others and increases opportunities for continuous improvement for all.

However, to ensure that shared information is useful to all, the industry must be aligned in the way that it reports and classifies Process Safety incidents.

To this end, the Process Safety Working Group:

- has drawn on the combined knowledge of the member organisations to identify an approach which is tailored to the needs of the electricity industry and is documented in this guideline
- supports the consistent application of agreed principles
- supports sharing of information across the industry
- recommends that any further Process Safety guidance is developed by this Working Group.

Information reported includes the number and nature of incidents and near misses occurring at sites, which can be analysed for trends, themes and learnings and facilitate industry-wide improvements in preventing Process Safety events from happening.

[1] API RP 754 "*Process Safety Performance Indicators for the Refining & Petrochemical Industries*".

4 Understanding Process Safety Risks

To effectively manage and continuously reduce the risk of Process Safety incidents, organisations must be able to systematically and consistently answer three key questions:

1 What can go wrong in our facilities?

2 What systems and controls do we have in place for preventing this?

3 What information do we have to ensure our systems are working effectively and our controls are not being eroded or failing?

The first and second questions above are usually answered through Bowtie analysis. The analysis identifies potential top-level Process Safety events (ie, **identifies** what could go wrong), the **threats** (ie, situations that would contribute to things going wrong) and **barriers** (ie, **systems and controls** in place to prevent things going wrong). The Bowtie analysis makes it clear when barriers and controls are not present, or have failed, or have been compromised or weakened.

To gather the information required to answer the third question, the introduction of key performance indicators (both leading and lagging) will provide systematic measures of overall performance and early warning of degrading systems or controls. The usefulness of such KPIs has been recognised internationally and guidance has been produced by several bodies (see section 10).

5 Guiding Principles for Defining the Classification Process

The Process Safety Working Group has agreed the following guiding principles for classifying Process Safety incidents within the electricity industry.

The classification process needs to:

- be simple to understand and apply
- be relevant to the business context of the electricity industry by covering our wide range of potential accident scenarios and controls
- allow easy analysis of the types of incidents that are captured.

6 Tiered Approach

The Process Safety Working Group has adopted a four-tiered approach to the classification of process safety incidents (adapted from API RP 754).

Definitions within each tier have been kept relatively high-level to help achieve broad consistency within organisations and across the industry. While more detailed definitions would reduce ambiguity and inconsistency, the Working Group recognises differences in the physical generation plant of the various users of the guide and therefore allows for some flexibility in the tier definitions.

The Working Group recommends a subcategorisation for Tier 3 and Tier 4 incidents to provide clearer guidance on the type of incidents to categorise as Process Safety incidents. It also allows for trending and analysis of challenges to process safety barriers. Interpretation at Tiers 3 and 4 is deemed too facility-specific for benchmarking or developing industry applicable criteria, but the information is useful to analyse at a company level.

Process Safety incidents are classified as one of four tiers. Each tier is defined in Table 1 below, however in general terms:

- Tier 1 captures loss of primary containment incidents with severe or catastrophic consequence.
- Tier 2 also captures loss of primary containment incidents but with lesser consequence (approximately an order of magnitude lower than a Tier 1 incident).
- Tier 3 captures challenges to safety systems, which provide opportunities to identify and correct these weaknesses.
- Tier 4 captures weaknesses in operating discipline and management system performance, such as an error in a process safety management system or a failure to apply a process safety management system.

Notes:

- The subcategories listed for Tier 3 and Tier 4 are for guidance only – individual companies can choose to modify the categories and subcategories to best match their own requirements (noting that Tiers 3 and 4 are intended for internal use only).
- Some StayLive member companies classify weaknesses in operating discipline and management system performance as Tier 4 incidents, and others roll them into a Tier 3 sub-classification. Both are valid responses.

Table 1 – Description of Process Safety Incident Tiers

Tier	Descriptor	Notes and Examples
Unplanned or uncontrolled release from a process of any material – severe consequences		
1	Loss of containment of any material including non-toxic or non-flammable materials (such as steam, hot water, compressed air or loss of greater than threshold values quantities of hazardous materials	Threshold values for toxic and flammable substances are to be taken directly from the API RP 754 schedules, while companies operating hydro dam facilities may choose to set their own limits or threshold values for an incident arising from a significant loss of a dam or primary containment of reservoir water.
1	Loss of containment or control of mechanical energy	For example, catastrophic failure of a turbine due to overspeed leading to plant damage > $100,000 (direct costs)
1	Loss of containment or control of electrical energy	For example, significant arc-flash events leading to a lost-time injury and/or plant damage > $100,000 (direct costs)
1	Loss of containment of water	For example, major failure of hydro dam containment leading to a lost-time injury and/or plant damage > $100,000 (direct costs). Threshold values for toxic and flammable substances are to be taken directly from the API RP 754 schedules

