



DOE Hydrogen Program

H2 Incident Reporting Database and H2 Safety Best Practices Website

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Project ID #SA3

This presentation does not contain any proprietary, confidential, or otherwise restricted information

Overview

Timeline

- ▶ Project start: 10/05
- ▶ Project end: 2012
- ▶ Percent complete: Ongoing

Budget

- ▶ Funding received in FY06: \$120K
- ▶ Funding for FY07: \$250K

Partners/Collaborators

- ▶ LANL
- ▶ Hydrogen Safety Panel and potentially all HFCIT projects

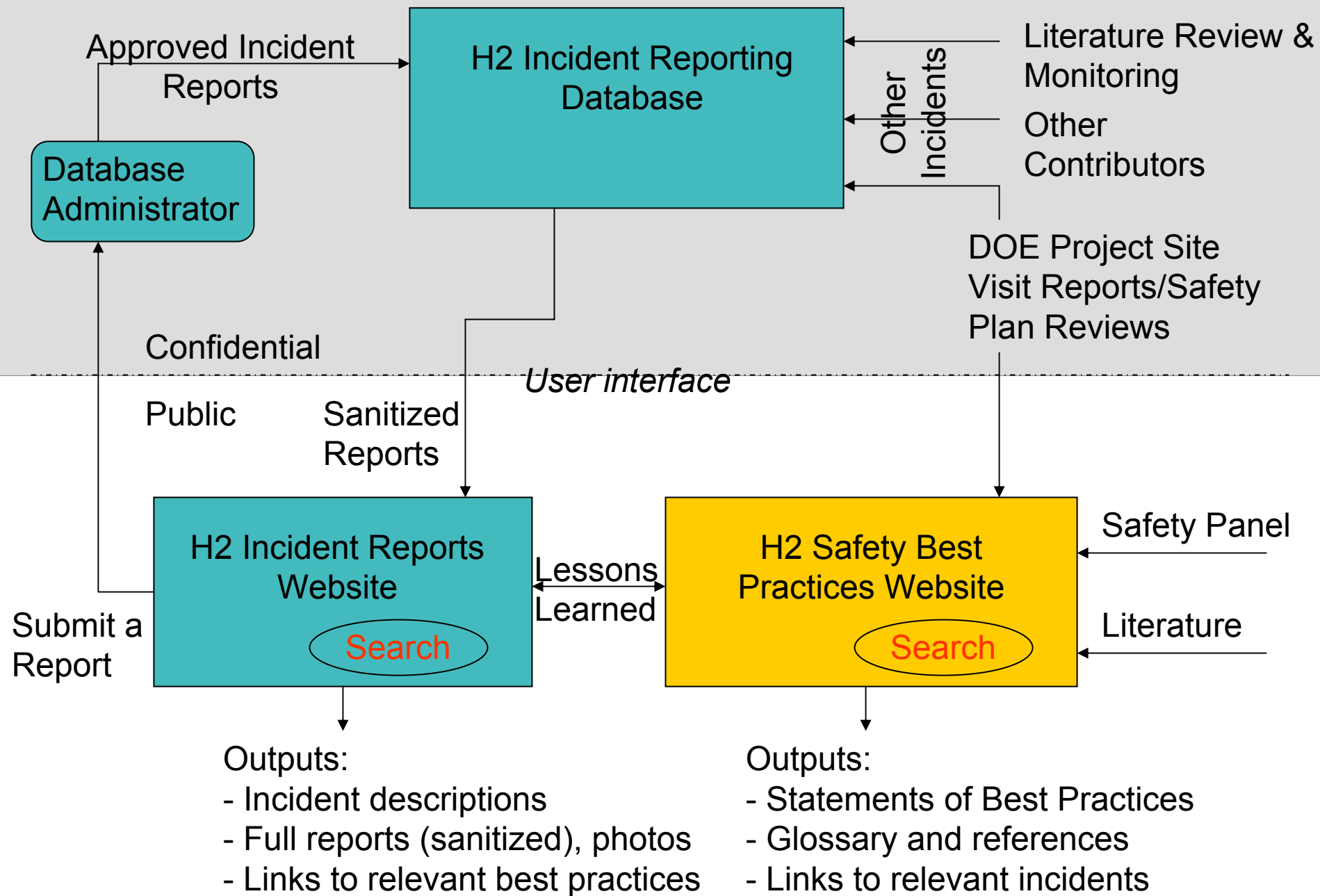
Barriers

- ▶ A. Limited Historical Database
- ▶ B. Proprietary Data
- ▶ C. Validation of Historical Data
- ▶ D. Liability Issues
- ▶ E. Variation in Standard Practice of Safety Assessments for Components and Energy Systems
- ▶ F. Safety is Not Always Treated as a Continuing Process
- ▶ G. Expense of Data Collection and Maintenance
- ▶ H. Lack of Hydrogen Knowledge by Authorities Having Jurisdiction
- ▶ I. Lack of Hydrogen Training Facilities for Emergency Responders

Objectives

- ▶ Establish a web-based system for open sharing of lessons learned from hydrogen incidents and near misses through use of a confidential reporting tool for such safety events.
- ▶ Provide a Hydrogen Safety Best Practices resource to enable widespread benefit from the wealth of knowledge and experience already attained in industry, aerospace and elsewhere.

