

CE 400 / CE 500

Process Safety Management

Lecture 18 Process Hazards Analysis II

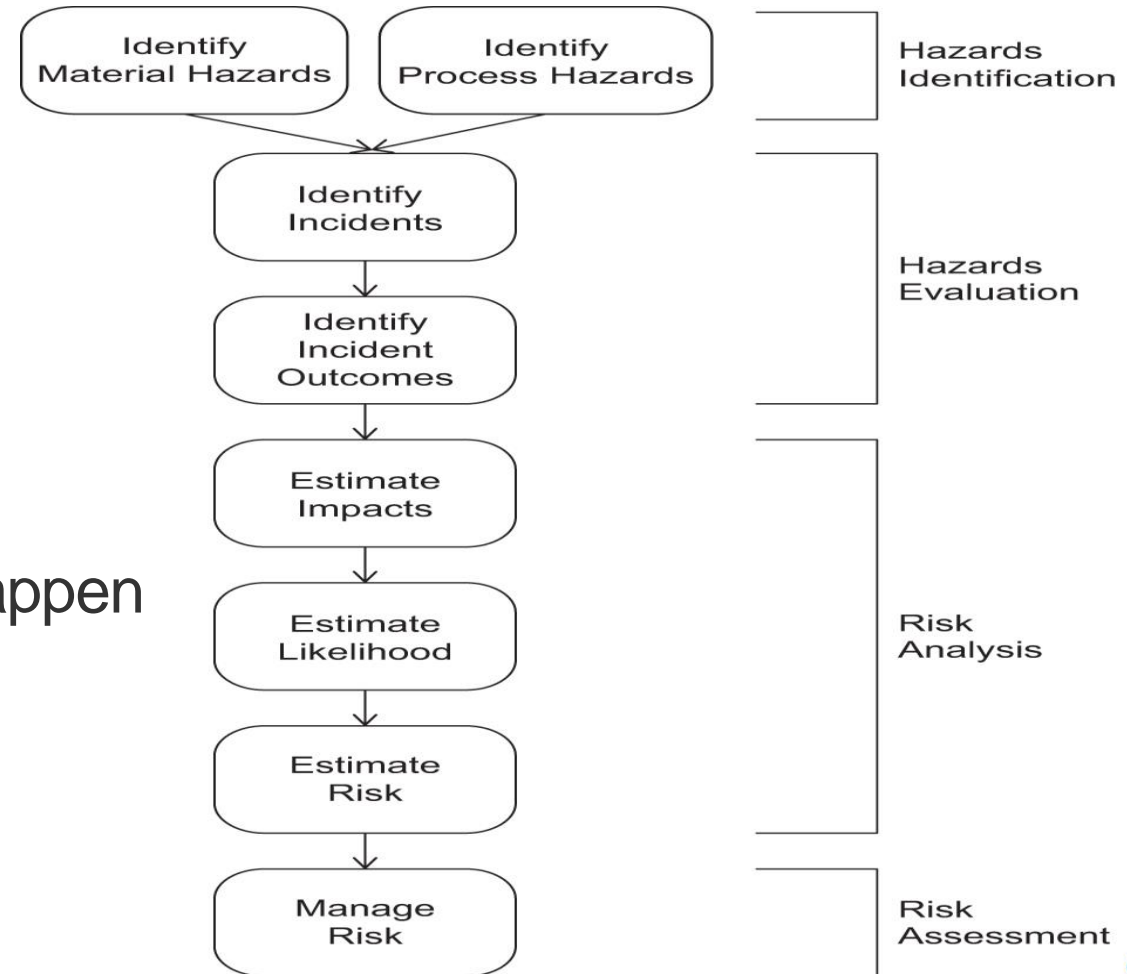
Instructor: David Courtemanche



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Process Hazards Evaluation

- First you have to identify the hazards
- Next identify what kinds of things can happen
 - HAZOP, What-If, FMEA
 - Next Lecture
- Then you estimate the consequences
 - Multiple subsequent lectures
- Then you estimate how likely it is to happen
 - A later lecture
- Then you determine the risk
 - Discussed in this lecture
- Then you make recommendations to mitigate the risk
 - A later lecture



Major steps in the hazards identification/evaluation and risk analysis/assessment procedures.

