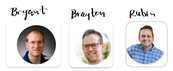
Grad Safety Workshop

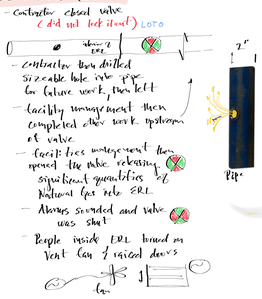
BYU Chemical Engineering
Feb 1 2024

Agenda.
- Intro to Safety Resources 2 min
- Recent NEAR MISSES 3 min
- Lab Cleanliness 5 min
- Electrical & OSHA Items 10 min
- Grad Safety Council 5 min
- Hazard Analysis Review 10 min
- Group Breakout Breakout with rank in group meetings

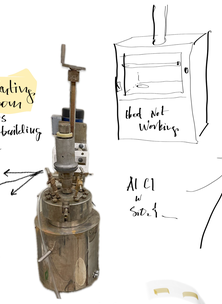


Recent NEAR MISSES in Chemical Engineering
- ERL Natural Gas Leak from 2"ish Hole under high pressure
- Reactor venting into room in CB basement
- Cl_2 Leak.

ERL Natural Gas Leak
- Contractor closed valve (did not lock it out) LOTO
- Contractor then drilled sizeable hole into pipe for future work, then left
- facility management then completed other work upstream of valve
- facilities management then opened the valve releasing significant quantities of Natural Gas into ERL
- Alarms sounded and valve was shut
- People inside ERL turned on vent fan & raised doors



Reactor Venting into room
they goes around building HVAC



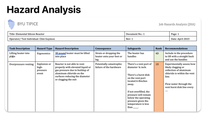
Reactor received pressures about PRV set point

Transitioning to a smaller reactor inside working hood

Jesus Christ

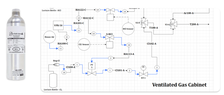
Hazards Analysis in 10 min!
- God is love.
- There is safety in keeping His commandments
- We can show love to God & others by working to keep ourselves & others safe.
- Systematic identification of hazards with effective control = safety
- There also is a regulation Process Safety Management to help:

Hazard Analysis


BYU TIPCC
Job Hazards Analysis (JHA)
Title: Balanced Whole Blender
Operations: Tank Unloading/ Filling Operations
Prepared by: J.L.
Page: 1
Rev: 1
Date: April 2015

Task/ Sub-tasks	Hazard Type	Hazard Description	Consequences	Safeguards	Risk	Recommendations
Lifting Tanker Lids	Ergonomics	Musculoskeletal stress for lifter	Strains or dropping the lid	The tanker has a hinge	M	Include in the procedure to have two people lift and set the tanker lids
Disconnection/ Unloading	Chemical Hazard, Toxic, Corrosive	Exposure to corrosive chemical property and the consequence of a chemical exposure to the operations personnel, the public, the environment, or dragging the tank	Injuries to personnel, Release of the hazardous chemical	Operator is in the Operator's Guide	H	Ensure that the operator is fully engaged in the unloading process and that the operator is within the line of sight of the tanker
				Manual Valves		Have water through the hose to wash the valves

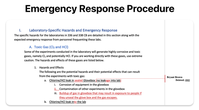
Process & Instrumentation Diagram



Standard Operating Procedures for Chlorine Supply Line

Contents
- 0.0 Initial Procedures Before Any Toxic Gas Work 1
- 0.1 Review Safety Procedures 1
- 0.2 Put on Proper PPE 1
- 0.3 Check safety Systems 1
- 1.0 Usage of Chlorine Supply Line 2

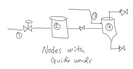
Emergency Response Procedure


1. Laboratory-Specific Hazards and Emergency Response
This specific hazards for the laboratories in 285 and 290 B are detailed in this section along with the expected emergency response from personnel frequenting these labs.
A. Fume Gas (CL and HCl)
Fume gas is a hazardous gas that is in the laboratory of germain highly corrosive and toxic gases, namely Cl_2 and potentially HCl. If you are working directly with these gases, use extreme caution. The hazards and effects of these gases are listed below.
1. Hazards and Effects
Fume gas has two main potential hazards and their potential effects that can result from the experiments with toxic gas.
- OSHA PEL TWA (8 HOUR) Sensitive: 1ppm (CL) 5ppm (HCl)
  1. Inhalation of fume gas causes severe irritation to the respiratory system.
  2. Contamination of other experiments in the glovebox
  3. Fume gas is highly corrosive and can cause severe injuries to people if they come in the glove box and let the gas escape.
- OSHA PEL TWA (8 HOUR) 1ppm (CL)

- Design Hazard Analysis
- Pre-start up Safety review
- HAZOP - Hazard & Operability Study
- FMEA - Failure Mode & Effects Analysis
- Team Environment

What is a Hazard Analysis?

