Bulk Hydrogen Storage

Strategic Directions for Hydrogen Delivery Workshop

May 7-8, 2003

Crystal City, Virginia
Main Themes/Caveats

- **Bulk Storage = Anything not on the vehicle**
  - 10’s of Tons -- End use point
  - 50-100 Tons – Terminals/City Gates
  - 1000’s Tons – Between Production Facility and Terminal/City Gate

- Bulk storage requirements less restrictive and different from on-board storage

- Uncertainty about evolution of infrastructure requires multiple pathways to be considered

*Bulk storage is an economic solution to address supply/demand imbalance*
Targets/Objectives

- Hard to quantify – scenario & end-use dependent
- Storage Materials (solid state) and container require different targets
- Cost – Capital, Operating
- Performance – Capacity, Footprint, Leak rates, Safety
Priority Barriers

- 5 Category Headings:
  - Bulk Storage Economics
  - Storage Performance Issues
  - Market and Institutional Issues
  - Storage Devices and Technologies
  - Infrastructure Definition – Interplay of Storage within the “Bigger Picture”

- Lack of Systems Optimization Analysis and Models to permit Optimization

- Leak Detection – will require Sensors, odorants, etc. to address Leaks (Safety Concerns)

- Lack of Codes/Standards to Address End Use Requirements

- Lack of Solid-phase Bulk Storage that is robust and economic (initial cost and life cycle issues)

- Lack of knowledge of $H_2$ interaction in Geologic Formations.
RD&D Needs

Top 6 Categories:
- Advanced Concepts
- Advanced Materials
- Codes & Standards
- Studies & Analyses
- Tools & Techniques
- Demonstration & Testing
RD&D Activities

- Top 6 Activities:
  - Develop Manufacturing Technologies for H.P. Tanks in large numbers of units and low cost.
  - Search for inexpensive solid materials for low pressure storage --- Weight is not a critical design parameter for bulk storage (vs. on-board)
  - Develop new materials to address unique H₂ leakage and Embrittlement Considerations
  - Develop Smart Sensors and odorants to be used for Leak Detection
  - Fund robust Systems Analysis and Modeling Programs to define the R&D Infrastructure Landscape
  - Develop Geologic Storage Technologies and Model H₂ storage in Various Geologic Formations.
“Take home” messages

- **Economics**
  Cost of Storage vis-à-vis a “no storage” infrastructure

- **Safety**
  Leak Detection is a Critical Issue for Safety and to promote Consumer Confidence

- **Lack of Infrastructure Definition**
  The type(s), quantity, operating parameters (pressure ranges, temperatures, cycling, etc.) of Storage will be dictated by the development of the surrounding production, consumption and delivery infrastructure.