Research and ASME Codes in Support of the Emerging H_2 Infrastructure

INTERNATIONAL PIPELINE CONFERENCE
CALGARY, ALBERTA, CANADA

OCTOBER 5, 2004

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Summary

- H_2 Standardization Approach
- Interface with Other Organizations
- Research
- Discussion of International Standards
- Discussion of Performance-Based vs. Prescriptive Standards

H_2 Standardization Approach

Being driven by the US Department of Energy

- Research
  - Hydrogen production
  - Fuel Cell Development
  - Hydrogen storage
  - Materials
- Technology Validation
- Education
- Safety
- Codes and Standards Development

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H_2 Standardization Approach

- Traditional approach to standardization

  Writing prescriptive standards after technology is established and after commercialization has begun

- Approach for the H_2 economy

  Writing standards with more performance based requirements during the technology development and before commercialization has begun

H_2 Standardization Approach

- The means to safely and efficiently generate, transport, distribute, store, and use H_2 as a fuel
- Standardization aids H_2 infrastructure development
  - Codes and standards protect the public
  - Provides confidence in the technical integrity of products
  - Should not limit technical innovation
  - Provides for uniform training, allowing for more rapid acceptance of technology
  - Facilitates doing business

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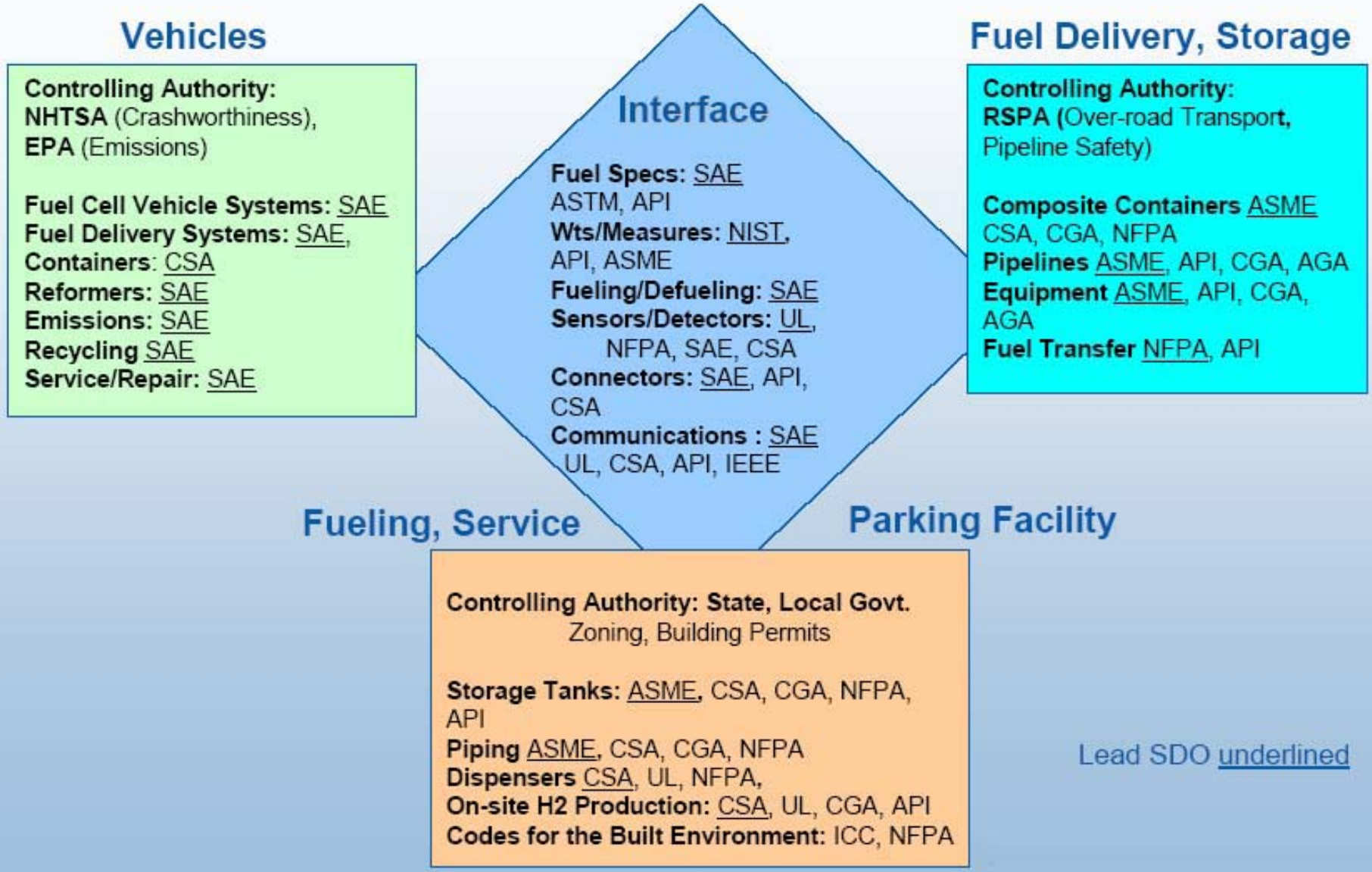
Approach to Standardization - Infrastructure