H2 Incident Reporting and Best Practices Databases



Approach

H2 Incident Reporting (IR) Database

1. Review literature, restricted access databases, and other sources for gathering information on past incidents and identify other ongoing collection efforts.
2. Monitor H2Incidents email for external submissions.
3. Develop, sanitize and review approved records.
4. Input records to database.
5. Encourage external review and respond as needed.

Hydrogen Safety Best Practices (BP) Website

1. Compile BP from project site visits, submitted safety plans and the extensive literature.
2. Request Hydrogen Safety Panel reviews of all BP sections, analyze and consolidate their comments, and modify best practices per their guidance.
3. Develop BP website design and content.
4. Link BP and IR websites through incidents that illustrate specific best practices, and vice versa. **incidents** \rightleftarrows **lessons learned** \rightleftarrows **best practices**
5. Encourage widespread public review, enhance website as new BP sections are suggested or new incidents are added to H2 Incident Reporting Database.

Technical Accomplishments/ Progress/Results

- ▶ H2Incidents.org contains 130+ incidents to date
- ▶ Most are from other databases but a few (~10) are from DOE projects, a few others submitted via the web.
- ▶ Website receives several hundred unique visits per month (April 2007 was >1000), ~20% from international domains.
- ▶ Ongoing discussions with Golden Field Office on how to formalize submission by DOE projects.

H₂Incidents
Hydrogen Incident Reporting Tool

About H₂Incidents | Search

Welcome!

Sort by...

- Damages and Injuries
- Equipment
- Factors
- Settings

Tools

- Advanced Search
- Submit an Incident
- H₂Incidents Home

What is H₂Incidents?

This Hydrogen Incident Reporting Database is intended to facilitate the sharing of lessons learned and other relevant information gained from actual experiences using and working with hydrogen. The database contains records of events involving either hydrogen or hydrogen-related technologies.

The focus of the database is on characterization of hydrogen-related incidents and near-misses, and ensuing lessons learned from those events. All identifying information, including names of companies or organizations, locations, and the like are removed to ensure confidentiality and to encourage the unconstrained future reporting of events as they occur.

[More About H₂Incidents...](#)

How does H₂Incidents work?

You can access incident reports on H₂Incidents in a number of different ways. Here on the home page, you can go directly to the latest posted incidents using the navigation in the box to the right labeled "Latest Reports." The bottom of this box also contains a total for the number of incident reports in the system. By clicking the "show all" text next to this number, you can view a [complete, alphabetical list of incidents](#).

To look for incidents related to specific details, you can use the left navigation. The four main headings—[Damages and Injuries](#), [Equipment](#), [Factors](#), [Settings](#)—will help you drill through the collection of incidents to find those that interest you. At any time, you can also use the [Search](#) box along the top of the page, or use the [Advanced Search](#) form for some more options as you search the database.

If you have an incident you would like to include in the H₂Incidents database, please visit the [Submit an Incident](#) page. This page will ask for a wide range of information on your incident. Please enter as much of the information as possible. In order to protect your and your employer's identities, information that may distinguish an incident (your contact information, your company's name, the location of the incident, etc.) will not be displayed in the incident reports on H₂Incidents.

Search H₂Incidents

Enter a search term below or use the [Advanced Search](#) form. Separate words or phrases with commas or spaces, then select whether to include **ALL** or **ANY** of the words when searching for matching incidents.

Find **ALL** of the terms entered.

Latest Reports

- [Hydrogen Refueling Operational Error](#)
- [Incorrect Relief Valve Set Point Leads to Explosion](#)
- [Technician Accidentally Removes Critical Bolts from a Dewar Fitting](#)
- [Hydrogen Storage Vessel Over-Pressurized](#)

TOTAL EVENTS REPORTED: 103 (SHOW ALL)

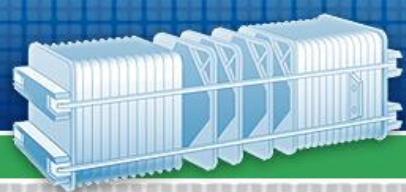
Contacts:
[Webmaster](#) | [Content Manager](#)

Last Updated: August 7, 2006

[Security & Privacy](#)

Related Sites:
[DOE Hydrogen Program](#)
[EERE Hydrogen and Fuel Cells](#)

H₂Incidents is intended for public use. It was built and is maintained by Pacific Northwest National Laboratory with funding from the U.S. Department of Energy.



