VIII.10 Hydrogen Safety Panel

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Project Start Date: 2004
Project End Date: Project continuation and direction determined annually by DOE

Fiscal Year (FY) 2012 Objectives
• Provide expertise and recommendations to DOE and assist with identifying safety-related technical data gaps, best practices and lessons learned.
• Help DOE integrate safety planning into funded projects to ensure that all projects address and incorporate hydrogen and related safety practices.

Technical Barriers
This project addresses the following technical barriers from the Hydrogen Safety section of the Fuel Cell Technologies Program Multi-Year Research, Development and Demonstration Plan:
(A) Safety Data and Information: Limited Access and Availability
(C) Safety is Not Always Treated as a Continuous Process
(G) Insufficient Technical Data to Revise Standards

Introduction
Safety is an essential element for realizing the “hydrogen economy” – safe operation in all of its aspects from hydrogen production through storage, distribution and use; from research, development and demonstration to deployment and commercialization. As such, safety is given paramount importance in all facets of the research, development,
demonstration and deployment work of the DOE Fuel Cell Technologies (FCT) Program Office.

Recognizing the nature of the DOE FCT Program and the importance of safety planning, the Hydrogen Safety Panel was formed in December 2003 to bring a broad cross-section of expertise from the industrial, government and academic sectors to help ensure the success of the program as a whole. The experience of the Panel resides in industrial hydrogen production and supply, hydrogen R&D and applications, process safety and engineering, materials technology, risk analysis, accident investigation and fire protection. The Panel provides expertise and recommendations on safety-related issues and technical data gaps, reviews individual DOE-supported projects and their safety plans and explores ways to bring best practices and lessons learned to broadly benefit the FCT Program.

**Approach**

The Panel strives to raise safety consciousness most directly at the project level. Safety should be driven at the project level by organizational policies and procedures, safety culture and priority. Project safety plans are reviewed in order to encourage thorough and continuous attention to safety aspects of the specific work being conducted. Panel-conducted safety reviews focus on engagement, learning, knowledge-sharing and active discussion of safety practices and lessons learned, rather than as audits or regulatory exercises. Through this approach, DOE and the Hydrogen Safety Panel are trying to achieve safe operation, handling and use of hydrogen and hydrogen systems for all DOE projects.

**Results**

The Hydrogen Safety Panel was formed in FY 2004 and the first meeting was held in Washington, D.C., December 11-12, 2003. The 16th Panel meeting was held in San Francisco, CA, September 11, 2011 in conjunction with the International Conference on Hydrogen Safety and focused principally on brainstorming new ideas to support the Safety, Codes & Standards sub-program vision and goals. The Panel was joined by stakeholders and other subject matter experts. In all 75 ideas were generated, collated and ranked and Table 1 emphasizes the initiatives which got the highest number of votes and were, therefore, worthy of further consideration.

The Panel conducted safety reviews for projects as noted in Table 3 since the last reporting (safety reviews have been conducted for 47 projects since March 2004). Final reports issued to DOE with recommendations are also noted [1,2].

In FY 2010, the Panel first established a follow-up protocol to interview project teams in order to identify
actions, findings and conclusions regarding safety review recommendations as one means for measuring the value of this work. Action on report recommendations represents a rich source of safety knowledge that can have broader benefits to others. Table 3 indentifies the follow-up interviews that were conducted since the last reporting [4-6] and Table 4 summarizes the conclusions for all follow-up interviews conducted to date.

The Panel concluded that all interviewees have improved the safety aspects of the work they are conducting. Overall, over 90% of the recommendations – 119 in number – have been implemented in some manner or are in progress for the 14 follow-up interviews conducted. The Panel has concluded that the mechanism used by the Panel for seamless discussion and knowledge sharing at the project level has helped augment the prime responsibility of any organization to ensure the safe conduct of work [7,8].

