WHERE ENERGY CHALLENGES MEET INNOVATION
COMPANY OVERVIEW

Domain

UPSTREAM

MIDSTREAM

DOWNSTREAM

Values

O&M Efficiencies and Optimization
Safe and Compliant Operations
Business Performance Outcomes

Solutions

SAFETY AND RISK MANAGEMENT
INTEGRITY MANAGEMENT
REGULATORY COMPLIANCE
ASSET MANAGEMENT
SOFTWARE AND TECHNOLOGY

Enabling Services & Technologies

Asset Integrity
Pipeline Safety Management Systems
Engineering
Geospatial Systems & Services

Risk Management
Regulatory
Field Assurance
Software & Technology
Just a Thursday afternoon in the park
Just a Thursday afternoon in the park
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What’s this – a pipeline?
Rupture, ignition and fire
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Wade King (10) died – severe burns over 90% of his body

Stephen Tsiorvas (10) died – severe burns over 90% of his body

Liam Wood (18) died – overcome by fumes, collapsed and drowned

Eight additional injuries reported

One single-family home was destroyed

City water treatment plant was severely damaged

Total property damage estimated at $45 million – plus fines and litigation
Causes of the rupture

- Damage to pipe during construction
- Inadequate inspection practices during construction
- Inaccurate evaluation of in-line inspection results post-construction
- Failure to properly test safety devices before going into service
- Failure to investigate and correct repeated unintentional valve closures
- Improper SCADA maintenance practices
Had pipeline not been damaged, likely would not have ruptured

Damage occurred during construction excavation in 1994 (5 years earlier)

Excavation inspection was inadequate – failed to identify damage

Examination of pipeline anomalies (from ILI data) was not performed

Had SCADA system been responsive to commands, likely rupture prevented

Degraded SCADA performance due to improper development practices

Proper maintenance and testing practices may have prevented issues
NTSB Conclusions

- Proper valve inspection/failure investigation may have prevented rupture
- Federal regulations for testing of safety devices were insufficient
- Emergency and environmental response was effective and well-managed
NTSB Recommendations

✓ P-02-4 – Develop and issue guidance to pipeline operators
  o Specific testing procedures for pump station commissioning and relief valve installation
  o Specific testing procedures to determine if relief valves are functioning properly

✓ P-02-5 – Issue an advisory bulletin to pipeline operators using SCADA
  o Implement off-line SCADA workstation for development work and functional testing
  o Use the off-line system to identify and correct errors/issues from development work
“The continued operation of this pipeline without corrective measures would be hazardous to life, property and the environment.”

- Review the SCADA system – identify and correct deficiencies
- Test isolation valves traversing populated/sensitive areas – remediate issues
- Develop a plan to:
  - Review existing valves and install new valves to minimize consequences of release
  - Review SCADA to detect deficiencies and schedule modifications
  - Conduct cathodic protection surveys and schedule remediation
  - Conduct pressure testing and ILI surveys – using best available technology
OPS Corrective Action Order

- Restrict MOP to 80% of normal operating pressure or surge pressure
- Monitor SCADA operation and report anomalies to OPS (for one year)
- Develop and implement a Controller Training Program – AOC response
- Review qualifications of Controllers – AOC recognition (using simulator)
- Review qualifications of SCADA maintenance and operations personnel
- Perform design review to ensure reliability of isolation and relief devices
- Conduct internal inspections, excavate and visually examine anomalies
- Consider possibility of internal corrosion during inspection and analysis
- Conduct hydrostatic pressure testing – 90% SMYS for eight hours
- Review normal, abnormal and emergency operating procedures
Pipeline Safety Act – 2002

- DOT, DOE and NIST – “program of research, development, demonstration and standardization to ensure the integrity of pipeline facilities.”

