

U.S. DEPARTMENT OF



What Can We Learn from Hydrogen Safety Event Databases?

Webinar Moderator: Jay Keller Consultant U.S. DOE Fuel Cell Technologies Office Safety, Codes and Standards

September 10, 2013

Overview Fuel Cells – An Emerging Global Industry

Top 10 companies for fuel cell patents: GM, Honda, Toyota, Samsung, UTC Power, Nissan, Ballard, Panasonic, Plug Power, Delphi Technologies

2007

2008

2009

2010

2011

2012

- Clean Energy Patent Growth Index^[1] shows growth in all clean energy technology patents
- More than 1,000 fuel cell patents issued in 2012

[1] http://cepgi.typepad.com/heslin_rothenberg_farley_/2013/03/clean-energy-patent-growth-index-2011-year-in-review.html

2003

2004

2005

2006

2002





Global Industry

Energy Efficiency & Renewable Energy

Worldwide Commitment to FCEVs

ENERGY Energy Efficiency & Renewable Energy

Interest in fuel cells and hydrogen is global, with more than \$1 billion in public investment in RD&D annually. The world's leading automakers have committed to develop FCEVs.

| Maj | jor Auto N | Nanufacturers' Activities and |
|------------|-------------------|---|
| - | | Plans for FCEVs |
| GM | General Motors | >120 vehicles deployed since 2007 in Project Driveway 2012: Technology readiness goal for FC powertrain |
| \bigcirc | Toyota | 2010-2013: U.S. demo fleet of 100 vehicles "FCHV-adv" can achieve 431-mile range &68 mpgge 2015: Commercialize cars at <\$100K |
| | Honda | Clarity FCX named "World Green Car of the Year"; EPA certified 72mpgge; leasing up to 200 vehicles 2015: Launch all-new fuel cell electric model sequentially in Japan, U.S. and Europe. |
| DAIMLER | Daimler | Plans for tens of thousands of FCEVs/year in 2015 – 2017 and hundreds of thousands a few years after Partnership with Linde to develop fueling stations. Moved up commercialization plans to 2014 |
| B | Hyundai- Kia | 2012-2013: 2000 FCEVs/year 2015: 10,000 FCEVs/year "Borrego" FCEV has achieved >340-mile range. |
| | Volkswagen | Expanded demo fleet to 24 FCEVs in CA Recently reconfirmed commitment to FCEVs |
| SATC | SAIC (China) | SAIC Motor Company is planning 20-30 prototypes in 2013 and >1,000 FCEVs in 2015. |
| NISSAN | Nissan | Commercial FCEVs planned for 2016. FCEVs are key part of "Nissan Green Program." Announced strategic partnership with Daimler on FCEVs. |
| Ö | BMW | Fielding a fleet of "F-Cell" vehicles in the U.S. 40 currently leased with another 20 on the way. |

Based on publicly available information during 2011 – 2012. Ford involved through Ballard-Daimler partnership (AFCC).

Market Growth & Potential

Fuel cell markets continue to grow

- ~30,000 units shipped in 2012 (~35% increase)
- 48% increase in global MWs shipped

Independent analyses show global markets could mature in the next 10–20 years, producing revenues of:

- \$14 \$31 billion/year for stationary power
- \$11 billion/year for portable power
- \$18 \$97 billion/year for transportation



Sources: Navigant Research, DOE Fuel Cells Market Report

3 | Fuel Cell Technologies Office

IPHE¹ - Proposed Hydrogen Safety Information Portal & Webinar

Safety Information Portal

- Information Portal will serve as a central point for access to the hydrogen safety lessons learned and best practices information.
- IPHE will consolidate information into a single, global, open-source, searchable information resource.

<u>Webinars</u>

- Regular IPHE webinars will serve as another pathway to share information while utilizing the resources, knowledge and experience of IPHE members and partners.
- Webinars will cover topics of interest to the global hydrogen and fuel cell community.

