U.S. Department of Transportation
Pipeline and Hazardous Materials
Safety Administration

Accidents & Control Room Influence

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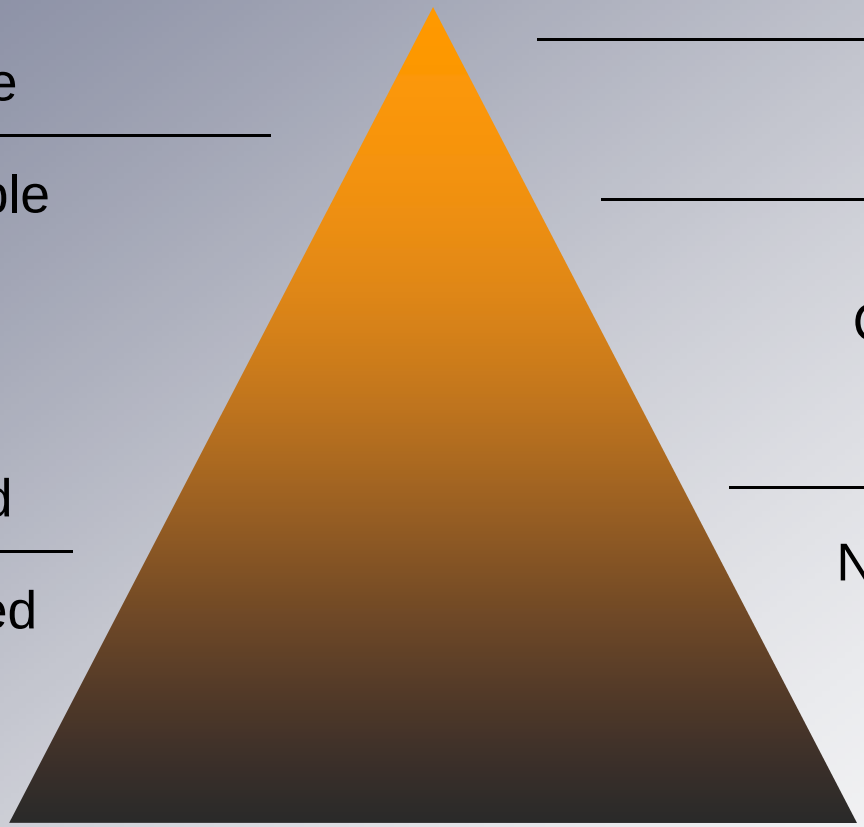
Objectives of the CRM Rule

- Create an environment to help assure controllers will be successful in maintaining pipeline safety and integrity
  - Assure pipeline operators are addressing fatigue risks in the control room
- Verify that procedures, systems and equipment are well thought out, and function as designed.