- Materials inspection and pipe anomaly detection

- Internal inspection and leak detection technologies

- Risk assessment methodologies

- Excavation, construction and repair technologies

- Pipeline security and fire safety

- Communication and control systems

- Pilot program to evaluate need for pipeline Controller certification
P-05-1 – Require operators to follow API RP-1165 for SCADA displays
P-05-2 – Require operators to review and audit SCADA-based alarms
P-05-3 – Require operators to train controllers on AOC recognition
Define controller roles and responsibilities – Shift turnover procedures
Hours-of-service limits and time-off requirements – protect against fatigue
Educate controllers and supervisors on fatigue causes / mitigation strategies
Review SCADA displays – ensure clear, reliable information – manage alarms
Involve controllers when planning / implementing changes
Establish, maintain and review controller knowledge, skills and qualifications
Analyze incidents for involvement of SCADA, controller action or fatigue
Standards for distribution pipeline integrity management programs (DIMP)
Requirement for certification of integrity management performance reports
Authority to waive safety standards and help restore disrupted operations
Review and updated incident reporting requirements
Excavation damage prevention – state one-call laws and program grants
Standards to reduce risks associated with human factors including fatigue
Standards to implement NTSB recommendations (P-05-1, P-05-2 and P-05-3)
Follow and integrate control room management procedures

- Define controller roles, responsibilities and authority – Record shift changes

- Provide necessary information
  - Implement API RP-1165 and conduct point-to-point verifications
  - Provide for verbal communication between controllers, management and field
  - Establish circumstances that require field personnel to promptly notify controllers
  - Define and record critical information – Exchange key information at shift-change
  - Establish sufficient overlap of shifts to permit exchange of necessary information
  - Test and verify any backup communication systems
  - Provide for manual operation or safe shutdown of affected pipeline facilities
Implement methods to prevent controller fatigue

- Establish shift lengths, schedule rotations and hours-of-service limits
- Educate/train controllers and supervisors on fatigue causes, effects and mitigation

Assure appropriate controller response to alarms and notifications

- Review SCADA once each week for:
  - Events that should have resulted in alarms but did not do so
  - Proper and timely controller response to alarms
  - Unexplained changes in the number of alarms or controller management of alarms
  - Identification of nuisance alarms and verification that alarms are not excessive
  - Identification of inadequate response to alarms, AOC and emergency conditions
  - Identification of maintenance issues, systemic issues, server load or comm problems
  - Identification of points off scan or that have forced or manual values
  - Comparison of controller logs or shift notes to SCADA alarm records
✓ Annually review SCADA configuration and alarms:
  o Number of alarms, unnecessary alarms and potential systemic issues
  o Verification of correct alarm setpoints
  o Clarity of alarm descriptors so controllers fully understand the meaning of each alarm
  o Alarm indications of emergency and abnormal operating conditions (AOC)
  o Recurring combinations of AOC - include in controller training program
  o Individual controller performance changes over time regarding alarm response
  o Individual controller workload – ensure sufficient time to assess and respond
✓ Require field personnel to notify controllers when emergencies exist and when making changes

✓ Establish communications when considering, planning and implementing changes to pipeline equipment, hydraulics or configuration

✓ Establish and conduct controller training prior to implementation of any merger, acquisition or divestiture plans

✓ Coordinate SCADA changes to allow opportunity for controller training

✓ Notify controllers of changes to alarm settings, relief valve settings or automated routines prior to implementation

✓ Implement procedures to track and correct controller-identified issues
Review control room operations following any reportable incident to determine and correct deficiencies related to:

- Controller fatigue
- Field equipment or operation of a relief device
- Procedures and training programs
- SCADA configuration or performance
- Accuracy, timeliness and display of field information

Establish a definition or threshold for close-call events to evaluate their significance, conduct reviews and share information with controllers.
Establish a controller training program

- Defined roles and responsibilities
- Hydraulic training to obtain a thorough knowledge of the pipeline system
- Procedures for pipeline operating setups infrequently used
- Recognition and response to AOC – use a simulator – involve controllers in development
- Leak detection tools and notification protocols in common corridors
- Emergency communications to public and response personnel
- On-site visits by controllers to field facilities – site-specific failure modes

Annually review training program content to identify potential improvements
Establish an operator qualification program for controllers – evaluate annually

Prohibit individuals without current qualifications from performing controller duties

Measure and verify controller performance including ability to promptly detect and appropriately respond to abnormal and emergency conditions

