Migrating an Organizational Incident Reporting System to a CCPS Process Safety Metric Model

2010 Mary Kay O’Connor Process Safety Center International Symposium
College Station, Texas
October 26, 2010

presented by

Delmar R. “Trey” Morrison III, PhD, PE, CFEI

Mark Fecke, PE, CFEI
John Martens, PhD, PE
Exponent, Lisle, IL, USA
Introduction

- Learning from past accidents
- Incident Reporting Systems
- Industry move to Metrics-based management – Process Safety Metrics
  - Leading and Lagging Indicators
- How do we get from OII reporting system to a Process Safety Metric reporting system?
Safe operation is goal for Chemical Concerns

Investigate incidents to learn/prevent

How can management?

- Track improvement
- Allocate efforts
- Develop organization-wide approaches
References

- *Process Safety Leading and Lagging Metrics* – CCPS
- *Developing Process Safety Indicators* – HSE
- *Guidance on Developing Safety Performance Indicators* - OECD
Types of Incidents

- Workplace & occupational safety incidents & near misses
- Minor process safety incidents & near misses
- Major process safety incidents & near misses
Comparison of Types

- **Occupational Safety**
  - Easily identifiable
  - Common & well understood metrics
  - Easily addressable root causes

- **Process Safety**
  - Harder to identify (incidents and near misses)
  - Difficult to classify and understand
  - Harder to address root causes
Comparison of Types

- Little relationship between success at OII level and preventing major process accidents
- Major accidents may be result of complex circumstances that are unlikely to be repeated
PSIs and Near Misses

• 4 criteria for appropriate PSI metrics
  – Chemical or process involvement
  – Exceeds a minimum reporting threshold
  – Located onsite in a process area
  – Acute release of chemical/energy

• Near Misses
  – Do not meet reporting threshold, but potentially unsafe conditions are noted
  – Slightly more subjective than PSI
Company X Background

- Multi-site North American Chemical Producer
- 40 Types of units/areas
- Existing OII-based Incident Investigation and Reporting System
- 5 years of data / 7000 incidents and near misses
- Desire to migrate systems to PS Metrics
Objectives

• Analyze current database and reporting structure
• Extract useful baseline metrics
• Recommend changes to
  – Investigation practices
  – Incident & near miss reporting
  – Database
## IRS Reporting Structure

<table>
<thead>
<tr>
<th>Report Section</th>
<th>Data Entry Type (Free-form versus Drop-down)</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Information</td>
<td>Combination</td>
</tr>
<tr>
<td>Incident Description</td>
<td>Free-form</td>
</tr>
<tr>
<td>Immediate Causes</td>
<td>Free-form</td>
</tr>
<tr>
<td>Basic Causes</td>
<td>Free-form</td>
</tr>
<tr>
<td>Risk Assessment</td>
<td>Drop-down</td>
</tr>
<tr>
<td>Corrective Actions</td>
<td>Free-form</td>
</tr>
<tr>
<td>Administrative Sign-off</td>
<td>Combination</td>
</tr>
<tr>
<td>Report Section</td>
<td>Data Entry Type (Free-form versus Drop-down)</td>
</tr>
<tr>
<td>------------------------</td>
<td>--------------------------------------------</td>
</tr>
<tr>
<td>General Information</td>
<td>Combination</td>
</tr>
<tr>
<td>Incident Description</td>
<td><strong>Free-form</strong></td>
</tr>
<tr>
<td>Immediate Causes</td>
<td><strong>Free-form</strong></td>
</tr>
<tr>
<td>Basic Causes</td>
<td><strong>Free-form</strong></td>
</tr>
<tr>
<td>Risk Assessment</td>
<td>Drop-down</td>
</tr>
<tr>
<td>Corrective Actions</td>
<td><strong>Free-form</strong></td>
</tr>
<tr>
<td>Administrative Sign-off</td>
<td>Combination</td>
</tr>
</tbody>
</table>
## Use of ISRS for Risk Analysis

