Introduction to CRM

Control Rooms are Essential

- Control rooms and controllers are critical to the safe operation of pipeline systems
- Control rooms often serve as the hub or command center for decisions such as adjusting commodity flow or facilitating an operator's initial response to an emergency
- Controllers are low risk as cause of events, but the impact on consequence of involvement can be very high

Risk and Consequence

- Low probability of controller error is frequently offset by the potentially high consequence of their involvement
- Controller responses to developing abnormal conditions, incidents and accidents can alleviate or exacerbate the consequences of some events, regardless of the initial cause

Examples

- Inadequate shift change linked to tank overflow and explosion
- Controller was not able to discern an abnormal operating condition among other alarms resulting in equipment failures
- Incorrectly displayed pressure data misled the controller, resulting in a rupture
- Confusion over a relocated valve contributes to magnitude of accident
- Lack of coordination between controller and SCADA technician contributed to significant product release, fire, and three fatalities

Bellingham, WA 1999: Root Cause

- Controllers must be qualified to perform their safety-related duties
- Controllers use their experience, training, technical skills, and intuition

However, controllers are dependent upon:

- Design, performance, robustness of applied SCADA systems and support applications
- Thoroughness of procedures
- Actions of others

A Second Look

- Inadequate shift change linked to tank overflow and explosion
  - **Poor or missing procedures?**
- Controller was not able to discern an abnormal operating condition among other alarms resulting in equipment failures
  - **Absence of alarm management?**
- Incorrectly displayed pressure data misled the controller, resulting in a rupture
  - **Inadequate SCADA design?**
- Confusion over a relocated valve contributes to magnitude of accident
  - **Change Management?**
- Lack of coordination between controller and SCADA technician contributed to significant product release, fire and three fatalities
  - **Communications?**

