PROCESS SAFETY INCIDENTS – BIG PICTURE REVELATIONS

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OVERVIEW

• Process safety incidents continue to occur
  ► Despite regulations and industry practices

• Objective of paper:
  ► Understand reasons for continuing incidents

• Identify trends and commonalities across a large set of process safety incidents

• Total of 80 incidents studied
  ► 68 CSB completed investigations
    ▪ 28 covered by PSM
  ► 12 from CCPS *Incidents that Define Process Safety*
CONTENTS OF PAPER

- Statistical analysis of process safety issues for CSB incidents
  - 15 common issues identified
  - Further issues identified with fewer incidents
- Identification of specific incidents for each type of issue
- Discussion of the nature of the issues
- Recommendations to address each type of issue
- Overall recommendations
  - Including some for the CSB
### ANALYSIS RESULTS

<table>
<thead>
<tr>
<th>Category</th>
<th>PSM covered</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-routine operations</td>
<td>64</td>
<td>62</td>
</tr>
<tr>
<td>Safeguards</td>
<td>57</td>
<td>56</td>
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<tr>
<td>Procedures</td>
<td>43</td>
<td>44</td>
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<tr>
<td>Stationary source siting</td>
<td>64</td>
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</tr>
<tr>
<td>Compliance with standards</td>
<td>29</td>
<td>38</td>
</tr>
</tbody>
</table>

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ANALYSIS RESULTS (CONT'D.)

- **Maintenance**: 32 PSM covered, 34 All
- **Process changes**: 29 PSM covered, 32 All
- **Previous incidents**: 18 PSM covered, 28 All
- **Emergency preparedness**: 18 PSM covered, 28 All
- **Design**: 29 PSM covered, 32 All

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ANALYSIS RESULTS (CONTD.)

- Deficient standards: 32 (PSM covered) 22 (All)
- Compliance with regs: 14 (PSM covered) 18 (All)
- Normalization of deviance: 18 (PSM covered) 18 (All)
- Facility siting: 25 (PSM covered) 16 (All)
- Audits: 18 (PSM covered) 13 (All)

Legend:
- Red: PSM covered
- Blue: All

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OTHER KEY POINTS

- Time trend analysis does not show any reduction in the types of issues identified.
- Percentages for issues actually may be higher.
- Most incidents involved multiple issues:
  - Average of 5
  - As many as 13
HUMAN AND ORGANIZATIONAL FACTORS (HOF)

Results

► Many HOF issues in incidents
► Insufficient detail in CSB reports to provide percentages
► Probably present to some degree in all incidents

Recommendation:

► Make HOF a separate process safety element
► Teach critical thinking for process safety
► Address cognitive biases in decision making
PROCESS HAZARD ANALYSIS (PHA)

● Results
  ► Deficiencies were present in all cases where a PHA was performed
    ▪ Incidents not identified
    ▪ Safeguards too general and relied on procedures

● Recommendations:
  ► Address competency of practitioners and teams
  ► Address NROs directly in PHA
  ► Don’t expect PHA to address maloperation
  ► Conduct SIMOPs
KEY RECOMMENDATIONS

- Address non-routine operations (NROs) throughout all process safety elements
  - Require the use of JSA for all NROs
- Develop international standards for key process safety elements
- Manage process risks using the ALARP principle
- Set safety goals and/or risk tolerance criteria and demonstrate compliance with them
RECOMMENDATIONS FOR THE CSB

Provide and perform an ongoing analysis of all CSB incidents by:

► Expanding the incident attributes that are addressed in investigations
► Providing an appendix to each investigation report that characterizes each attribute for the incident
► Compiling a data base of incidents and their attributes that is searchable
CONCLUSIONS

- Process safety incidents continue to occur because there are common deficiencies in process safety practices
- Companies cannot rely on compliance with existing process safety regulations to protect against incidents
  - Regulations are seriously deficient
- Virtually all incidents that have occurred were preventable
- Future incidents can be prevented if we use the lessons than can be learned from identifying commonalities across incidents