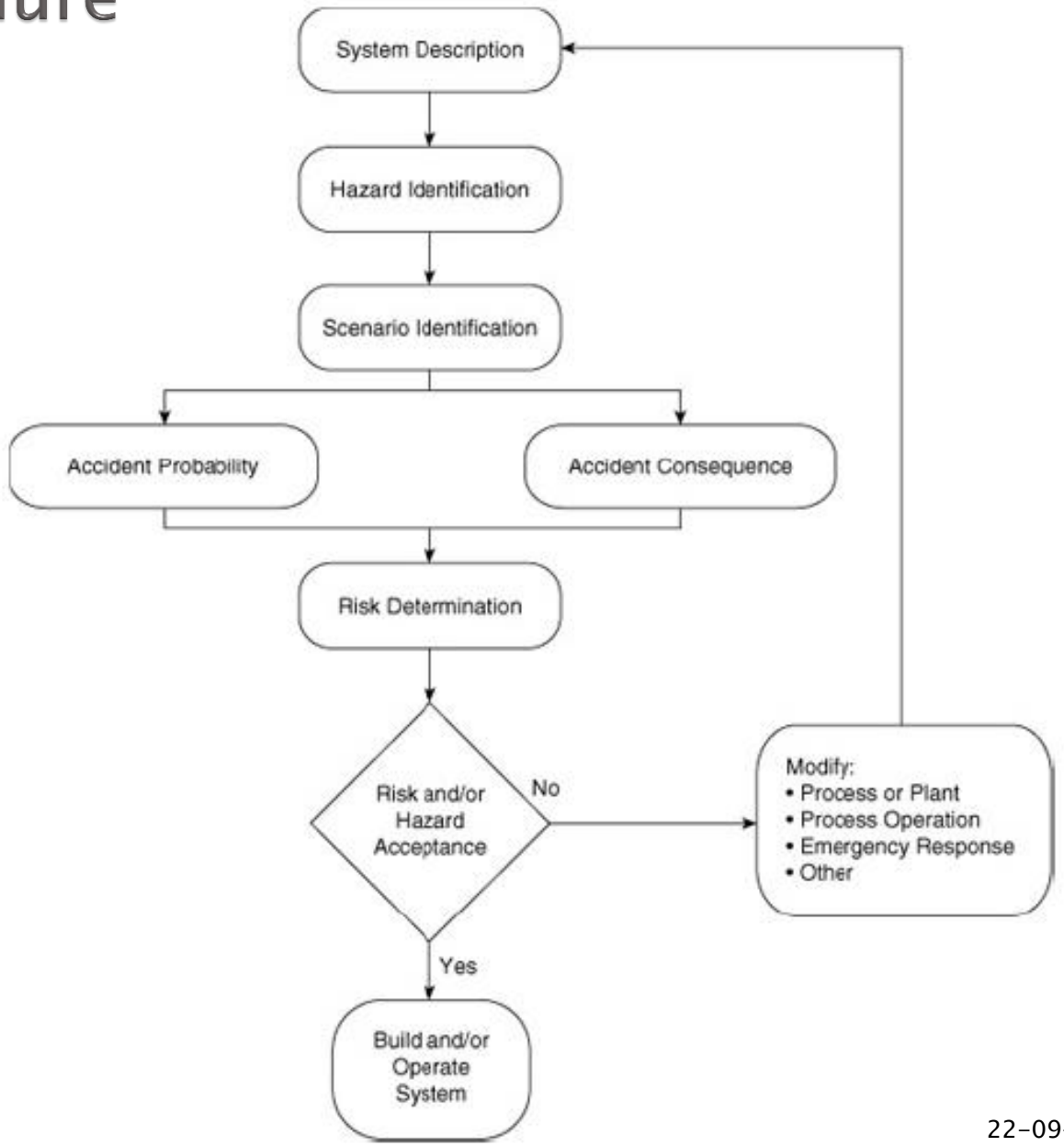
Hazards Identification

Hazards Identification

- Identify the hazards and reduce the risk well in advance of an accident.
- Each process the following questions must be asked:
    1. What are the hazards?
    2. What can go wrong and how?
    3. What are the chances?
    4. What are the consequences?
- The first question represents hazard identification. The last three questions are associated with risk assessment
- combined category called hazard evaluation
- Risk assessment procedure that determines probabilities is frequently called probabilistic risk assessment (PRA)
- Whereas a procedure that determines probability and consequences is called quantitative risk analysis (QRA).

