



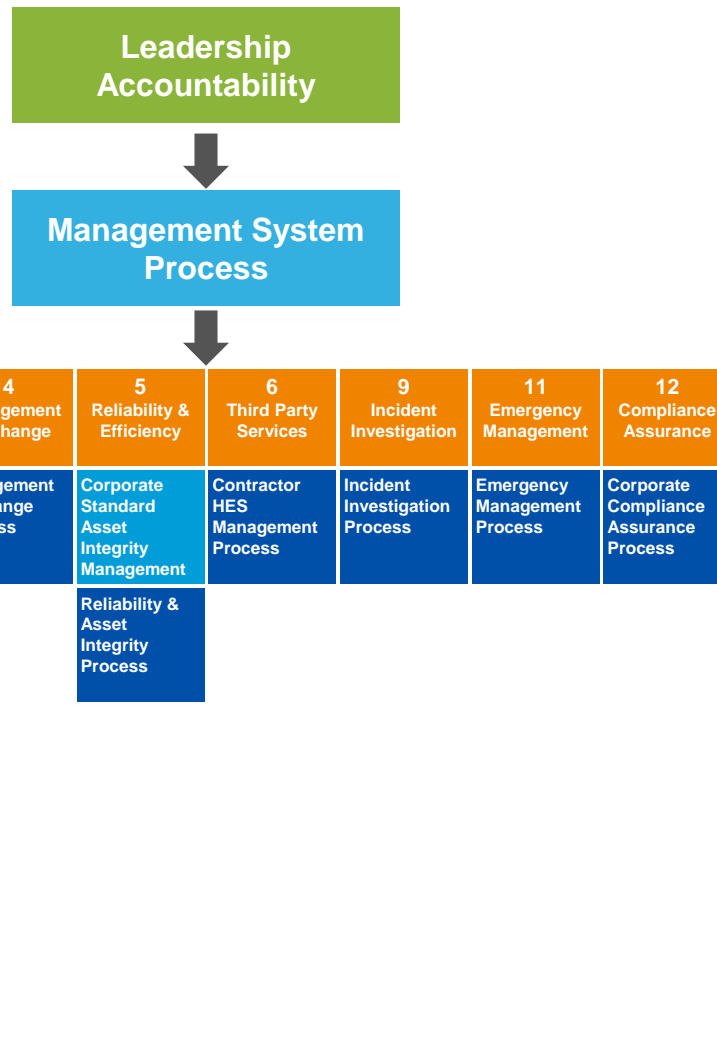
Process Safety Management in R&D

Jeff Hedges
Georgie Scheuerman
Terri Van Hare
Gary Jzyk

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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

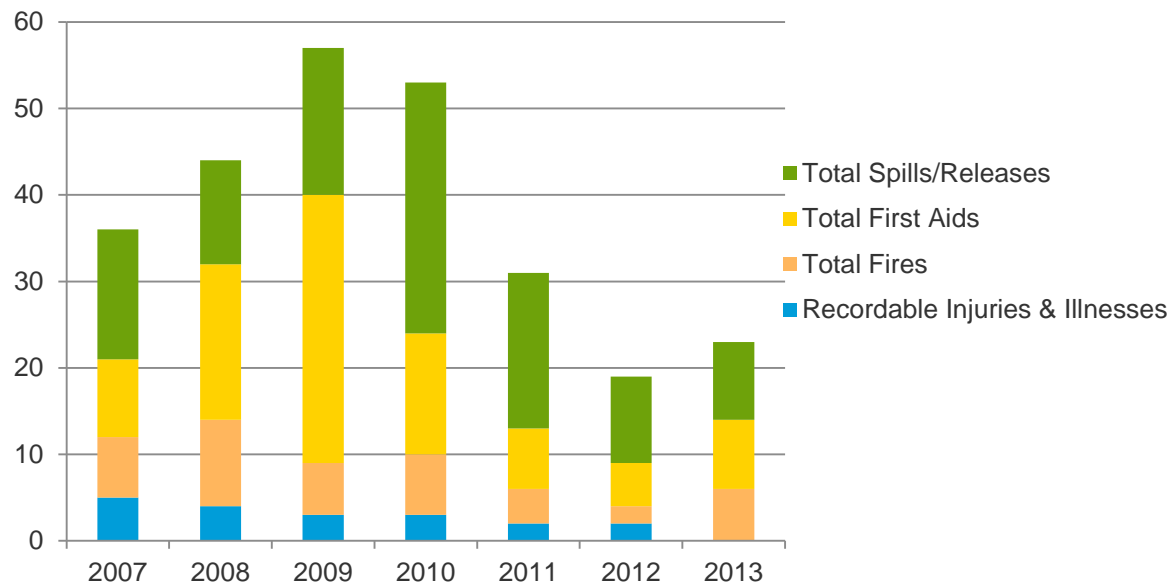
- Continue to drive to Zero Incidents and Injuries

