OUTLINE

» History
» What have we produced
» What are we currently working on
» Where do we go from here
A BRIEF HISTORY

» 2013
  » Process Safety declared a “strategic priority” by Enform Board

» 2013 – 2014
  » Background research
  » Formulating and discussing strategies
  » Meeting with international and local SMEs on process safety
  » Q1 2014 Released strategy document with help from Peter Wilkinson / Noetic
ENFORM - PROCESS SAFETY

» Since then we have developed three guidelines:
In 2016 we released free online Process Safety Awareness training.
KPI’S FOR PROCESS SAFETY

» In 2016 we conducted a KPI survey:
  » Opportunity for the majority of companies to implement process safety and associated KPI’s
  » Those companies that had more progressive programs experienced concrete benefits
## KPI SURVEY

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Example Metrics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start-ups and shutdowns (S&amp;S)</td>
<td>Number of incidents or near misses during unplanned S&amp;S; Number of unplanned S&amp;S; number of personnel trained on Start up &amp; Shutdown before commencing, etc.</td>
</tr>
<tr>
<td>Management of Change (MOC)</td>
<td>Number of incidents where MOC was a causal factor; Average time taken to implement change, etc.</td>
</tr>
<tr>
<td>Permit to Work (PTW)</td>
<td>Number of PTWs issued; Incidents during PTW; Number of PTWs found to be inadequate/not cover all hazards, etc.</td>
</tr>
<tr>
<td>Contractor Management</td>
<td>Contractor training and safety meetings; checks completed before hiring (audit), etc.</td>
</tr>
<tr>
<td>Emergency Management</td>
<td>Number of ERP elements that are not fully functional; Percentage of staff who have participated in a drill, etc.</td>
</tr>
<tr>
<td>Compliance with Standards</td>
<td>Number of inspections; Number of compliance violations, etc.</td>
</tr>
<tr>
<td>Management/Workforce Engagement</td>
<td>Number of inspections by management and workers; Issues identified through inspections; Issues resolved post inspection, etc.</td>
</tr>
<tr>
<td>Hazard ID and Risk Assessment (HIRA)</td>
<td>Number of HIRA completed on schedule; Number of events where inadequate HIRA was a causal factor, etc.</td>
</tr>
<tr>
<td>Competence of Personnel</td>
<td>Includes all levels from management down; Number of workers with overdue training certificates; Number of incidents related to competence; training provided, etc.</td>
</tr>
<tr>
<td>Operational Procedures</td>
<td>Number of incidents related to unclear procedures or operational shortcuts, etc.</td>
</tr>
<tr>
<td>Inspection and Maintenance</td>
<td>Number of incidents related to maintenance issues; Number of leaks and repairs; Number of emergency work orders, etc.</td>
</tr>
<tr>
<td>Plant Design</td>
<td>Number of incidents related to problems with plant design; Number of post-start-up modifications; Number of deviations from code/standard, etc.</td>
</tr>
<tr>
<td>Safety Instrumentation and Alarms (SIA)</td>
<td>Number of activations; Number of faults during testing; Amount of time between alarm and response, etc.</td>
</tr>
</tbody>
</table>
2017

» Conducted several bowtie workshops
» Held a 2-day PSM course instructed by Brain Kelly
» Drafting element guidance sheets
» Data focus
  » WCB data
  » AER Release data
  » Insurance data
  » Generate our own data
WCB DATA

- Fires, explosions or exposures that cause injury or illness
AER RELEASE DATA

- Pipelines and wells make up the majority of releases (65%) of waste, produced water, crude, gas and fresh water
- The top five causes of release (61% total) are:
  - Internal Corrosion (14%)
  - Malfunction (14%)
  - Mechanical/Structural (14%)
  - Accident (10%)
  - Oversight (9%)
CAUSE, BY SOURCE