✓ Safety information sharing

- ✓ H2 resource availability analysis (IEA HIA² Task 30) results
- ✓ Status of infrastructure deployments
- ✓ Policy Examples to Promote H2 and FCs

Two webinars per year

¹IPHE – International Partnership for Hydrogen and Fuel Cells in the Economy ²IEA HIA – International Energy Agency Hydrogen Implementing Agreement <u>Webinar Objective</u>: To Share U.S. and E.U. information as it pertains to Hydrogen Safety and Best Practices, Lessons Learned and Available Databases

- Each speaker up to 15 minutes for formal remarks
 - We will entertain panel discussion questions at the end of the formal presentations for 20 minutes
 - Webinar is being recorded and will be posted approximately 10 days after the webinar. This will be through the U.S. DOE Fuel Cell Technologies Office homepage.

www1.eere.energy.gov/hydrogenandfuelcells/webinar_archives_2013.html

- Safety Information helps guide R&D.
- It is critical to collect and disseminate relevant information.

| Equipment | Total Incidents | Database web address – www.h2incidents.org |
|---------------------------------|--------------------|---|
| Riping/Fitting/Valves | 102 | |
| Hydrogen Storage | 49 | Examples: |
| Vehicle & Fueling System | 40 | Piping (36) |
| Safety Systems | 25 | Valve (36) |
| Ventilation System | 22 | Flexible Tubing (8) Gasket (6) |
| Laboratory Equipment | 19 | Bolts (6) |
| Pressure Relief Devices | 16 | |
| Motive Power Systems | 15 | Cross–Search Categories : |
| Heating Equipment | 14 | Settings |
| Electrical Equipment | 14 | Damage and Injuries |
| Process Equipment | 14 | Probable Causes |
| Batteries and Related Equipment | 13 | Contributing Factors |



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PNNL-SA-97884

What Can We Learn from Hydrogen Safety Event Databases? H2Incidents.org

STEVEN C.WEINER

Battelle Washington Office Washington, DC

| | H ₂ Incident Reporting and Lessons Learned | | | | | |
|--|--|--|--|--|--|--|
| 10000 | About Haincidents Advanced Search | | | | | |
| Angaton 3 | /elcome! | | | | | |
| Clear Find Records >> | What is H2Incidents? | Submit an Incident | | | | |
| E Laboratory (72) E Evelone Statue (20) | This database is supported by the U.S. Department of Energy. The safety event records have been contributed by a variety of global sources, including industrial, government and academic facilities. | Latest Reports | | | | |
| <u>Commercial Facility</u> (19) <u>Power Plant</u> (15) L Show All Options | Hyliocidents is a database-driven website intended to facilitate the sharing of lessons learned and other relevant information gained from actual experiences using and working with hydrogen. The database also serves as a voluntary reporting tool for capturing account of events molwhar with hydrogen of hydrogen-elitide textinologies. | Hydrogen Gas Regulator Failure Industrial Hydrogen Purifier Explosion | | | | |
| Equipment Papers/Stings/Subses (105) Hedmann Statage Equipment (53) | The bous of the database is on characterization of hydrogen-related incidents and near-misses, and ensuing lessons learned from those events. All deriving information, including sames of comparison or organizations, locations, and the like, is remosed to exact confidentially and to encourage the unconstrained future reporting of events as they occur. More Abast Haincolemis | TOTAL EVENTS REPORTED: 200 (SHOW ALL) | | | | |
| Vehicle & Fueling Instance (41) Safete Insterns (28) 1 Steve All Casterns | How does H_2 Incidents work? You can access incident reports on Hybroidents in a number of different ways. Here on the home page, you can go directly | Hydrogen Leak Detection Ventilation of Facilities where Hydrogen is Used | | | | |
| Damage and Injuries | to the latest postel incidents using the nargation in the box to the right labeled "Latest Reports." The bottom of this box also contains a traff or the number of incident reports in the system. By clicking the "show all" text next to this number, you can see a complete, alphabetcal list of incidents. | LESSON'S LEARNED ARCHIVES | | | | |
| Hann (03) Henric Hann (27) Lost Time Histor (18) Lost Time Histor (18) Lost Time All Colleges | To both the explosits studied to specific dutals, you can use that it subjects. The far man handings—fillings (Explorent, Durage and Hysios). Ethodo Canasa, Constrainting Factors, and Help you did Hongo the collection of collection is of the close at reset. You, To see a graphical presentation of the number of incident associate with each of these ran handings, simply click can be handing and them mores are the clust to see a larger image. At any time, you can also use the Asian Securit form, found at this of the handing, can more specifies beautify the didabase. | | | | | |
| Probable Causes Ecusement Failum (34) Haman Error (33) Danian Ellaw (28) Failum to Failum Standard Securition Proceeding (20) | Eyo las en includer par weld las to action in the Hydrafent database, please with the "Salard in Vicinitia gap." But notes: Please rest as includer a part of the Hydrafent database, before a performance index and part employer index and index and/or, your company's same, the location of the incohert, etc.) will not be displayed in the incohert sports on Minoder index and/or. | tion that may distinguish an incident (your contact | | | | |