Interface With Other Organizations

- DOE Harmonization Workshops, Lead SDO's assigned
  - Fuel Delivery and Storage
    - Composite Containers - ASME, CSA, CGA, NFPA
    - Piping – ASME, CGA, CSA, NFPA
    - Pipelines - ASME, AGA, API, CGA
    - Equipment – ASME, AGA, API, CGA
  - Fueling and Service
    - Storage Tanks - ASME, API, CGA, CSA, NFPA
    - Piping - ASME, CGA, CSA, NFPA
  - H_2 Generation and Fuel Cells
    - Performance Test Procedure – ASME, UL, CSA
    - Piping – ASME, CGA, CSA, ICC, NFPA
    - Storage Tanks – ASME, API, CGA, CSA

Interface With Other Organizations

- Member of DOE H_2 C&S Coordinating Committee (HCSCC)
- Jurisdictions and Regulatory
  - National Board of Boiler and Pressure Vessel Inspectors (NBBI)
  - ASME Conference Committee
    - Includes jurisdictional representatives from US and Canada
    - First consideration vote of BPVC standards actions

ASME H_2 Technical Reports

- Research needs identified by H_2 Task Forces
- To be documented in Technical Reports
  - H_2 standardization interim report
  - H_2 storage tanks
  - H_2 transport tanks
  - H_2 piping and pipelines
  - Portable H_2 tanks
- Direct interface with Project Teams
- Technical basis for draft standards
- Managed by ASME C&S Technology Institute (CSTI)
- Development began in July 2004
  - Scope: development of Technical Reports
  - 18 month program

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Other Research

- DOE Sponsored Research
- Sandia National Laboratories
  - Developing Material Compatibility Technical Reference
  - Interface with ASME Project Teams
    - To include pipeline materials
    - Ferritic steels, austenitic stainless steels, aluminum alloys, copper alloys, composite materials
    - Properties expected to include general, permeability & solubility, mechanical, and metallurgical considerations

International Standards

- International
  - ASME C&S International Presence
    - BPVC accepted in over 80 countries
    - 1,600 accredited manufacturers outside of U.S.
  - ISO Technical Advisory Group (TAG) Participation
    - ASME administers 47 U.S. TAGs
    - Administers ISO/TC11 (B&PV) U.S. TAG
    - Member of ISO/TC 197 (Hydrogen) U.S. TAG
  - Pressure Technology Sectoral Technical Advisory Committee (PT-STAC)
    - Advise U.S. DOC and USTR on pressure equipment issues

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International Standards

- Countries concerned that foreign standards and testing requirements may restrict exports
- Public and private sectors support development of international standards
  - Improving efficiency of production
  - Facilitating international trade
  - Use of international standards in regulations
- Example: pressure technology
  - Countries obligated to protect citizens through regulations
  - Each reserves the right to chose appropriate standards
  - SDOs can not impose standards on regulatory authority
  - Various national standards have served sector well
  - Regulators have a high level of confidence in supporting standards

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International Standards

- Harmonized prescriptive international standards for mature sectors?
  - Most likely not globally relevant
  - Most likely not universally adopted
  - Example: ISO/TC11 (Boilers and Pressure Vessels) experience
  - Technology-neutral, performance-based standards assure technical relevance by aligning recognized standards to meet basic criteria

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International Standards

- Recommendation
  - Recognize WTO principles include many consensus standards and member body organizations; multiple paths to international standardization
  - Recognize international standards must meet safety and market-driven needs on a global basis
  - Recognize best approach will be industry or technology sector-specific
  - Recognize best solution must be market driven
  - Encourage building upon existing globally-relevant market-drive standards for H_2
  - Encourage coherence among technical standards efforts

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Performance-Based vs. Prescriptive Standards

- Performance-based
  - States goals and objectives to be achieved
  - Describes acceptable methods to determine whether goals and objectives have been met
  - Focuses on desired characteristics of the final product
  - Also called “objective-based”
- Prescriptive
  - Prescribes materials, design, construction requirements without stating goals and objectives
  - Focuses on requirements for the processes to produce the final product
- ASME standards include both prescriptive and performance-based elements

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Performance-Based vs. Prescriptive Standards

- Advantages of Performance-based
  - User flexibility
  - Transparency
  - Earlier adoption of new technology
  - Efficiency
- Different Approaches
  - Effectiveness of performance-based standards depends on ease of judging whether goals and objectives are met
  - Prescriptive requirements should be considered when performance-based requirements lead to costly or complicated testing procedures
  - Alternate prescriptive and performance-based requirements may be appropriate

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Performance-Based vs. Prescriptive Standards

- Example: bolted flange joint
  - Performance based:

    Bolted flanged joints shall be leak-free for intended service. The joint shall be hydrotested at 1.5 times design pressure without leaking, and shall be demonstrated to be able to withstand expected external forces without leakage while at design pressure and temperature.
  - Prescriptive:

    Bolted flanged joints shall meet the requirements of ASME B16.5
  - Prescriptive with performance-based alternative

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- ASME H_2 C&S Website:

  www.asme.org/cns/hydrogen

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