Number of Releases (50 releases or more, 2012 - 2016)
INSURANCE DATA

» Top 100 major losses
# GENERATE DATA - FIELDS

- Unique Identifier (#)
- Date
- Occupancy
- Province
- Regulator
- Mechanical Integrity Failure
- Failure Type
- Equipment Involved
- Primary Management System Failure
- Secondary Management System Failure
- Tertiary Management System Failure
- Unique Casual Mechanism
- Operating Mode
- Safety Critical Device

- Did failure to identify release contribute to the loss?
- Did inability to isolate primary containment contribute to loss?
- Did failure in emergency response contribute to the loss?
- Estimated Volume
- Released Product or Waste
- Were workers injured?
- Was there community impact?
- Was there a fire or explosion?
- What was the Tier?
- Description of incident
- Link to regulator investigation report
FOCUS ON DATA

<table>
<thead>
<tr>
<th>No.</th>
<th>Make</th>
<th>Model</th>
<th>Type</th>
<th>Size</th>
<th>Capacity</th>
<th>Operating Hours</th>
<th>Fuel Type</th>
<th>Horsepower</th>
<th>Engine Speed</th>
<th>Starting Method</th>
<th>Nm</th>
<th>Rpm</th>
<th>Max. Torque</th>
<th>Main Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>XYZ</td>
<td>M120</td>
<td>S120</td>
<td>220</td>
<td>250</td>
<td>500</td>
<td>Diesel</td>
<td>150</td>
<td>4000</td>
<td>Start/Stop</td>
<td>150</td>
<td>1200</td>
<td>1200</td>
<td>High Efficiency</td>
</tr>
<tr>
<td>2</td>
<td>ABC</td>
<td>M220</td>
<td>S220</td>
<td>330</td>
<td>300</td>
<td>800</td>
<td>Gas</td>
<td>200</td>
<td>4500</td>
<td>Manual</td>
<td>200</td>
<td>1500</td>
<td>2500</td>
<td>Dual Ignition</td>
</tr>
<tr>
<td>3</td>
<td>DEF</td>
<td>M330</td>
<td>S330</td>
<td>440</td>
<td>400</td>
<td>1200</td>
<td>Diesel</td>
<td>250</td>
<td>5000</td>
<td>Electric</td>
<td>250</td>
<td>2000</td>
<td>3500</td>
<td>Turbocharged</td>
</tr>
<tr>
<td>4</td>
<td>GHI</td>
<td>M440</td>
<td>S440</td>
<td>550</td>
<td>500</td>
<td>1500</td>
<td>Gas</td>
<td>300</td>
<td>5500</td>
<td>Start/Stop</td>
<td>300</td>
<td>2500</td>
<td>4500</td>
<td>Electronic Ignition</td>
</tr>
</tbody>
</table>

