Hydrogen Codes and Standards

2004 DOE Hydrogen, Fuel Cells & Infrastructure Technologies Program Review

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National Renewable Energy Laboratory
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This presentation does not contain any proprietary or confidential information.
Objectives

• Facilitate the creation and adoption of standards and model building codes for hydrogen systems in commercial, residential, and transportation applications
• Harmonize the technical requirements of international standards and regulations
• Integrate codes and standards activities from R&D to commercialization
Budget

• Funding in FY04
  – Total $1,725 K
  – Subcontracts $1,040 K
    • ANSI, ASME, CGA, CSA America, ICC, NFPA, NHA, UL, Vista, Consultants (Brad Bates, Kelvin Hecht, Ron Sims)
Technical Barriers
Codes and Standards

• J. Consensus national agenda on codes and standards
  – A. Limited government influence on model codes
  – B. Competition among standards/code development organizations
  – C, D, E. Large, diverse number of state/local jurisdictions; limited state funds for new codes; training differences for code officials

• H. International competitiveness and national agendas
  – F, G. Limited DOE role in the development of ISO standards and inadequate representation by government and industry at international forums

• P. Current large footprint requirement for hydrogen fueling stations
  – N. Lack of technical data for underground and above ground storage
  – O. Insurance rates tied to current codes and standards
Technical Targets

• Negotiate DOE licenses for critical standards and model codes
• Facilitate adoption of model building codes in three key regions
• Establish comprehensive training program for code officials and fire marshals
• Support and facilitate completion and adoption of ISO standards for hydrogen refueling and storage
• Agree in principle to adopt a global technical regulation for hydrogen fuel cell vehicles under GRPE
• Implement research program to develop defensible standards for hydrogen systems, refueling stations, underground storage, vehicle components
Approach

• Develop unified national agenda
  – National templates
    • accelerate development of priority standards
    • designate lead and supporting SDOs by consensus
  – Provide support to key SDOs
  – Facilitate access to standards through ANSI website
• Coordinate national activities
  – Hydrogen Codes and Standards Coordinating Committee
• Harmonize technical standards and global technical regulations
• Develop comprehensive R&D Plan
  – Fundamental properties of hydrogen
  – Materials compatibility
  – Potential unintended release scenarios
  – Flammable cloud formation and ignition
  – Flame jet characteristics
  – Testing and validation needs
Overall Timetable

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<td>R&amp;D</td>
<td>Codes and Standards</td>
<td>Regulations</td>
<td>Commercialization Decision</td>
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<td>Fundamental Properties</td>
<td>FVC Formation</td>
<td>LFL</td>
<td>Sensors</td>
<td>Fuel Specs</td>
<td>Containers</td>
<td>Dispensers</td>
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<td>Dispensers</td>
<td>Crashes</td>
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<td>Draft GTR Vehicle Systems</td>
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# Codes/Standards Timetable

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<td><strong>Dispensing Systems</strong></td>
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<td>[Hoses HGV 4.2 (CSA]</td>
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<td>Temperature Compensating Devices HGV 4.3</td>
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<td>Breakaway Devices HGV 4.4</td>
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Technical Accomplishments/Progress

• Negotiate DOE licenses for critical standards and model codes
  – agreement with ANSI to create hydrogen portal on national standards network
  – agreement with key SDO to negotiate posting and downloading hydrogen standards and model codes

• Facilitate adoption of model building codes in three key regions
  – initiated incubator project with ANSI, SDOs, and state code officials in NY, MA, CT, RI
  – additional projects planned for SE and one other region

• Establish comprehensive training program for code officials and fire marshals
  – Handbook for local code officials—How to Permit a Hydrogen Fueling Facility—prepared with ICC, NFPA, and PNNL

• Implement research program to develop defensible standards for hydrogen systems, refueling stations, underground storage, vehicle components
  – Draft DOE Codes and Standards R&D Plan prepared (with SNL, PNNL, LANL)
  – participate in separation distance validation project (ICC, SNL, SRI)
  – Draft C/S R&D Roadmap for FreedomCAR-Fuel Partnership (with SNL, PNNL, LANL)

• Support and facilitate completion and adoption of ISO standards for hydrogen refueling and storage
  – member of ISO/TC197 Working Group to prepare hydrogen fueling facility standard

• Agree in principle to adopt a global technical regulation for hydrogen fuel cell vehicles under GRPE
  – Contract with CGA and CSA to coordinate ISO/TC197 and IEC/TC105
Technical Accomplishments/Progress

• Established national agenda for codes and standards
  – national templates adopted by consensus and being implemented
    • subcontracts negotiated and issued to CGA, CSA America, ICC, NHA, NFPA, UL
    • negotiations in final stage with ANSI and ASME
  – standards for fueling systems, containers (on-board, portable), sensors, fuel cells for hand-held devices, fuel purity under way
  – standards for piping, pipelines, bulk storage, composite containers, transportable containers begun
• Model codes will provide for additional hydrogen applications
  – 2006 edition of International Code Council model codes
  – NFPA 52 and 55 under revision
• R&D Plan to establish scientific basis for technical requirements
  – synchronize codes and standards with R&D
  – workshops on Unintended Release Scenarios and Materials Compatibility (with SNL)
  – fuel purity guidelines/specification workshop (April 26)
### Technical Accomplishments/Progress

