Safety and Risk Management Aspects for Major Accident Industry in Poland

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PROCESS SAFETY MANAGEMENT
What is PSM?

COMPREHENSIVE EVERGREEN SYSTEM FOR PREVENTION OF MAJOR ACCIDENTS

Focus on
- AVOIDING THE OCCURRENCE OF CATASTROPHIC RELEASES
- MINIMIZING THE CONSEQUENCES OF CATASTROPHIC RELEASES

Accidents are viewed as lack of Management Control
Process Safety Development


- Increasing number and size of facilities
- Highly complex new technologies using large inventories, working under extreme operating conditions.

Increase awareness and concern about major accident (safety science, organisations and government and industry Regulations (Seveso Directive in EU) !
Industrial plant changes
Major Accidents

Flixborough Incident 1974
Losses and causes for major accidents

Losses in USA refineries due to major accident hazards

The main causes of major accidents - management oversights and omissions (up to 70-80%)
The key element of PSM applicable to major hazard industry is *Risk Management Process*. 

Elements of PSM
Process Safety Management Benefits

- Protecting people
- Avoiding production and Markets lost after accident
- Satisfying regulatory requirements
- Reduction of insurance costs
Process Safety Management and Risk Management Process
Process Risk Management

HAZARD ANALYSIS
Identification of hazards

RISK ANALYSIS
Risk calculation

RISK ASSESSMENT
Comparing and judging the significance of the risk

ALTERNATIVES GENERATION
Identifying alternatives for managing risk

RISK COST BENEFIT ANALYSIS
Risk cost benefit analysis

ALTERNATIVES SELECTION
Selection of optimal alternative (one or more)

IMPLEMENTATION AND ENFORCEMENT
Implementives, monitoring and enforcing alternative

INFORMATION for owners and society

OTHER INFORMATION
State of the art in Process Safety Management in Poland

358 Seveso Plants (171 upper-tier and 187 lower-tier plants)

1205 non-Seveso Establishments

<table>
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<tr>
<th>Advantages of Polish process safety measures</th>
<th>Disadvantages of Polish process safety measures</th>
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<tr>
<td>- general conformity to the technical standards,</td>
<td>- not appreciation of safety management system,</td>
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<td>- quite good technical standards,</td>
<td>- limited staff involved in process safety manag,</td>
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<td>- well organized health and safety staff and</td>
<td>- not enough specialists and tools in process risk</td>
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<tr>
<td>Labour Inspection,</td>
<td>- limited application of risk analysis,</td>
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<td>- well organized accident investigation process and rescue system.</td>
<td>- unsatisfactory safety culture.</td>
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Elements of PSM of special interest to the Polish Industry

1. Process Risk Management
2. Management of Change
3. Human Error - Safety Culture
4. Learning from Incident
5. Safety Performance Indicators
The methods used in Risk Management

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<th>Group</th>
<th>Relevance criteria</th>
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<td>Input data and level of team expertise</td>
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<td>Complexity of the plant and method</td>
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- Ranking methods: Low
- PHA methods: Low
- Scenario analysis methods: Medium/High
- LOPA Basic methods: Medium
- Complex methods, QRA: High
- Time required: Low
- Complexity of the plant and method: Low
- Nature and degree of uncertainty: Medium
- Applicability to SEVESO sites: Medium
- Nature and degree of uncertainty: Medium/high
- Applicability to SEVESO sites: Medium
- Time required: Very long
The LOPA assumes that no layer of protection is perfect; every layer has some probability failure on demand (PFD). Therefore the risk of occurrence of unwanted consequences depends on the failure of the Independent Protection Layers-IPLs.
## LOPA

### Advantages
- Focuses on major accident hazard events
- Useful for prioritizing hazard scenario and making a risk-based decision
- Allocates risk reduction measures efficiently
- Is less work-demanding than FTA/QRA
- Is intuitive, easy to learn and well understood by industry people
- Possible extension of LOPA framework to other risk assessment purposes

### Disadvantages
- Does not identify incident scenario
- No effect of the mitigated severity of consequence on the risk index
- Uncertainty of frequency data used
- PFD only available for basic IPLs and initiating causes
- Doesn’t pay an attention to non-SIS layer of protection, especially human and operating culture
ExLOPA for ATEX

\[ R_n (T_{\text{EXP}}) = f (F_{\text{atex}}, P_{\text{EFI}}, F_{\text{SM}}, \text{SC}) \]
Management of Change

Establish and implement Written Management of Change Procedures which address:

Technical Basis
Impact on Safety and Health (risk assessment)
Modifications to Operating Procedures
Necessary Time Period for the Change
Authorization Requirements
Safety Culture

Achieving a positive safety culture in organization is fundamental to managing health and safety effectively.

The following organisational factors need to be included:

- Visible management commitment (leadership)
- Management style
- Good communication between all levels of employee
- A balance of health and safety and production goals
- Participation in safety Health & safety resources
- Risk-taking behavior
- Trust between management and frontline staff
- Industrial relations and job satisfaction
- Safety training

Safety culture assessment should be adopted!
You don’t improve what you don’t measure

An effective Process Management System requires the use of key performance indicators.

In Poland, there is practice to analyse so-called "lagging metrics". They represent a retrospective measures of unexpected failures occurring in normal operations.

In terms of prevention it is important to use "leading metrics", representing measures of activity in risk control discover during routine checks.

The leading metrics can be subsequently used for assessment of potentiality of major hazards occurrences.
Lagging and leading metrics

**lagging metrics** represent a retrospective measures of unexpected failures occurring in normal operations. **leading metrics**, representing measures of activity in risk control, are discovered during routine checks before major failure.
Learning from incidents

Six steps for effective learning from incidents

1. Detection of a SHE incident
2. Reporting of the incident
3. Apply proper analysis of the incident (Tripod, MART, MORT)
4. Establishing of the learning effects
5. Implementation of the learning effects
6. Checking the effectiveness of the implementation

Learning must go on various organizational levels: site level, plant level and corporate level.
Conclusions

1. There is need for national data base on incident /accidents and development of cooperation with other international sources.

2. Risk management process implementation requires process safety education program to be included in Polish Higher Learning. Uncertainty aspects in analysis should be widely considered.

3. Special attention should be paid to the management of change, safety performance Indicators, safety culture and learning from incidents. These elements should be an integral part of PSM in each Polish major hazard company.

4. Attention should be paid also to the Non-Seveso establishments which poses the events with the attributes of a major accident.