CEPA S200
The Risk-based Approach

Presented by
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February 24, 2004
Toronto, Ontario

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Objectives

- Describe
  - Principles of risk-based management
  - How CEPA S200 fits with risk-based management
  - Risk assessment as a tool for meeting and exceeding the regulatory intent

- Provide further thoughts on what the future might bring
Risk and Risk-based Management

- The concept of risk includes five components:
  - Hazard inherent in an activity otherwise deemed beneficial
  - An undesirable event, which brings out the hazard
  - Adverse consequence of the undesirable event
  - Uncertainty of whether the undesirable event will happen or not (likelihood)
  - Perception about the combination of the above

- We base our decisions on perception.

- Accurate understanding of the inherent hazards, and consequences and likelihood of undesirable events, will lead to:
  - more balanced perceptions;
  - and hence to:
    - better decisions in “managing that activity” (synonymous with “managing the risks of that activity”).
Process for Risk-based Management

1. **Initiation**

2. **Scope & System Definition/ Stakeholders Needs Analysis**
   - Learning Loop
   - Continual Improvement Loop

3a. **Risk Analysis**
   - Risk Evaluation: Do we need to reduce risk?
     - Yes
     - New Risk Treatment
     - No
     - 5a. **Action**
     - 5b. **Monitoring**
     - 6. **Learn More**

3b. Cannot Decide
   - Need More Information

4. **New Risk Treatment**

Ongoing Stakeholder Participation Throughout All Steps:
Communication and Feedback
Risk Treatment as Part of Risk-based Management

- For a given “system” (e.g., an industrial plant, with its “risk treatment” practices, including process safety management practices and emergency preparedness)
  - If risk “analysis and evaluation” indicates that the risk is too high, then additional “risk treatment” measures are considered
    - In this context, additional “risk treatment” could include
      - revised operating procedures (prevention),
      - improved design standards (prevention),
      - more stringent emergency response training, including improved emergency response plans (mitigation),
      - etc.
CEPA Section 200 -

- The focal points of CEPA S200 are:
  - Prevention
  - Emergency response

- The focus, therefore, is on “risk treatment”

- However, that is not all:
  - A “risk analysis and evaluation” tool is incorporated
  - There are “risk monitoring” provisions
General Framework for Risk Analysis

Define System

Hazard/ Hazardous Event Identification

Consequence Analysis

Frequency Analysis

Risk Estimation

Risk Evaluation
Typical Risk Analysis and Presentation Tools

- Hazard/ Hazardous Event Identification
  - Checklist
  - Screening Level
  - What-if
  - HAZOP
  - FMEA
  - ...

- Modelling Tools
  - FTA
  - ETA

- Risk Map
  - Consequence Category
  - Frequency Category

- Risk Ranking
  - Consequence Category
  - Frequency Category

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Risk Analysis Techniques

- Risk analysis and evaluation can take place at different levels of detail.

- A **hierarchy** of risk analysis tools are available, depending on the requirements at hand:
  - Qualitative Techniques (Checklists, Screening Level Risk Analysis, What If, HAZOP, FMEA, FTA, ETA)
  - Semi-Quantitative (Index/Matrix) Methods
  - Quantitative Risk Analysis (QRA – FTA, ETA, Fire/ Explosion/ Dispersion Modelling, Vulnerability Modelling, Probit Techniques)

- Use of a hierarchical approach saves time and resources while at the same time ensuring systematic coverage of all facilities for significant hazards.

- Often, qualitative techniques such as SLRA, HAZOP, etc., are used in conjunction with semi-quantitative matrix methods for priority setting.
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<tbody>
<tr>
<td>Natural Gas Supply</td>
<td>1.1</td>
<td>Fireball and Jet flame from transmission line</td>
<td>Underground pipeline rupture due to corrosion, third party damage with ignition of released gas</td>
<td>1</td>
<td>4</td>
<td>L</td>
<td>2</td>
<td>2</td>
<td>VL</td>
<td>2</td>
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<tr>
<td>1.2</td>
<td>Fireball and Jet flame from transmission line</td>
<td>Aboveground pipeline rupture due to corrosion, third party damage, collision with ignition of gas</td>
<td>1</td>
<td>4</td>
<td>L</td>
<td>2</td>
<td>2</td>
<td>VL</td>
<td>3</td>
<td>4</td>
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<td>1.3</td>
<td>Gas release (with traces of H2S)</td>
<td>Upstream failure to treat gas at source</td>
<td>1</td>
<td>2</td>
<td>VL</td>
<td>1</td>
<td>2</td>
<td>VL</td>
<td>1</td>
<td>2</td>
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<tr>
<td>Process Steam Supply</td>
<td>2.1</td>
<td>Firebox explosion</td>
<td>Insufficient purge and failure of burner management system</td>
<td>2</td>
<td>1</td>
<td>VL</td>
<td>2</td>
<td>1</td>
<td>VL</td>
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<tr>
<td>2.2</td>
<td>Steam drum BLEVE</td>
<td>Material failure</td>
<td>1</td>
<td>1</td>
<td>VL</td>
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<td>1</td>
<td>VL</td>
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<td>3</td>
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Actions:
- Work permit system; cathodic protection
- Install collision protection at main gas inlet to plant process area. Improve line labelling and develop unique colour code for piping.
- Check possibility of H2S in gas supply
- Inspections before installations; NDT testing
Quantitative Techniques