Safety Pyramid Is Why



Serious Failure

Significant and Minor Events

Intervention by Controllers, other Personnel or Safety Systems

Near Miss, Identified

Near Miss, Undetected

Reportable

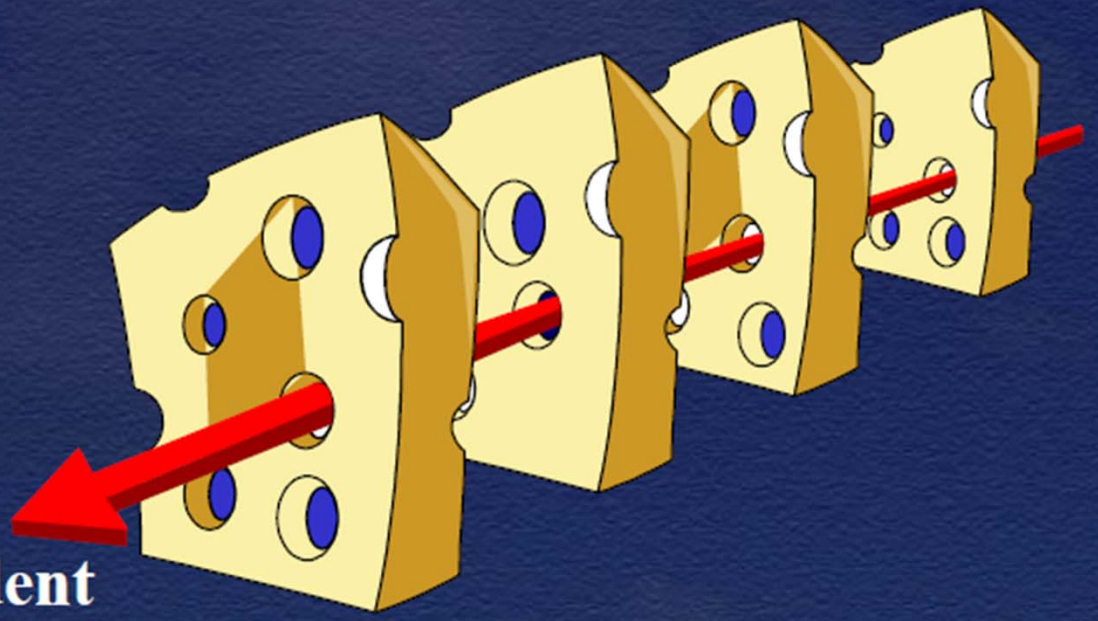
Un-reportable

Recorded

Un-recorded

Control Room Management Processes can help assure that developing situations don't climb the pyramid to become Significant Events or Serious Failures

"Swiss Cheese" Model (Reason)



Successive layers of defenses, barriers, and safeguards

NTSB

General Observations

- Even though Section G of the CRM rule exists
  - Operators are not looking at Fatigue or control room elements on all reportable events
    - Excavation Damage is a primary opportunity to identify controller response and evaluate specifics associated with ROC alarms
  - To prove Fatigue was an issue in an accident,
    - If possible, two week work/sleep histories should be captured quickly
    - Don’t forget the drug and alcohol

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Hazardous Liquid

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*6. Was a Supervisory Control and Data Acquisition (SCADA)-based system in place on the pipeline or facility involved in the Accident?

☐ No
☐ Yes ⇨

6.a Was it operating at the time of the Accident? ○ Yes ○ No

6.b Was it fully functional at the time of the Accident? ○ Yes ○ No

6.c Did SCADA-based information (such as alarm(s), alert(s), event(s), and/or volume calculations) assist with the detection of the Accident? ○ Yes ○ No

6.d Did SCADA-based information (such as alarm(s), alert(s), event(s), and/or volume calculations) assist with the confirmation of the Accident? ○ Yes ○ No

*7. Was a CPM leak detection system in place on the pipeline or facility involved in the Accident?

☐ No
☐ Yes ⇨

7.a Was it operating at the time of the Accident? ○ Yes ○ No

7.b Was it fully functional at the time of the Accident? ○ Yes ○ No

7.c Did CPM leak detection system information (such as alarm(s), alert(s), event(s), and/or volume calculations) assist with the detection of the Accident? ○ Yes ○ No

7.d Did CPM leak detection system information (such as alarm(s), alert(s), event(s), and/or volume calculations) assist with the confirmation of the Accident? ○ Yes ○ No

*8. How was the Accident initially identified for the Operator? *(select only one)*

☐ CPM leak detection system or SCADA-based information (such as alarm(s), alert(s), event(s), and/or volume calculations)
☐ Static Shut-in Test or Other Pressure or Leak Test
☐ Controller
☐ Air Patrol
☐ Notification from Public
☐ Notification from Third Party that caused the Accident
☐ Local Operating Personnel, including contractors
☐ Ground Patrol by Operator or its contractor
☐ Notification from Emergency Responder
☐ Other _____

*8.a If "Controller", "Local Operating Personnel, including contractors", "Air Patrol", or "Ground Patrol by Operator or its contractor" is selected in Question 8, specify the following: *(select only one)*

○ Operator employee ○ Contractor working for the Operator

Done Unknown Zone

Hazardous Liquid

*9. Was an investigation initiated into whether or not the controller(s) or control room issues were the cause of or a contributing factor to the Accident? *(select only one)*

☐ Yes, but the investigation of the control room and/or controller actions has not yet been completed by the Operator *(Supplemental Report required)*

☐ No, the facility was not monitored by a controller(s) at the time of the Accident

☐ No, the Operator did not find that an investigation of the controller(s) actions or control room issues was necessary due to: *(provide an explanation for why the Operator did not investigate)*

_____

_____

_____

☐ Yes, specify investigation result(s): *(select all that apply)*

○ Investigation reviewed work schedule rotations, continuous hours of service (while working for the Operator) and other factors associated with fatigue

○ Investigation did NOT review work schedule rotations, continuous hours of service (while working for the Operator) and other factors associated with fatigue *(provide an explanation for why not)*