ETC Laboratories: Shaping an OE/IFO Culture





Total Incidents



Trends:

- No recordable injuries or illnesses in 2013.
- Sustaining overall the reduction in incidents & significant near misses.
- Increase in fires in 2013.

Process Safety Management



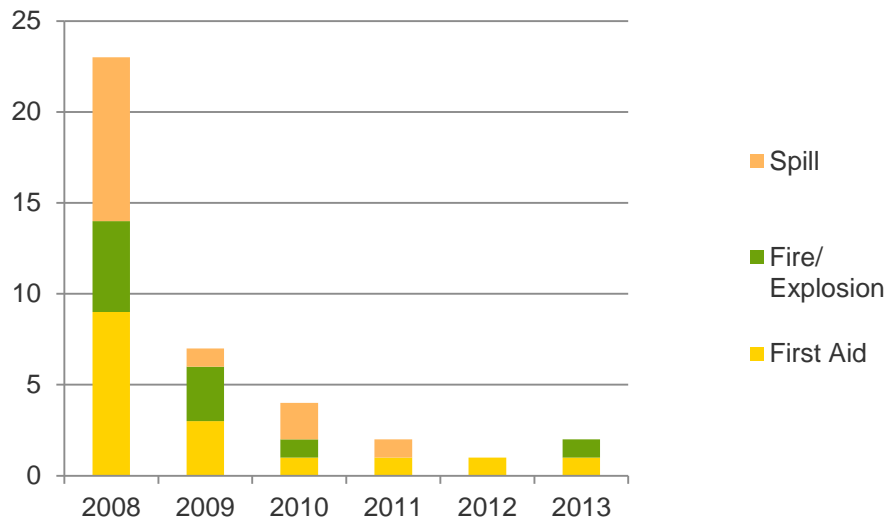
- Laboratory Design & Operation
- MOC use and practices
- Procedure development & use
- Process Hazards Assessments
- Pre-startup safety reviews
- Drawing & P&ID maintenance

ETC Labs – Hood Analysis

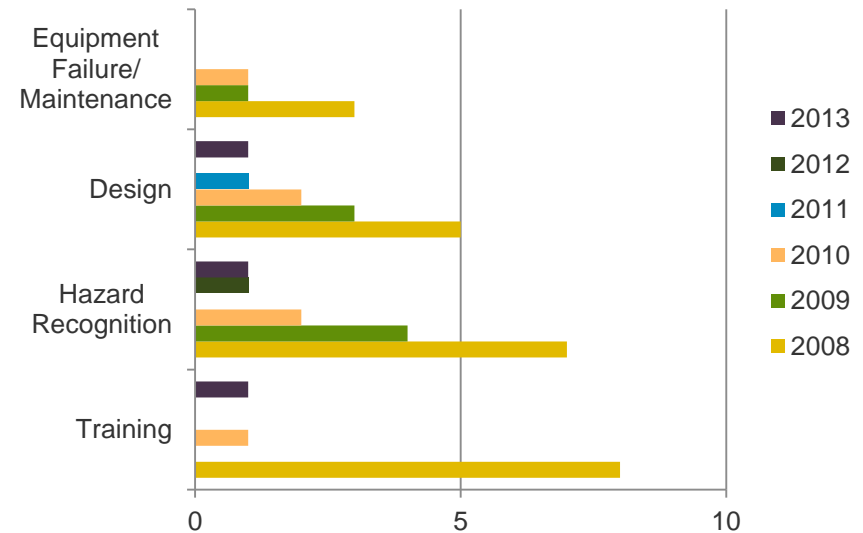
Dramatically helped reduce Incidents! Kicked off Dec 2008



