The EPA Class VI GS Rule: Regulation and Implementation

Progress Review Meeting of STAR Grant Researchers

January 7-8, 2013

Washington, DC

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Office of Ground Water and Drinking Water

Washington, DC

U.S. Environmental Protection Agency

Presentation Summary

- UIC Program Background
- Class VI Rulemaking and Requirements
- Class VI Permits
- Implementation of the Class VI Program
- Contact Information

UIC Program Background

- 1974 Safe Drinking Water Act (SDWA; reauthorized in 1996)
  - Federal regulations to ensure protection of Underground Sources of Drinking Water (USDWs) from injection
- USDWs are defined as
  - Any aquifer or portion of an aquifer that contains water that is less than 10,000 ppm total dissolved solids or contains a volume of water such that it is a present, or viable future source for a Public Water Supply System
- The UIC Program regulates injection of *all* fluids – liquid, gas, or slurry (*includes* CO_2)
  - Some natural gas storage, oil and gas production, and hydraulic fracturing fluids w/o diesel are exempted

UIC Well Classification

Well Class	Function	Inventory
Class I	Hazardous industrial and municipal wastes	650
Class II	Fluids related to oil and gas production	151,000
Class III	Solution mining (e.g. salt, uranium)	21,400
Class IV	Shallow hazardous waste – only used for remediation activities	24 sites
Class V	Shallow injection of nonhazardous fluids	500,000 – 650,000 (Estimate – precise inventory is unknown)
Class VI	**Geologic sequestration of carbon dioxide**	**N/A**


EPA
United States Environmental Protection Agency
Office of Water (4606) Washington, DC 20460
EPA 816-H-01-004 Draft May, 2010 www.epa.gov/safewater
Safe Drinking Water Act
Underground Injection Control (UIC) Program
Protecting Public Health and Drinking Water Resources
Class I wells- Isolate hazardous, industrial and municipal wastes through deep injection
Class II wells- Inject oil and gas production wastes
Class III wells- Minimize environmental impacts from solution mining operations
Class VI wells- Minimize environmental impacts from geologic sequestration
NEW
Class V wells- Manage the shallow injection of all other fluids to prevent contamination of drinking water resources
CHEMICAL PLANT
WASTE WATER TREATMENT PLANT
TREATED MUNICIPAL WASTE WATER
HAZARDOUS AND NON-HAZARDOUS INDUSTRIAL WASTES
AVERAGE = 4000 FEET
DRINKING WATER RESOURCES
BASE OF UNDERGROUND SOURCES OF DRINKING WATER
CONFINING FORMATION
BRINE DISPOSAL
OIL & GAS RECOVERY
PRODUCTION WELL*
OIL
ENHANCED RECOVERY
*PRODUCTION WELLS ARE NOT REGULATED BY THE UIC PROGRAM
SALT MINING
URANIUM MINING
URANIUM SOLUTION MINING
SALT SOLUTION MINING
SALT LAYER
*PRODUCTION WELLS ARE NOT REGULATED BY THE UIC PROGRAM
Class IV wells- Prevent ground water contamination by prohibiting the shallow injection of hazardous waste except as part of authorized cleanup activities
HAZARDOUS WASTE
COAL-FIRED POWER PLANT
CO_2 STORAGE
FOOD PROCESSING
FARM HOUSE
AUTOMOTIVE SERVICE STATION
APARTMENT BUILDING
LIGHT INDUSTRY
STREET DRAINAGE
STORM WATER DRAINAGE
INDUSTRIAL WASTE
LARGE-CAPACITY SEPTIC SYSTEMS
100 FEET
In your community, there may be industrial waste disposal wells, storm water drainage wells, large-capacitysептic systems, and other Class V wells. They are regulated and are not allowed to endanger drinking water resources.
Class V wells continued
SOURCE WATER PROTECTION AREA
SCHOOL
AUTOMOTIVE SERVICE STATION
DRINKING WATER PLANT
LARGE-CAPACITY CESSPOOL
MOTOR VEHICLE WASTE DISPOSAL WELL
PUBLIC WATER SUPPLY WELL
All large-capacity cesspools are banned.
New motor vehicle waste disposal wells are banned nationwide.
Existing motor vehicle waste disposal wells in source water protection areas or other sensitive ground water areas must close or receive a permit.
Not drawn to scale