Setting the standard in oil and gas safety
<table>
<thead>
<tr>
<th>Number</th>
<th>Date</th>
<th>Occupancy</th>
<th>Province</th>
<th>Regulator</th>
<th>Mechanical Integrity Failure</th>
<th>Failure Type</th>
<th>Equipment Involved</th>
<th>Other Equipment Description</th>
<th>Primary M5 Failure</th>
<th>Secondary M5 Failure</th>
<th>Tertiary M5 Failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1-Dec-12</td>
<td>Pipeline</td>
<td>BC</td>
<td>OGC</td>
<td>Yes</td>
<td>Pressure (Over/Under)</td>
<td>Not indicated</td>
<td></td>
<td>Operation Practices &amp; Procedures</td>
<td>Risk Assessment</td>
<td>Management of Change</td>
</tr>
<tr>
<td>2</td>
<td>1-Aug-10</td>
<td>Drilling</td>
<td>BC</td>
<td>OGC</td>
<td>No</td>
<td>N/A</td>
<td>Pipe</td>
<td></td>
<td>Operation Practices &amp; Procedures</td>
<td>Risk Assessment</td>
<td>Management of Change</td>
</tr>
<tr>
<td>3</td>
<td>8-Feb-11</td>
<td>Pipeline</td>
<td>BC</td>
<td>OGC</td>
<td>No</td>
<td>N/A</td>
<td>Pipe</td>
<td></td>
<td>Operation Practices &amp; Procedures</td>
<td>Risk Assessment</td>
<td>Control of Work</td>
</tr>
<tr>
<td>4</td>
<td>1-Mar-14</td>
<td>Cementing</td>
<td>BC</td>
<td>OGC</td>
<td>No</td>
<td>N/A</td>
<td>Wellhead</td>
<td></td>
<td>Operation Practices &amp; Procedures</td>
<td>Management of Change</td>
<td>Control of Work</td>
</tr>
<tr>
<td>6</td>
<td>10-Jan-10</td>
<td>Pipeline</td>
<td>BC</td>
<td>OGC</td>
<td>No</td>
<td>N/A</td>
<td>Pipe</td>
<td></td>
<td>Operation Practices &amp; Procedures</td>
<td>Risk Assessment</td>
<td>Control of Work</td>
</tr>
<tr>
<td>7</td>
<td>11-Dec-14</td>
<td>Wellhead</td>
<td>BC</td>
<td>OGC</td>
<td>Yes</td>
<td>Component Fatigue</td>
<td>Welded Connection</td>
<td></td>
<td>Operation Practices &amp; Procedures</td>
<td>Inspection Program</td>
<td>Availability of Safety Critical Devices</td>
</tr>
<tr>
<td>8</td>
<td>4-Feb-12</td>
<td>Drilling</td>
<td>BC</td>
<td>OGC</td>
<td>Yes</td>
<td>Component Fatigue</td>
<td>Threaded Fitting</td>
<td></td>
<td>Competency</td>
<td>Operation Practices &amp; Procedures</td>
<td>Inspection Program</td>
</tr>
<tr>
<td>9</td>
<td>24-Jan-12</td>
<td>Tank Farm</td>
<td>BC</td>
<td>NEB</td>
<td>Yes</td>
<td>Pressure (Over/Under)</td>
<td>Flanged Fitting</td>
<td></td>
<td>Risk Assessment</td>
<td>Operation Practices &amp; Procedures</td>
<td>Management of Change</td>
</tr>
<tr>
<td>10</td>
<td>26-Jul-09</td>
<td>Pipeline</td>
<td>AB</td>
<td>NEB</td>
<td>Yes</td>
<td>External Corrosion</td>
<td>Pipe</td>
<td></td>
<td>Operation Practices &amp; Procedures</td>
<td>Inspection Program</td>
<td>Risk Assessment</td>
</tr>
<tr>
<td>12</td>
<td>15-May-02</td>
<td>Pipeline</td>
<td>BC</td>
<td>NEB</td>
<td>Yes</td>
<td>Pressure (Over/Under)</td>
<td>Pipe</td>
<td></td>
<td>Operation Practices &amp; Procedures</td>
<td>Inspection Program</td>
<td>Materials of Construction</td>
</tr>
<tr>
<td>15</td>
<td>1-Mar-15</td>
<td>Hydraulic Fracturing</td>
<td>BC</td>
<td>WorkSafeBC</td>
<td>No</td>
<td>N/A</td>
<td>Pipe</td>
<td></td>
<td>Operation Practices &amp; Procedures</td>
<td>Management of Change</td>
<td>Inspection Program</td>
</tr>
</tbody>
</table>
2017 AND BEYOND

» Continue to raise awareness
» Incident library (repository of industry learnings)
» Process safety website
» Incorporation of PSM wherever possible
» Hydrate management guideline
» Process safety bulletins

How do we help service companies with PSM?
UNIQUE PERSPECTIVES

» Example: Trucking company transporting category 1 (PG1) crude oil
» A grounding rod is very important to preventing fires
» How many people treat grounding rods as safety critical equipment?
» What is the quality of this barrier?
UNIQUE PERSPECTIVES

» In order for personal and process safety to be effective it requires a team effort

» We need to work together and be mindful of barriers created by company created structures, process, data collection, etc.

» How do we empower others to be advocates for process safety?

» My IH story on unplanned releases
MERCURY EXPOSURE AND PSM

QUESTIONS?