_____

_____

_____

○ Investigation identified no control room issues

○ Investigation identified no controller issues

○ Investigation identified incorrect controller action or controller error

○ Investigation identified that fatigue may have affected the controller(s) involved or impacted the involved controller(s) response

○ Investigation identified incorrect procedures

○ Investigation identified incorrect control room equipment operation

○ Investigation identified maintenance activities that affected control room operations, procedures, and/or controller response

○ Investigation identified areas other than those above ⇨ Describe: _____

_____

_____

_____

General Observations

- Procedures and connections not fully developed
  - Emergency Procedure Crosslink
  - O&M Procedure Crosslink
    - Abnormal, Normal, Specific
    - Enhanced Level of Detail
    - More than Generic Company Wide Procedures
- Leak Detection
- Communications and Power

General Observations

- Make sure:
  - Specifically identify in the roles and responsibility documents if the controller could shut down the pipeline
- Remember the supervisor functions
  - Emergency?
  - Shutdown Only?
  - ESD?
  - LASD?

General Overview

- Controllers were not informed of things happening in the field that could affect them:
  - Pressure restrictions due to integrity management
  - PLIDCO sleeve installations that required a reduced pressure or flow condition
  - Pig runs that impacted control room operations
  - Line maintenance that impacted thru put.

General Overview

- Controllers were unaware of things happening in the field that could affect them:
  - New pipeline facility construction and start up on a moments notice without adequate training or preparation
  - No control room input to control changes or set up for new facilities
  - Mergers or Acquisitions and suddenly the controller without training

General Overview

- Previous accidents/incidents have indicated that communication with the control room is not always adequate nor informative
  - Training needed with all parties
  - Lack of understanding between locations for similar terminology

General Overview

- Include in procedures how deficiencies that are identified in RCFA investigations relative to the control room will be communicated and addressed
- Procedures should identify and explicitly address the contribution of erroneous training

General Overview

- Procedures identify how training is impacted by lessons learned or near miss events
- Contributory factors may provide training and procedure revision insights
- Document how deficiencies found in accident/incident investigations have been corrected
- Document how lessons learned are shared with all controllers

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Lessons Learned
Bellingham, WA 1999

Little Known Lessons Learned

- Server load is important
- When server reloads occur should be well thought out
- If a command doesn't go the first time, don't just keep trying endlessly
- When an asset is not behaving like normal, don't assume all is well and wait to shutdown.
- When anyone in the company sees a concerning element associated with operations, call the control room
- All employees should be trained to call the control room and actions employed
- Controller training and understanding can have a significant impact

Different Incident Picture Inserted Natural Gas Compressor Station Explosion

Lessons Learned

- If you have a local control room that is used routinely or in emergencies,
  - Make sure any emergency equipment that is necessary to monitor is in plain site and accessible
  - Make sure valve status's associated with even fuel lines are understood

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Different Accident Picture Inserted
Multiple Pipelines
Liquid Line MIC in Casing

Lessons Learned

- Instrumentation alarms are important
- Controllers should not have to rely on verbal communication between each other if they have to also answer phones
- Automatic display changes when controllers monitor multiple facilities is not a good idea unless adequate screens exist
- Make sure field locations know what to call certain valves
- Make sure the field locations and control room know locations as the same name
- If you don't have check valves, better make sure backflow from tankage is prevented
- If go through an integrity audit and promises to implement ROC alarms, follow it through to implementation
- Poor maintenance

Lessons Learned

- If you automatically disable alarms, make sure that when this automatic provision is lifted, alarm setpoint values return to where they were
- Make sure you have enough staff to send all that may have influenced the event from the control room to a drug and alcohol test quickly
- Make sure instrumentation that the control room needs is installed properly and has the a high maintenance priority
- If you have more than one controller responsible for a portion of the system, make sure what they control comes into their alarm or event environment
- Make sure that training matches procedures
- Verify controller displays are accurate
- Have maximum and minimum alarms controllers cannot move

The Importance of Alarm Management

- Console 4 (Controller #1)
  - High and Low for May 21 – May 23
    - High - 4,630 Per Day, Low – 1015 Per Day
    - 192 Per Hour Average, 42 Per Hour Average
- Console 2 (Controller #2)
  - High and Low for May 21-May 23
    - High – 6,202 Per Day, Low – 1,343
    - 258 Per Hour Average, 55 Per Hour Average

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Different Accident Picture Inserted Liquid Pipeline Stopple Fitting Leak