Incident Report

Sort by...

Damages and Injuries

Equipment

Factors

Settings

Tools

Advanced Search

Submit an Incident

H₂Incidents Home

Contacts:

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Last Updated: February 7, 2007

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Technician Accidentally Removes Critical Bolts from a Dewar Fitting

No Incident Date defined

Severity:

Incident

Was Hydrogen released?

Yes

Was there Ignition?

No

Description

Incident Synopsis

A technician accidentally loosened critical bolts holding a fitting to the top of an H₂ tank, which caused a large hydrogen leak in the dewar. The fitting contained various instruments, and upon loosening the third bolt, H₂ gas exited through an opening in the seal. The Viton or neoprene O-ring was blown out of its groove and was immediately frozen making it impossible to reseal the fitting cover. The area was evacuated, the dewar was vented and the gasket was replaced. The ullage space was not purged with helium gas during the gasket replacement which may have been responsible for small leaks which developed during the transfer.

Cause

The fitting containing the instruments was mounted on a flange, which was in turn secured to another flange. A set of long bolts and short bolts were used to retain the components. The bolt heads were identical and not identified, hence leading to the error in loosening the wrong bolts. The leaks that occurred after the gasket was replaced were probably due to moisture condensation on related vent valve components.

Lessons Learned/Suggestions for Avoidance/Mitigation Steps Taken

Proper bolt identification can prevent similar occurrences in the future. This can be achieved by simply painting the critical bolt heads a certain color (or by purchasing bolts with painted bolt heads). An explanation form should then be clearly posted, which indicates which bolts are critical, and which aren't. This information should then be disseminated to all of the relevant technicians.

Primary Cause(s)

- Routine Maintenance

Setting:

- Laboratory

Equipment:

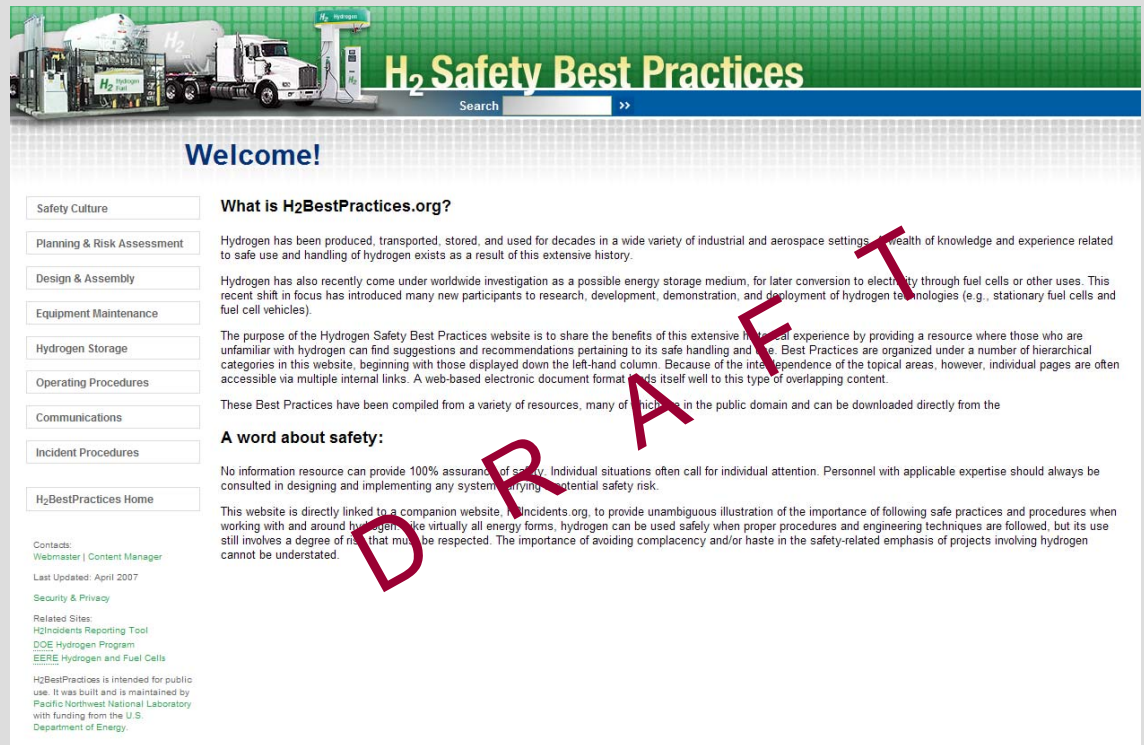
- Hydrogen Storage (vessels, cylinders, etc.)
- Piping/Fitting
- Dewar

Characteristics:

- Low Temperature (< -100°C)

Technical Accomplishments/ Progress/Results

- ▶ Working outline of the Best Practices website content has been developed, and production of the website is underway.
- ▶ Best Practices website design is under development.





