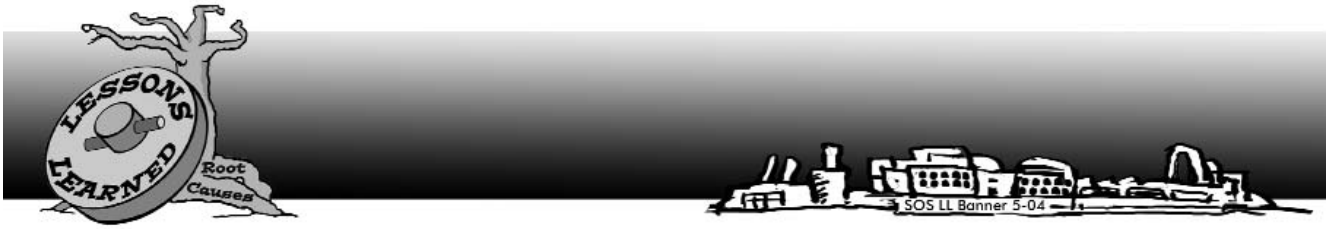

Hydrogen Release

Purpose

To share "lessons learned" gained from incident investigations through a small group discussion method format.

To understand "lessons learned" through a Systems of Safety viewpoint.

TONY MAZZOCCHI CENTER
FOR HEALTH, SAFETY AND ENVIRONMENTAL EDUCATION
A PROJECT OF THE UNITED STEELWORKERS AND THE LABOR INSTITUTE

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Lessons Learned

Volume 07, Issue 21

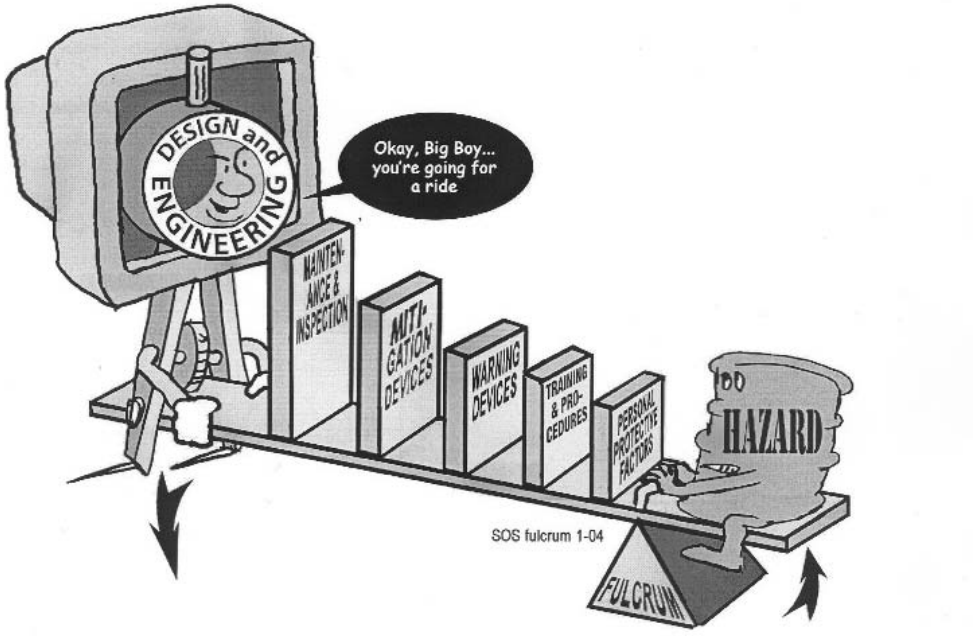
Background Information

Before beginning this Lessons Learned, please review this and the next page which contain information that will introduce the concepts of Lessons Learned and Systems of Safety.

Creating a safe and healthy workplace requires a never ending search for hazards that sometimes are not obvious to us. These hazards exist in every workplace and can be found by using various methods. Lessons Learned are just as the name suggests: learning from incidents to prevent the same or similar incidents from happening again.

Systems Are Not Created Equal: Not equal in protection and not equal in prevention.

Using our Systems Focus to uncover system flaws or root causes is only one part of controlling hazards. We also need to look at the systems involved to decide on the best way to deal with the problem. The most effective way to control a hazard is close to its source. The least effective is usually at the level of the person being exposed. The system of safety in which the flaw is identified is not necessarily the system in which you would attempt to correct the flaw.



