Why Process Safety Management
Why Now
What is Process Safety Management?

- Process Safety Management (PSM) is a management system approach focused on preventing incidents. The focus on process safety originated in complex chemical operations, but applies to all asset intensive operations.

- Process safety can be incorporated into an existing integrated management system, or can be a stand-alone system.

- Process Safety focuses on:
  - Technology
  - Facilities
  - Personnel
20 elements of a Process Safety Management System (CCPS)
Many of the elements in PSM are similar to other management systems.

The value of Process Safety is related to hazard and risk identification and management of risks.

Process Safety brings specific value with respect to:
- Operational Readiness
- Process and Hazard awareness
- Quantitative risk analysis

PG&E representation of the 20 elements of Risk Based Process Safety from CCPS
“Guidelines for Risk-Based Process Safety”, 2007, AIChE, NY
Risk-Based Pipeline Safety

• Many of the elements in PSM are similar to other management systems

• The value of Pipeline Safety is related to hazard and risk identification and management of risks

• Process Safety brings specific value with respect to:
  – Operational Readiness
  – Process and Hazard awareness
  – Quantitative risk analysis

PG&E representation of the 20 elements of Risk Based Process Safety from CCPS
“Guidelines for Risk-Based Process Safety”, 2007, AIChE, NY
<table>
<thead>
<tr>
<th>CCPS Risk Based Process Safety Management</th>
<th>API RP 1173 Pipeline Safety Management System</th>
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<tbody>
<tr>
<td>1. Process Safety Culture</td>
<td>1. Leadership &amp; Management Commitment</td>
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<td>15. Conduct of Operations</td>
<td>2. Stakeholder Engagement</td>
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<td>5. Stakeholder Outreach</td>
<td>3. Risk Management</td>
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<td>4. Workforce Involvement</td>
<td>4. Operational Controls</td>
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<td>10. Asset Integrity and Reliability</td>
<td>6. Incident Investigation</td>
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<td>11. Contractor Management</td>
<td>17. Incident Investigation</td>
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<td>2. Compliance with Standards</td>
<td>14. Operational Readiness</td>
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<td>17. Incident Investigation</td>
<td>6. Process Knowledge Management</td>
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<td>18. Measurement and Metrics</td>
<td>19. Auditing</td>
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<td>3. Process Safety Competency</td>
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<td>12. Training and Performance Assurance</td>
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<td>6. Process Knowledge Management</td>
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<td>19. Auditing</td>
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<tr>
<td>20. Management Review and Continuous Improvement</td>
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</tbody>
</table>
How do PSM and PSMS Align?

- AGA Safety & Occupational Health Committee (SOHC) PSM for natural gas developed in parallel with API 1173

- AGA SOHC process safety approach facilitates much of what API 1173 demands from a management system perspective.

- AGA PSM not only helps with what should be done, it describes how to get there.
Your speakers today

• Ruth Dekker, Union Gas - Implementing a Process Safety approach

• Marcello Oliverio, Enbridge - 5 elements of the Process Safety Management System

• Chris Conlon, National Grid - 5 elements of the Process Safety Management System
Welcome!

Ruth Dekker
Manager Operations Management System Framework
Union Gas, an Enbridge Company

Implementing a Process Safety Approach
Integrated Management Systems
What we’ve learned

Ruth Dekker, Manager Operations Management System Framework,
Union Gas Ltd   Nov 1, 2017
Union Gas overview

- Major Canadian natural gas storage, transmission and distribution company based in Ontario
- Over 100 years of experience and safe service to customers
- Dawn Storage facility – largest underground storage facility in Canada
- Dawn Hub, the second largest physically traded hub in North America

1.4 Million Retail Customers

1.2Tcf Pipeline Throughput

65,390 km / 40,630 mi Distribution Pipe

162 Bcf Storage Capacity

4,850 km / 3,015mi Transmission Pipe

- Assets of $8.2 billion, ~1.4 million customers, ~2,300 employees
- One of Canada's Top 100 Employers 2011-2017
- An Enbridge company

For more information visit www.uniongas.com
Why did we embark on this journey at Union Gas?