The Premise



"Hydrogen and fuel cell safety event information can serve as a rich and valuable resource if it is systematically collected, analyzed and used to enhance hydrogen safety knowledge. The sharing of lessons learned from safety events can serve to help prevent similar events from happening in the future..."

Ref: Learning from Safety Events, A Statement from the Hydrogen Safety Panel, January 17, 2012.

What is H2Incidents.org?



- Database-driven website to facilitate the sharing of lessons learned and other relevant information gained from actual experiences using and working with hydrogen.
- Focus on characterization of hydrogen-related incidents and near-misses, and ensuing lessons learned from those events.



H2Incidents.org History



- Launched in 2006 to store information and analysis of hydrogenrelated safety events including describing the event, its setting and equipment, its characteristics, causes and contributing factors
 - 210 Safety event records to date
 - Voluntary reporting tool for capturing records of events involving hydrogen or hydrogen-related technologies.

Key Attributes

- Search Incidents
- Enter Incidents
- New Lessons Learned

The road to "H2incidents.org" began in Pisa....



Capturing the Event Focusing on Lessons Learned

Each safety event record contains

- Description
- Severity (Was hydrogen released? Was there ignition?)
- Setting
- Equipment
- Characteristics (High pressure? Low temperature?)
- Damage and Injuries
- Probable Cause(s)
- Contributing Factors
- Lessons Learned/Suggestions for Avoidance/Mitigation Steps Taken

Lessons learned content enhanced by links to "H2best practices.org"





Two Looks at H2incidents.org



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Search capabilities allow the user to seek information of interest.

Developing Safety Event Records



- Both incidents and near-miss records are sought
- Encourage self-submittal through an easy-to use online form
- Identify potential records through other means, e.g. media reports and other databases
- Work with "incident owners" and other submitters
 - Discuss, encourage and reach agreement for the submittal of a safety event record
 - Discuss, clarify and edit description, information and lessons learned.
 - Ensure anonymity in the safety event record itself
 - Obtain organizational approval for posting
- Provide expert review of safety event records by the Hydrogen Safety Panel and other subject matter experts.

H2incidents.org Emphasizing Lessons Learned



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Lessons Learned Corner Archives

- Hydrogen leak detection
- Ventilation of facilities where hydrogen is used
- Hydrogen compatibility of materials
- · Learning from burst disk failures
- Adequate ventilation of battery charging facilities

- · Hydrogen use in anaerobic chambers
- The importance of purging hydrogen piping and equipment
- Working with reactive metal-hydride materials in the laboratory
- Management of change

Linking H2incidents.org and H2bestpractices.org Enhancing the Value of Both



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H₂ Incident Reporting and Lessons Learned Welcome! Clear Find Records >> What is H₂Incidents? Settings Laboratory (72) This database is supported by the U.S. Department of Energy Latest Reports Eueling Station (22 The safety event records have been contributed by a variety of Commercial Facility (19) global sources, including industrial, government and academic Hydrogen Cylinder Leak at Fueling Statio facilities. Power Plant (15) Pressure Relief Device Fails at Fueling 4 Show All Options H₂Incidents is a database-driven website intended to facilitate the Station sharing of lessons learned and other relevant information gained Equipment from actual experiences using and working with hydrogen. The TOTAL EVENTS REPORTED: 210 (SHOW ALL) database also serves as a voluntary reporting tool for capturing Piping/Fittings/Valves (105) records of events involving either hydrogen or hydrogen-related Hydrogen Storage technologies. New! Lessons Learned Corner Equipment (53 Vehicle & Fueling The focus of the database is on characterization of hydrogen Hydrogen Leak Detection 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, is removed to Safety Systems (28) Ventilation of Facilities where Hydrogen is 4 Show All Options Used ensure confidentiality and to encourage the unconstrained future reporting of events as they occur. LESSONS LEARNED ARCHIVES Damage and Injuries Property Damage (112) More About Holncidents. None (84) Minor Injury (27) How does H₂Incidents work? Lost Time Injury (18) You can access incident reports on Halncidents in a number of different ways. Here on the home page, you can go 4 Show All Options directly to the latest posted incidents using the navigation in the box to the right labeled "Latest Reports." The bottom Probable Causes 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 Equipment Failure (86) Human Error (33) To look for incidents related to specific details, you can use the left navigation. The five main headings-Setting Intr nent, Damage and Injuries, Probable Causes, Contributing Factors-will help you drill through the collection of Design Flaw (28) incidents to find those that interest you. To see a graphical representation of the number of incidents associated with Failure to Follow Standard 'es (20) each of these main headings, simply click on the heading and then mouse over the chart to view a larger image. At any time, you can also use the Advanced Search form, found at the top of the page, for some more options to search 50 4 Show All Options the database Contributing Factors If you have an incident you would like to include in the H2Incidents database, please visit the Submit an Incident page Hyd This page will ask for a wide range of information on your incident. Please enter as much of the information as Human Error (50) 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 Situational Awareness (50) Change in Procedures, reports on Holncidents Ot Equipment, or Materials (34 Training Issue (32) Safe 4 Show All Option: lear Find Records >>