Major Safety System	Design & Engineering	Maintenance & Inspection	Mitigation Devices	Warning Devices	Training & Procedures	Personal Protective Factors
Level of Prevention	**Highest—the first line of defense**	**Middle—the second line of defense**				**Lowest—the last line of defense**
Effectiveness	**Most Effective**	←			→	**Least Effective**
Goal	*To eliminate hazards*	*To further minimize and control hazards*				*To protect when higher level systems fail*
EXAMPLES OF SAFETY SUB-SYSTEMS**	**Technical** Design and Engineering of Equipment, Processes and Software Management of Change (MOC)** Chemical Selection and Substitution Safe Siting Work Environment HF **Organizational *(must address a root cause)*** Staffing HF Skills and Qualifications HF Management of Personnel Change (MOPC) Work Organization and Scheduling HF Work Load Allocation of Resources Buddy System Codes, Standards, and Policies**	Inspection and Testing Maintenance Quality Control Turnarounds and Overhauls Mechanical Integrity	Enclosures, Barriers Dikes and Containment Relief and Check Valves Shutdown and Isolation Devices Fire and Chemical Suppression Devices Machine Guarding	Monitors Process Alarms Facility Alarms Community Alarms Emergency Notification Systems	Operating Manuals and Procedures Process Safety Information Process, Job and Other Types of Hazard Assessment and Analysis Permit Programs Emergency Preparedness and Response Training Refresher Training Information Resources Communications Investigations and Lessons Learned Maintenance Procedures Pre-Startup Safety Review	Personal Decision-making and Actions HF Personal Protective Equipment and Devices HF Stop Work Authority

HF - Indicates that this sub-system is often included in a category called Human Factors.
* There may be additional subsystems that are not included in this chart. Also, in the workplace many subsystems are interrelated. It may not always be clear that an issue belongs to one sybsystem rather than another.
** The Codes, Standards and Policies and Management of Change sub-systems listed here are related to Design and Engineering. These subsystems may also be relevant to other systems; for example, Mitigation Devices. When these sub-systems relate to systems other than Design and Engineering, they should be considered as part of those other system, not Design and Engineering.

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Title: Hydrogen Release

Identifier: Volume 07, Issue 21

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Lessons Learned Statement:

A release of hydrogen gas resulted because the diaphragm on the regulator failed and there was the inability to remotely shut off the H_2 system. By utilizing ***Systems of Safety***, incidents of this severity can be corrected and controlled.

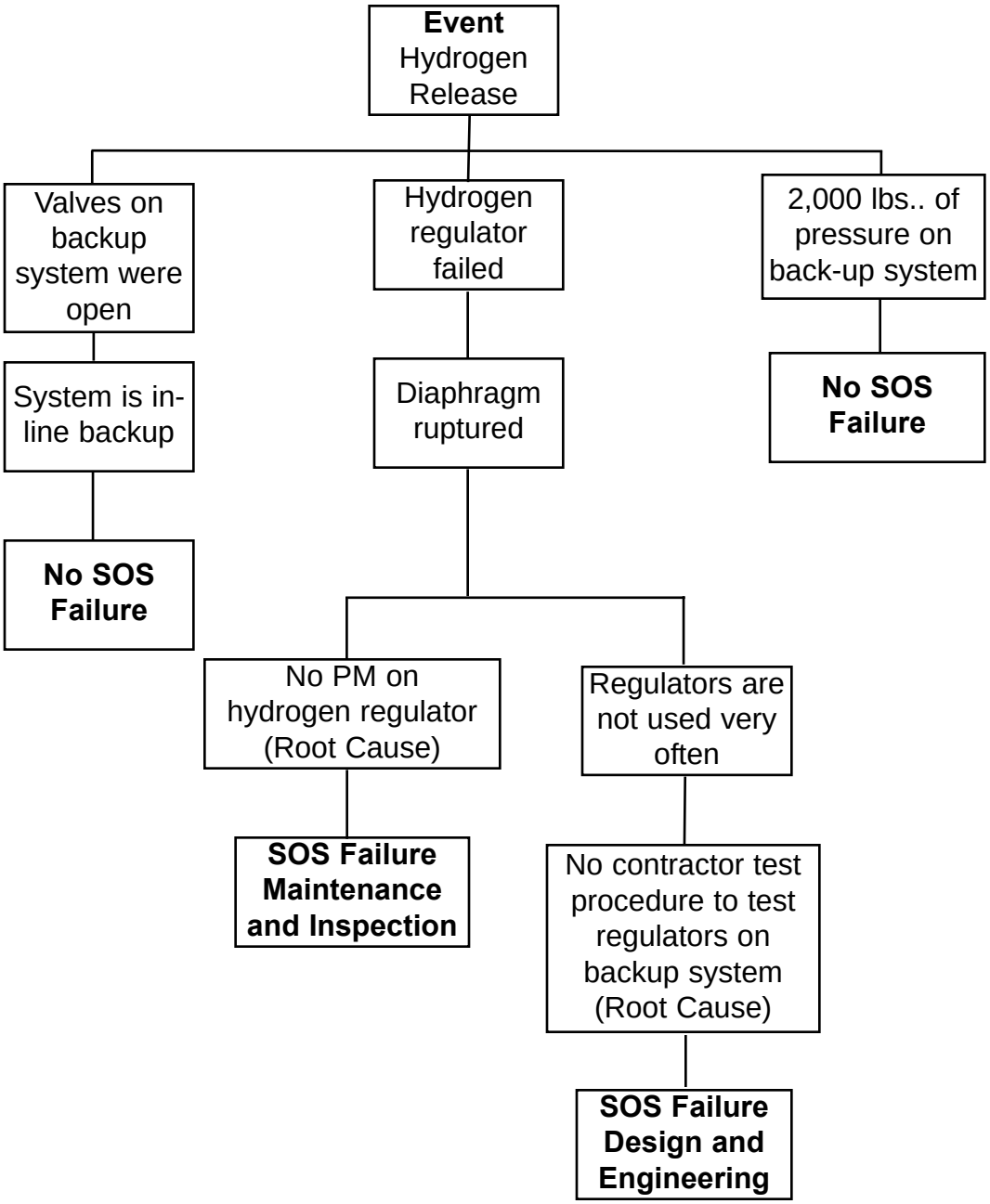
Implementing the **Maintenance and Inspection** fixes could have had the regulator tested periodically to identify any weaknesses or faults prior to failure. The **Design and Engineering** ***System of Safety*** would have found a way to shut off the valves by remote control to eliminate exposure to the gas. The **Training and Procedures** ***Systems of Safety*** could implement training on high pressure systems and Lower Explosive Limit (LEL); what it means and who it affects.