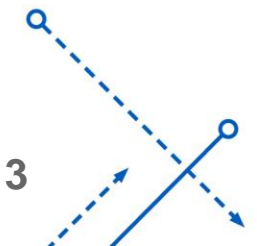
Identify the Hazards – Material Hazards

- Start with the chemicals you are dealing with – what are the hazards of:
 - Raw Materials
 - Intermediate Chemicals
 - Products
 - Waste Products
 - Unintended products
- Manufacturers Safety Data Sheets are a good place to start



Benzene SDS

- A lot of the things here are Environmental, Health, and Safety concerns
- Consult with Chemists and other Experts!
- Conduct a Field Tour with the Team

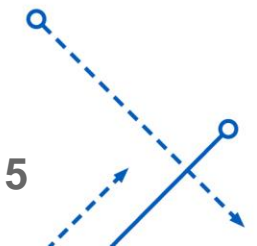


Identify the Hazards – Other Hazards of the Process

- What are temperatures and pressures that you are operating at?
 - Can personnel be exposed to thermal hazards
 - Can equipment fail under pressure and expose personnel to blast waves?
 - Specifically can you build up pressure exceeding the vessel design
- Are there mechanical hazards?
- Are there electrical hazards?
- Many common electrical and mechanical hazards are actually covered by electrical codes, vessel codes, and machine safety guidelines as opposed to Process Safety
 - Your process may have unique hazards that are specific to your process

The Field Tour

- The field tour often seems unnecessary to many team members
 - “I’ve been working in this area for years, what new am I going to see?”
- The field tour provides the following benefits:
 - The team gets grounded on what the boundaries of the study are
 - The team members are looking at the process from a PHA viewpoint, perhaps for the first time
 - The tour guide can walk the team through the process and team can discuss what process steps are occurring in each piece of equipment
 - Some questions or concerns might become apparent that the drawings and documents won’t bring up
 - Some members may not be familiar with every piece of equipment

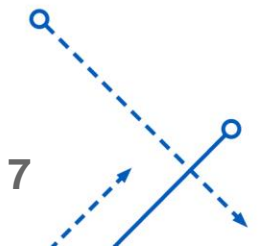


Identify the Hazards

- Consider the process and the process conditions
 - The SDS is typically for room temperature and pressure
 - A combustible liquid at room temperature may be a flammable liquid at the conditions of your process
 - What reactions can occur between the chemicals
 - What if two chemicals meet that are not supposed to see one another?
- Consider ALL possible process conditions, not just planned conditions
 - Don't just consider the temperature and pressure and expected concentrations
 - If you are using 250 lb steam (which is 406° F) to heat something to 300° F and the control system fails you could get to 406° F
 - What if the mixing is bad?

Chemical Interactions

- Use the Chemical Interaction Matrix to be aware of the hazards that mixing the chemicals in your process can generate
- Be sure that you consider all possible ranges of composition, temperature, and pressure when constructing the matrix
- Also need to consider interaction with the materials of construction and with contaminants
 - Rust
 - Oxygen
 - Water

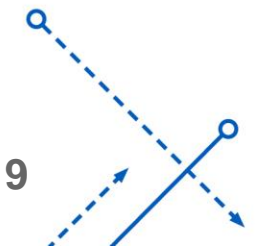


Process Hazards Evaluation

- Once you have identified what kinds of hazards that your process presents you can move on to the next steps:
 - HAZOPS, etc can be used to identify and document:
 - What can lead to events
 - What the magnitude of releases or quantities of explosive materials are involved
 - What safeguards you have in place to prevent each particular event
 - Then you determine the magnitude of the consequences and estimate the likely frequency of each event
 - Next we will jump ahead to how all of this leads into assessment of risk

Risk and Frequency Definitions

- It is obvious that we don't want to ever have injuries, fatalities, or environmental incidents
 - But where do you draw the line?
 - Are you going to permanently shut down your plant because someone might get a first degree burn on their finger once in one hundred years of operation?
- OSHA 1910-119 does not give specific requirements
- Your company must set their own tolerance levels
 - From a liability standpoint they need to be in line with what the rest of the industry has established



Risk Definitions Example

- Define Consequence levels
 - Level C1 - no harm whatsoever
 - Level C2 - minor injury, first aid case
 - Level C3 - moderate injury, medical treatment case
 - Level C4 - permanent injuries or fatalities
- Define Frequency Levels
 - Level F1 - estimated once per 10,000 years
 - Level F2 - estimated once per 1,000 years
 - Level F3 - estimated once per 100 years
 - Level F4 - estimated once or more per 10 years



Risk Matrix Example

- Tells acceptability of the combinations of Severity (consequence) and Likelihood (frequency)

	F1	F2	F3	F4
C4	III	II	I	I
C3	IV	III	II	I
C2	IV	IV	IV	III
C1	IV	IV	IV	IV

- Risk I - must mitigate to Risk III or IV with highest urgency
- Risk II - must mitigate to Risk III or IV with high urgency
- Risk III - at discretion of team whether or not this is acceptable
- Risk IV - okay as is

Recommendations

- Recommendations can lower the likely consequence severity
 - Reduce the potential of the unmitigated event
 - Put in safeguards
 - Dike to contain spill
 - Blowout panel to direct pressure wave away from personnel

OR

- Recommendations can reduce the likely frequency
 - Interlocks
 - Redundant control methods
- Recommendation must get the Risk level for the event to a III or IV

