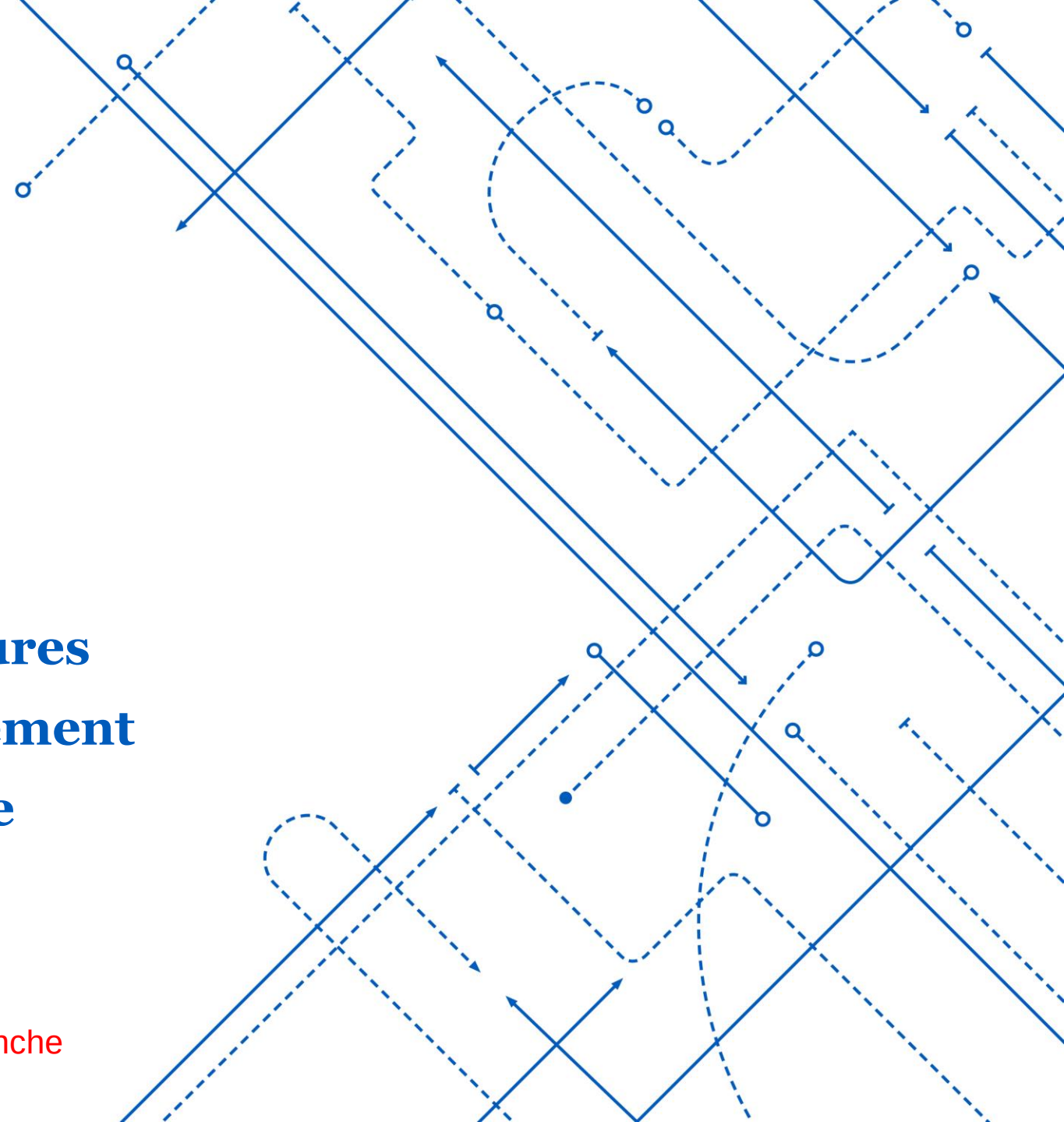

CE 400 / CE 500

Process Safety Management

Lecture 36 Safety Procedures
Alarm Management

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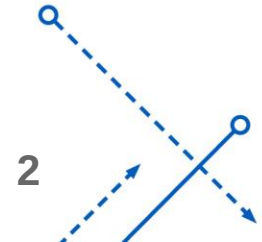
Operating Procedures

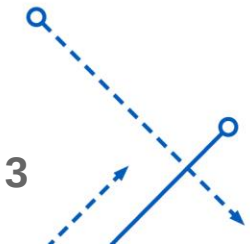
- Written operating procedures are essential to maintain safe and consistent operation of a chemical process
- Without written procedures, different operators will run the process using different procedures and criteria
- Without written procedures, the manner of operation will drift with time

- This can lead to:
  - Deviations in Quality
  - Disastrous Safety Consequences
    - Deviations in procedure can contradict safety design features
    - Invalidate assumptions made during Hazards Evaluations