1. Good business
2. Common sense
3. Compliance
Structure the IMS to suit your business

Our experience

Common Requirements:

- Governance / Leadership Commitment
- Risk Management
- Compliance Management
- Management of Change
- Monitoring/Audit
- Corrective Action

Regulatory Requirements
National Energy Board Onshore Pipeline Regulations
TSSA Code Adoption Requirements

Leading Standards
ISO 9000/14000/55000
API RP 1173 Pipeline Safety Management Systems
CSA Z662 Oil & Gas Pipelines

Best Practices
Process Safety Management
Responsible Care
Aviation Industry Knowledge Sharing

Integrated Management System
Enterprise Wide Management System Framework (MS Framework)

Union Gas Operations Management System (OMS)

Operational Safety and Compliance Programs

- Asset Integrity Management
- Emergency Preparedness
- Security Management
- Asset Management
- Measurement Accreditation
- Damage Prevention
- Control Room Management

OMS Elements

Governance
OMS Governance Framework
Objectives & Targets
Resources

Compliance Requirements

Risk Management

Operational Controls
Operational Planning
Training & Competency
Communication
Supplier & Contractor Management
Documents & Records
Management of Change

Monitoring
Performance Measurement
Assessment Processes
Incident Reporting & Investigation
Corrective Action

Management Review

Personal Safety and Compliance Programs

Environmental
Occupational Health
Personal Safety
Executive engagement is essential

- Committee charters document accountabilities
- Transparent and timely access to data & metrics
- Knowledge and information for risk based decision making
- Templates for presentations ensure consistency and right level of detail

Front Line Input: Risk Workshops / Role Hazard Analysis / New Risk Identifications, Maintenance Capital Budget Risk Based Submissions, Field Identification
Risk Management
Knowledge and information for risk based decision making

Hazard Identification

Risk Matrix

Risk Management Cycle

Identify PEMR, DOAR, EPASS, Incident Reviews, etc.

Monitor Report, Review, Communicate

Assess Budget Reviews, Risk Workshops

Mitigate Allocate Resources, Implement
Compliance Management
Captures all applicable codes and regulations related to Operations and EHS

- One common compliance registry
- Documented accountabilities for compliance requirements
- Proactive representation on regulatory committees
- Frequent review of evolving regulatory changes
It’s a work in progress

Our experience
It’s a continual process
Our experience

Incident Management
Audit Management

Risks, Metrics & Operational Controls
IMS Framework & Program Reviews
It can’t be undertaken overnight

Our experience

1999...

2008
MS Framework Development

2011
Common Risk & Audit Management

2012
Executive Governance for Line-of-Sight

2014
Management of Change

2015
Corporate Alignment

2017
Continual Improvement
Welcome!

Marcello Oliverio, P.Eng.
Process Safety Program Manager
Enbridge Gas Distribution

5 Elements of the Process Safety Management System
Safety Culture

- Safety culture is that assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, safety issues receive the attention warranted by their significance (adapted from IAEA Safety Series 75 – INSAG-4)

- An amalgamation of values, standards, morals and norms of acceptable behavior.

- Aimed at maintaining a self-disciplined approach to safety

- Everyone needs to be on board
Compliance with Standards

• External safety regulations, codes, standards and recommended practices based on the collective wisdom of the group who developed them

• Written at three levels
  • minimal requirements ("least safe")
  • good engineering practices (RAGAGEP)
  • best practices ("most safe")

• May be developed in another industry and not fully applicable to gas industry – e.g. API 754

• Internal standards and guidelines are an organization’s response to these external inputs

• Need a management system to:
  • Ensure, monitor conformance
  • Keep abreast of latest versions and new documents
  • Respond to / influence proposed changes
Process Knowledge Management

• Technical information needed to effectively be able to identify hazards and understand their risk

• Supports:
  • Safe design
  • Safe operation
  • Continual improvement

• Includes:
  • Design basis docs, P&IDs/other drawings, process control docs
  • Operating & maintenance procedures
  • Emergency procedures
  • Chemical hazards information
  • Equipment layout / plot plan
  • Learnings from historical incidents

• Process for:
  • Keeping information up to date
  • Easy storage and retrieval
  • Collecting data – e.g., through in-house equipment testing, industry data, research
Safe Work Practices

• Procedures and permits for non-routine work
  • e.g., procedure for replacing a leaking meter
• Routine work covered by (normal) operating procedures and maintenance procedures
  • e.g., procedure for routine meter exchange
• Non-routine activity is an activity that is not fully described in an operating procedure
• Safe work procedures typically control
  • hot work – e.g. cutting off a service from a live main
  • opening process vessels & piping, including lockout/tag out
  • confined space entry
  • emergencies
• Safe work practices can be risk assessed to drive improvements
Asset Integrity and Reliability