Hood Incidents



Top Root Causes

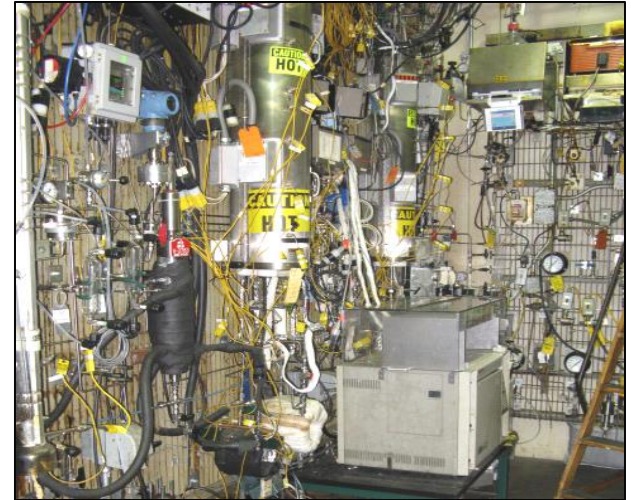


Hood Audit Team (HAT) Mission: Promoting Safe Fume Hood Practices and Reducing Incidents in Hoods by Auditing, Teaching, and Closing Gaps.

- 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 system control and unstable operations. After 3 months of failed attempts to operate including 1 spill/vapor release and 3 fires, the unit was shutdown using SWA.
- **Findings:** Modifications had been made without a MOC, without a reliable design and operating envelope for existing equipment. Flow rates were greater than the equipment capacity.
- **Solution:** Conducted a MOC including a HazOp study. Redesigned pumps, 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. Unit ran as designed and met all business objectives with no safety incidents or operational interruptions.
- **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"

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

Incident Investigation & Reporting OE Process

Current State in ETC Laboratories



- Rigorous and well established in lab operations since 2008.
- Use of Incident Tracking database to track and manage incident and Near Miss data and fulfill reporting requirements to Corp as well as outside agencies.
- 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 improvement efforts.
- Investigations and Studies continue to daylight process safety improvement opportunities – Lessons Learned are shared broadly in monthly OE Toolkits