Burning Gas Cloud Modelling

Wind

Limit of Fire Damage

Point of Release

Edge of Flammable Cloud
100% Fatalities

Actual Situation

Model

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CEPA Section 200

- The risk analysis and evaluation tool incorporated into the CEPA S200
  - Checklist of hazardous materials, with specified threshold quantities

- The threshold quantities provide a basis for evaluating whether an emergency plan is needed for the purposes of the legislation

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“Risk” versus “Consequence”

➤ Note:

➤ Strictly speaking, the Schedule 1 list of substances is more of a “consequence” analysis tool, rather than “risk”
  ➤ It does not include consideration of the frequency of a hazardous event involving the hazardous material on the list
CEPA S200 - Thresholds

- For the derivation of the thresholds, certain consequence (as opposed to risk) criteria were used (Lacoursiere, 2002).
  - These criteria typically consist of a given damage level at 100 m from the event location, e.g.,
    - for toxic gases, IDLH, or Immediately Dangerous to Life and Health concentration in air
    - for explosions, 3 psi overpressure
  - They follow the US EPA Risk Management Program consequence modeling methodologies for establishing thresholds.

- Recommendation:
  - It would be useful for companies to understand these criteria, so that, for substances that may not be on the list,
    - they could do their own risk assessment to establish appropriate thresholds, and
    - develop environmental emergency plans for the protection of the public and the environment as part of their efforts of continual improvement, even though there may not be legislative requirements to have such plans.
The inspection provisions in the regulations provide the basis for monitoring their implementation, and are part of the quality management loop.

Training requirements can be considered as additional risk treatment measures.

Testing requirements can be considered as additional risk monitoring measures to strengthen the usefulness of the environmental emergency plan.

While these training and testing requirements provide learning opportunities for emergency personnel, they do not constitute part of the learning loop for decision-making.

→ Training is part of the continual improvement loop.
→ Testing of the plan is part of the quality management loop where deficiencies as compared to the plan are identified and corrected.

→ If, as part of the testing, weaknesses in the plan or in the capabilities of the responders are identified, then the risk evaluation decision diamond will require additional training and modifications to the plan itself through the continual improvement loop.
CEPA S200 – Plan Basis

- The regulations require “the identification of any environmental emergency” to form the basis of the plan.

- Identification of the hazardous substance through the Schedule 1 “check” list is not sufficient for this purpose.
  - Further examination of possible scenarios is needed.

- Recommendation:
  - The hazard/ hazardous event identification methods described earlier in this presentation are likely candidates for this purpose of identifying environmental emergency scenarios to form the basis of the plan.
  - SLRA, HAZOP, What-if, etc.
CEPA S200 – Notification of the public

- The regulations require an environmental emergency plan to include “the measures to be taken to notify members of the public who may be adversely affected by an environmental emergency”.

- This implies knowledge of the extent of the potential impact zones by the company to form the basis of the plan.

- Recommendation:
  - The US EPA RMP scenario definitions and consequence modeling methodology would likely be acceptable for this purpose, given the heavy reliance on this methodology in establishing of the CEPA thresholds.
  - Other, more sophisticated consequence analysis techniques are also available, if improved accuracy is desired.
Further Thoughts

- The prevention provision in the legislation is somewhat new as emergency response plans go.
  - This provision fills a significant gap that existed in Canadian legislation, namely process safety management.
  - The US equivalent of this provision is the OSHA 1992 Process Safety Management regulations.
Further Thoughts - 2

- The CEPA Section 200 regulations include public health and safety as a specific focus.
  - A particular concern with environmental emergencies is the potential presence of members of the public that could be in harms way.
  - Presence of the public, in turn, is a strong function of the land use around the facility.
  - Land use planning is generally controlled by municipalities, under certain environmental guidelines set by the provincial environment ministries regarding different types of industries.
  - Typically, the potential for environmental emergencies originating from a facility that has hazardous materials do not factor into land use planning (unless a municipality has its own - very progressive - by-laws in this regard).
  - This issue seems to be “falling through the cracks” between different jurisdictions,
    - Significant gap within the Canadian legislative framework regarding management of risks to public health and safety.
Example Risk Acceptability Criteria for Land-use Planning

Annual Individual Risk (chance of fatality per year)

<table>
<thead>
<tr>
<th>Risk source</th>
<th>No other land use</th>
<th>Manufacturing, warehouses, open space (parkland, golf courses, etc.)</th>
<th>Commercial, offices, low-density residential</th>
<th>All other uses including institutions, high-density residential, etc.</th>
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<tbody>
<tr>
<td>100 in a million</td>
<td>10 in a million</td>
<td>1 in a million</td>
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<td>(10^{-4})</td>
<td>(10^{-5})</td>
<td>(10^{-6})</td>
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Allowable Land Uses
THANK YOU!

QUESTIONS AND DISCUSSION