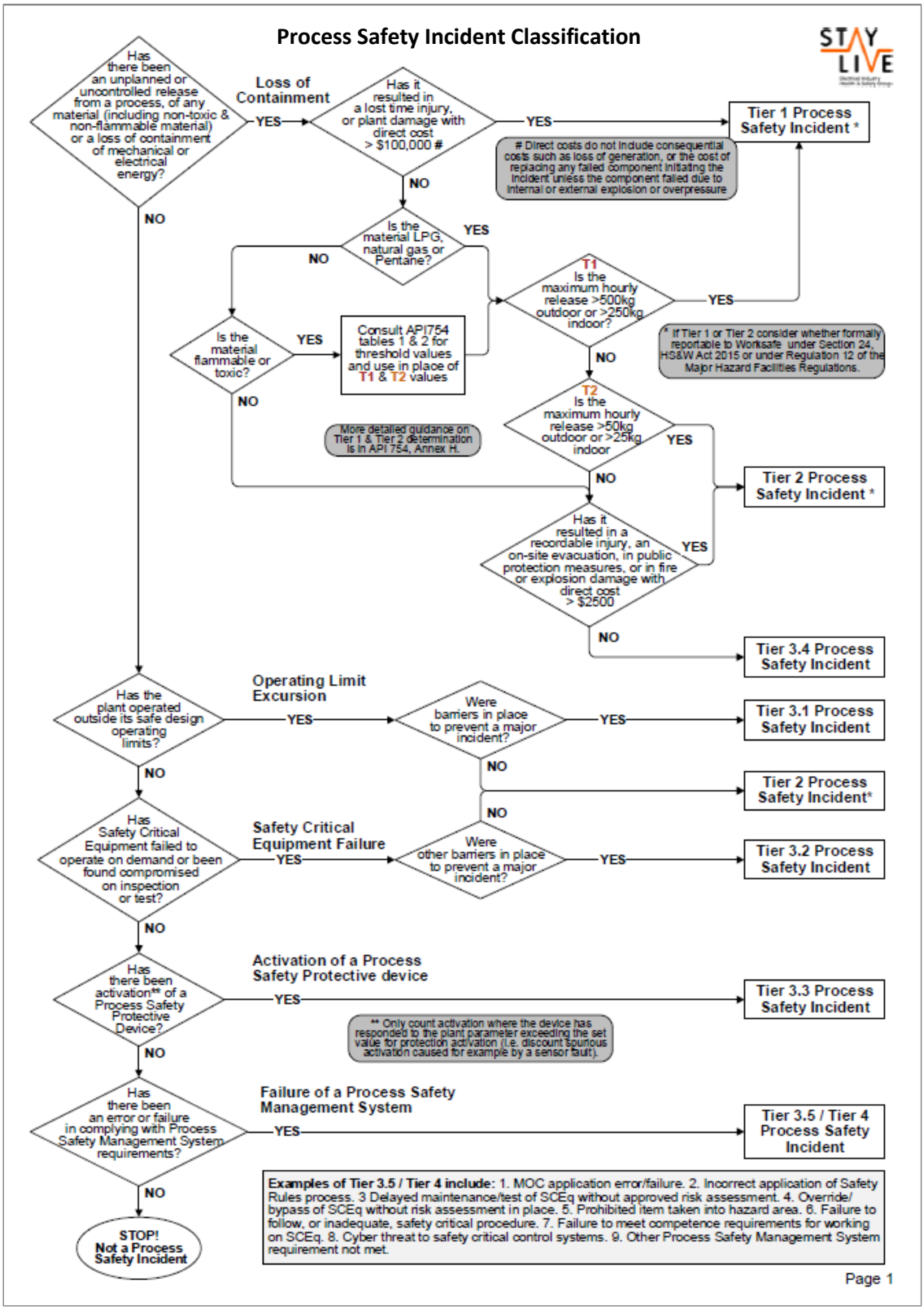
Tier	Descriptor	Notes and Examples
Unplanned or uncontrolled release from a process of any material – less severe consequences		
2	Loss of containment	Threshold values for toxic and flammable substances are to be taken directly from the API RP 754 schedules, while companies operating hydro dam facilities may choose to set their own limits or threshold values for a Tier 2 incident arising from a significant loss of a dam or primary containment of reservoir water.
2	Loss of containment or control of mechanical energy	For example, leading to a recordable injury, on-site evacuation, public protection measures, or fire or explosion damage of > $2,500
2	Loss of containment or control of electrical energy	For example, leading to a recordable injury, on-site evacuation, public protection measures, or fire or explosion damage of > $2,500
Challenges to process safety systems		
3.1	Plant operating outside its safe design operating limits.	
3.2	Safety Critical equipment failing to operate on demand or found compromised* during inspection or test	*Compromised means that the inspection or test indicates that if called upon, the equipment would not operate with the required level of reliability
3.3	Activation of a process safety protective device.	Activation is counted as a Process Safety incident only if the equipment is responding to a genuine exceedance of the activation parameter. Spurious trips caused, for example, by a faulty sensor sending an incorrect trip signal are therefore excluded. **Note:** This criterion is the one that generally requires the greatest guidance on interpretation.
3.4	Loss of primary containment where the loss of material is less than the threshold for a Tier 2 incident.	Given the variables in environment and compliance regulations at various locations there is a degree of flexibility in how Tier 3 thresholds are set for each organisation.
3.5	Error or failure in applying a process safety management system.	**Note:** These could be categorised as Tier 4 instead depending on the approach decided by the company.
Errors or failures in operating discipline and management system performance		
4.1*	Management of Change Process error or failure.	*Some companies classify these types of events as Tier 4 incidents, and others roll them into a Tier 3 sub-classification. Note, this applies to all categories below.
4.2	Incorrect application of the Permit (tag out/lock out) process.	

