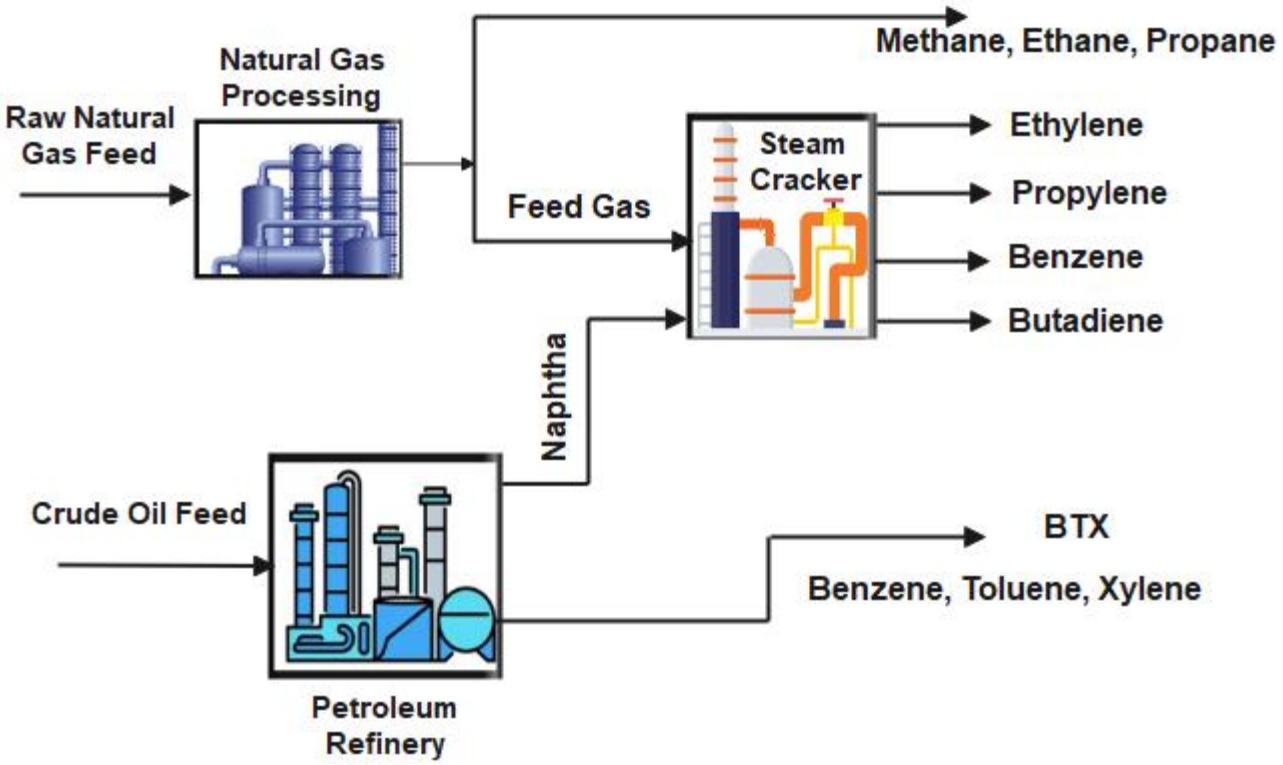
Petrochemical Safety and Engineering

What is the petrochemical industry?

- The petrochemical industry produces chemicals derived from petroleum and natural gas, used as the building blocks for various products.

