White Paper: CCPS Process Safety Metrics Review Considerations from an ASM Perspective

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CCPS Process Safety Metrics Review: Considerations from an ASM Perspective

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ASM Center for Chemical Process Safety – Metrics Project*

- Three Key Deliverables (for 2007)
  - Common Industry-Wide Lagging Metric
  - Near-Miss or Other Lagging Metrics
  - Draft of Leading Metrics

- Format
  - Pamphlet with Recommendations in the three areas mentioned above (Leading metrics, Lagging Metrics, Near Miss reporting) - COMPLETE!
  - Guideline Book - by EOY 2008

*Taken from a presentation by Tim Overton of CCPS to ASM Consortium, 22-Jan-08
Overview

• What is the ASM Consortium?
• Relation to Center for Chemical Process Safety and CCPS Metrics
• CCPS Process Safety Metrics Summary
• ASM Consortium Assessment
• Recommendations:
  – Some Specific Items
  – Some General Items
• Summary and Conclusions
Founded in 1994

Creating a new paradigm for the operation of complex industrial plants, with solution concepts that improve Operations’ ability to prevent and respond to abnormal situations.

www.asmconsortium.org

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What is an Abnormal Situation?

- An industrial process is being disturbed and the **automated control system can not cope**...
- Consequently, the operations team must **intervene to supplement** the control system.

This impacts **safety and profitability** in multiple ways:
Sources of Abnormal Events

Established in literature; confirmed by 18 plant studies - US, Canada, & Europe

People:
• Fail to detect problems in reams of data
• Are required to make hasty interventions
• May be unable to make consistent responses
• May be unable to communicate well
ASM Areas of Focus

- Abnormal Situation Understanding
- Management Structure & Policy
- Training and Skill Development
- Communications
- Procedures
- Control Room and Field Environment
- Monitoring, Control and Support Applications

ASM = **Prevention, Detection, Mitigation** of Abnormal Situations
ASM CCPS PS Metrics Project*

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The Safety Pyramid*

*from *Process Safety Leading and Lagging Metrics*, Dec. 2007, Center for Chemical Process Safety

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CCPS PS Metrics Project

Three Key Deliverables (for 2007)

- Common Industry-Wide Lagging Metrics
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ASM Areas of Focus

The Safety Pyramid*

- Process Safety Incident
- Other Incidents (e.g., all other Loss of Primary Containment or fires)
- Near Miss: System failures which could have led to an incident
- Unsafe Behaviors or insufficient operating discipline

ASM R&D Areas of Focus

- Abnormal Situations
- ASM Practices

*from Process Safety Leading and Lagging Metrics, Dec. 2007, Center for Chemical Process Safety
1. **Count of Process Safety Incidents (PSI)**
   Any releases of material or energy from a process unit resulting in:
   - Employee lost time injury(s)
   - Fire or explosion damage > $25K
   - Chemical release from primary containment > standardized thresholds

2. **Process Safety Incident Rate (PSR)**
   - \( \frac{\text{PSI} \times 200,000}{\text{Total Work Hrs}} \)

3. **Process Safety Severity Rate (PSSR)**
   - \( \frac{\text{Severity weighted PSI}}{\text{Total Work Hrs}} \)
ASM Assessment:

- The ASM Consortium strongly supports the effort to create common industry-wide lagging metrics and agrees with CCPS choices and metrics.
- Little research overlap due to ASMC focus on all abnormal situations.
**CCPS Near-Miss & Other Lagging Metrics**

- **Near Miss:** An undesired event that under slightly different circumstances could have led to harm to people, environment, property, or equipment or loss of process.