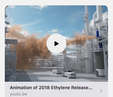
- SYSTEMATIC REVIEW of HAZARDS
  - Failure Mode & Effects Analysis (FMEA) with a fault tree (FTA)
  - Hazards & Operability Study (HAZOP)



Failure Mode & Effects Table

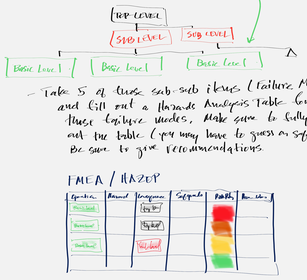
Operation	Hazard	Description	Consequence	Safeguard	Risk	Recommendation
Table Saw	Blade Contact	Blade Pressure	Kickback	Pressure Push Stick	3D	None

RISK ASSESSMENT MATRIX				
SEVERITY / PROBABILITY	Catastrophic (I)	Critical (II)	Marginal (III)	Negligible (IV)
Frequent (A)	High	High	Serious	Medium
Probable (B)	High	High	Serious	Medium
Occasional (C)	High	Serious	Medium	Low
Remote (D)	Serious	Medium	Medium	Low
Improbable (E)	Medium	Medium	Medium	Low
Eliminated (F)	Eliminated			


Animation of 2018 Ethylene Release...
youtube.com

Video Link:
Go to csb.gov and check on videos, there find the 2018 Ethylene release video.

Example Accident Scenario
Release of Ethylene Oxide
- For a top level event of outline the qualitative fault tree Analysis with at least 10 basic items



- Take 5 of these sub-sub items (Failure Modes) and fill out a Hazards Analysis Table for these failure modes. Make sure to fully fill out the table (you may have to guess on safeguards. Be sure to give recommendations.

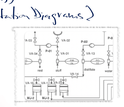
FMEA / HAZOP

Operation	Hazard	Consequence	Safeguards	Risk	Rec. Action
Process Start		Injury			
Operation		Injury, Death			
Shutdown		Injury, Death			

NEEDED INFORMATION FOR EFFECTIVE HAZARDS ANALYSIS

Chemical Information
- Flammability
- Toxicity
- Reactivity

Process Information
- PFD (Process Flow Diagrams)
- P&ID's (Piping & Instrumentation Diagrams)
- Equipment Details
- Procedures
  - Start-Up
  - Operation
  - Shut Down



Other Important Info
- Near Miss Details
- Accident History

14 Points of PSM: OSHA 1910.119

- Employee Participation (a)
  - Employees involved in PSM
- Process Safety Information (d)
  - understand hazards
    - technology → process chemistry, flow diagram, inventory, safe upper & lower limits, deviation consequences
    - used → toxicity, MSDS, reactivity, etc
    - produced
    - equipment → metallurgy, construction, electrical rated, material & energy balances, safety systems, P&ID's, PRV/RLP's
- Process hazards analysis (PHA) (e)
  - what if
  - checklist
  - HAZOP
  - FMEA
  - Equivalent
  - Hazards addressed
  - Incidents 10y
  - Engineering & administrative controls (safeguards)
  - Consequences
  - Facility siting
  - Qualitative evaluation
  - team effort
  - System to address findings
    - documentation
  - revalidation (5yrs)
  - Documentation of PHA
- Operating Procedures (f)
  - Written operating procedures
    - startup, normal, emergency, etc, startup after emergency
    - operating limits
    - Safety & health considerations
    - Safety systems
    - Accessible
    - Reviewed
    - LOTO, confined space
- Training (g)
  - initial training → safety/health, emergency ops, safe work
  - Refresher training
  - Documentation
- Contractors (h)
  - Special work → excludes incidental service
    - safety program verified
    - informed on process hazards by employer
    - injury & illness log
  - Contractor staff
    - properly trained
    - hazards consequences/mitigations
    - follow safety rules
    - recognize hazards
- Pre-Startup Safety Review (i)
  - required when new or significant changes
  - P&ID's & design
  - Safety operating maintenance, emergency procedures in place
  - PHA completed
  - Training completed
- Mechanical Integrity (j)
  - passive vessels, tanks, PRV, PPE, emergency, robotic pumps
  - Written procedures
  - training for maintenance
  - Inspection & testing → P&ID's, frequent, documentation
  - Deficiencies
  - Reliability
- Hot Work (k)
  - permit for hot work in covered process
  - Documentation w/ fire prevention measures
- Management of Change (l)
  - procedures to manage changes
    - chemical, technology, equipment, procedures, etc
  - Employees trained on consequences of change
  - Update PSI
  - Update procedures
- Incident Investigations (m)
  - Investigate each incident (near misses included)
    - toxic, hazardous release (catastrophic)
  - within 48 hrs
  - human effect
  - report generated
  - System to address findings
  - reports reviewed w/ employees
  - reports retained for 5 years
- Emergency Planning & Response (n)
  - Emergency Action plan implemented
- Compliance Audits (o)
  - evaluated every 3 years
  - Report created
  - Document responses
  - 2 most recent audits retained
- Trade Secrets (p)
  - PSI must be available for PHA, etc
  - Confidentiality
  - Employees have access to PHA & other PSM documents