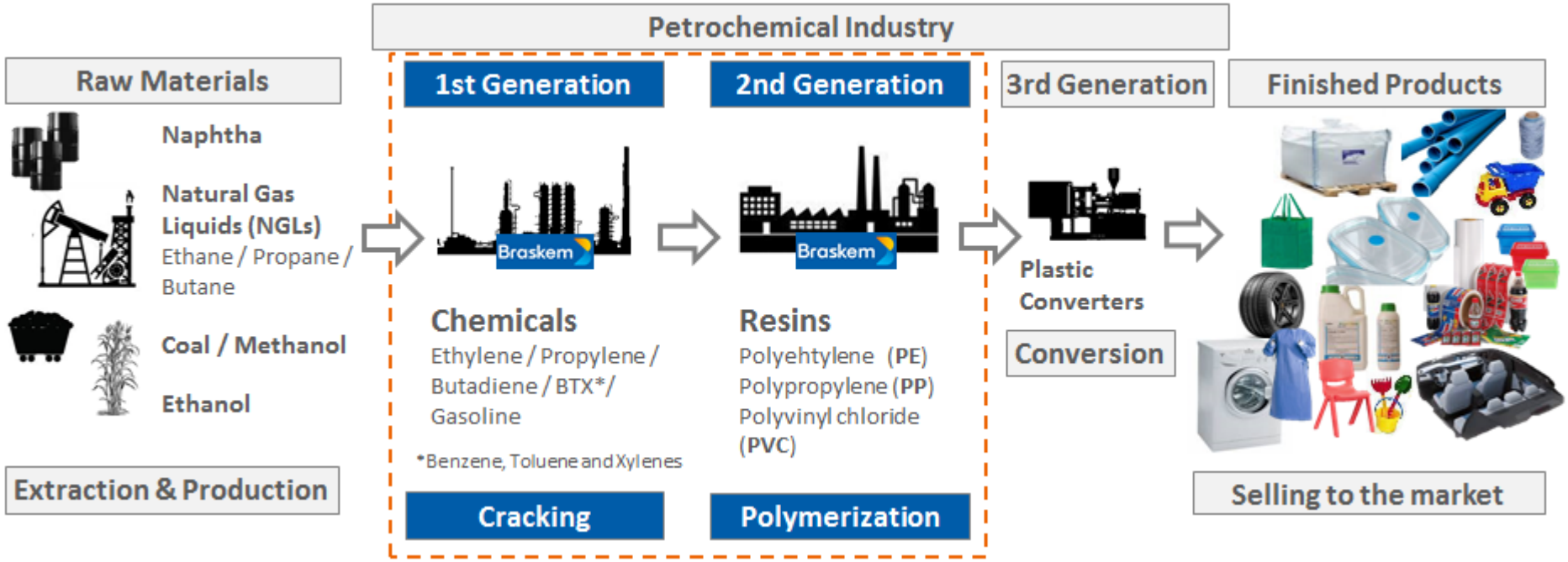


Introduction

- The petrochemical industry is a cornerstone of modern life, producing the materials that drive out economy.
- However, it is not without its dangers.
- Safety should always be a top priority, whether you are working directly with petrochemicals or living in proximity to petrochemical facilities.

Understanding Petrochemical

- Before delving into safety measures, it is crucial to understand what petrochemical are?
- These are chemicals derived from petroleum and natural gas, and they serve as the building blocks for various produces.
- Common petrochemicals include ethylene, propylene, benzene and many more.



- The worker safety is dependent on worker behavior and human factors.

Stay Alert

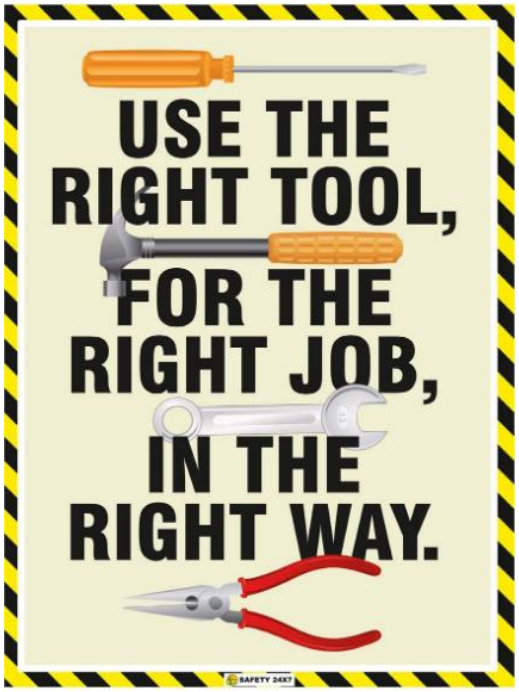
- The more awake a worker is, the less likely he or she is to get hurt
- If you are unsure how to operate equipment or perform a task, ask your supervisor.
- Make sure you know in advance the correct, safe way to do the work safety