Hazards identification and risk assessment procedure



Hazard identification and risk assessment

- hazard identification methods described as:
  - Process hazards checklists: list of items and possible problems in the process must be checked
  - Hazards surveys: This can be as simple as an inventory of hazardous materials, can be as detailed as the Dow indexes.

    (The Dow indexes are a formal rating system, much like an income tax form, that provides penalties for hazards and credits for safety equipment and procedureS)
  - Hazards and operability (HAZOP) studies:

    Various events are suggested for a specific piece of equipment with the participants determining whether and how the event could occur and whether the event creates any form of risk.

Hazard identification and risk assessment

Safety review: Formal type of HAZOP study.

The results are highly dependent on the experience and synergism of the group reviewing the process

Process Hazards Checklists

This checklist might contain the following items:

- Check oil in engine
- Check air pressure in tires
- Check fluid level in radiator
- Check air filter
- Check fluid level in windshield washer tank
- Check headlights and taillights
- Check exhaust system for leaks
- Check fluid levels in brake system
- Check gasoline level in tank

Typical process safety checklist

	Completed ↓	Does not apply ↓	Further study required ↓
General layout			
1. Areas properly drained?	☐	☐	☐
2. Aisleways provided?	☐	☐	☐
3. Fire walls, dikes and special guardrails needed?	☐	☐	☐
4. Hazardous underground obstructions?	☐	☐	☐
5. Hazardous overhead restrictions?	☐	☐	☐
6. Emergency accesses and exits?	☐	☐	☐
7. Enough headroom?	☐	☐	☐
8. Access for emergency vehicles?	☐	☐	☐
9. Safe storage space for raw materials and finished products?	☐	☐	☐
10. Adequate platforms for safe maintenance operations?	☐	☐	☐
11. Hoists and elevators properly designed and safeguarded?	☐	☐	☐
12. Clearance for overhead power lines?	☐	☐	☐
Buildings			
1. Adequate ladders, stairways and escapeways?	☐	☐	☐
2. Fire doors required?	☐	☐	☐
3. Head obstructions marked?	☐	☐	☐
4. Ventilation adequate?	☐	☐	☐
5. Need for ladder or stairway to roof?	☐	☐	☐
6. Safety glass specified where necessary?	☐	☐	☐
7. Need for fireproofed structural steel?	☐	☐	☐
Process			
1. Consequences of exposure to adjacent operations considered?	☐	☐	☐
2. Special fume or dust hoods required?	☐	☐	☐
3. Unstable materials properly stored?	☐	☐	☐
4. Process laboratory checked for runaway explosive conditions?	☐	☐	☐
5. Provisions for protection from explosions?	☐	☐	☐
6. Hazardous reactions possible due to mistakes or contamination?	☐	☐	☐
7. Chemistry of processes completely understood and reviewed?	☐	☐	☐
8. Provisions for rapid disposal of reactants in an emergency?	☐	☐	☐
9. Failure of mechanical equipment possible cause of hazards?	☐	☐	☐

- **First column:** indicate those areas that have been thoroughly investigated.
- **Second column:** is used for those items that do not apply to the particular process.
- **Last column :** mark those areas requiring further investigation.

Typical process safety checklist

- Checklists should be applied only during the preliminary stages of hazard identification
- Checklists are most effective in identifying hazards arising from process design, plant layout, storage of chemicals, electrical systems, and so forth.

Hazards Surveys:

- As simple as an inventory of hazardous materials in a facility or
- As complicated as a rigorous procedure such as the Dow Fire and Explosion Index (F&EI)
- and the Dow-Chemical Exposure Index (CEI), which are two popular forms of hazards survey

Hazards Surveys

- The Dow F&EI is designed for rating the relative hazards with the storage, handling, and processing of explosive and flammable materials.
- mostly independent of judgmental factors
- The form shown in Figure consists of three columns of numbers.
  - The first column is the penalty column. Penalties for various unsafe situations are placed in this column.
  - second column contains the penalty actually used. This allows for a reduction or increase in the penalty based on extenuating circumstances not completely covered by the form.
  - In the event of uncertainty here, the complete penalty value from the first column is used
  - The final column is used for computation.

