Deep Well Injection

Subsurface Technology, Inc.
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- 32 Years of Specialty Well Consulting
  - Permitting, installation and O&M
  - Current FGD and IGCC Projects
  - EOR experience
- Multiple Offices
  - South Bend, IN
  - Houston, TX (corporate)
  - Baton Rouge, LA
- 50 employees
  - Engineers
  - Geologists
  - Scientists
  - Technicians
Well Construction

- Well Bore
- Casing
- Injection Tube
- Packer
- Wellhead
Underground Injection Control
40CFR144 and 146

Safe Drinking Water Act

- Class I-Industrial Waste
- Class II-Oilfield Waste
- Class III-Solution Mining
- Class IV (illegal) – inject above the USDW
- Class V- other
- Class VI- CO\(_2\) (proposed)

**Indiana:**
- DNR oversees Class II
- Others are USEPA direct implementation
- Indiana interested in overseeing the proposed Class VI wells
Proposed CLASS VI

- Several technical workshops
- Public Comment period ended in December 08
- Many uncertainties
- Similar to Class I Hazardous
Class VI Wells
Building on Existing UIC Program Framework

- Site Considerations
- AoR
- Construction
- Operation
- Mechanical Integrity
- Monitoring & Reporting
- Well Plugging and Post-Injection Site Care
Protection of the USDW

• Risks Posed by Injection of CO\textsubscript{2}
  
  - Leaching and Mobilization of Contaminants
  - Changes in Regional Groundwater Flow
  - Movement of Saltier Formation Fluid Upwards
Well Site Considerations

Adequate Receiving and Confining System
  + Sufficient Depth (> 2,625 feet bls*)
  + Seismic history
  + Areal Extent
  + Thickness
  + Porosity and Permeability
  + Compatibility with formation fluids
  + Absence of Vertically Transmissive Geologic or Artificial Features

*below land surface
Target Formations

Potential Storage Capacity

Deep Saline Aquifers    88.6%

Depleted Oil and Gas Reservoirs    4%

Un-mineable Coal Seem    1.5%
Area of Review

- Zone of Endangering Influence (modeling)
- Reservoir Transmissibility
- Injection Rate, Duration, Volume
- Boundary Conditions
- Pressure-Volume-Temperature Behavior
- Injection Depth
- Relative Permeability Effects of Injection into Brine-Filled Reservoir

Corrective Action Plan to address artificial penetrations
Area of Review (cont.)

• Describe plans to delineate the AoR
• Use of Multiphase modeling
• Initial model with application
  – Phased implementation of CAP
• Update with collected data
• Reevaluate AoR
• May require permit amendment
Construction

Follow Class I Lead

- USDW Protection
- Demonstratable Confinement
- Casing - Cement Bond
- Packer placement
- Compatible Well Construction Material
Operation

• Operate within permit limitations

• Continuously Monitor:
  – Annulus
  – Injection Rate
  – Injection Temperature
  – Injection Pressure

• Cease operation if exceedance

• Surface and Down-hole shutoff valves
Reporting

• Monthly Operating Report
  – Permit required parameters
    • Volumes
    • Rates
    • Temperature
    • Pressure

• Annual Testing

• Periodic Re-Permitting?
Mechanical Integrity Test

• Annual
  – Assures casing and cement integrity
  – Confirms injectate location

• After Major Repair
Monitoring

• Plume and Pressure front monitoring
  – Cross wellbore detection
  – First formation above the confining zone
• Surface Air and Soil Monitoring
Monitoring and Reporting (cont.)

- **Internal Integrity**
  - As required by permit
    - Annulus test
    - Casing log

- **External Integrity**
  - Transient Pressure Test
  - Cement bond log
  - Radioactive Tracer Survey
  - CO2 monitoring
Well Plugging and Post Injection Site Care

- Operating Permit
- Financial Assurance
- Updated Cost/Accurance
- Proposed for 50 years
Thank you
Subsurface Technology
800 323 2470