<table>
<thead>
<tr>
<th>Category</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Unassigned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potential Severity</td>
<td>Serious</td>
<td>Major</td>
<td>Minor</td>
<td>Blank</td>
</tr>
<tr>
<td>Event Recurrence Probability</td>
<td>Likely</td>
<td>Possible</td>
<td>Unlikely</td>
<td>Blank</td>
</tr>
<tr>
<td>Exposure Frequency</td>
<td>Frequent</td>
<td>Occasional</td>
<td>Rare</td>
<td>Other</td>
</tr>
</tbody>
</table>
Ex™

Analysis of All Reports

Comparison: Total Incident Rate (TIR) and Near Miss Rate (NMR) for 11 large sites.
Extracting Most Severe Incidents & Near Misses
Finding PSIs in Database

- Site A – 1000 incident reports
- **PSI criteria:**
  - Releases, spills
  - Fires in equipment
  - Deviations from normal safe conditions in equipment/processes
  - Broken equipment in process units or boilers, not PPE or tools
  - Instrumentation and controls issues
<table>
<thead>
<tr>
<th>Category</th>
<th>Incident Rate</th>
<th>Near Miss Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>OII</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Process Safety</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Vehicle Accident</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Other</td>
<td>-</td>
<td>1</td>
</tr>
</tbody>
</table>
Suggestions

• Select specific metrics
• Risk assessment system
• Investigation expectations/training
• Incident reporting system/database
<table>
<thead>
<tr>
<th>Process Safety Incident</th>
<th>Near Miss</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Number of incidents</td>
<td>1. Number of near miss events</td>
</tr>
<tr>
<td>2. PSTIR (annualized)</td>
<td>2. NMTER (annualized)</td>
</tr>
<tr>
<td>3. PSISR (annualized)</td>
<td>3. Near Miss Rate by Potential Severity Levels</td>
</tr>
<tr>
<td>4. Process Safety Rate by Severity Levels</td>
<td></td>
</tr>
<tr>
<td>5. Average time to complete investigation reports</td>
<td></td>
</tr>
<tr>
<td>6. Repeat causes</td>
<td></td>
</tr>
</tbody>
</table>
• Process Safety Total Incident Rate
  – Comparison between sites
  – Comparison to industry
  – Future: comparison among units

\[
PSTIR = \frac{\text{Total PSI} \times 200,000}{\text{Total employee and contractor work hours}}
\]
• Process Safety Incident Severity Rate
  – Evaluate aggregate costs
  – Prioritize areas for focus

\[
\text{PSISR} = \frac{\text{Total Severity Score for all PSI} \times 200,000}{\text{Total employee and contractor work hours}}
\]
<table>
<thead>
<tr>
<th>Severity</th>
<th>Score</th>
<th>Health &amp; Safety</th>
<th>Environment</th>
<th>Community</th>
<th>Facility</th>
</tr>
</thead>
</table>
| 1        | 27    | Multiple worker fatalities | Major environmental impacts  
Large, hazardous unconfined release | Public fatalities  
Major adverse public reaction | Extensive property damage or business loss (>5MM) |
| 2        | 9     | Worker fatality | Significant environmental impacts  
Unconfined release | Public injuries  
Adverse public reaction | Significant property damage or business loss  
($1MM to 5MM) |
| 3        | 3     | Worker injuries (Recordable, Offsite Medical Aid, Lost Time) | Moderate environmental impacts  
Small, localized unconfined release | Minor public injuries  
Moderately adverse public reaction | Moderate property damage or business loss  
($100M to 1MM) |
| 4        | 1     | Minor worker injuries (Non-recordable, Onsite Minor First Aid) | Minor environmental impacts  
Hazardous release contained | No public injuries  
No adverse public reactions | Low property damage or business loss  
(<100M) |
| 5        | 0     | No worker health effects | Insignificant release quantity | No public health effects  
No adverse public reaction | No property damage or business loss |
Defining PSIs for New IRS

- CCPS Guidelines:
  1. Chemical or chemical process involvement
  2. Release/incident exceeds a minimum reporting threshold
  3. Incident located onsite in a process area
  4. Acute release of chemical/energy
Available for free download at http://www.aiche.org/ccps/knowledgebase/measurement.aspx
**Introduction**

In this section, you will be asked a series of questions to determine whether the incident you are evaluating meets the criteria to be called a "Process Safety Incident".

Following is a list of things you will need to know in order to answer the questions.