Form used in the Dow Fire and Explosion Index

FIRE & EXPLOSION INDEX

AREA / COUNTRY	DIVISION	LOCATION	DATE
SITE	MANUFACTURING UNIT	PROCESS UNIT	
PREPARED BY:	APPROVED BY: (Superintendent)	BUILDING	
REVIEWED BY: (Management)	REVIEWED BY: (Technology Center)	REVIEWED BY: (Safety & Loss Prevention)	
MATERIALS IN PROCESS UNIT			
STATE OF OPERATION __ DESIGN __ START UP __ NORMAL OPERATION __ SHUTDOWN	BASIC MATERIAL(S) FOR MATERIAL FACTOR		
MATERIAL FACTOR (See Table 1 or Appendices A or B) Note requirements when unit temperature over 140 °F (60 °C)			

1. General Process Hazards	Penalty Factor Range	Penalty Factor Used(1)
Base Factor	1.00	1.00
A. Exothermic Chemical Reactions	0.30 to 1.25	
B. Endothermic Processes	0.20 to 0.40	
C. Material Handling and Transfer	0.25 to 1.05	
D. Enclosed or Indoor Process Units	0.25 to 0.90	
E. Access	0.20 to 0.35	
F. Drainage and Spill Control _____ gal or cu.m.	0.25 to 0.50	
General Process Hazards Factor (F_1)		
2. Special Process Hazards		

LOSS CONTROL CREDIT FACTORS

1. Process Control Credit Factor (C_1)

Feature	Credit Factor Range	Credit Factor Used(2)	Feature	Credit Factor Range	Credit Factor Used(2)
a. Emergency Power	0.98		f. Inert Gas	0.94 to 0.96	
b. Cooling	0.97 to 0.99		g. Operating Instructions/Procedures	0.91 to 0.99	
c. Explosion Control	0.84 to 0.98		h. Reactive Chemical Review	0.91 to 0.98	
d. Emergency Shutdown	0.96 to 0.99		i. Other Process Hazard Analysis	0.91 to 0.98	
e. Computer Control	0.93 to 0.99				

PROCESS UNIT RISK ANALYSIS SUMMARY

1.	Fire & Explosion Index (F&EI) ..... (See Front)		
2.	Radius of Exposure ..... (Figure 7)	ft or m	
3.	Area of Exposure	ft^2 or m^2	
4.	Value of Area of Exposure		$MM
5.	Damage Factor ..... (Figure 8)		
6.	Base Maximum Probable Property Damage – (Base MPPD) [4 x 5]		$MM
7.	Loss Control Credit Factor ..... (See Above)		
8.	Actual Maximum Probable Property Damage – (Actual MPPD) [6 x 7]		$MM
9.	Maximum Probable Days Outage – (MPDO) ..... (Figure 9)	days	
10.	Business Interruption – (BI)		$MM

Hazards Surveys

- The first step in the procedure is to conceptually divide the process into separate process units. A process unit is a single pump, a react
- The next step is to determine the material factor (MF) for use or, or a storage tank.
- Higher the value of the MF, the more flammable
- The general process hazard factor (F1) and special process hazard factor (F2)
- Multiplied together to produce a unit hazard factor (F3)
- The Dow F&EI is computed by multiplying the unit hazard factor by the MF

Hazards Surveys

The next step is to determine the general process hazards. Penalties are applied for the following factors:

- Exothermic reactions that might self-heat
- Endothermic reactions that could react because of an external heat source such as a fire
- Material handling and transfer, including pumping and connection of transfer lines
- Enclosed process units preventing dispersion of escaped vapors
- Limited access for emergency equipment
- Poor drainage of flammable materials away from the process unit

Compound	Material factor
Acetone	16
Acetylene	29
Benzene	16
Bromine	1
1,3-Butadiene	24

Dow Fire and Explosion Index	Degree of hazard
1–60	Light
61–96	Moderate
97–127	Intermediate
128–158	Heavy
159 and above	Severe

Penalties for special process hazards

1. Toxic materials, which could impede fire fighting
2. Less than atmospheric pressure operation with a risk of outside air entering
3. Operation in or near the flammable limits
4. Dust explosion risks
5. Higher than atmospheric pressure
6. Low-temperature operation with potential embrittlement/ ductility of carbon steel vessels
7. Quantity of flammable material
8. Corrosion and erosion of process unit structures
9. Leakage around joints and packings
10. Use of fired heaters, providing a ready ignition source
11. Hot oil heat exchange systems where the hot oil is above its ignition temperature
12. Large rotating equipment, including pumps and compressors

Thanks