Lessons Learned

- Controllers need to understand what is being done in the field
  - Stopple installations
    - Purpose and how it can fail
- Consistent training
  - Slack line conditions
- Understand the support systems
  - Leak Detection
- False alarms can mask real problems

Different Accident Picture Inserted
Liquid Pipeline
Plidco Sleeve Leak and Ignition

Lessons Learned

- Know and Abide by the Manufacturer's Fitting Recommendations (Proper Installation, How the Fitting Works, Pressure Restrictions)
- Work to make sure operating procedures are correct and well understood
- Assist in making sure the control room understands what you are doing in the field
- Be alert for AOC's
- Keep an eye out for ignition sources that should not be present at the job site

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Different Accident Picture Inserted
Liquid Pipeline HVL
2” Bypass Stopple Leak and Stuck Pig

Lessons Learned

- Use Stopple Fittings correctly, as indicated by the manufacturer
- Make sure the Control Room knows what maintenance activity you are performing in the field
- If you stick a pig, carefully construct your bypass and make sure you communicate your actions to all impacted including the control room

Just for Information

- If providing Trends on pressure or flow, make sure that the information makes some sense with the evidence before sending them
  - Received information as pressures from transmitters that been left on line but were considered not used

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Different Accident Picture Inserted
Liquid Pipeline
Plant with
Jurisdictional Piping

Lessons Learned

- If a particular alarm is part of a required action and procedure, make sure it is always working
  - High Level In the Accumulator
  - Personnel were to dump the accumulator
    - Disconnected during a control room and never reconnected

Different Accident Picture Inserted Liquid Pipeline – NTSB Investigation SCC

Lessons Learned

- Leak detection needs improved on downed pipelines
- Support staff may also suffer from fatigue
- Forced points can lead to confusion
- Think leak first
- Don’t work around the controller
- Make sure those giving instructions to the controller are trained
- Follow procedures
- Don’t wait for the public to find your leaks or ruptures
- If controllers tell you they need a change, listen and act
- Don’t dismiss comments from others in the control room
- Instrumentation needs to be in the correct location
- Leak detection should be set up correctly for pipeline and facility maintenance also

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Different Incident Picture Inserted
Natural Gas Pipeline
NTSB Investigation

Lessons Learned

- Upgrade your scada system if it is older and you have limited functions or concerns
- Know and train controllers on how equipment fails when loosing power
- Review where remote controlled valves are located versus population
  - ***Drills can be helpful if done right
- Isolate the area away from commodity quickly – remote valves first, manual second
  - If you don't have them, add them

Lessons Learned

- Think leak control versus town loss
- Anticipate problems when changing controls and normal power supply arrangements
- Enhanced field to control room communication needed when performing maintenance activities, especially when impacting SCADA data.
- Alarms due to maintenance can hide other issues

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Different Incident Picture Inserted Natural Gas Transmission Pipeline Cracked Girthweld in a Casing

Lessons Learned

- Value of Controller Experience
- Instrumentation weakness
- Common Lines feed a fire
- Do not start up when a known fire is present
- Make sure controllers know where line break valves are located and what they operate on
- Make sure controllers understand where cross-connects are located on common line operations
- Unless OQ'd and planned for through training, supervisors are NOT controllers

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Different Accident Picture Inserted
Liquid Pipeline
Crude Oil
Vibration

Lessons Learned

- Don’t make it hard for the public to call in a release
- If you have a 3rd party take your 800 calls, make sure they transfer the calls regarding potential leaks promptly
- If you are in a control room operating a new facility, think about vibration and pulsation issues
- Make sure control valves and VFDs don’t fight each other
- Instrumentation needs to be in the right place and supported correctly
- Listen to field and control room personnel

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Different Accident Picture Inserted
Liquid Pipeline
Jet Fuel A
Overpressure

Lessons Learned

- Electrical power outage occurred and communications was lost with a pump station
- The operator manned the facilities and took over local control
- The next day, power was restored
- Local personnel gave instructions to the controller to open certain valves and start specific pumps and tested multiple flow paths including an area thru a trap that the controller could not see values for pressure
- The field instructions were performed as requested by the controller
- The controller pumped against a closed valve and over pressured the line
- Clocks in Field Equipment and Scada were not Synch.