Safety event lessons learned content enhanced by links to best practices and/or LLC content.



Laboratory Safety

Safety event links illustrate what can go wrong if best practices are not followed.

H2 Safety Best Practices

Welcome!

| | Welcome: | Search H ₂ BestPractices |
|---|---|--|
| H ₂ BestPractices Home | What is a best practice? | Enter a search term below. |
| Introduction to Hydrogen | A best practice is a technique or methodology that has reliably led to a desired result. Using best practices is a commitment to utilizing available knowledge and technology to achieve success. | |
| So you want to know something about hydrogen | What is H ₂ BestPractices.org? | Glossary |
| Hydrogen Properties Hydrogen Compared with | A wealth of knowledge and experience related to safe use and handling of hydrogen exists as a result of an extensive history in a wide variety of industrial and aerospace settings. Hydrogen is gaining increasing attention worldwide as a possible energy storage medium, for later conversion to electricity through fuel cells or for use as a combustion fuel. This focus has introduced many new participants to research, development, demonstration, and deployment of hydrogen technologies (e.g., use cell whiches and stationary fuel cells). | Acronyms Bibliography Codes & Standards |
| Other Fuels Safety Practices Safety Culture Safety Planning | The purpose of the Hydrogen Safety Best Practices online manual is to share the benefits of extensive experience by providing suggestions and recommendations pertaining to the safe handling and use of hydrogen. Best Practices have been compiled from a vanety of resources, many of which are in the public domain and can be downlaaded directly from the References section. Many others can be obtained via reference links found at various places within the manual. Best Practices are organized under a number of hierarchical categories in this online manual, beginning with those sistle via multiple eit-hand column. Because of the interdependence of the topical areas, howere, individual pages are often accessible via multiple | NFRA 2, Hydrogen Technologies Code 2011 Edition New! Bulletin Archives |
| Incident Procedures | internal links. A web-based electronic document format lends itself well to this type of overlapping content. | Related Sites |
| Communications Design and Operations Facility Design Considerations | Please notice the mouse-over feature on this website. When a word in the text appears in blue font, you can see its definition by placing your cursor over the word. All the definitions are compiled into a <u>Clossary</u> that can be accessed from the References section of every page. There is also an <u>Accounts</u> list and a <u>Bibliography</u> that can be accessed from wery page. When you click on the link to the Bibliography, it will take you to the alphabetized list of references for the particular section from which you accessed it. Please contact us if you notice any definitions, acromyns, or references that should be in these lists but aren't. | H-Incidents Database FCHEA Hydrogen and Fuel Cell Safety DOE Hydrogen Program Hydrogen Safety Bibliograph Database |
| Storage & Piping | A word about safety | Contact Us |
| Operating Procedures Equipment Maintenance | Following the best practices contained in this online manual represents a commitment to the safe use and handling of hydrogen, but it should be recognized that no information resource can provide 100% assurance of safety. Personnel with applicable expensis should always be consulted in designing and implementing any system carrying a potential safety risk. Additionally, since following these best | ⊠ h2bestpractices@pnnl.gov |

practices does not guarantee compliance with local codes, standards, and regulations, users should check with their local Authority

Having Jurisdiction to ensure that those requirements are adequately addressed.

