U.S. DEPARTMENT OF ENERGY

Hydrogen Safety, Codes & Standards

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2006 DOE Hydrogen Program
Merit Review and Peer Evaluation Meeting

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Goals and Objectives

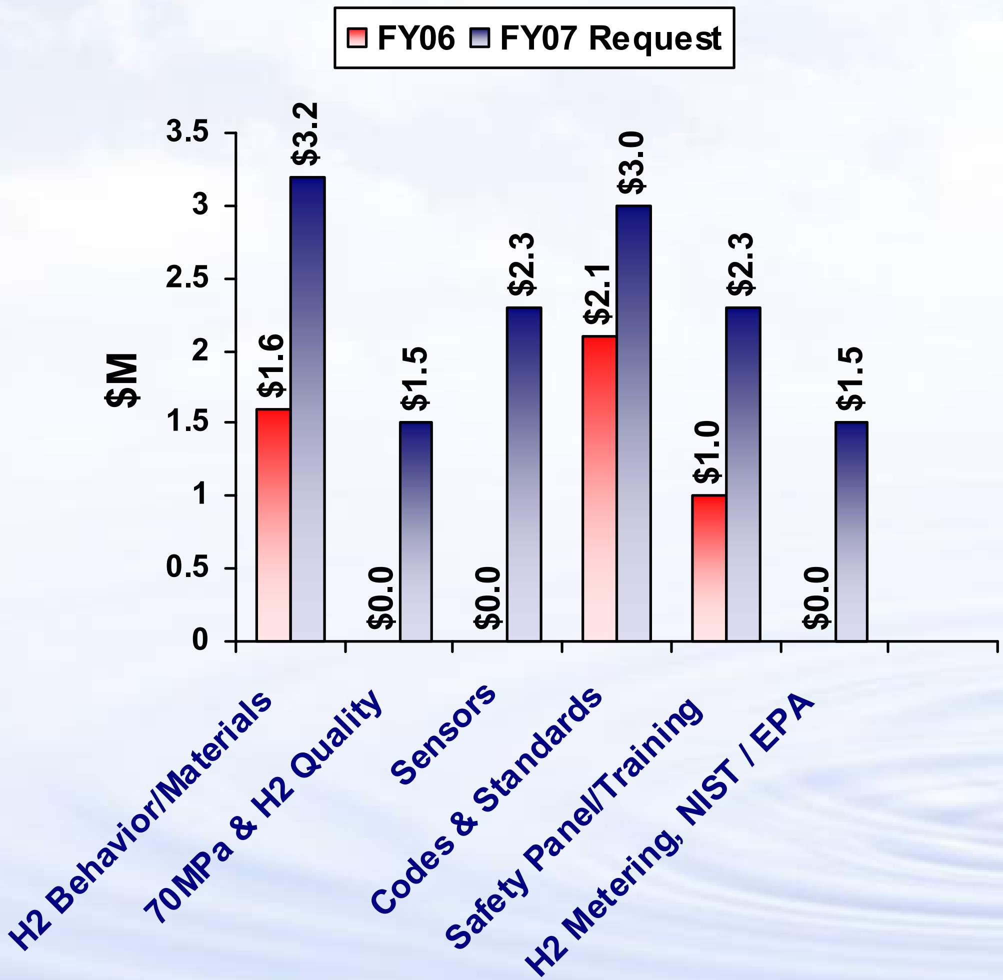
Safety: Develop and implement the practices and procedures that will ensure safety in the operation, handling and use of hydrogen and hydrogen systems for all DOE funded projects and to utilize these practices and lessons learned to promote the safe use of hydrogen throughout the emerging hydrogen economy.

Codes & Standards: Perform underlying research to enable codes and standards to be developed for the safe use of hydrogen in all applications. Facilitate the development and harmonization of international codes and standards

- Establish Program safety policy and guidance and continue activities of the Safety Review Panel to provide expert guidance.
- Promote widespread sharing of safety-related information, procedures and lessons learned to first responders, jurisdictional authorities and other stakeholders.
- Publish a handbook of Best Practices for Safety. The Handbook will be a “living” document that will provide guidance for ensuring safety in future hydrogen endeavors, by 2008.
- R&D to provide critical hydrogen behavior data and hydrogen sensor and leak detection technologies; provide a sound basis for model code development and adoption.
- Support and facilitate the drafting and adoption of model building codes for hydrogen applications in key US regions
- Facilitate development of Global Technical Regulations (GTR) for H2 vehicle systems under the United Nations Economic Commission for Europe, World Forum for Harmonization of Vehicle Regulations, and Working Party on Pollution and Energy Program (ECE-WP29/GRPE).