H₂ Safety Best Practices

Search >> [Storage](#) >> [Compressed Gas](#) >> [Storage Vessels](#) >> [Cylinder Handling and Securing](#)

Cylinder Handling and Securing

[Safety Culture](#)

[Planning & Risk Assessment](#)

[Design & Assembly](#)

[Equipment Maintenance](#)

[Hydrogen Storage](#)

[Operating Procedures](#)

[Communications](#)

[Incident Procedures](#)

[H₂BestPractices Home](#)

Definitions

An **oxidant** is a chemical reagent that oxidizes another material (e.g., causes combustion of a fuel to occur).

References

For additional details, see Air Products "Safetygram #4 Gaseous Hydrogen" on the Air Products website at www.airproducts.com/productsafety.

For more good practices, see "Gas Cylinder Safety Guidelines", prepared by Iowa State University Environmental Health & Safety, Ames Laboratory Environment, Safety, Health & Assurance, August 1997.

Compressed gas cylinders should be secured and stored upright in a well-ventilated, cool, dry, secure area that is protected from the weather and free of combustible materials. They should be stored away from heavily traveled areas, emergency exits, and areas where salt or other corrosive materials are present. Signs that say "No Smoking" and "No Open Flame" should be posted.

Cylinders can be used individually or manifolded together to provide a larger hydrogen storage volume. Hydrogen may also be stored in large, high-pressure horizontal gas storage tubes at a stationary facility. Mobile gas storage tubes are usually mounted on trucks referred to as tube trailers for transporting between locations.

Common gas facilities for fuels and oxidants are strongly discouraged. If such facilities are necessary, they will require a locally granted waiver. The installation must have proper purging procedures, blocking valves, venting systems, and personnel technically trained in gas handling.

Cylinders should never be dropped, dragged, or rolled. Hand-trucks should be used for moving cylinders from one location to another.

Supporting Examples

The ANSI/AIAA Guide to Safety of Hydrogen and Hydrogen Systems describes a tube trailer explosion that occurred after a hydrogen tube trailer and an oxygen tube trailer were simultaneously connected to the same manifold. Insufficient barriers and incorrect purging procedures led to damage of one shutoff valve and flow of higher-pressure oxygen into one tube of the hydrogen trailer. Ignition was likely due to high-velocity flow through a valve.

Related Incidents

- [Hydrogen Tube Trailer Explosion](#)
- [Hydrogen Cylinder leak](#)

Contacts:
[Webmaster](#) | [Content Manager](#)

Last Updated: April 2007

[Security & Privacy](#)

Related Sites:
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[DOE Hydrogen Program](#)
[EERE Hydrogen and Fuel Cells](#)

H2BestPractices is intended for public use. It was built and is maintained by Pacific Northwest National Laboratory with funding from the U.S. Department of Energy.

Future Work

- ▶ Incident information to be pursued and added to database as it occurs, is obtained through continuing literature review or is submitted externally.
- ▶ Preliminary trends (e.g., involving storage, human error) are already starting to become apparent in information obtained to date; upcoming summary features of H2Incidents.org will enable their highlighting and increase utility of the site.
- ▶ User interaction to be encouraged through additional input features.
- ▶ Working towards a limited public review of the draft Best Practices website by the end of FY07; public release planned for second quarter of FY08. All content to be reviewed by the Hydrogen Safety Panel.
 - Extensive comments expected. Please add yours!
- ▶ Integrated operating versions of both sites available to public in early calendar 2008.
 - Websites will be “living” sites, updated whenever new incidents or best practices information becomes available, or when valid external comments received.
 - BP website outline will be expanded to cover other components as gaps are identified.

Summary

- ▶ This project is on schedule to produce a draft version of the H2 Safety BP website for limited public review by the end of this FY.
- ▶ The first operational component, H2Incidents.org, already appears to offer value to the hydrogen community by its continued visitation and feedback received from others.
- ▶ Utility of the system will be further enhanced through additions made this year.
- ▶ Completed, integrated IR/BP system should be publicly available before this time next year.