Class VI Rule Development

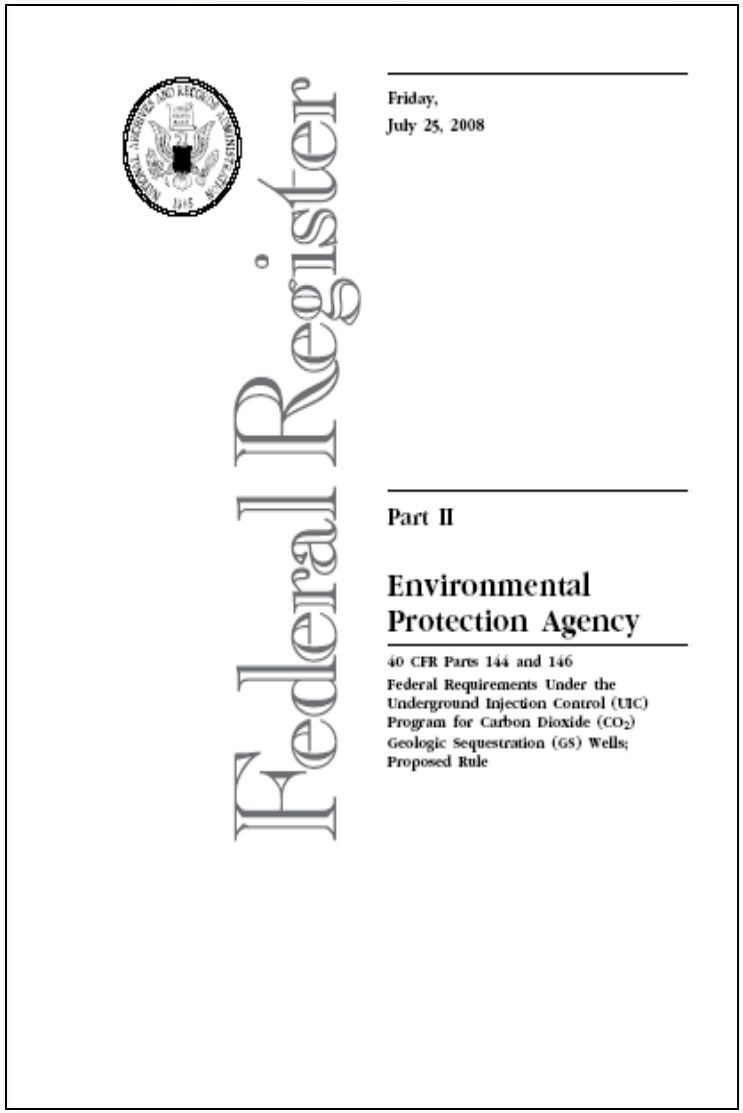
- **Technical Workshop Series (2005-2008)**
  - CO_2 Modeling: Houston, TX (2005)
  - Risk Assessment: Portland, OR (2005)
  - Site Characterization: Berkeley, CA (2006)
  - State Regulators: San Antonio (2007)
  - Well Construction and Mechanical Integrity Testing: Albuquerque, NM (2007)
  - Area of Review: Washington, DC (2007)
  - Measurement, Monitoring, and Verification: New Orleans, LA (2008)

- **Two Stakeholder Meetings (2007 & 2008 in DC Area)**
  - EPA's rulemaking process
  - Technical and implementation challenges

Goals of Rulemaking Process

- First and foremost, ensure protection of USDWs; we are not officially climate change advocates
- Use a clear and transparent process
- Use an adaptive approach that will incorporate new data and GS project information
- Capitalize on EPA, State, and Industry experience with CO2 injection
- Involve, inform, and educate stakeholders including the public

GS Rule Summary



Federal Register

Friday,
July 25, 2008

Part II

Environmental Protection Agency

40 CFR Parts 144 and 146
Federal Requirements Under the Underground Injection Control (UIC) Program for Carbon Dioxide (CO_2) Geologic Sequestration (GS) Wells; Proposed Rule

