Process Safety Management in R&D

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ETC Laboratory Process Safety/Operational Excellence Overview

**History**

- Meeting some OE expectations, some OE expectations found Less Than Satisfactory based on Corp OE Audit 2004.
- Incidents and Injuries led to several safety stand downs and data driven PSM/OE improvement initiative in 2008

**Current State**

- Meeting PSM/OE expectations based on Corp OE Audit in 2009 & 2013 and annual ETC Self Assessments.
- Sustained decrease in incidents, injuries and serious near misses

**Future State**

- Continue to drive to Zero Incidents and Injuries
ETC Laboratories: Shaping an OE/IFO Culture

Leadership Accountability
- Structured leader walkabouts
- Measuring and monitoring
- Daily safety meetings
- Near miss reporting
- OE Toolkits
- Site wide solutions
- II&R
- QA/QC

Operational Discipline
- Hazard Identification
- JSA use and fluency
- SWA use & reinforcement
- Daily safety meetings
- BBS
- SOP, SWP use & reinforcement
- Near miss/IF report sharing
- Incident investigation sharing

Process Safety Management
- Laboratory Design & operation
- MOC use and practices
- Procedure development & use
- Process Hazards Assessments
- Pre-startup safety reviews
- Drawing & P&ID maintenance

Zero is Achievable
ETC Lab – Total Incidents & Significant Near Misses

Trends:
- Three straight years of incidents & significant near misses trending down.
- Spills/Releases continue to be the most common type of incident & near miss.
- Fires continuing to trend down over past three years.
Process Safety Management

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ETC Labs – Hood Analysis
Dramatically helped reduce Incidents! Kicked off Dec 2008

Hood Incidents & Significant Near Misses

Top Root Causes


- Hazard Recognition has improved!
- All Lab personnel trained in 2009 on Hazards Identification Tool but need to continue efforts to improve fluency.
- Major effort to close gaps on procedures, design, and training over last 3 years is paying off !!!
Why are MOC and Pre-Startup Important?

- **Incident:** Reactor modifications lead to poor seal control and increased temps. After 3 months of failed attempts to operate including 1 spill/vapor release and 3 fires, the unit was shutdown.

- **Findings:** Modifications had been made without a MOC, without a reliable design and operating envelope for existing equipment (pump). Flow rates were greater than the equipment capacity (letdown system and product cooling).

- **Solution:** Conducted a MOC including a HazOp study. Redesigned pump, reactor and cooling system, revised operating envelope and safeguards. Within 5 weeks retrofits were installed, personnel were re-trained and the unit was re-started. No safety incidents or business interruption to date.

- **The objective of MOC and Pre-Startup is to prevent Incidents, improve Reliability and improve Efficiency** by ensuring that unacceptable risks are not introduced into our businesses

"There is always time to do it right"
Purpose of MOC and Pre-Startup Procedures

- Systematically manage changes to equipment, facilities and operations
- Ensure changes are:
  - Evaluated for health and safety hazards, environmental impacts and mitigations
  - Reviewed and approved for installation/implementation by designated Subject Matter Experts (SMEs)
  - Communicated to ALL personnel impacted by the change
  - Adequately trained on
  - Approved for Startup
  - Updated in critical OE documentation such as Procedures, Drawings, Operating Envelopes, Maintenance & Inspection Records
Leadership Accountability

- Structured leader walkabouts
- Measuring and monitoring
- Daily safety meetings
- Near miss reporting
- OE Toolkits
- Site wide solutions
- Incident Investigation and Reporting (II&R)
- QA/QC
Rigorous and well established in lab operations since 2008.

- Use of Incident Tracking database to track and manage incident data and fulfill reporting requirements to Corp as well as outside agencies.

- Near Miss Safety Sharing System used for reporting Near Misses, Safety Sharing's and Spill Releases.

- Monthly review of incidents at all levels of leadership (team leaders to Department GM).

- Annual review of all incident data trends to determine how best to steer Investigations and Studies continue to daylight process safety improvement opportunities – Lessons Learned are shared broadly in monthly OE Toolkits.

  - Example - Heptane Spill:

Microsoft Office Word Document
ETC Labs – Fire Incident Analysis

Trends:

• Our effort to close gaps on procedures, design, and training over last 3 years are helping to reduce fires.

• Lack of or inadequate procedures and design used to be a major root cause of fires.

• Designs have improved using reviews through MOC and PHAs.

• To help recognize hazards, all Lab personnel have been trained on Hazard Identification Tool.

• Oversight and Operational Discipline are the keys.

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Fires and Damage

Top Root Causes
ETC Labs - Spills & Release Incident Analysis

Trends:

- Attention to secondary containment and use of Incidental Spill Plans has helped to reduce the severity of spills.
- Recognizing hazards remains an area of opportunity.
ETC Lab Incidents/Near Misses
No Injuries but Unscheduled Research Unit Downtime

New Ionic Liquid Technology
- Pin hole leaks of ionic liquid/hydrogen vapors due to corrosion
- *Material was constructed of Monel, should have been Hastelloy*

New Biofuels Technology
- Pin hole leak of hydrogen/hydrocarbon vapor due to corrosion
- *Material was constructed of 321SS, should have been 316SS*

New Hydroprocessing Technology
- Pin hole leak of VGO & deionized water due to corrosion
- *Material was constructed of 347SS, should have been 316SS*
Operational Discipline

- Hazard Identification
- Job Safety Analysis use and fluency
- Stop Work Authority use & reinforcement
- Daily safety meetings
- Behavioral Based Safety
- SOP, SWP use & reinforcement
- Near miss/IF report sharing
- Incident investigation sharing
Stop-Work Authority

All Chevron Employees and contractors have the authority – and responsibility – to stop any unsafe condition.
## Job Safety Analysis

### Technology Center Job Safety Analysis (JSA)

<table>
<thead>
<tr>
<th>Type</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Utility</td>
<td>■ Falling object&lt;br&gt; ■ A collapsing roof</td>
</tr>
<tr>
<td>Motion</td>
<td>■ A person body positioning while working (lifting, straining, bending, reaching)&lt;br&gt; ■ Vehicle, vessel or equipment movement</td>
</tr>
<tr>
<td>Mechanical</td>
<td>■ Rotating equipment&lt;br&gt; ■ Compressed springs&lt;br&gt; ■ Pinch point&lt;br&gt; ■ Bump point</td>
</tr>
<tr>
<td>Electrical</td>
<td>■ Power lines&lt;br&gt; ■ Static charges&lt;br&gt; ■ Lighting</td>
</tr>
<tr>
<td>Pressure</td>
<td>■ Pressure piping&lt;br&gt; ■ Compressed cylinders&lt;br&gt; ■ Control lines&lt;br&gt; ■ Vessels</td>
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Preventing Serious Injuries and Incidents
Laboratory Guide

Applying the Hazard Identification Tool
What We Have Learned From Our Journey?

- Using a data-driven approach to identify and prioritize gaps in operational discipline works.

- Setting expectations and measuring results for visible PSM/OE leadership works. What gets measured, gets done.

- Creating an open culture of sharing and reporting can move the OE needle in the right direction.

- Never let up on striving to get to the next level of excellence in PSM/OE.
CVX Global Laboratory: Shaping an OE/IFO Culture

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**OE/Safety Technical User Group (TUG)**
- OE support for Global Labs
- Share OE processes & Safe Work Practices
- Sharing of Laboratory Incidents and lessons learned
- Global Lab OE Toolkits

Zero is Achievable