- Was a chemical or chemical process involved?
- In what type of facility did the incident occur?
- If personnel were injured, what types of injuries (RWC, DAWC, Fatality, etc.) and whether there were any hospital admissions as a result of the injuries.
- Direct cost of the incident ("direct cost" is defined in Help, accessible when you get to the question).
- Chemical names and quantities released.

**Note:** This tool does not save any of the evaluation data. You may quit the tool at any time, but when you come back, you must start again at the beginning.

**EXCLUSIONS:** You may choose to view the list of exclusions by clicking the button below. If the incident you are evaluating meets any of the exclusions, it is NOT a Process Safety Incident, and you do not need to do this evaluation.
Criterion 1: CHEMICAL PROCESS INVOLVEMENT

Did the incident involve a chemical or chemical process?

Guidance

A chemical or chemical process must have been directly involved in the damage caused.

For this purpose, the term "process" is used broadly to include the equipment and technology needed for chemical production, including reactors, tanks, piping, boilers, cooling towers, refrigeration systems, etc.

An incident with no direct chemical or process involvement, e.g., an office building fire, even if the office building is on a plant site, is not reportable.

Injuries and "Process Involvement"

An employee injury that occurs at a process location, but in which the process plays no direct part, is not reportable as a PSI (though it could be an OSHA or other agency reportable injury).

The intent of this criterion is to identify those incidents that are related to process safety, as distinguished from personnel safety incidents that are not process-related. For example, a fall from a ladder resulting in a lost workday injury is not reportable simply because it occurred at a process unit. However, if the fall resulted from a chemical release, then the incident is reportable.

For more guidance on injuries, see Criterion 3A.
Criterion 2: LOCATION

Did the incident occur in facilities involved in the production, distribution, or storage of chemicals?  

YES NO

Guidance

An incident satisfies the location criteria if the incident occurs in production, distribution, storage, utilities or pilot plants of a facility reporting metrics under these definitions.

This includes tank farms, ancillary support areas (e.g., boiler houses and waste water treatment plants), and distribution piping under control of the site.

All reportable incidents occurring at a location will be reported by the company that is responsible for operating that location. This applies to incidents that may occur in contractor work areas as well as other incidents.

At tolling operations and multi-party sites, the company that operates the unit where the incident initiated should record the incident and count it in their PSI metric.
Criterion 3A: INJURY THRESHOLD

Did one or more people receive a DAWC (or equivalent) injury as a result of process-related loss of primary containment, fire, explosion or overpressure?

**Guidance**

Answer the question NO if any of the following are true:
- There were no injuries of any type to anyone,
- There was one or more injury or fatality, but it was not the result of a loss of containment or fire, explosion or overpressure,
- There was one or more injury and it WAS result of a loss of containment or fire, explosion or overpressure, but the most severe injury did NOT result in a Days Away from Work Case (DAWC, or equivalent) or fatality.

Answer the question YES if any of the following are true:
- Employee or contractor working on the site received an OSHA DAWC injury (or equivalent),
- Employee or contractor working on the site received a fatality,
- Anyone else on the site (e.g. visitor, vendor) received a fatality or an injury severe enough to require admission to a hospital,
- Anyone off-site received a fatality or an injury severe enough to require admission to a hospital.

**Examples**

Examples of DAWC injury or fatality cases that WOULD be reportable include:
- a burn from steam released during cleaning,
- a physical injury from a cap blown off by pressure during a pressure test, or
- a chemical burn from a spill while taking a sample.

Each of these cases are directly due to the release of energy or material from the process.

Examples of DAWC injury or fatality cases that WOULD NOT be reportable include:
- a fall from an elevated work station while performing maintenance,
- a burn from a fire in a laboratory or office building, or
- injuries from an excavation cave-in.

None of these cases are directly due to the release of energy or material from the process.
This incident DOES meet the criteria for a Process Safety Incident.

Proceed with Severity Index determination

Close
Conclusions

- Migrating an existing database is not easy – each record may have to be reviewed
- With some assumptions, a basis for past incidents can be created
- PS Metrics requires
  - Corporate definitions
  - Corporate expectations
  - Training, Tools, Database
- CCPS tools are available
QUESTIONS?