Evaluate physical abilities, hearing, color perception and visual acuity

Address gradual degradation in performance or physical abilities

Document when oral examination is used to evaluate, including topics covered

Revoke qualification for extended absence, inadequate performance, impaired physical ability, influence of drugs or alcohol, or any other reason necessary to support safe pipeline operation

Restore qualification by specifying the circumstances for which a complete re-qualification is required
Initially and annually validate by senior executive officer signature that:

- Controller training and qualification programs were reviewed and deemed adequate
- Only qualified controllers were permitted to operate the pipeline system
- All CRM requirements have been met
- Ergonomic and fatigue factors have been addressed
- Controllers were involved in identifying ways to sustain and improve pipeline safety and integrity through the CRM program

Maintain records that demonstrate compliance and documentation to support deviations from procedures – report deviations to PHMSA upon request
Pipeline Incidents – 2010

✓ July – 30” crude oil pipeline rupture and release
  o 843,444 gallons of crude oil released into wetlands, creeks and rivers
  o No fatalities – 320 people reported symptoms consistent with exposure
  o NTSB investigation, report and 19 new recommendations (2012)

✓ September – 30” natural gas pipeline rupture and fire
  o Eight people killed – several others injured or evacuated
  o 38 homes destroyed – another 70 homes damaged
  o NTSB investigation, report and 30+ new recommendations (2011)
  o PHMSA Gas Mega Rule – Part 1 will address several NTSB recommendations
  o PHMSA CRM Rule – with substantial changes from NPRM
CRM Rule – 2011

- Integrate CRM procedures with operating and emergency procedures
- Define the roles, responsibilities and authorities of controllers
- Provide the information and tools that controllers need
- Mitigate the fatigue risk associated with shift worker fatigue
- Manage the SCADA alarms presented to controllers
- Manage changes that may impact controller ability to operate
- Review reportable Incidents – identify and address deficiencies
- Train controllers on their responsibilities and the facilities they operate
- Demonstrate compliance upon request from federal/state agencies
- Retain compliance records – document deviations from procedure
What is NOT there?

- Responsibility to coordinate activities with common corridor operators
- Controllers to have unique SCADA login credentials
- Implementation of API RP-1165 in its entirety
- Baseline point-to-point verification on 100% of SCADA displays
- Verification that SCADA displays accurately depict field configuration
- Plan for systematic reverification of SCADA display accuracy
- Means for timely verbal communication between controllers and field
- Field to notify controller of situation that could develop into an incident
- Controller to record critical information during shifts
What else is NOT there?

- Responsibility to coordinate activities with common corridor operators
- Controllers to have unique SCADA login credentials
- Implementation of API RP-1165 in its entirety
- **Baseline point-to-point verification on 100% of SCADA displays**
- **Verification that SCADA displays accurately depict field configuration**
- Plan for systematic reverification of SCADA display accuracy
- Means for timely verbal communication between controllers and field
- Field to notify controller of situation that could develop into an incident
- Controller to record critical information during shifts (shift logs)
Also NOT there?

- Sufficient overlap of shifts to permit the exchange of information
- Additional fatigue monitoring measures in single-console control rooms
- Manager approval of hours-of-service exceptions

**Weekly SCADA system reviews for:**

- Ensure proper and timely **controller response** to alarms and events
- Identify unexplained changes in number of alarms or controller management of alarms
- Identify nuisance alarms and verification that the number of alarms is not excessive
- Identify acknowledged alarms with no adequate or timely response
- Identify abnormal/emergency conditions and review controller response actions
- Identify SCADA **system maintenance issues, systemic problems** and server load
- Compare controller logs to SCADA alarm records to identify issues
And also NOT there?

- Specific requirements for annual SCADA reviews
- Field to notify controller when performing maintenance
- Procedures for tracking and correction of controller-identified problems
- Merger, acquisition and divestiture plans to establish training and OQ
- Changes to alarm and relief valve settings communicated to controllers
- Incident reviews to include SCADA display accuracy and training programs
- Establish definition/threshold for close-call events – review and share
- Simulations to include communication between controllers and others
- On-site field visits – become familiar with equipment and personnel
Other stuff that is NOT there?