- **Proposed Rule** for GS of CO_2
  - Announced by Administrator: October 11, 2007
  - Signed by Administrator: July 15, 2008
- **NODA** published in 2009
- **Final Rule** published on December 10, 2010 revises UIC Program to address Geologic Sequestration via Class VI wells

Class VI Rule Overview

Considerations for GS

- Large Volumes
- Buoyancy
- Viscosity (Mobility)
- Corrosivity

New well class established: Class VI

UIC Program Elements

- Site Characterization
- Area of Review (AoR)
- Well Construction
- Well Operation
- Site Monitoring
- Post-Injection Site Care
- Public Participation
- Financial Responsibility
- Site Closure

Tailored GS Class VI Requirements

- Our understanding was not to “reinvent the wheel”
- Class VI builds on existing UIC program criteria and standards for GS of CO_2
- Many requirements were taken from the Class I HW well model but tailored for supercritical nature of injected CO_2

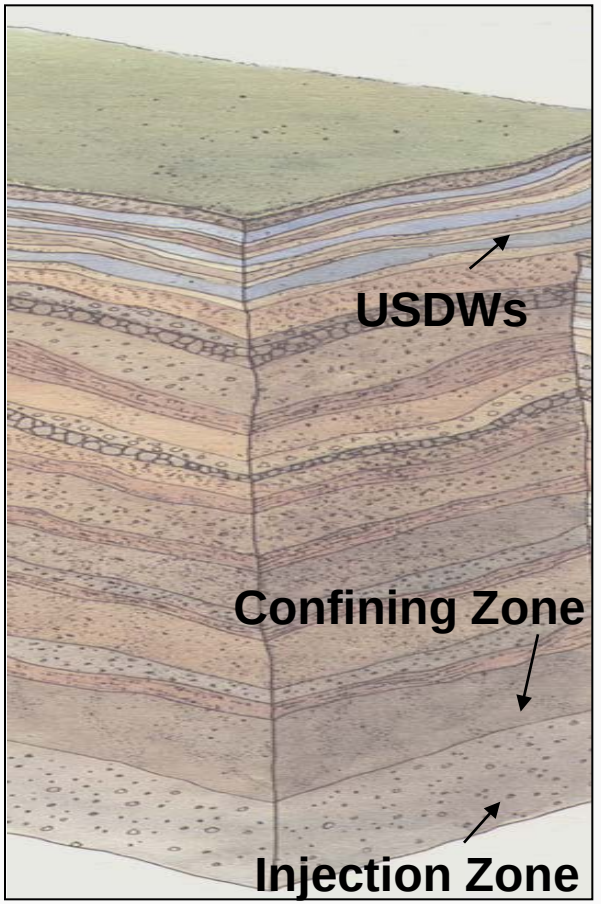
Class VI Unique Requirements

- Tailored and very detailed geologic site characterization requirements (40 CFR 146.82, 146.83 and 146.87)
  - Identification and characterization of injection and confining zone(s)
  - Establish baseline information and comprehensive project information prior to GS project construction and operation

Site Characterization

GS Rule Approach

- Director has discretion to require identification of additional confining zones
- Owners and Operators submit information on the following:
  - Structure and Stratigraphy
  - Seismicity
  - Baseline Geochemistry