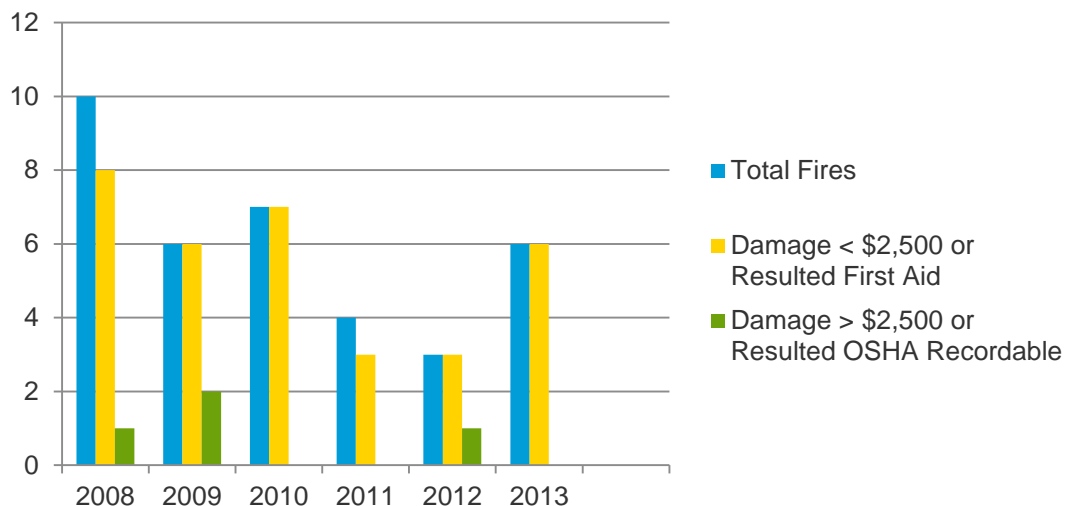
ETC Labs – Fire Incident Analysis



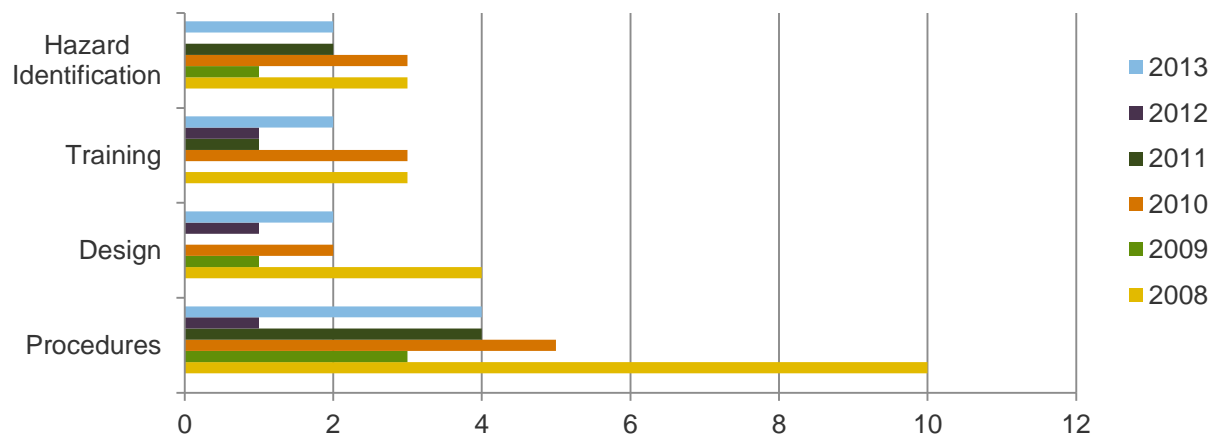
Trends:

- 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.

Fires and Damage



Fires: Top Root Causes

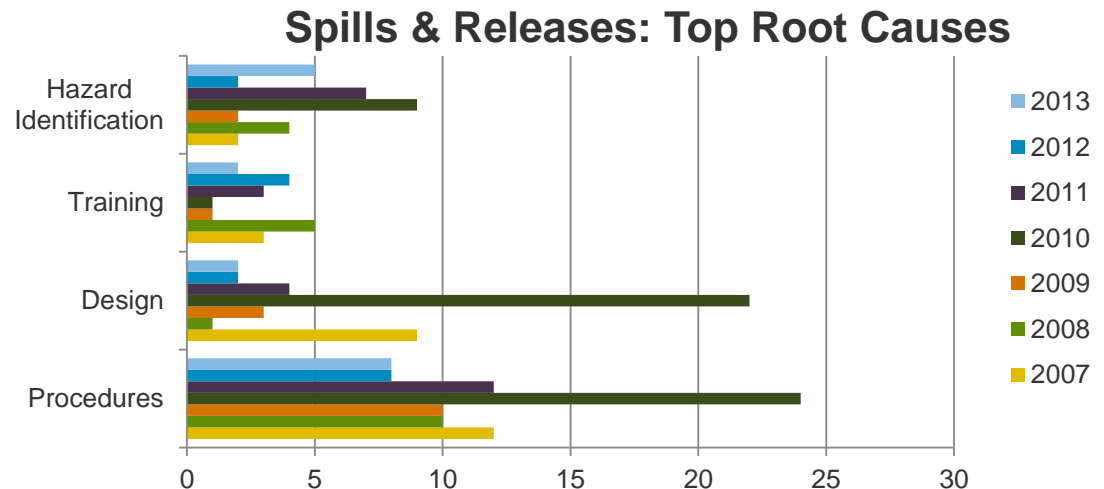
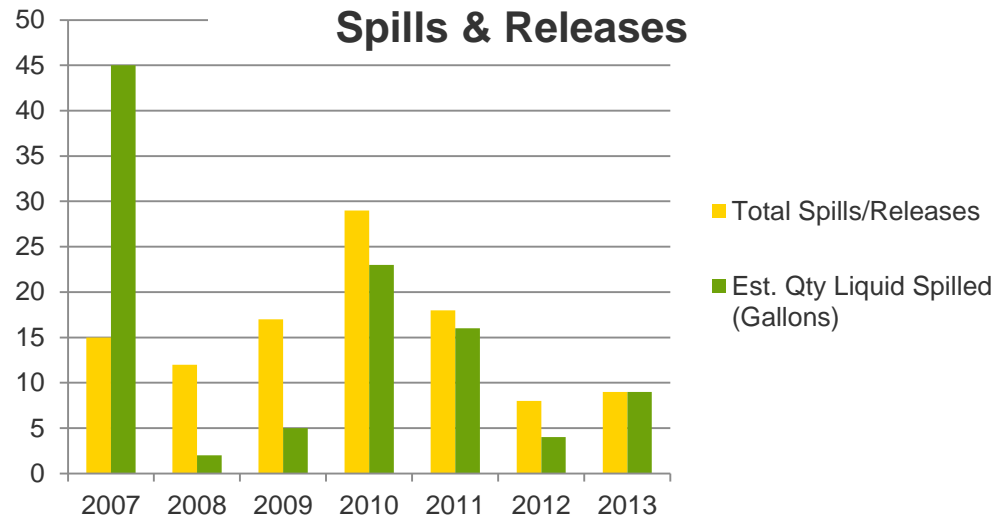