- Activities aimed at
  - minimizing probability of failure (PoF) for components & LOPC
  - achieving high reliability for engineered safety systems
  - Ageing should be taken into account

- Tasks:
  - Preventative maintenance
  - Predictive maintenance
  - Inspections
  - Testing

- An effective asset integrity program
  - Helps minimize risk
  - Ensures equipment and systems are properly designed, fabricated and installed
  - Operation is within the safe operating limits
  - Maintenance, test and inspection tasks completed by competent individuals using approved procedures
  - Repairs conform to codes & standards and manufacturers recommendations
  - System in place to address deficiencies
  - Suitable oversight to maintain a dependable practice
Welcome!

Chris Conlon
Director
National Grid

5 Elements of the Process Safety Management System
What is a Process Hazard Analysis (PHA)?

- **PHA Definition:** Organized effort to *identify* and *analyze* the significance of hazardous situations associated with a process or activity to aid management in making critical safety decisions.

- PHAs can pinpoint weaknesses in the design, construction, operation, maintenance and decommissioning of facilities that could lead to accidental releases of energy, fires, explosions or environmental consequences.

- They focus on *process safety issues* not personal safety.
What does a PHA do?

- PHAs help a business identify and manage its process safety risks

- PHAs answer the following questions
  1. What are the worst things that can go wrong?
  2. How likely are they to occur?
  3. What are the consequences?
  4. What safeguards do we have in place...
     - to stop them from occurring?
     - to reduce their severity or control them?
     - to protect us from them in the event they happen?
  5. What additional safeguards do we need to add to perform the job or process safer?
Sample PHA Hazard Scenario

Cause:
• Operator incorrectly drives heavy equipment over shallow gas transmission main due to human factors

Consequence:
• Gas transmission line is damaged and releases gas with the potential to ignite

Safeguards:
• Job brief identifying potential hazards before work starts
• Pipeline is marked out and inspector is present during crossing
• Equipment operator is qualified to use heavy equipment
• Equipment route crosses the pipeline at angle (not a safeguard)

Risk: High

Action: Identify weight of heavy equipment, depth of cover to main and perform engineering loading calculation to determine if add’l safeguard or different route is needed to protect main
What is Management of Change (MOC)?

- **MOC Definition:** Process to ensure that a potential change in a process safety asset is analysed from a risk perspective to incorporate any impact to risks or hazard scenarios.

- Changes can be experienced at any point during the lifecycle of the asset, including:
  - Design
  - Construction
  - Maintenance
  - Operation
  - Decommissioning
What does an MOC do?

- An MOC ensures the following is performed BEFORE a potential change is implemented:
  - The potential change is reviewed for process safety risks in a manner based on the level of risk.
  - The change is documented, evaluated, and approved before start-up of the modified equipment / system.
  - Process safety information such as drawings, operating and maintenance procedures, employee training, are updated to reflect the change.
  - Change is reviewed and authorized by competent personnel.
What Classes of Change are Included in an MOC Program?

Examples of changes included in the MOC program are listed below:

- Process equipment changes
- Process control changes
- Operations and technology changes
- Procedural and policy changes
- Safety system changes
- Inspection, testing, maintenance changes
- Site infrastructure changes
- Organizational change *

NOTE: * Organizational change are also sometimes in a separate organizational change procedure.
What is Pre Startup Safety Review (PSSR)?

- **Pre Start-up Safety Review (PSSR) Definition:** A final check initiated by a trigger event prior to the use or reuse of a new or changed aspect of a process to ensure that assets are in a safe condition to be started.

A PSSR is typically required:

- Before startup of a new or significantly modified facility is authorized.
- PSSR **is** required if the modifications to a facility are significant enough to require a change in the asset’s PSI.
- PSSR **is not** required for facilities that have been modified so slightly that PSI does not change.
What does a PSSR do?

- A PSSR ensures the following BEFORE an asset is placed into operation:
  - that there is a systematic process to verify that assets are in a safe condition
  - that personnel are appropriately prepared before start-up of new assets or returning assets to normal operation following a prolonged outage and or modification or repair
  - that an evaluation of the design of the new assets, modifications or repairs and process for ensuring the quality of the work completed for all company owned / operated facilities
Sample PSSR

Initiating Event: New Gas Transmission Line Heater is Installed and the Following Needs to be Confirmed

- PHA and MOC action items are all complete
- Process control, alarms, emergency shutdown and safety systems have been end to end tested and found to be functioning as designed
- Equipment shall be properly appropriately isolated from other systems not yet ready for start-up
- Xrays, Pressure testing and other required testing is completed
- Operating and emergency procedures are written and operators are trained in them before startup
- There are no safety critical open items to do before putting the unit in service.
What is a Process Safety Incident?