Wear the Right Clothes

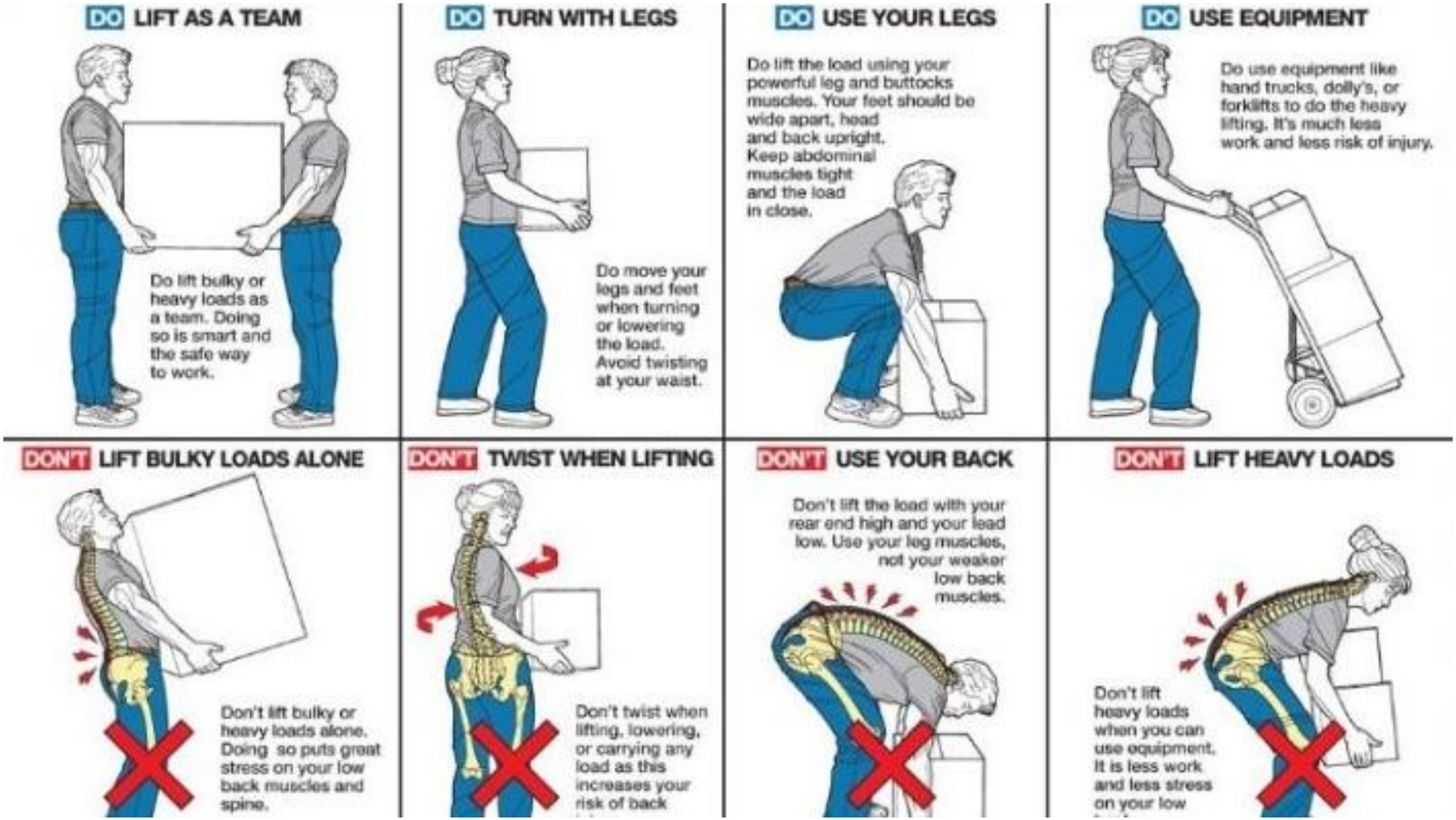
- Wear protective clothing and equipment as required

Use the right tools

- If you need a hammer, get a hammer
- It may be handier to use a pair of pliers, wrench, screw driver or ever your fist.
- But you will have only yourself to blame if you break your fingers