(National Template for Hydrogen Generators and Stationary and Portable Fuel Cells)

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<thead>
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<th>Stationary Fuel Cells</th>
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<td>Controlling Authority: CPSC, DOT RSPA, OSHA, EPA (Methanol), State, Local Govt. (Zoning, Building Permits)</td>
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<td><strong>Handheld Systems:</strong> UL, CSA</td>
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<td><strong>Portable Systems:</strong> CSA, UL, CGA, H2 Fuel Specifications: CGA, SAE, Performance Test Procedures: ASME, CSA, NHA-GTI</td>
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| Installation Piping: ASME, CSA, CGA, NFPA, ICC |
| Storage: ASME, CGA, CSA, API, NFPA |
| Compressors Safety Certification: CSA, UL |
| Compressor Design, Performance & Safety: API |
| Sensors/Detectors: UL, CSA, NFPA |
| Fuel specifications: CGA, SAE, API, ASTM |
| Weights/Measures: NIST, API, ASME, NCWM |
| Dispensers: CSA, UL, NFPA, SAE, API |
| Non-vehicle Dispensing: CGA |
| Codes for the Built Environment: ASHRAE, ICC, NFPA, CGA |
| Interconnection: IEEE, UL, NFPA |

| Interface |
| Stationary Fuel Cells |
| Portable Fuel Cells |
| **H2 ICEs:** CSA, UL |
| **H2 Fueled Turbines:** CSA, UL, ASME, API |
| **H2-O2 Steam Generators:** CSA, ASME, UL, NFPA |
| Performance Test Procedures: ASME, CSA, NHA-GTI |

**Note:** Leads will change depending on type of environment.
Technical Accomplishments/Progress

“Voluntary consensus process (ANSI)”

Lead SDO
Technical Committee (experts)
Draft Standard
Published Standard
Code (ICC, NFPA)

DOE “license”
ANSI Website
DOE Users Group

National Templates
NREL subcontract

For sale to public

Regulation
local, state, federal, international

Working Group

Expressed Standard
Balloting
Published Standard
(Update standard)
Technical Accomplishments/Progress
Codes and Standards R&D Roadmap Engineering for Hydrogen Systems

• Basic
  – Combustion/Flammability
  – Physical and Chemical

• Material Properties and Compatibility
  – Technical Reference
  – Crack Growth
  – Fatigue

• Designing for Safety
  – Release Scenarios
  – Control Options
  – Cost/Benefit Analysis
  – Sensors/Odorants/Tracers
  – Modeling

BOTH
Interactions and Collaborations

• DOE H₂ Codes/Standards Coordinating Committee (HFCIT Program)
  – ANSI, API, ASME, ASTM, CGA, CSA, ICC, NFPA, IEEE, SAE, UL
  – DOT, NIST
  – LANL, NREL, PNNL, SNL
  – Coordinate and manage national templates for DOE
  – Open to all interested parties
    • Contact Russ Hewett (russell_hewett@nrel.gov)
New Website for Hydrogen/Fuel Cells Codes and Standards

www.fuelcellstandards.com

(will be linked to DOE HFCIT website: http://www.eere.energy.gov/hydrogenandfuelcells/)
Responses to Previous Year Reviewers’ Comments

• Comment: Needs additional people (critical mass)
  – one additional person on team; plans to add several more staff postponed due to budget cut in C&S program

• Comment: Should use as much as possible to use web tools and additional ones for information dissemination
  – new website launched; ANSI hydrogen portal under negotiation

• Comment: Get some additional social/technical links into program
  – incubator project with ANSI launched; member of new FreedomCAR Hydrogen Fuel Partnership C&S Tech Team; draft R&D Roadmap prepared

• Comment: Engage Weaver/Hollywood for some sense of the demo - what's good and bad
  – training and education through ICC, NFPA, ANSI
Future Work

• Remainder of FY2004
  – Draft standards for hydrogen fueling systems
    • Dispensing systems
    • Hoses
    • Temperature compensation
    • Break-away devices
    • Priority-sequencing
    • Manual/automatic valves
  – Draft standard for hydrogen containers
    • HGV-2
    • PRD-1
  – Coordinate codes and standards development and R&D Roadmap with DOE fleet demonstration project
  – Consensus “mini-template” for fuel purity guidelines/specifications based on workshop
  – Hydrogen portal on ANSI’s NSSN
    • NE regional meeting of code officials
  – Present paper at WHEC-15

• FY2005
  – Technical reports for bulk (composite) storage containers, piping, pipelines
  – Draft standard for hydrogen sensors/detectors
  – Draft standards for stationary reformers, electrolyzers
  – Revised ICC and NFPA model codes for the built environment