Objective of Control Room Regulations

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

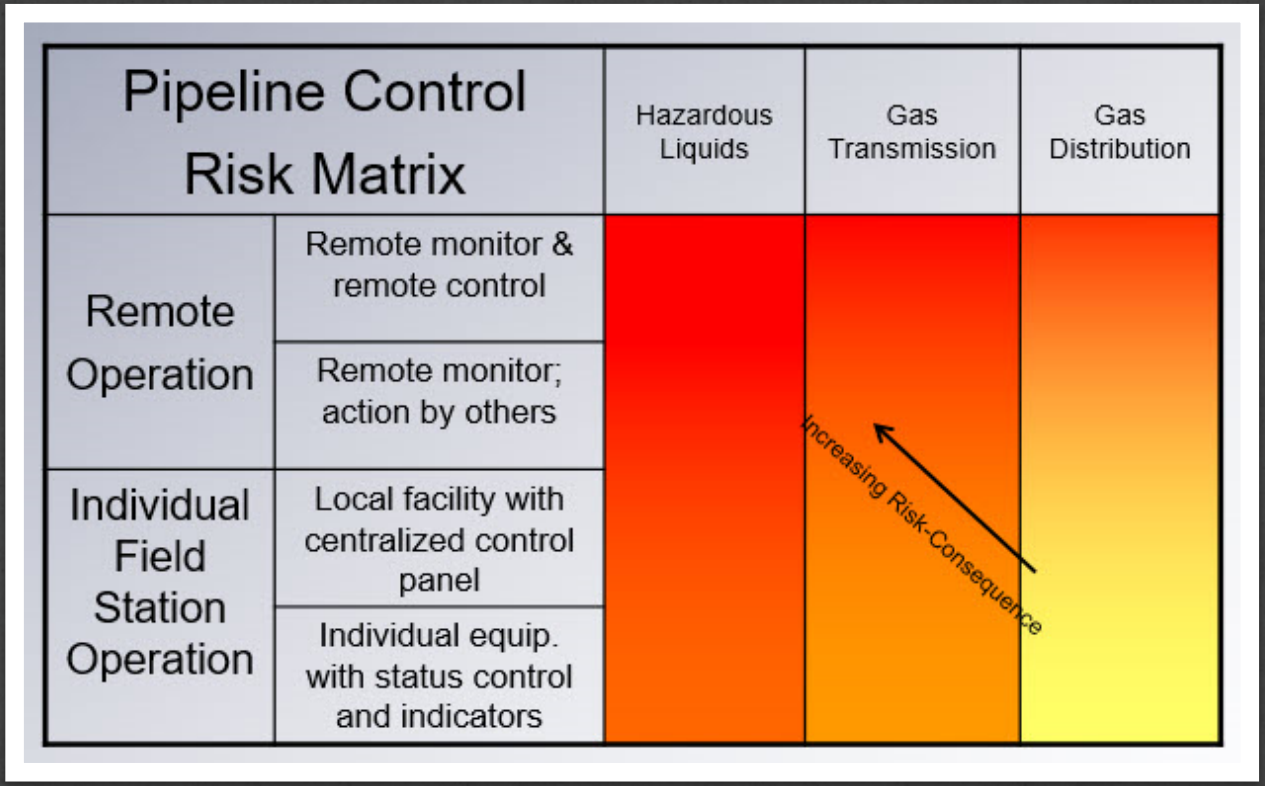
Focusing on Risk

- Remote monitor/control may be performed in a formal control room, or numerous less formal settings such as individual office, service vehicle, or residence
- Location of control actions does not define the nature or complexity of operations
- Established definitions for large or small operators, and less than 20% SMYS, are not good qualifiers in defining control room risks

Focusing on Risk

- More complex and diverse operations call for more thorough control room systems and processes
- Involvement of field personnel in control activities has the potential to influence risk
- Most operators are performing a subset of good control room practices, but frequently without a basis for their design choices, and sometimes without formalized procedures