ETC Labs - Spills Incident Analysis



Trends:

- Attention to secondary containment and use of Incidental Spill Plans has helped to reduce the severity of spills.
- Always following procedures and recognizing hazards remains an area of opportunity.



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



Continual reinforcement by Lab Leaders that all lab, shop and contractor workforce have Stop Work Authority and recognition when it is used.



Job Safety Analysis



Technology Center Job Safety Analysis (JSA)



Date: []	Name of Task: []	Type of Work: <input type="checkbox"/> Lab/Shop <input type="checkbox"/> Field <input type="checkbox"/> Office	JSA: <input type="checkbox"/> New <input type="checkbox"/> Revised <i>If revised, date or document number of original:</i> []	Team Members Creating JSA: 1. [] 2. [] 3. [] 4. [] 5. [] 6. []	<p>Hierarchy of Controls</p> <ol style="list-style-type: none"> 1. Remove energy source 2. Prevent the release of energy 3. Protect from the release 4. Use Stop Work Authority
OpCo: []	Task Description: []	Responsible Person (Approver) (print & sign): []			
Unit/Group: []					
Facility Location: []					

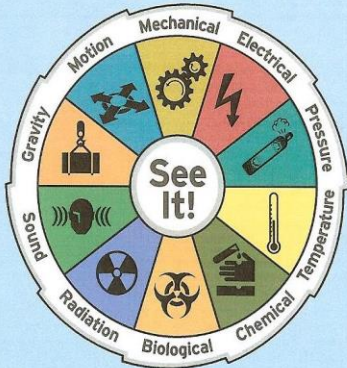
Hazardous Energies List and Examples (which apply to Task)

Type	Example
Gravity	<input type="checkbox"/> A falling object <input type="checkbox"/> A collapsing roof <input type="checkbox"/> A body (item or person) tripping or falling <input type="checkbox"/> Open excavation <input type="checkbox"/> Other _____ _____ _____
Motion	<input type="checkbox"/> A person body positioning while working (lifting, straining, bending, reaching) <input type="checkbox"/> Vehicle, vessel or equipment movement <input type="checkbox"/> Flowing water <input type="checkbox"/> Wind <input type="checkbox"/> Other _____ _____ _____
Mechanical	<input type="checkbox"/> Rotating equipment <input type="checkbox"/> Compressed springs <input type="checkbox"/> Pinch/puncture points <input type="checkbox"/> Drive belts <input type="checkbox"/> Conveyors and motors <input type="checkbox"/> Other _____ _____ _____
Electrical	<input type="checkbox"/> Power lines <input type="checkbox"/> Static charges <input type="checkbox"/> Lighting <input type="checkbox"/> Energized equipment <input type="checkbox"/> Wiring <input type="checkbox"/> Batteries <input type="checkbox"/> Other _____ _____ _____
Pressure	<input type="checkbox"/> Pressure piping <input type="checkbox"/> Compressed cylinders <input type="checkbox"/> Control lines <input type="checkbox"/> Vessels <input type="checkbox"/> Tanks <input type="checkbox"/> Hoses <input type="checkbox"/> Pneumatic and hydraulic equipment <input type="checkbox"/> Other _____ _____ _____

Preventing Serious Injuries and Incidents Laboratory Guide



Preventing
Serious Injuries
and Incidents
Laboratory Guide



The diagram is a circular tool for hazard identification. At the center is a white circle with the text "See It!". Surrounding this center are ten colored segments, each representing a different hazard category. Each segment contains a black icon: a scale for Gravity, a hand holding a hammer for Motion, a gear for Mechanical, a lightning bolt for Electrical, a pressure gauge for Pressure, a thermometer for Temperature, a hand holding a test tube for Chemical, a biohazard symbol for Biological, a radiation symbol for Radiation, and sound waves for Sound. The labels for these categories are written around the perimeter of the circle.

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.