Lessons Learned

- Not only controllers can be fatigued, fatigue was not confirmed
- The field needs to understand what the controllers can see and what they cannot if they are providing instructions
- Responsibility needs to be clear
- Training should be implemented for the field and the controller

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Different Accident Picture Inserted
Liquid Pipeline
Crude Oil
Commissioning Overpressure

Lesson's Learned

- When preparing to commission facilities, don't assume the controls are correctly set up in a PLC/RTU load
- Delay putting commodity in the system until controls can sufficiently be tested if at all possible
- Verify PIDs are correct before introducing any pressure or commodity into the system
- Make sure the local control room display screens are correct if technicians are trained to use them for calibrations
- Don't reset something repeatedly in order to clear an override safety and keep checking something that does not make sense
- Always be aware of liquid sumps
- Confirm open and closed control paths

Different Accident Picture Inserted
Liquid Pipeline
River Flooding

Lessons Learned

- The procedures in the Control Center were not adequate in that the controller shut in the line but because it was on a general downslope, it kept flowing into the river.
- The operator had valves they could have shut immediately to provide greater protection of the river put did not do it.
  - Use what you have

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Different Incident Picture Inserted
Natural Gas Transmission
Vent Valve Malfunction
Work Around

What Happened and Lesson Learned

- A compressor unit is shutdown and a vent valve inadvertently opens
- Two alarms are received by the controller after shutdown pertaining to the open vent valve
- By procedure, controller was supposed to call the field but does not and simply acknowledges the alarms
- The Vent valve blew for at least 8 hours
- Part of the reason alarms were available is this problem had happened several times in the past and a work around had been implemented

Other Accident Learning

- Relief valve, relief valve, relief valve
- WHY IMPACTS THE CONTROL ROOM
  - If they activate, remember it is a sign that the process moved beyond the planned range
    - Vibration or pulsation?
    - Trash? Where is it coming from – Line Up?
    - Other operator sending you problems?
    - Poor maintenance technicians
  - In many cases, there are meters that could be compared routinely to find releases rather than blowing and being reported

Other Accident Learning

ENGINE SHUTDOWN VALUES and LINE BREAK VALVES

- If you have a special permit or have a limited pressure on compressor units, make sure that your engine shutdowns are set correctly.
- If you have automatic line break valves, make sure that your engine controls are set up to shutdown rather than continue pumping against a closed valve.
  - Whether doing maintenance or remotely controlled

Other Accident Learning

- Control room asked to perform unusual activities without any warning due to a leak at an anomaly but were not told about it, were just told an integrity dig was happening
  - Infrequently used procedures and advance training?
- Control room experienced a leak and did everything right but in the process of investigating it was determined that the control room had inadequate instrumentation to know if any of the product was moving to the end of the pipeline
  - One pressure transmitter and one flow meter at the beginning of the pipeline
  - Other operator personnel had to be called to know more

Objectives of the Rule

- **Ask:**
  - CAN THE CONTROLLER SUCCEED AT THE ROLES AND RESPONSIBILITIES ASSIGNED IN CURRENT ENVIRONMENT?
  - WILL THIS AFFECT THE CONTROLLERS OPPORTUNITY TO SUCCEED?
- **Don't Know:**
  - Ask a controller, we will.

Key Takeaways

- Make sure your controllers know field terminology
- Stress to the field the need to communicate activities with the control room
- Use low minimum and high maximum pressure alarms that cannot be changed by controllers
  - If zero's, use an algorithm with knowledge associated with line up and past experience on timing
- Take advantage of ROC alarms
- Know your leak detection systems
- Routing commodity through traps or sumps to various locations seems to cause more than one problem
- Implement the needed instrumentation correctly and maintain it

Key Takeaways

- Use what is available on metered volumes or pressure changes to pick up flow on down pipelines
  - Laterals and existing meter locations should be reviewed for possible LUAF
  - The public should not be the operator's only leak detection system
- If procedures require an alarm, make sure the technology works
- Consistency in training versus procedures
- If commissioning, assign responsibility to monitor pressures
- Training, training and more training for all parties
- Make sure controllers know and understand how equipment will fail, especially related to power loss
- Think outside the box..... to learn.....as on the next slide.....

Lesson's Learned from SRCR

- Not an accident
  - Welker Operator and Monitor Set up Fails
  - Determined to have manufacturer issues
  - SRCR is filed because more than one location existed with this equipment
- But in the investigation it is determined:
  - An ESD switch did not work
  - Overpressure was seen in remote control room but page acknowledge on another alarm did not allow it to be seen
  - Displays did not alarm correctly
- Alarm Logger was incorrectly programmed – gave temperature value instead of pressure