**Process Safety Event Categories**
* Tier 1: Catastrophic
* Tier 2: Serious
* Tier 3: Significant
* Tier 4: Potential
How do Incident Investigations Help Lower Risk?

- Effective incident investigations identify the root cause and contributing factors from an incident that can be corrected to prevent future incidents.
- Lower tier incidents provide an opportunity to learn from them and correct processes before a major incident occurs.
- Existing or missing layers of protection can be identified and strengthened to prevent future incidents.
- External incidents can provide an opportunity to evaluate internal practices and improve them.
What are Leading and Lagging Metrics and How do they Help Us Lower Risk?

- Leading metrics are proactive monitoring. They are focused on future safety performance and continuous improvement. They report what employees are doing on a regular basis to prevent injuries such as % maintenance completed vs. plan, # of action items unassigned, % MOC training completion

- Lagging metrics are reactive monitoring. They measure bottom line events that evaluate overall effectiveness of PSMS at your facility such as # process safety incidents, # pipeline leaks, # human factor incidents.
What are Examples of Leading & Lagging Metrics?

### Sample Process Safety KPIs

<table>
<thead>
<tr>
<th>Ref</th>
<th>Risk Control Measure</th>
<th>Type</th>
<th>KPI Measure (See Measure Description Tab)</th>
<th>Dept Annual Target</th>
<th>Dept Total - YTD</th>
<th>Comments</th>
<th>Rating</th>
<th>Comments on Action Item Status</th>
<th>Target Date for Action Items</th>
<th>Action Item Owner</th>
</tr>
</thead>
<tbody>
<tr>
<td>PS.1</td>
<td>Process Safety Leadership</td>
<td>Leading</td>
<td>Percent of current personnel that completed PS leadership training</td>
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<td></td>
<td></td>
<td>Leading</td>
<td>Number of PHA-Related Action Items which remain unassigned after being identified, or uncompleted after assigned due date</td>
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<td></td>
<td></td>
<td>Leading</td>
<td>No. of Managers and Supervisors Process Safety Goals completed</td>
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<td>PS.2</td>
<td>Process Safety Asset Design, Mgmt of Change and Operational</td>
<td>Leading</td>
<td>Percent of employees trained in Corporate MOC policy</td>
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<td></td>
<td></td>
<td>Lagging</td>
<td>Number of occurrences when Modifications were performed without an MOC evaluation</td>
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<td></td>
<td></td>
<td>Lagging</td>
<td>Number of occurrences when Startups of new equipment were performed without an PSSR evaluation</td>
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<td>PS.3</td>
<td>Operational procedures</td>
<td>Leading</td>
<td>Number of existing plant Isolation Procedures reviewed</td>
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<td></td>
<td></td>
<td>Lagging</td>
<td>Number of incidents with operational procedures as root cause or contributing factors</td>
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<td>PS.4</td>
<td>Workforce Competence</td>
<td>Lagging</td>
<td>Percent of Operators/Mech/Tech with under 1 year experience in plant</td>
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<td></td>
<td></td>
<td>Leading</td>
<td>Percent of personnel in key process safety related positions eligible to retire</td>
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<td>PS.5</td>
<td>Human factors</td>
<td>Leading</td>
<td>Percent of personnel that completed human factors training</td>
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<td></td>
<td></td>
<td>Lagging</td>
<td>No of Abnormal Condition Reports with human error as the root cause</td>
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<td>PS.6</td>
<td>Emergency Arrangements</td>
<td>Leading</td>
<td>No of internal (Company Employees Only) plant drills conducted</td>
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<td></td>
<td>Leading</td>
<td>No of drills/plant tours conducted with external first responders such as FQ, Hazmat teams, etc.</td>
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Summary

A robust process safety program enhances business five ways...

- Displays company’s high level of corporate and social responsibility
- Improves safety and environment for employees and the communities we serve
- Gives company the freedom to manage business
- Helps company manage risk and prevent major losses
- Creates sustained value for company and its shareholders

Facilitates Pipeline SMS