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Just one example....



- A recent event that is relevant to the focus on deployment of hydrogen and fuel cell technologies
- Root causes for PRD failure
 - Incompatible materials
 - Improper assembly
 - Over-hardening of inner assembly materials
- But there is usually something else one can learn from the incident
 - Timely communication during emergency events
 - Training of personnel focused on improving response time
 - Effective communication between employees, first responders and suppliers

| | About H;Incidents Adv | t Reporting Lessons Learned | | | |
|---|--|--------------------------------|---|--|--|
| Clear Find Records >> Settings | Pressure Relief Device F | Fails at Fueling Station | | | |
| Laboratory (72) Fueling Station (22) | | | Incident Date: 2012 | | |
| Eucling Station (22) Commercial Facility (19) Power Plant (15) 4_Show All Options | severity: Incident | Was Hydrogen released? Yes | Was there Ignition? Yes | | |
| Equipment Piping/Fittings/Valves (105) | | | Ignition Source: Either static electricity or spark from escaping particle | | |
| Hydrogen Storage Equipment (53) Vehicle & Fueling Systems (40) Safety Systems (28) 4 Show All Options | kilograms of hydrogen gas. The gas ig department to enter the station and sto | | | | |
| Damage and Injuries | closed adjacent streets, and ordered a high school to shelter in place. There were no injuries and very little property damage. The corrugated roof on an adjacent canopy over a fueling dispenser was slightly singed by the escaping hydrogen fame, causing less than 300 in damage. | | | | |
| None (84) Minor Iniury (27) Lost Time Iniury (18) \$how All Options | The station's operating systems worked as they were designed to function in an emergency. All equipment and fuel supplies were completely isolated, and all storage vessels were well within acceptable and safe pressure and temperature limits prior to and throughout the incident. After a thorough analysis of the incident was conducted, corrective actions were taken to replace PRO valves, heighten vent stacks, modify response procedures and improve communication protocols with first responders. A considerable amount of time was taken to review the station desion, evaluate | | | | |
| Probable Causes Equipment Failure (86) Human Error (33) | emergency action plans and procedure | | luct follow-up drills with employees and first responders. The | | |
| Design Flaw (28) Failure to Follow Standard Operating Procedures (20) Show All Options | Setting • Fueling Station • Outside - paved parking lot | | | | |





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First mobile app targeted for AHJs, end-users and other stakeholders

- Integrates H₂incidents.org, H₂bestpractices.org and other resources into a single, searchable iPad and iPhone application
- Features include safety planning guidance and checklists

Announced by the U.S. Department of Energy September 2013





"...Informed analysis of leaks, fires and explosions, and equipment failure and ignition data derived from these safety events can facilitate the development of risk assessment models and help technical experts identify gaps in applicable codes and standards that can be addressed by a variety of means."

Ref: Learning from Safety Events, A Statement from the Hydrogen Safety Panel, January 17, 2012.



- Safety knowledge tools such as "H2incidents.org" provide a powerful resource for conveying data, information and knowledge
- Content must be current, relevant to the community being served and valuable to the user
- Prompt and timely responses to user feedback and inquiries to <u>h2incidents@pnnl.gov</u> are important
- Progress is being made but there is more to be done!



Acknowledging....



- Fuel Cell Technologies Office (Sunita Satyapal, Director) and Staff, U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy
- All those who have contributed safety event information, knowledge and lessons learned to our database
- International Conference on Hydrogen Safety

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or



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Contacts

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Related References



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HIAD The EUROPEAN HYDROGEN INCIDENT & ACCIDENT DATABASE

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Typical (vehicle) safety research cycle



Review accident data:

- **1.** To identify problems
- 2. To assess success of implemented changes

Introduce procedures into legislative and / or consumer testing Perform research to understand problem: 1.Detailed accident analysis 2.Laboratory experiments

Develop test procedures to implement changes

Centre



Modified from TRL presentation



Safety research cycle for low carbon vehicles

Review accidentent: 1. To ited accident: 2. Limited according ass datauccess of implemented changes HIAD ambition is filling this gap for hydrogen technologies

Introduce procedures into legislative and / or consumer testing



Perform researchicles understrew vehicles 1.Detailedvailable 2.Laboratoresearchinalysis

Develop test procedures to implement changes

Centre

Modified from TRL presentation



What is HIAD?