Operating Procedures

- Attributes of good written operating procedures:
  - Step by Step directions
  - Covers Each Operating Phase
    - Start up
    - Shutdown
    - Normal
    - Transition
    - Emergency
  - Describes hazards of process
  - Describes purpose of the step
  - Describes safe operating limits for the various parameters
  - Describes hazards associated with deviation from procedure



Operating Procedures

- Attributes of good written operating procedures:
  - List the required PPE (Personal Protective Equipment)
  - Steps to correct for deviations
  - Avoid “Traps”
    - Warnings must not come in a subsequent step
    - i.e. step 8 is a warning about how not to do step 7
  - Contains description of engineering and administrative controls
- Operating procedures for response to Alarms

Hot Work Permits

- Some operations necessarily generate heat and ignition sources
  - Welding
  - Grinding
  - Torch Cutting
  - Soldering
- These operations cannot be done safely with a flammable environment present
- Very specific steps must be taken to ensure that it is safe to perform this work

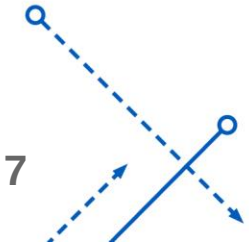
Hot Work Permits

- Permits are valid for a designated period of time (one shift)
- Permit Procedures include the following:
  - Check for presence of flammable materials
    - Specifically in low lying areas for heavier than air materials
    - Continuous monitoring for flammable vapors during work
    - Inside and around vessel if work is occurring directly on vessel
  - Remove all containers of flammable or combustible material within a 35-foot radius of the hot work
  - Have fire extinguisher in area. Confirm that smoke detection, sprinkler, and alarm systems are working
  - Inform operations and all in the area and post signed permit
    - Maintain file of past permits

Vessel Entry

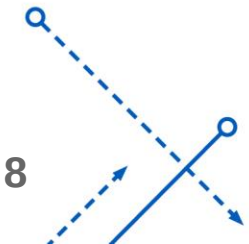
- Also referred to as “Confined Space”
- Confined spaces include:
  - Vessels
  - Other process equipment
  - Diked area
  - Large pipe openings

- Major concern is that personnel will be overcome by fumes or lack of oxygen
- Also addresses concerns of being injured by moving equipment



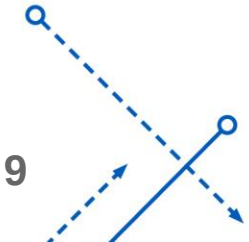
Vessel Entry

- Entry into confined space is not allowed without a permit
- Permits includes:
  1. Area supervisor takes complete control of the equipment
  2. Isolate the equipment
     - Disconnect all process lines connecting the vessel to rest of the process
  3. Clean all equipment
  4. Manage all other permits (Lock-Tag-Try, Hot Work, etc) to prevent inadvertent activation of equipment
  5. Have a second attendant in the area to help with emergencies
  6. Emergency equipment must be present, as needed



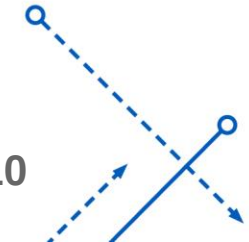
Vessel Entry

- Permits include:
  7. Have harness system to enable removal of personnel without the need for other personnel to enter
     - Many fatalities have occurred when personnel enter to rescue a fellow worker who become overcome by fumes or lack of oxygen
  8. Continously monitor the oxygen level to be sure it is above 19.5%
  9. Add ventilation, if needed
  10. Provide lighting as needed
  11. Have two-way radio for communication so that operator can summon help
  12. Use ladder to enter vessel, as needed
  13. Manager in charge signs and posts permit in the area



Lock-Tag-Try

- This is the most common permit discussed in this lecture
- Used when operators and/or maintenance personnel are working on equipment
- Prevents injuries due to accidental release of stored energy from equipment
  - Electrical
  - Gravitational
  - Mechanical
  - Thermal
- Prevents injuries due to accidental release of chemicals



Lock-Tag-Try

- The “Lock” part literally means using locks on valves,etc to maintain them in a safe position
- The “Tag” part literally means having tags on the locks which indicate that the lock is part of an equipment lockout
- The “Try” part means that after the lockout has been installed the operator locking the equipment out trys to energize the equipment or open valves, etc in order to ensure that the equipment has been made safe
  - All personnel working on the equipment must also perform the “Try” step

Lock-Tag-Try

- De-energize equipment
  - Electrical drives for equipment are shut off and switch is locked in open circuit position
  - Pressurized lines are relieved of pressure
    - Double Block and Bleed
- Lock Valves in Safe Position (typically closed)
  - All lines connecting equipment to sources of chemicals are closed and locked in closed position
- Operations locks out equipment and generates Lock Out Card
  - Lists all valves/drives locked (all equipment has identifying tags and numbers)
  - Lists lock/key number for each valve/drive