✓ Hydraulic pipeline training
✓ Site-specific training on equipment failure modes
✓ Specific training on leak detection tools and leak response protocols
✓ Operator Qualification (OQ) program requirements – annual evaluations
✓ Controller performance measurements
✓ Evaluation of physical abilities – hearing, color perception, visual acuity, etc.
✓ Initial and annual certification of CRM program compliance
  o Training/OQ programs and ergonomic/fatigue factors
  o Involvement of controllers in continuous improvement programs
And finally – also NOT there?

- Hydraulic pipeline training
- Site-specific training on equipment failure modes
- Specific training on leak detection tools and response protocols
- Operator Qualification (OQ) program requirements – annual evaluations
- Controller performance measurements
- Evaluation of physical abilities – hearing, color perception and visual acuity
- Initial and annual certification of CRM program compliance
  - Training/OQ programs and ergonomic/fatigue factors
  - Involvement of controllers in continuous improvement programs
✓ Provides DOT with enhanced safety review and civil penalty authority

✓ Study and report on several areas of safety technology

✓ Evaluate integrity management and leak detection requirements

✓ Evaluate if integrity management requirements in HCA should also apply to other areas (MCA)

✓ Consider requirements for use of automatic-shutoff, remote-control and excess-flow valves
Pipeline Safety Act – 2016

✓ Regulations for underground gas storage facilities – API RP-1170 and 1171
✓ Consider annual in-line inspection of inland pipelines below 150 feet of water
✓ Update regulations governing permanent small-scale LNG facilities
✓ Require HL operators to provide safety data sheets (SDS) post-incident
✓ Reports on:
  - Improving damage prevention programs through technology
  - Establishing a national pipeline safety regulatory inspection database
  - Materials, training and corrosion prevention technologies
  - Natural gas leak detection reporting requirements
  - Feasibility of odorizing all transported gas
Based on recommendations from the 2010 oil pipeline rupture

Define roles, responsibilities and qualifications of individuals with authority to direct or supersede specific controller actions

Conduct annual control room team training and exercises
  - Involve controllers and individuals with authority to direct or supersede actions
  - Include others who operationally collaborate with controllers during normal, abnormal or emergency operations
  - Model training after Crew Resource Management training used by other industries
  - Include exercise scenarios based on actual or realistic operator-specific events
SO – is there a pattern here?

- Operators conduct business while meeting minimum regulatory requirements
- Incidents occur – people, property and the environment are impacted
- NTSB investigates, reports and recommends actions
- PHMSA issues Safety Advisories and conducts inspections
- Congress reauthorizes the Pipeline Safety Act – directs PHMSA to implement mandates and recommendations
- PHMSA updates regulations – implements mandates and recommendations
- Rinse and Repeat
Operators conduct business while meeting minimum regulatory requirements

Incidents occur – people, property and the environment are impacted

NTSB investigates, reports and recommends actions

PHMSA issues Safety Advisories and conducts inspections

Congress reauthorizes the Pipeline Safety Act – directs PHMSA to implement mandates and recommendations

PHMSA updates regulations – implements mandates and recommendations

Rinse and Repeat

This process is incredibly slow and demonstrably ineffective
Can we break the pattern?

- Operators conduct business while *exceeding* regulatory requirements
- Incidents are *avoided* – people, property and the environment are safe
- NTSB doesn’t need to investigate, report or make recommendations
- PHMSA reports operational *safety successes* and continues inspections
- Congress congratulates PHMSA (and themselves) on safety successes
- PHMSA updates regulations with *new*, proven practices and technologies
- Everyone lives happily ever after
“Now, we could do it with conventional weapons – but that could take years and cost millions of lives. No, I think we have to go all in. I think that this situation absolutely requires a really futile and stupid gesture be done on somebody’s part!” – Eric “Otter” Stratton
A Challenge

- Identify and define ways to improve safety – beyond regulatory requirements
- Present your ideas with stakeholders – gain buy-in / approvals to proceed
- Implement new policies, processes, procedures and/or programs
- Define success / establish effectiveness metrics
- Regularly assess, document and report your results
- Develop a presentation, present a white paper or publish an article
- Come back next year and share your experience
Thank You!

Questions or Comments?
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THANK YOU