Use lifting devices & Learn how to lift

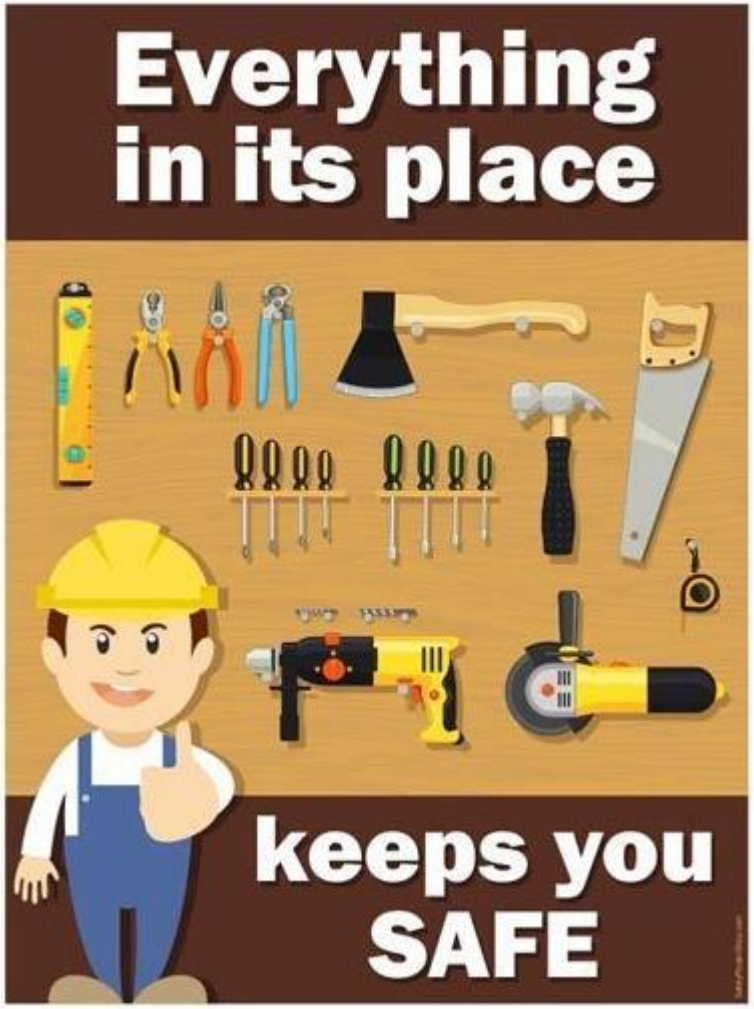


Don’t be a prankster

- Practical Jokes and horseplay can be dangerous around machinery
- If you feel the urge to play, resist it until after work

Be Tidy

- Good housekeeping reduces hazards in the workplace or your home
- Always put away tools when they are not in use
- Keep the floors clean, pick up scraps, wipe up spills
- A slip or trip can be fatal



Reporting is important

- Never fail to report accidents
- Defective equipment
- Unsafe condition

Get first aid immediately

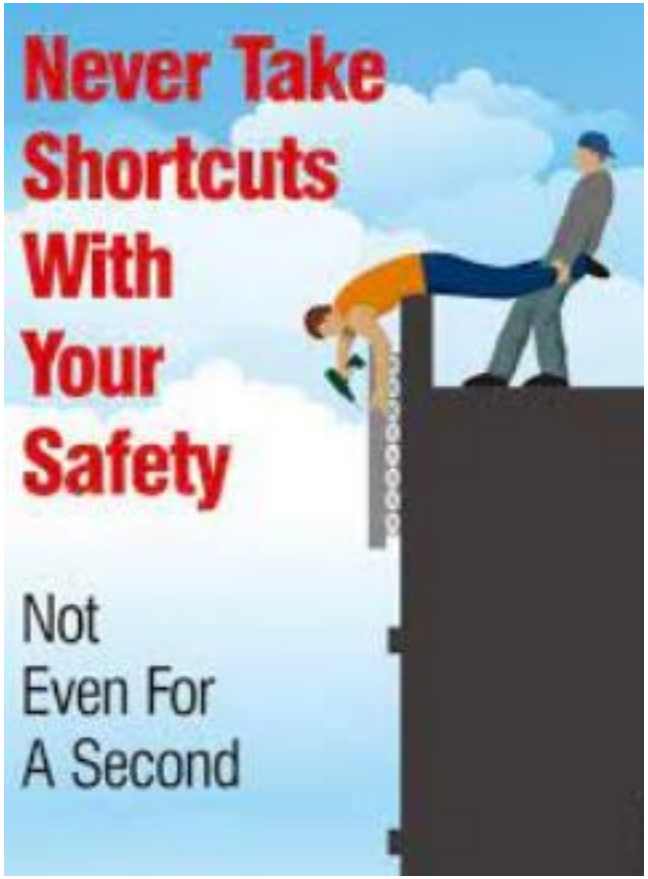
- Neglect of the injury may lead to serious infection, even permanent injury