Safety Codes and Standards Budget

FY 2007 Budget Request = $13.8M
FY 2006 Available Funds = $ 4.7M

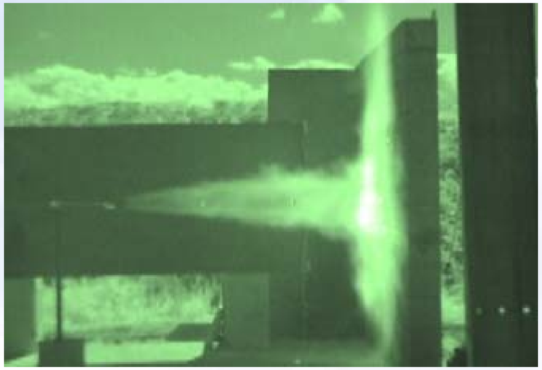


- **Emphasis:**
  - Technically validated performance data needed for new codes and standards
  - Performance based standards which do not limit technologies
  - Restart hydrogen sensors R&D
  - Hydrogen quality and high pressure refueling
  - Conduct risk assessment and establish protocols to identify and mitigate risks
  - Establish consensus R&D for global harmonization of hydrogen quality standards

- **2007 Budget Obligations:**

Hydrogen Metering (NIST)	$ 1.5M
Restore Laboratory R&D	$ 4.7M
Ensure Safety of DOE R&D	$ 2.3M
Support Codes & Standards (Domestic and International)	$ 3.0M
Renew Sensors R&D	$ 2.3M
Total	**$13.8M**

Technical Risks/Major Barriers



- **Insufficient Technical Data Available**
- **Jurisdiction**
  - Large Number of Authorities Having Jurisdictions (AHJ's)
    - Approximately 44,000 Federal, State and Local AHJ's
  - Non-uniform training of AHJ's
  - Non-uniform requirements
- **International Standards**
  - Competing Organizations (ASME, ASTM, EN, ISO, IEC, etc)
  - Disorganized approach
  - International competition
- **Harmonization of Domestic and International Standards**

Approach

- Perform R&D that focuses on basic hydrogen properties and behavior, as well as the testing of materials and components to support the development of hydrogen codes and standards.
- Continue execution of a national template which identifies organizations and responsibilities in the hydrogen codes and standards development process.
- Work domestically and internationally to facilitate the development of performance-based standards and to ensure that U.S. consumers can purchase products that are safe and reliable, regardless of their country of origin, and that U.S. companies can compete internationally.
- Conduct safety reviews of current and future projects, including practices and procedures.
- Maintain and expand Bibliographic and Incident Reporting databases and other data on safety, including component reliability, materials, sensors and hydrogen releases.
- Develop the training tools and hardware for a safety training program of emergency responders and authorities having jurisdiction.

Accomplishments

Hydrogen Incidents Database

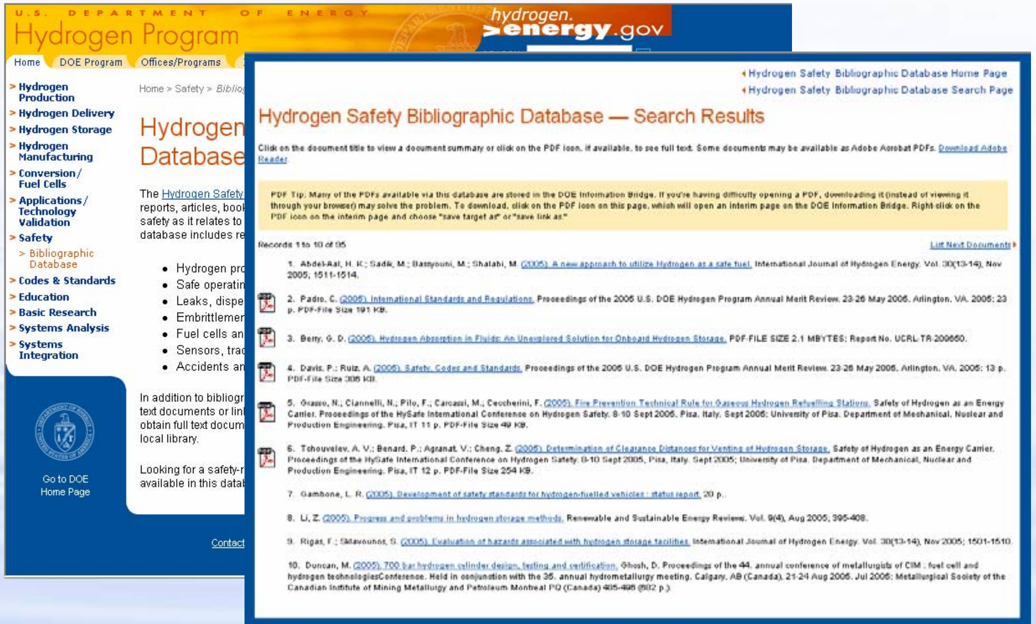
www.h2incidents.org

Reports contain summaries, at-a-glance information, and links to related information such as full reports, photos or videos, etc.