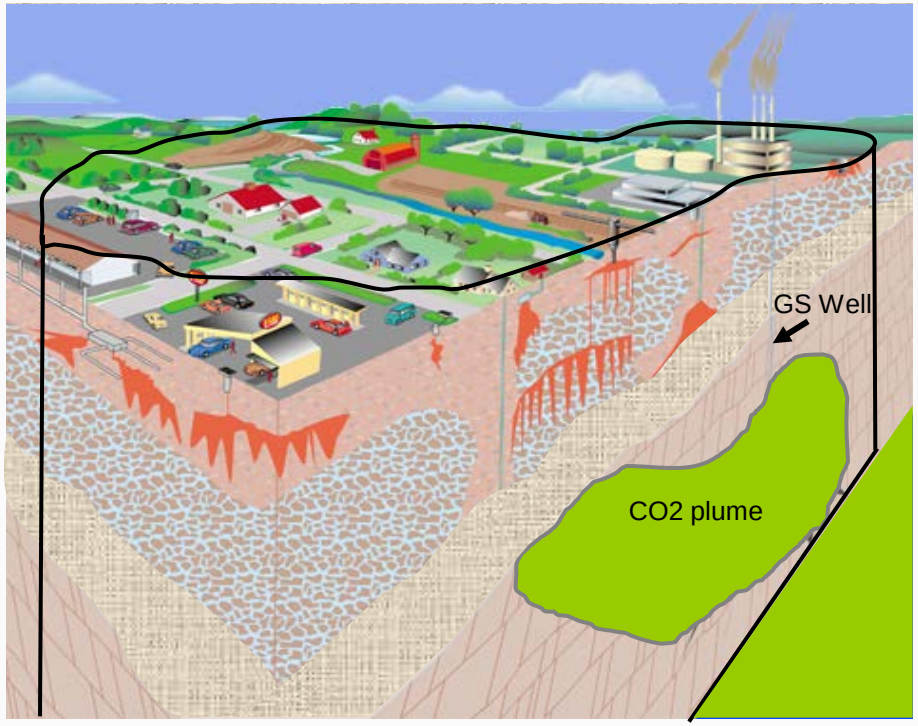
Class VI Unique Requirements

- Periodic re-evaluation of the AoR (40 CFR 146.84)
  - AoR based on computer modeling and must account for injectate and area of elevated pressure over time
  - AoR based on site characterization data and updated as operational and monitoring data is collected
  - AoR must be evaluated every 5 years by UIC Director

Area of Review

GS Rule Approach

- Use computational modeling only
- AoR reevaluation at a minimum of every 5 years
- Use phased corrective action for abandoned wells at Director's discretion



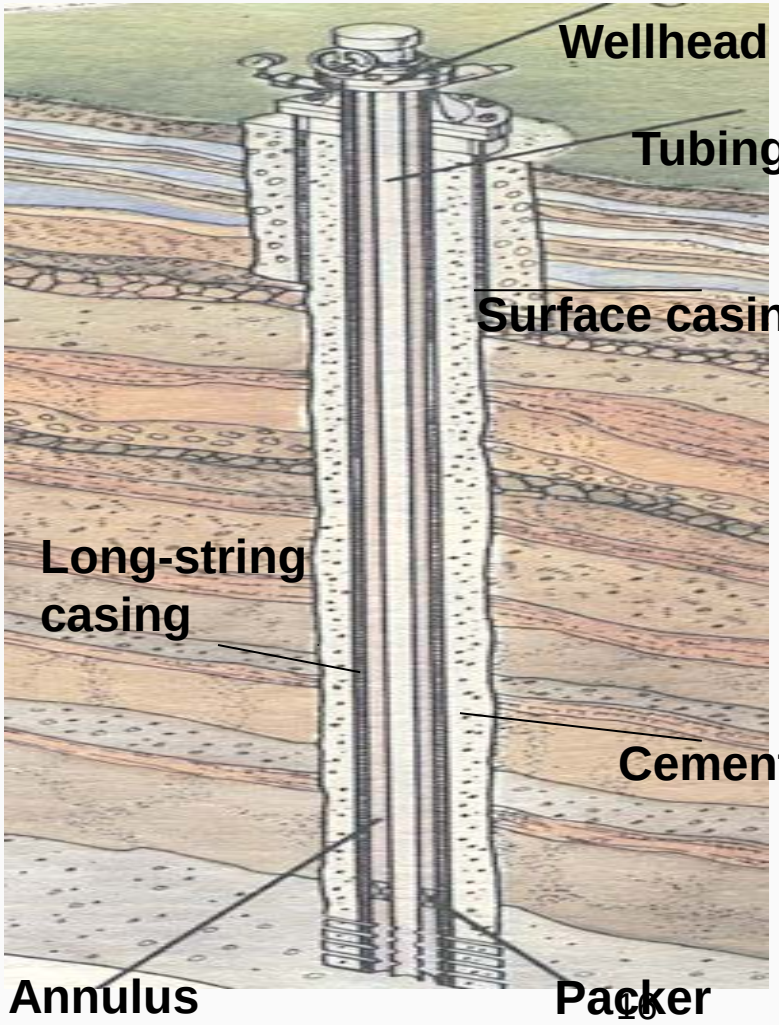
Class VI Unique Requirements

- Establishes specific standards for the construction and operation of Class VI wells (40 CFR 146.81,146.86 and 146.88):
  - Construction with injectate-compatible materials
  - “Grandfather existing well construction (Class I, II, V) at UIC Director’s discretion
  - Site specific operational conditions