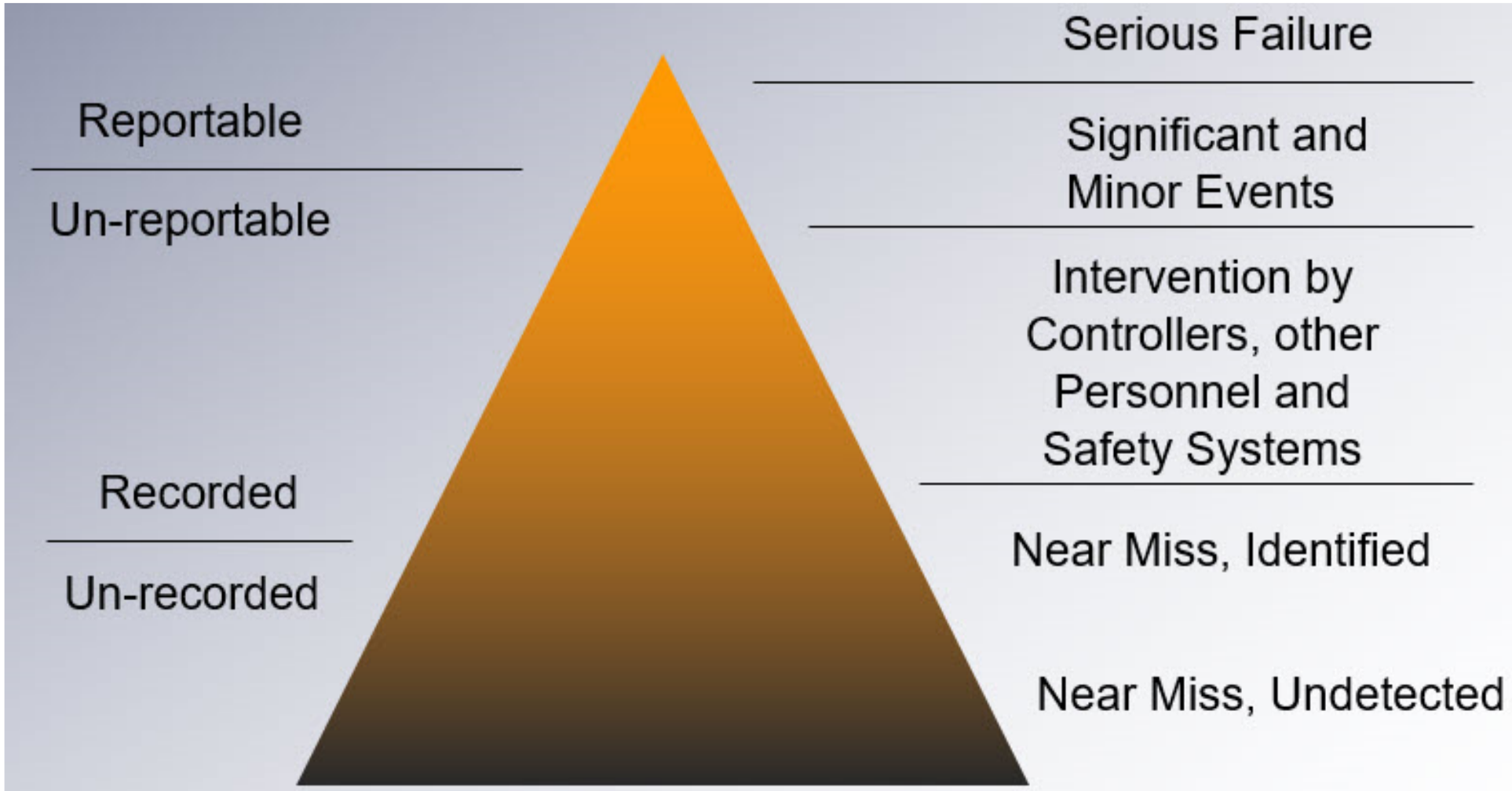
Pipeline CRM Risk Matrix



- Red indicates highest risk
- Yellow indicates lower risk

- Risk derived from monitor and control
- Matrix coding principally represents the combination of frequency and consequence of pipeline upset conditions and failures, where CRM may be a contributing factor

Safety Pyramid



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

CRM Language

Controller Definition

- A qualified individual
- Remotely monitors and controls the safety-related operations of a pipeline facility via a SCADA system from a control room
- Has operational authority and accountability for the remote operational functions of the pipeline facility
- A person that has responsibility to monitor a SCADA system and contacts others to initiate corrective actions
- A person that has responsibility to monitor a SCADA system and personally initiates corrective action via the SCADA system

SCADA + Controller → Control Room

- If there is no SCADA System, then no one can meet the definition of a Controller
- If there is a SCADA System, but no one meets the definition of a Controller, then there cannot be a Control Room
- A Control Room may be:
  - Secure Room at Company Headquarters
  - Open Office Cubicle
  - Manager's Office
  - Compressor/Pump Station Control Building
  - Cab of Pick-Up Truck
  - Kitchen in a Private Residence

Who is not a CONTROLLER?

Technicians in the field directed to manipulate a valve, etc.

An individual who does not use a computer-type interface

People who monitor pipeline status for non-operational purposes, like business or maintenance personnel

CRM Safety-Related

Safety-related means any operational factor that …

- Is (principally) necessary to maintain pipeline integrity
- Could (help) lead to the recognition of a condition that could impact the integrity of the pipeline
- Could (help) lead to the recognition of a developing abnormal or emergency situation

Alarm

- An audible or visible means of indicating to the controller that equipment or processes are outside operator-defined, safety-related parameters

Pipeline Facility

- How does the term “pipeline facility,” as used in the definitions of Control Room and Controller, relate to other terms such as “pipeline system” that were not used in those definitions?
  - Since both 49 CFR 192.3 and 195.2 define “pipeline facility,” PHMSA found it was better to use the same terminology in both regulations
  - “Pipeline facility” is defined broadly and includes line pipe, pipelines, pipeline systems, valves, rights-of-way, buildings, and any other equipment used in the transportation of gas and hazardous liquids
  - Part 192 does not define “pipeline system”

What is SCADA?

Supervisory
Control
And
Data
Acquisition
System

A computer-based system or systems used by a controller in a control room that collects and displays information about a pipeline facility and may have the ability to send commands back to the pipeline facility

How is SCADA used?

- Gathers field data from numerous remote locations
- Presents structured data to controllers

- Offers basic numerical analysis, trends, and summary reports
- Allows controllers to send commands to field equipment

- Enhances controller's ability to monitor and forecast the need and timing of actions
- Can detect possible operating anomalies

- Modeling
- Simulations
- Can help speed up reactions to emergency conditions

Major SCADA Functions

- Gather system data for system performance monitoring
- Alarm for equipment failures, leaks, and exceptions to expected values
- Remotely control field devices to start and stop pumps, open and close valves, adjust levels
- Emergency Shutdowns (ESD's)
- Store historical data for trending and forecasting of field values and product accounting

If an individual does not use a computer and display screen, but only monitors several discrete alarm indicator lights from a remote location and initiates action when an alarm (light) occurs, is that person a controller?

- No
- An individual who does not use a computer type interface is not considered to be a controller