Back your safety program

- If you have an idea young believe will reduce accidents, tell you supervisor about it
- Set an example by obeying safety rules
- Cooperate with your safety committee

Avoid shortcuts & Never take a change

- Be punctual at your workplace



Develop the safety and health programs for your industry

- Accident Prevention Program (APP)
- Personal Protective Equipment (PPE)
- Hazardous Chemicals Communication Program
  - If your employees are exposed to hazardous chemicals in the workplace
- Respiratory Protection Program
  - If your employees use respirators to do their work
- Hearing Loss Prevention Program
- Fall Protection Work Plam

Accident Prevention Program

- Your responsibility
  - To establish, supervise and enforce an accident prevention program that is effective in practice
    - Develop a written accident prevention program
    - Develop, Supervise, implement and enforce safety and healthy training programs that are effective in practice
    - Make sure your accident prevention program is effective in practice

Development of Written Accident Prevention Program

- Develop a accident prevention program that is outlined in writing. The program must be tailored to the needs of your particular workplace or operation and to the types of hazards involved
- The term accident prevention program refers to your written plant to prevent accidents, illness and injuries

Accident Prevention Program content includes….

- Total safety and health program
- On the job orientation showing employed what they need to know to perform their initial job assignments safety
- How and when to report on the job injuries including instruction about the location of first aid facilities in your workplace
- How to repot unsafe conditions and practices
- Use and care of required personal protective equipment

Cont…….

- What to do in an emergency, including how to exit the workplace
- Identification of hazardous gases, chemicals or materials used on the job and instruction about the safe use and emergency action to take after accidental exposure

SAFETY & HEALTH TRAINING PROGRAM

- Develop, supervise, implement and enforce training programs to improve skill, awareness and competency of all your employees in the field of occupational safety and health
- Training includes on the job instruction to employees prior to their job assignment about hazards.
  - Such as
    - Safe use of powered materials – handling equipment such as forklift, backhoes etc.
    - Safe use of machine tool operations
    - Use of toxic materials
    - Operation of utility systems
- Training Documentation Form can help you verify in writing that each employee who needs training has received and understood it.

APP in effective in practice

- Establish, supervise and enforce your accident prevention program in a manner that is effective in practice
- Your employees are encouraged to use this form to help carry out the accident prevention program in your workplace

Safety Management Principle

Hazard and Risk

- Hazard is a scenario
  - It is situation resulting in more likelihood of an accident
- Risk is realization of hazard
  - Incident becomes an accident

Hazard Identification

- Deals with Engineering Failure Assessment
- Evaluate the reliability of specific segments of plant operation
  - To determine probabilistic results of failure
- Faulty tree analysis is one such common form of engineering failure assessment
- Hazards are common in process industry like petroleum industry
- It is not identified until an accident occurs