HIAD aims to be an repository of any accidental even related to hydrogen technology

> Originally designed to be a multi-task tool:



Open platform for lessons learned and risk communication



Data source of information to assist risk assessment approaches

Fully operational with about 250 events published









HIAD history

with an analysis module.

HIAD was originally developed in the European Network of Excellence for Hydrogen Safety (HySafe 2004-2009).

After the end of HySafe, the International Association for

Hydrogen Safety **IA-HySafe** became the focal point for all

hydrogen safety related issues. HIAD was further developed

HIAD is maintained, updated and funded by the **Joint Research Centre**, and is available at https://odin.jrc.ec.europa.eu/.







HIAD Structure – 4 modules



DEM – Data Entry Module: Users can register as "event provider" and insert/update events directly on the database

DRM – Data Retrieval Module: Allows the user to access hydrogen events recorded on HIAD

DAM – Data Analysis Module: Is a tool for conducting online simple analyses of the data recorded into the database

MAP: a GIF based tool which links events to their geographical distribution



Event structure

Pre-event conditions: Date/time of event, Weather conditions, Geographical location, applications, Operation phase or mode.

- **Nature of event:** Systems and components affected or involved, Chain of events, Causal relations, Relevant safety systems and emergency response, Release, fire and explosion specifications/details.
- **Consequences of event:** Fatalities and injuries, Property, environment and economical loss and damage.
- **Post-event actions:** Clean-up and restoration, Legal/legislation initiatives, Lessons learned, Investments made.
- **References:** Hyperlinks/references to files and documents, web-sites, etc., Specification of attachments, e.g. maps, drawings, photos, etc.





DEM = Data Entry Module Inputs

Users can enter events into HIAD in two ways:

- Users can e-mail the event to JRC who can insert it on behalf of the users
- Alternatively users can register as "event provider" and insert/update events directly on the database, using the DEM.

Only fields describing the dynamics of the event are mandatory. All other fields are not mandatory and the event can be introduce as a **<u>completely anonymous event</u>** without any information on location, company, etc.





Quality Assurance Process





Each event undergoes a QA process.

<u>An event is published</u> (visible) in HIAD only after QA process.



DAM = Data Analysis Module

| presented as a pla |) can search for event versions based on up to 5 in list or in a cross table based on 2 database fie pinations of search fields and cross table fields w | ds. | | |
|--------------------|--|---------------------|---|---------------|
| Step 1: Select and | submit search fields and cross table fields. | | | |
| Step 2: Add searc | h values and criteria. | | | |
| Step 1: | Other sets: | Tech. Info & Peop | ole Other & Postevents | Subevent Deta |
| Event | City | 🕖 Tech. info | □ Application | 0 |
| | Country | 0 | Application chain | 0 |
| | 🗆 Street | 0 | Application stage | 0 |
| | 🗆 State | 0 | 🗖 Storage medium | 0 |
| | 🗆 Year | 0 | 🗖 Storage quantity | 0 |
| Event Nature | Systems involved | 0 | 🗆 Actual pressure (in storage medium) | 0 |
| | 🗖 Principal event | 0 | 🗌 🗖 Design pressure (of storage medium) | 0 |
| | Event nature summary | 0 | 🗖 Type of location | 0 |
| Subevent | 🗆 Subevent type | 0 | 🗖 Location description | 0 |
| | Emergency action | 0 | 🗖 Potential ignition source | 0 |
| | Emergency evaluation | 0 | 🗆 Surroundings | 0 |
| Event scenario | 🗖 Presence of scenario | 0 | 🗖 Operational condition | 0 |
| | 🗖 Scenario known | 0 | 🗖 Operations phase | 0 |
| | 🗆 Scenario author | 0 | 🗖 Pre event summary | 0 |
| | 🗆 Year | 🕖 🛛 People Injuries | Persons affected onsite | 0 |
| | 🗆 Date | 0 | Persons affected rescued | 0 |
| | 🗖 Scenario analysis type | 0 | 🗆 Persons affected offsite | 0 |
| | 🗆 Established frequency (scenario) | 0 | 🗖 Persons at risk onsite | 0 |
| | 🗖 Scenario reference | 0 | 🗖 Persons at risk offsite | 0 |
| | 🗆 Scenario comments | 0 | \Box Total number of affected persons | 0 |
| Event weather | 🗆 Season of the year | 0 | Total number of injured persons | 0 |
| | 🗆 Weather type | 0 | \Box Total number of fatalities | 0 |
| | □ Wind direction | 0 | 🗆 Injury comments | 0 |



