Presentation Outline

• Approval for new code development
• Charge from BPTCS to B31 Standards Committee for Hydrogen Piping/Pipeline code development
• B31.12 Status & Structure
• Hydrogen Pipeline issues
• Research Needs
• Where Do We Go From Here?
Code for Hydrogen Piping and Pipelines

• B31 Hydrogen Section Committee to develop a new code for $H_2$ piping and pipelines
  - Include requirements specific to $H_2$ service for power, process, transportation, distribution, commercial, and residential applications
  - Balance reference and incorporation of applicable sections of B31.1, B31.3 and B31.8
  - Have separate parts for industrial, commercial/residential and pipelines
  - Include new requirements for construction, operation, and maintenance
Performance-Based vs. Prescriptive Standards

- **Performance-Based**
  - States goals and objectives to be achieved
  - Describes acceptable methods to determine goals and objectives have been met
  - Focuses on desired characteristics of final product

- **Prescriptive**
  - Prescribes materials, design, construction requirements without stating goals and objectives
  - Focuses on requirements for processes to produce the final product

- **ASME standards include both prescriptive and performance-based elements**
Hydrogen Standards Development Project Schedule

- Task force Recommendations- Complete
- BPTCS Action- Complete
- Technical Reports: Jul ’04 – Nov ’05
- Draft Standard Available: Nov ’05
- B31 Standards Committee: Nov ’05 – Nov’06
- Finalize Standard : Mar ’07
- Publish : 3rd Quarter ‘07
ASME B31.12 Structure and Basis

• B31.12 is divided into three subsections
  – Section A: Industrial Piping
  – Section B: Pipelines and Distribution Piping
  – Section C: Residential piping

• There is also a section for the common use and reference by sections A, B and C
Section B: Pipeline and Distribution Piping

• Model document for section B is ASME B31.8

• Anticipated operating ranges:
  – Pressure: full vacuum to 3,000 psig
  – Temperature: -40°F to 300°F
Common Section

• This section of the code will be located at the front of the code book and contain the following information:
  – Scope of the code
  – Materials section
  – Welding and forming section
  – Operation and maintenance section
• The above sections will be referenced by Sections A, B and C.
Hydrogen Pipeline Issues

• Materials
  - Loss of 30% in toughness & 15% burst strength
  - Rapid hydrogen assisted fatigue crack growth
  - Sustained-load cracking in HAZ of welds
Hydrogen Pipeline Issues

- Materials (cont’d)
  - Are micro-alloyed steels more resistant to the effects of hydrogen environments
  - Do FRP pipes offer advantages over metallic pipe in hydrogen service
Hydrogen Pipeline Issues

• Materials (cont’d)
  - Liner material for FRP pipe
  - Design analysis method for FRP pipeline system
  - Expected design life of FRP Pipeline
Hydrogen Pipeline Issues

- Public Perspective & Education
  - Common perception of hydrogen
  - Public Education with real information
Research Needs

• Testing of all commonly used pipeline materials for loss of fatigue and impact strength in a high pressure hydrogen environment. Research the effects of pressure cycling on mechanical properties.

• Testing of pipe welds for sustained-load cracking for all commonly used pipeline materials. Review as welded, post weld heat treated and annealed weld performance.
Research Needs

• Determine if FRP pipes with metallic or plastic liners are viable alternatives for metallic pipes. Test joining methods for hydrogen compatibility. Develop a simplified analysis method for these pipes.

• Testing of commonly used plastic pipe materials for compatibility with high purity hydrogen environments. Test bonded and fusion joints for hydrogen resistance
Where Do We Go From Here?

• Near term, the ASME B31.12 Task Group will utilize “Design Factors” to make system design more conservative until actual material test data is available
• Encourage Risk Analysis of converted and new hydrogen pipeline systems
• Impose System Integrity Management using ASME B31.8S as a model
Where Do We Go From Here?

- Require in-service inspection, system maintenance and operator training with qualification for converted and new systems. Reference B31Q (not yet published)
- Review results of material testing programs, operating results and service histories and adjust ASME B31.12 as needed
Where Do We Go From Here?

- Education of the public through a joint effort by DOE in partnership with ASME.