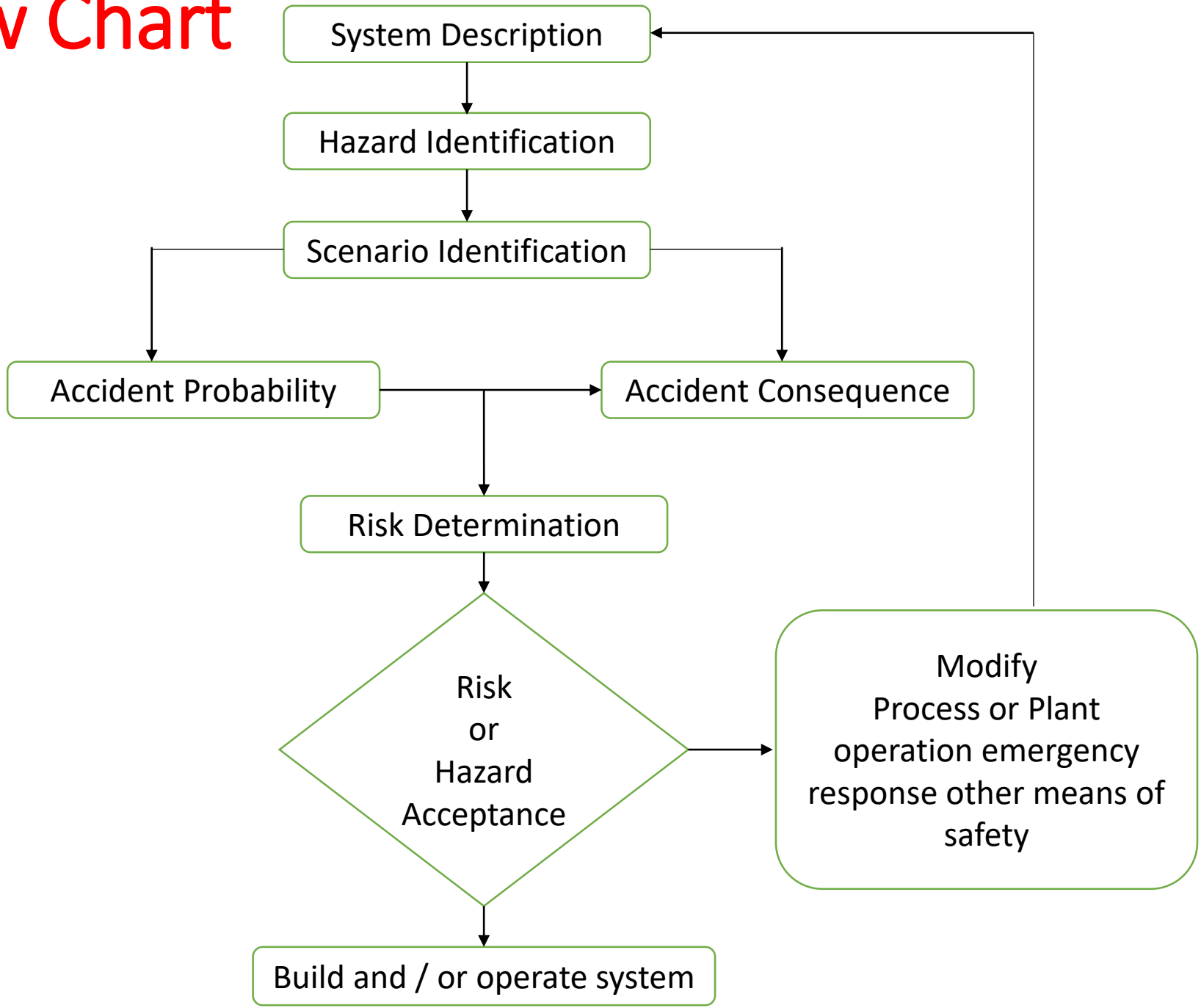
Cont.....

- It is therefore essential to identify the hazards if one wants to reduce risk
- What are hazards?
  - Hazard identification
- What can go wrong and how?
  - Risk Assessment (Probability of failure)
- What are the changes?
  - Frequency of occurrence
- What are the consequences?
  - Financing risk

Cont.....

- Hazard identification and risk assessment combined together is called as hazard evaluation
- Risk Assessment is also called as hazard analysis

Flow Chart


System Description
Hazard Identification
Scenario Identification
Accident Probability
Accident Consequence
Risk Determination
Risk
or
Hazard
Acceptance
Modify
Process or Plant
operation emergency
response other means of
safety
Build and / or operate system

Hazard Evaluation

- Hazard evaluation can be performed at any stage
  - During the initial design (example FMEA)
  - During ongoing operation of the project (example HaZOP)
- If the hazard evaluation shows low probability and minimum consequence
  - Then the system is called Gold Plated system
  - Potentially unnecessary and expensive safety equipment and procedures are implemented in the system

FMEA - Failure Mode and Effects Analysis HaZOP - Hazard and Operability study

Important steps in hazard evaluation?

- Risk Acceptance step
- Level of risk acceptance is subjective to each organization
  - Therefore they should be pre-defined
- But there are also standard procedures to define / determine level of acceptance of risk level
- Hazard identification methods

Hazard Identification Methods

- **Process Hazard Check Lists**
  - List of items and possible problems in the process that must be checked
- **Hazard Surveys**
  - Inventory of hazardous materials
- **HaZOP**
  - Hazard and operability studies carried out to identify the possible hazards
- **Safety Review**
  - Less formal type of HaZOP study
  - Results depends on the experience of the person

Hazard Identification - Other Methods

- ***What if* analysis**
  - Less formal method
  - Apply what if logic to number of investigations
  - For example, the question shall be what if the power stops?
  - The result to such questions yield list of potential consequences and how to solve such problems
- **Human Error Analysis**
  - This method is used to identify parts and procedures of a process
  - Generally applied to the process that has higher probability of human error
  - For example, fire alarm / buzzer system in the control panel

Cont....