Discussion:

The internal diaphragms of an H_2 regulator failed allowing the release of hydrogen gas. The gas was leaking out of a weep hole at 2,000 lbs. of pressure for approximately 80 minutes. The Emergency Response Team (ERT) was notified and responded to H_2 blowing to a pond remediation site. An outside fire department was notified to hose down the area so the ERT would be able to reach the site to start the shutdown process. ERT shut down the valves to the tube trailer; but the leak persisted because the valves were still open, feeding the trailer on the up side of the regulator. The ERT shut down the valve to repressure the trailer and was able shut down the power to the H_2, system stopping the leak. The hydrogen system used on this site was owned, operated and maintained by an outside contractor.

Analysis

The Logic Tree is a pictorial representation of a logical process that maps an incident from its occurrence, "the event," to facts of the incident and the incident's root causes.



Recommended Actions

1. Review and revise SPI.
2. Install alarm on H_2 system for 21 control room.
3. Investigate removal of tube trailers as backup.
4. Require contractors to install remote shutoff valves for H_2 systems.
5. Require contractors to put in remote power shutoffs to H_2 pumps.
6. Require contractors to train area operators and shift superintendents and ERT in H_2 handling.
7. Require contractors to have regular PM on regulators used on H_2 system.
8. Start using color card system on valve positions in H_2 area.
9. Continue using jumbo tube trailer until alternate system can be addressed.
10. Have vendor decide which is best way to install regulators.
11. Have all plant personnel trained on high pressure safety.
12. Have training on LEL (Lower Explosive Limit) and what it means.
13. Consider LEL monitors around Hydrogen areas.
14. Have vendor supply P&ID's for H_2 system.
15. Have vendor provide proof of lockout/tagout and line break training.
16. Have vendor leave copy of logbook for repairs completed in plant.

Education Exercise

Working in your groups and using the Lessons Learned Statement, Discussion, Analysis and Recommended Actions, answer the two questions below. Your facilitator will give each group an opportunity to share answers with the large group.

1. Give examples of ways to apply the Lessons Learned Statement at your workplace.

_____

_____

_____

_____

_____

_____

2. Of the examples you generated from Question 1, which will you pursue in your workplace? (**Note:** When we say something "you" may pursue, we mean a joint labor-management activity or a union activity rather than an activity carried out by you as an individual.**)**

EVALUATION

Lessons Learned: Hydrogen Burn

Please answer the two questions below:

1. **How important is this lessons learned to you and your workplace? (Circle one.) Rate on a scale of 1 to 5, with 5 being the most important.**

1	2	3	4	5

2. **What suggestions would you make to improve this Lessons Learned?**

End of Training Trainer's Instructions

Please complete the information below.

Trainer's Name _____
(Please Print)

Date of training: _____

No. of Participants: Total _____ Hourly _____ Management _____

Location of Training: _____

USW Local # _____

Send this page **plus the Education Exercise and Evaluation for each participant and the Sign-in sheet** to:

Doug Stephens
United Steelworkers International Union
3340 Perimeter Hill Drive
Nashville TN 37211

Thank you for facilitating the sharing of this
Lesson Learned with your coworkers.

Sign-In Sheet

Name of Class_____ Date of Class_____

Instructors: _____

Please Check One* H	M	Print Name	Signature

***H = Hourly Worker**
M = Management or Salaried Worker