Lock Out Box

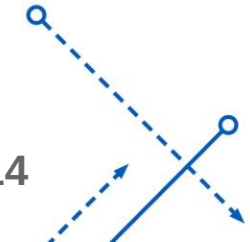
- If more than one person is working on the equipment and/or more than one lock is required for safe operation the keys to each lock are placed in lock out box
- All personnel working on the lockout equipment confirm that the lockout is complete
  - Checks lockout card versus Lock Out Operating Procedure for that equipment
  - Physically checks location to confirm that correct valves and drives are locked in correct position and with lock identified on lockout card
  - Performs “Try” step
  - Confirms that all keys are located in lockout box
- Places “Personal Lock” on Lock Out Box
- Keeps key to personal lock on their person at all times until their lock is removed
- When each person has completed their work they remove their lock from the box
- Person who performs lockout places Area Lock on box
  - First lock on and last lock off

Alarm Management

- Many case studies have shown that there was an alarm that successfully went off during an event that lead to unacceptable consequences
- Furthermore, had operators responded properly to that alarm the consequences could have been avoided
- So why did they not respond?

The Alarm Was One of a Huge Number of Active Alarms at the Time!

- It simply got lost in a “flood” of alarms and therefore missed…

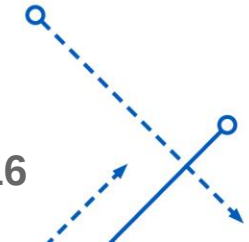


Alarm Management

- Originally, when the Chemical Process Industry was beginning, there were no Distributed Control Systems
  - Pressure gauges, temperature dials, and rotameters gave the operators their information and individual adjustments were made manually
- Alarms had to be configured to an Annunciator Panel
- Each alarm was costly to add
- As a result the only alarms that operators had to monitor were all extremely important
- If an alarm went off it definitely got attention!

Alarms in the DCS Era

- Distributed Control systems are wonderful!
- They monitor and control thousands of points
  - A “point” is a piece of information
  - Possible points for one additive system (there may be many others):
    - Pump rpm
    - Pump output
      - (control loop % of speed requested)
    - Pump power draw
    - Pressure in line on pump discharge
    - Flow rate from flow meter
    - Concentration of additive in total mix
    - Temperature from temperature sensor
- Each one of these points could have a high/low/deviation/high-high alarm configured
- Each point has multiple alarms available and the instinct is to assign a value to all of them at installation
- For your entire process, this adds up quickly! And…leads to many unnecessary alarms that distract the operators from the essential alarms



Alarm Management Process

- Step 1: **Charter team**
  - This is an extremely time consuming enterprise
  - It will require support from upper management to undertake and implement
  - Team consists of DCS engineer, operators, mechanics, and trained facilitator
- Step 2: **Compile database of all existing points and alarms**
  - Point names
  - All alarms and alarm limits for each point
- Step 3: **Compile Baseline Data**
  - How often is system in alarm – total # of alarms, time in “flood”
  - Which alarms/systems are “bad actors”

Alarm Management Process

- Step 4: **Alarm Justification**
  - Establish Ground Rules:
    - Consequence Levels – *similar* to in a Hazards Evaluation
      - Will have both “safety” and “quality” levels
    - Response Time Frames
      - How long will it take for the consequence to occur after the time of the alarm sounding?
  - Go through each and every one of the thousands of alarms
  - Document the consequences of the system being in this state and not being corrected
    - Distinquish between “Quality” and “Safety”
  - Determine the Response Time Frame

Alarm Management Process

- Step 4: **Alarm Justification, continued**
  - Document the required Operator Response to the alarm
  - Some alarms actually do not have an Operator Response
    - There just is not anything they can or need to do
      - Shutting down IS a response, calling in technical help IS a response
      - If evacuation is required that is MOST DEFINITELY a response!
    - If there is no appropriate response then there is NO ALARM justified

Alarm Management Process

- Step 4: **Alarm Justification, continued**
  - Rate the alarms – example table

Consequence / Time Frame	None	Low	Mid	High
Seconds	No alarm	Mid	High	Critical
Minutes	No alarm	Low	Mid	Critical
Hours	No alarm	No alarm	Low	High

Alarm Management Process

- Step 5: Approval
  - Present report to upper management for approval
- Step 6: Implementation
  - Needs to be done under the Management of Change system
  - Recommended to be done in stages – perhaps on selected systems
- Step 7: Collect Current Data
  - Compare current state to baseline state
  - Compare to Industry Standard Performance

Alarm Management Process

- Step 8: Ongoing Monitoring (this step NEVER stops…)
  - Regularly audit performance
    - How are you doing versus Industry Standards?
  - Are alarms increasing in general?
  - Are certain systems increasing in the frequency of their alarms?
    - Maybe alarm limits need to be revisited
    - Maybe the system needs repair
    - Maybe the system needs to be redesigned or upgraded

Alarm Management Process

- Observations:
  - Few programs I was ever involved with met with such resistance from site management
    - It required a lot of time from a lot of people
    - They did not see the benefit
    - It was driven by a corporate mandate: so in the end, they had to support it
    - Once it was complete they understood its value…
  - Few programs were so enthusiastically viewed by the operators after implementation
    - They loved the elimination of all of the “nuisance” alarms