- **Failure Mode, effects and criticality Analysis (FMECA)**
  - This method tabulates the list of equipment in the process
  - Also the possible failure modes of each item
  - Effect of particular failure is considered with respect to the process

Fire & Explosion in Petrochemical industry

Fire and Explosion

- Chemical process systems contain substantial hazards in the form of fire and explosions
- Three common chemical plant accidents are **Fire**, **Explosion** and **Toxic Release**

Fundamentals of fire and explosion

- Fire
  - A rapid exothermal oxidation of ignited fuel
  - Fuel can be in sold, liquid or vapor form
  - Vapor and liquid fuel are easier to ignite
  - Fries release energy slowly
  - Fires can also result from explosions

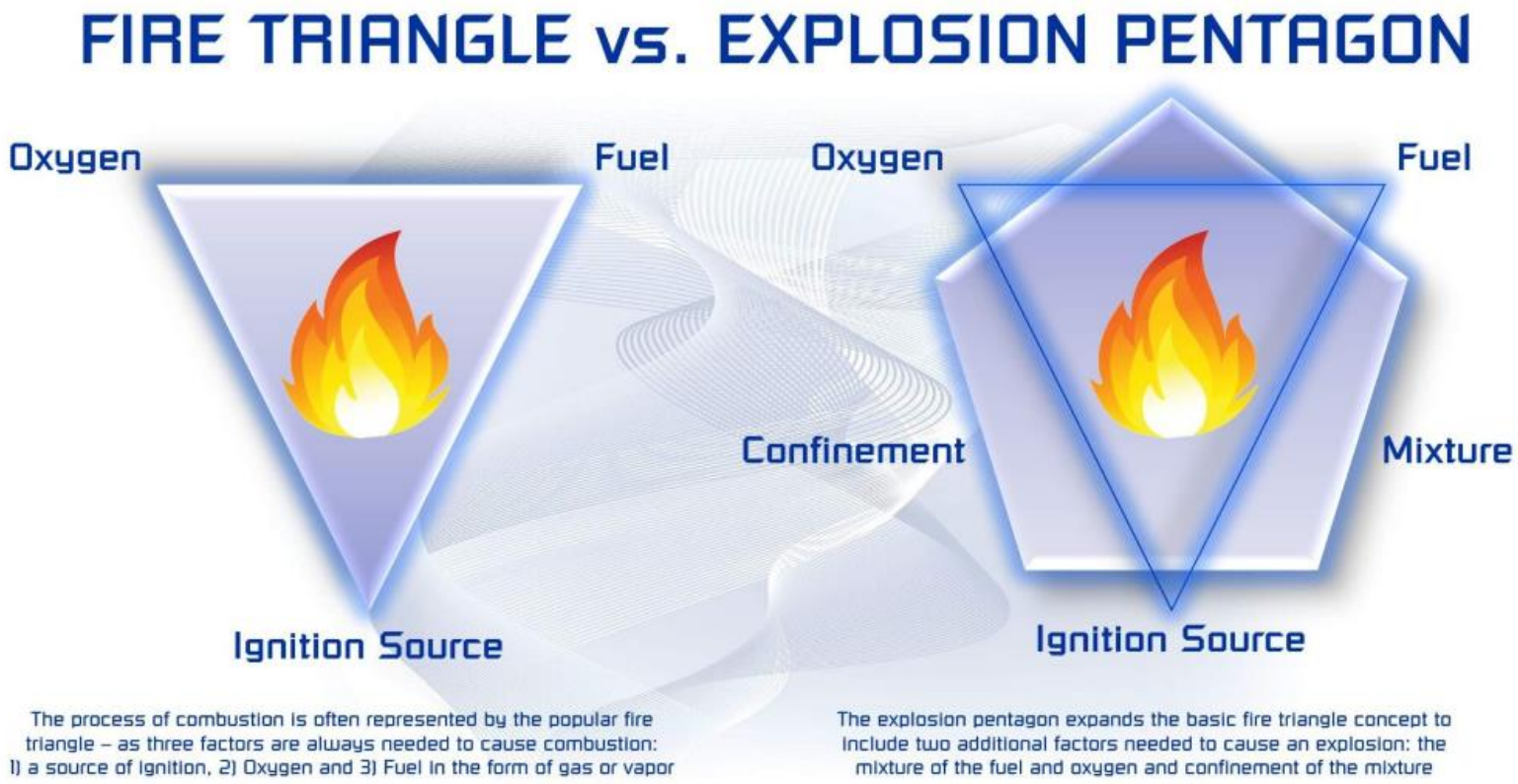
Cont….