The Hydrogen Safety Panel has been engaged in discussing how hydrogen and fuel cell safety event and equipment failure information and data can serve as a rich and valuable resource if it is systematically collected, analyzed and used to enhance our knowledge. The Panel issued a unanimously endorsed statement to DOE to identify appropriate mechanisms for such information sharing and to facilitate the necessary interactions for such discussion with project teams that would fully recognize and respect confidentialities and contractual obligations [9].

Leadership has been provided to the International Energy Agency Hydrogen Implementing Agreement Task 31 (Hydrogen Safety) for the work under Subtask D, Knowledge Analysis, Dissemination and Use. Under this task, collaborations in safety event databases continued between member countries. Online tools were demonstrated at the International Conference on Hydrogen Safety [10].

Collaborations to share and disseminate safety information and knowledge continue to be an important aspect of Hydrogen Safety Panel work. For example, the Panel contributed to the University of California Center for Laboratory Safety Workshop, Irvine, CA, March 15-16, 2012. The workshop examined new, more effective ways to make certain that research is performed safely. Work on incidents, lessons learned and best practices was shared with attendees [11].

Conclusions and Future Directions

The work and approaches taken by the Panel will continue to focus on how safety knowledge, best practices and lessons learned can be brought to bear on the safe conduct of project work and the deployment of hydrogen technologies and systems in applications of interest and priority in the DOE FCT Program.

The Panel will undertake a number of initiatives over the next year including:

- Safety plan reviews, safety review site visits and a final report for ARRA fuel cell deployment projects in specialty vehicle, auxiliary and back-up power, portable and combined heat and power applications.

### Table 3. Project Safety Reviews and Reports since July 1, 2011

<table>
<thead>
<tr>
<th>Program Area</th>
<th>Project Title</th>
<th>Contractor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage</td>
<td>New Carbon-Based Materials with Increased Heats of Adsorption for Hydrogen Storage [4]</td>
<td>Northwestern University, Evanston, IL</td>
</tr>
<tr>
<td>Storage</td>
<td>Design of Novel Multi-Component Metal Hydride-Based Mixtures for Hydrogen Storage [5]</td>
<td>Northwestern University, Evanston, IL</td>
</tr>
<tr>
<td>ARRA</td>
<td>Fuel Cell-Powered Lift Truck Fleet Deployment [6]</td>
<td>Sysco Food Services, Houston, TX</td>
</tr>
</tbody>
</table>

### Table 4. Categorizing Actions Taken on Report Recommendations - 14 Interviews

<table>
<thead>
<tr>
<th>Category</th>
<th>Recommendations Implemented</th>
<th>In Progress</th>
<th>No Action</th>
<th>Total Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety Vulnerability/ Mitigation Analysis</td>
<td>23</td>
<td>4</td>
<td>6</td>
<td>33</td>
</tr>
<tr>
<td>System/Facility Design Modifications</td>
<td>8</td>
<td>5</td>
<td>1</td>
<td>14</td>
</tr>
<tr>
<td>Equipment/Hardware Installation and O&amp;M</td>
<td>15</td>
<td>6</td>
<td>1</td>
<td>22</td>
</tr>
<tr>
<td>Safety Documentation</td>
<td>14</td>
<td>7</td>
<td>0</td>
<td>21</td>
</tr>
<tr>
<td>Training</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Housekeeping</td>
<td>14</td>
<td>6</td>
<td>1</td>
<td>21</td>
</tr>
<tr>
<td>Emergency Response</td>
<td>8</td>
<td>3</td>
<td>2</td>
<td>13</td>
</tr>
<tr>
<td>Total</td>
<td>85</td>
<td>34</td>
<td>11</td>
<td>130</td>
</tr>
</tbody>
</table>
Follow-up teleconferences with all project teams for which safety review site visit reports have been issued in order to identify actions taken, findings, conclusions and other learnings.

Completion of a safety checklist for an outdoor supply system providing hydrogen for an indoor application to be utilized as a resource for hazard analysis.

Additional topics for study and knowledge dissemination that utilize the new initiative ideas discussed previously and consistent with the Hydrogen Safety Panel's charter to identify safety-related data and knowledge gaps.

**FY 2012 Publications/Presentations**


**References**