- **Process Safety Near Miss:**
  - Any significant release of a hazardous substance that does not meet the threshold for a “Process Safety Incident” lagging metric, or
  - Challenge to Safety Systems
    - Pressure Relief Device (PRD)
    - Safety Instrumented System (SIS)
    - Process Deviation or excursion

- **Management System Failures/Issues:**
  - Discovery of a failed safety system upon testing
  - Discovery of a defeated safety system
  - “Errors of Omission / Commission”
  - Unexpected / Unplanned Equipment Condition
  - Physical Damage to Containment Envelope
ASM Assessment:

- Strong agreement on Near Miss definition and proposed metrics
- Strong overlap in area of “process deviation or excursion”:
  - **CCPS**: “Near Misses involving a process deviation or excursion include:
    - Excursion of parameters such as pressure, temperature, flow outside operating window but remaining within process safety limits.
    - …beyond pre-established critical control points…
    - Unusual or unexpected runaway reaction…”
  - **ASMC**: “An abnormal situation is
    - a disturbance or series of disturbances in a process that cause plant processes to deviate from their normal operating state and operations intervention is necessary to return to normal operating state.”
- The point: A process deviation or excursion / abnormal situation:
  - Can progress into a safety incident.
  - Usually is prevented/detected/mitigated via the same operating methods.
Alarms in an effectively rationalized alarm system could be counted as near misses:

- Illustration of the difference between an effectively designed alarm system and an ineffectively designed alarm system. (excerpt from EEMUA Pub 191, 2007)
- In an effectively rationalized alarm system, the count of alarms represents the count of transitions into the “upset” region.
Leading Metrics:

- Based on hazards inherent in operations, critical causal factors from major incidents, metrics in CCPS risk-based safety book
- Give early indication of deterioration in the effectiveness of key safety systems
- And enable remedial action to restore these key barriers within Safety Management Systems

Metrics:

1. Maintenance of Mechanical Integrity
2. Action Items Follow-up
3. Management of Change
4. Process Safety Training & Competency (& training competency assessment)
5. Safety Culture
ASM Assessment:

- Strongest area of overlap – though from different viewpoints:
  - CCPS: focus on Process Safety Management System perspective
  - ASM: focus on operating team management and behaviors
- The Key is to look at where the Operations Management Systems practice breakdowns have potential to lead to material or energy releases.

Some relevant ASM Research in progress:

  - Identified top 10 failure modes based on 14 incident reports; investigating another 16
CCPS Leading Metrics Areas

1. Maintenance of Mechanical Integrity
2. Action Items Follow-up
3. Management of Change
4. Process Safety Training & Competency (& training competency assessment)
5. Safety Culture

ASM: Top 10 Failure Modes

5. Corrective Actions for Reported Problems
2. Comprehensive Hazop & Communications
8. MOC
4. Initial and Refresher Competency-based Training
10. Compliance with Risk-based procedure policy
1. Effective 1st Line Leadership Roles
3. Strong Safety Culture
6. Formal Shift Handover Communications
7. Task-based Communications Protocol
9. Periodic Cross-Functional Communications

GAP? – Operating Team Communications
Other Strategic Areas of Discussion

Observation: There are many more near misses than actual incidents:
  – So reporting on them must be streamlined.
  – But they have greater potential to lead us to real solutions.

Areas for future work:
• Dialog on how Near Miss and Other Lagging Indicators should be utilized by companies to get the most benefit from them.
  – SSPS Report notes that sometimes there is an inverse relationship between near miss reporting and actual incidents.
  – This paper notes that incentives based on near miss metrics often suppresses reporting of them.
• Potential standardization of common root cause categories
  – Can common root cause categories help to link the leading metrics back to the key lagging metrics, and
  – Help to improve operating behaviors and hence reduce incidents?
Summary and Conclusions

- Strong synergy between CCPS Metrics and ASM Consortium Research and Development:
  - CCPS focus on actual incident rates, incident thresholds and metrics, and equipment-centric issues.
  - ASM Consortium focuses on human factors, operating team behaviors and a broader definition of abnormal situations.

- Some specific suggestions, e.g.,
  - Use of Alarm metrics as near miss indicators
  - More emphasis on human factors, e.g., communications issues

- Some general suggestions for future work, e.g.,
  - Dialog on site utilization of near miss metrics, leading to reduced near misses.
  - Common root cause categorization for linking metrics to specific solutions