- Explosion
  - Explosion is a rapid expansion of gases resulting in a rapidly moving pressure or shock waves
  - Expansion can be mechanical or resulting from chemical reaction
  - Expansion can be mechanical or resulting from chemicals reaction
  - Explosion damage is caused by pressure or shock wave
  - Explosion release energy rapidly and it can result from fire

FIRE ELEMENT	TYPE	EXAMPLES
Fuel	Liquid	Gasoline, Acetone, Ether, Pentane
	Solid	Plastic Wood dust, fibers, metal particles
	Gases	Acetylene, Propane, CO, Hydrogen
Oxidizers	Gases	O_2 Fluorine, Cl_2
	Liquids	Hydrogen peroxide, HNO_3
	Solids	Metal peroxides, ammonium
Ignition Sources	Sparks, Flames, Static Electricity, Heat	

Accident Prevention

- Fire and explosion accidents can be prevented using the knowledge of the following
  - Fire and explosion characteristics of materials
  - Nature of fire and explosion process
  - Procedures to reduce fire and explosion hazards



Fire and Explosion characteristics of materials

- **Auto-Ignition Temperature (AIT)**
  - A fixed temperature above which material may not require any external ignition source for combustion
- **Flash Point**
  - Lowest temperature at which liquid gives up enough vapor to maintain continuous flame

Cont.....

- **Flammability Limits**
  - Range of vapor concentration that could cause combustion on meeting ignition source.
  - There are two limits,
    - LFL
      - Below which mixture will not burn. It is too lean
    - UFL
      - Above which mixture will not burn. It is too rick

Cont.....

- **Limiting Oxygen Concentration (LOC)**
  - Minimum O_2 concentration below which combustion is not possible, with any fuel mixture
  - It is expressed as volume % of oxygen
  - It is also called as minimum oxygen concentration (MOC) or Max. Safe Oxygen Concentration (MSOC)

SHOCK WAVE

- An abrupt pressure wave moving through a gas
- A shock wave in open air is followed by wind
- The combined shock wave and wind is called **blast wave**
- Pressure increases in the shock wave is so rapid that the process is mostly **adiabatic**
- Over pressure
  - Pressure on an object as a result of an impacting shock wave

WORKPLACE SAFETY

SAFETY FIRST RULES

Stop Mobile Phone Use

Use of mobile phone is strictly prohibited while driving a vehicle or Material Handling Equipment (MHE) to minimize distractions.

Avoid Elevated Loads

Never walk or work under suspended loads elevated by cranes or Material Handling Equipment (MHE).

Fit For Work

Do not report to work, operate a vehicle or any equipment while under the influence of alcohol or drugs.

Equipment Maintained

Inspect equipment prior to use. Lockout defective equipment.

Take Five

Take 5 minutes before you begin a task to assess the risks. Control and eliminate the risks while performing the task.

Yes, I am Prepared

Know where to go and what to do during an emergency.

Follow Safety Data Sheets (SDS) guidelines on handling hazardous material/dangerous goods.

Fall Prevention

No working at height without authorization. If it is required to work at height, the required fall prevention controls must be put in place.

I am Accountable

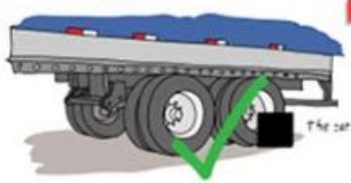
Report all incidents, near-misses and unsafe conditions. Never walk by a problem.

Responsible Operations

Operate vehicles and Material Handling Equipment (MHE) at safe speed. Wear seat belt and required Personal Protective Equipment. No passengers on MHE.

Stand in Line of Sight

Be seen and be safe. Stand at areas where truck or Material Handling Equipment (MHE) operators can see you.



Traffic & MHE Safety

Chock truck/container wheels before loading or unloading. Lock and secure vehicle or Material Handling Equipment (MHE) when not in active use.