Hydrogen Bibliographic Database

www.hydrogen.energy.gov

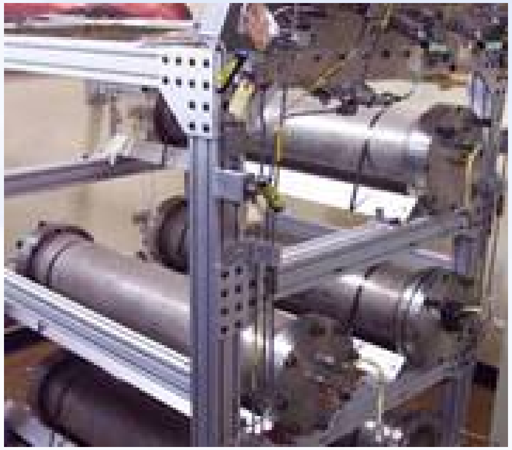
This searchable database provides references for information on hydrogen safety.



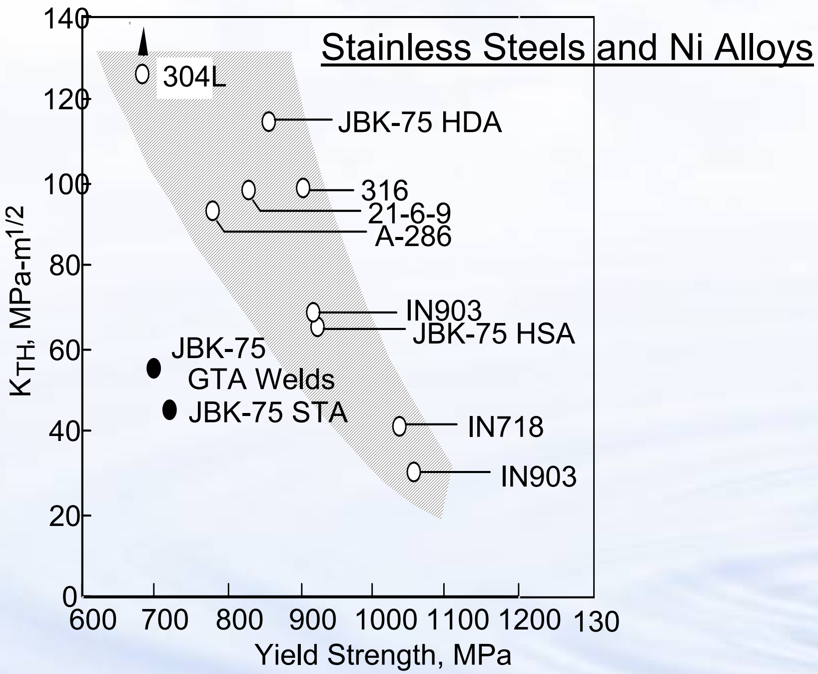
Accomplishments

Materials R&D: 9 of 15 Chapters now available of hydrogen material classes

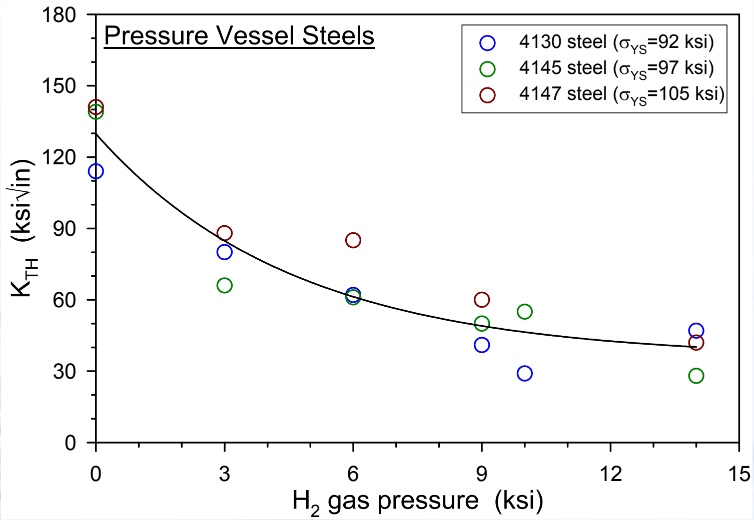
www.ca.sandia.gov/matlsTechRef



Effect of Strength on Cracking in H_2



Effect of Pressure on Cracking in H2



- Increased material strength lowers threshold for H_2-assisted crack growth
- Increased H_2 gas pressure lowers threshold for H_2-assisted crack growth

For More Information

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