Tier	Descriptor	Notes and Examples
4.3	Delayed/missed maintenance or test of safety critical equipment without a formal risk assessment in place.	
4.4	Override or bypass of safety critical equipment without a documented risk assessment in place.	
4.5	Prohibited item taken into hazard area.	
4.6	Inadequate, or failure to follow, a safety critical procedure.	
4.7	Failure to meet competency requirements for work on safety critical equipment.	
4.8	Cyber threat to a safety critical control system.	
4.9	Other process safety management system requirements not met.	

7 Process for Incident Classification

Figure 1 outlines the recommended process for classifying process safety incidents within the New Zealand electricity industry.

Figure 1 – Process Safety Incident Classification



Before finalisation of a Process Safety incident classification, validation by staff with process safety expertise is recommended.

Staff with process safety expertise can coach others in the classification of Process Safety incidents to assist in raising awareness and achieving consistency.

8 Tier Escalation Scenarios

There are examples of process safety incident scenarios where the event has progressed along the route to harm but has stopped short of a Tier 1 or Tier 2 consequence. In these cases, the avoidance of a Tier 1 or Tier 2 consequence has been by good fortune rather than by the presence of engineered processes or controls. In such cases, the full significance of some incidents would not be captured adequately, and an escalation process is appropriate.

The Process Safety Working Group therefore recommends:

- Incidents involving loss of primary containment of mechanical, electrical and bulk water energy sources are to be included as Tier 1 or Tier 2 incidents if they result in the **specified consequences** for that Tier.
- Tier 3 incidents are to be escalated to Tier 2 in those instances where there were **no engineered processes or controls in place** to prevent Tier 1 or Tier 2 consequences and these consequences would have occurred had other credible conditions been present at the time of the incident.
- The level of any incident may be escalated to Tier 2 or Tier 1 if those reporting believe that the higher Tier **more accurately reflects the significance** of the incident. Individual companies should identify their arrangements and authorities for exercising this discretion.
- The Process Safety Working Group recommends that activation of any process-safety-related **protection** is a Tier 3 Incident, irrespective of the process safety hazard it is providing protection against.
- If there has been a Tier 3 incident relating to plant operating outside its **safe design limits** or resulting from safety critical equipment being found to be compromised, then it will be escalated to a Tier 2, if there were no installed controls or barriers in place to prevent Tier 2 or Tier 3 consequences and only “good fortune” with respect to other factors avoided significant consequences.

9 Definitions

Term	Definition
Containment, primary	A tank, vessel, pipe, truck, rail car, or other equipment designed to keep material within it, typically for the purposes of storage, separation, processing, or transfer of material.
Containment, secondary	An impermeable physical barrier specifically designed to mitigate the impact of materials that have breached primary containment. Secondary containment systems include, but are not limited to, tank dikes, curbing around process equipment, drainage collection systems, the outer wall of open top double walled tanks, etc.
StayLive	A New Zealand industry group with the goal of driving material and sustainable improvement in health and safety for employees, contractors and members of the public across the electricity industry.

10 References

- Process Safety Performance Indicators for the Refining and Petrochemical Industries. ANSI/API Recommended Practice 754, April 2016
- High level framework for process safety management. 1st Edition December 2010. Energy Institute, London. ISBN 978 0 85293 584 2
- Developing process safety indicators. A step-by-step guide for chemical and major hazard industries. HSG254. UK Health and Safety Executive. ISBN 978 0 7176 6180 0