Data Analysis example: total number of involved people

| Total number of aff | ected perse | -> Chang | је | | | | |
|---------------------|-------------|-----------|------|----------|---------|------------|-------|
| Year - Principal | Burst of | Explosion | Fire | Fire - | Pipe | Release of | Total |
| event | tank | | | hydrogen | rupture | hydrogen | |
| 1985 | 0 | 2 | 0 | 0 | 0 | 0 | 2 |
| 1986 | 0 | 7 | 0 | 0 | 0 | 0 | 7 |
| 1987 | 0 | 8 | 0 | 0 | 0 | 0 | 8 |
| 1988 | 0 | 3 | 0 | 0 | 0 | 0 | 3 |
| 1989 | 0 | 124 | 15 | 7 | 0 | 0 | 146 |
| 1990 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| 1991 | 0 | 26 | 0 | 0 | 0 | 70 | 96 |
| 1992 | 0 | 24 | 0 | 0 | 0 | 0 | 24 |
| 1993 | 0 | 4 | 0 | 4 | 0 | 0 | 8 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1995 | 0 | 24 | 0 | 0 | 0 | 0 | 24 |
| 1996 | 0 | 2 | 0 | 0 | 0 | 0 | 2 |
| 1997 | 0 | 73 | 4 | 0 | 0 | 0 | 77 |
| 1998 | 0 | 0 | 0 | 3 | 0 | 0 | 3 |
| 1999 | 0 | 53 | 0 | 1 | 0 | 0 | 54 |
| 2000 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| 2001 | 0 | 21 | 7 | 4 | 0 | 0 | 32 |
| 2002 | 0 | 188 | 0 | 0 | 0 | 0 | 188 |
| 2003 | 0 | 2 | 0 | 0 | 0 | 0 | 2 |
| 2004 | 0 | 3 | 0 | 1 | 0 | 0 | 4 |
| 2005 | 0 | 23 | 0 | 0 | 0 | 0 | 23 |
| 2006 | 0 | 12 | 3 | 5 | 0 | 0 | 20 |
| 2007 | 0 | 1 | 88 | 9 | 0 | 3 | 101 |
| 2008 | 0 | 6 | 0 | 0 | 0 | 3 | 9 |
| Total | 0 | 607 | 117 | 35 | 0 | 76 | 835 |

Events 1985-2008: total number of involved people.





MAPS module



The screen shows you the HIAD events as they are scattered over the globe. Only events where the city or town is known are displayed. Events where only the country/continent is known are not displayed. impression.



Lesson learned and improvement actions

- A database such as HIAD is an essential reference and qualitative/quantitative tool for
- A structured dissemination of information
- An optimisation of safety for an emerging technology.

It will increase importance and expand usage with increasing technology deployment.

To this purpose, the experience with HIAD of the past years has generated improvement needs...





Lesson learned

Requirement 1 - commitment to reporting:

First responders or facility owners do not have as a duty a HIAD input.

Therefore a commitment to reporting also to HIAD should be required by licensing bodies. A 'distributed', Europeanwide network of data providers should be in place.

Requirement 2 - availability of accurate event reports:

Event description providers tend to input a minimal number of information, and many fields remain empty.

Local journal articles almost never provide data with the required quality and resolution.

Therefore final internal accident reports should be made available for HIAD input (a very good example: the Emeryville accident report).





Improvement actions so far

1. Since 2013 all the European FCH JU projects, and especially the Demo projects are committed to report safety related events in HIAD



A similar commitment is wished also from commercial installations

2. The US and the European databases 'speak' to each others, and a small exchange of events has started





Improvement actions to come

Improve end-user usefullness

HIAD has been written for expert operators, not for end users; the level of details of the data expected/required must take into account the average availability of data.







Improve quality assurance service

A broader and permanently available, quality assurance group is required, also for the interaction with the event provider.

<u>Solution</u>: not available at the moment; joining forces between databases could be a way forward.





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Thank You

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