Well Construction

GS Rule Approach

- Inject below USDWs
- Long-string casing cemented in place for entire length
- Surface casing through the base of the lowermost USDW and cemented to surface
- Well materials must be compatible with injectate and formation fluids



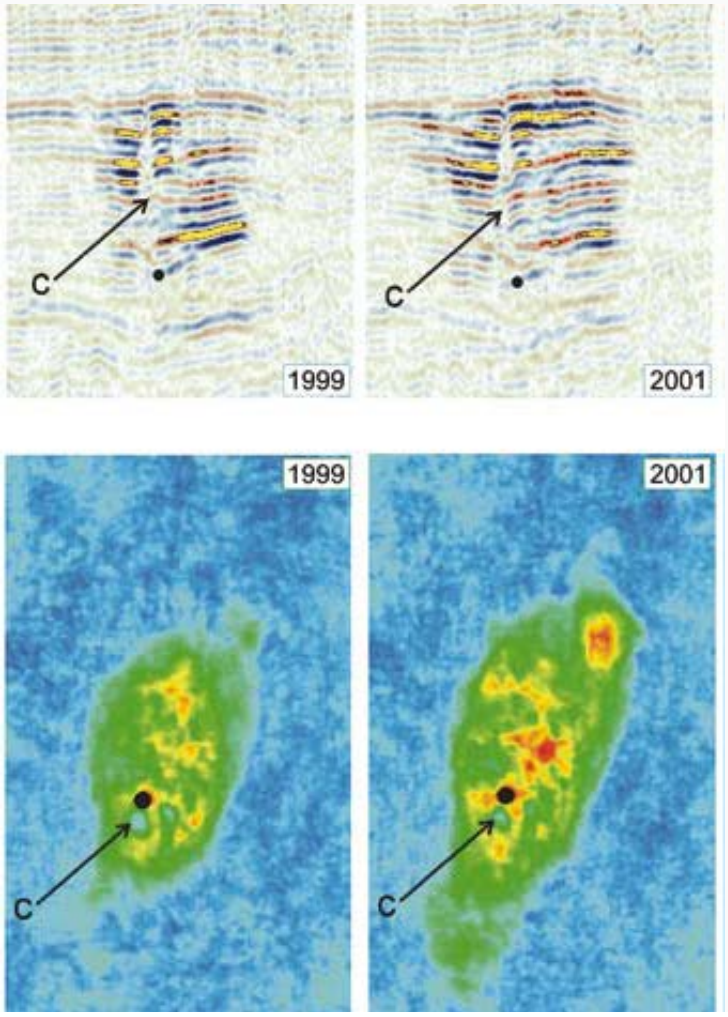
Class VI Unique Requirements

- Requires rigorous testing and monitoring for each GS project (40 CFR 146.88,146.89 and 146.90)
  - Mechanical integrity testing of injection wells
  - Ground water monitoring
  - Tracking location of injected CO_2 plume and elevated pressure

Site Monitoring

GS Rule Approach:

- Determine extent of CO_2 movement and associated area of pressure (pressure front)
- Tracking of the plume and pressure front is required, techniques, frequency, and spatial resolution are not specified
- Tracers are not required
- Surface-air and soil-gas monitoring are at the Director's discretion



Seismic Monitoring Results, Sleipner

Class VI Unique Requirements

- Class VI only by permit with lifetime permit duration:
  - No automatic transfer of permit
  - Area permits are not allowed
  - Permit duration includes post injection monitoring
  - Provisions for transitioning from Class I, II, V
- States may apply for Independent Class VI Primacy

Class VI Unique Requirements

- 5 Specific Project Plans Required with Permit Application:
  - Area of Review and Corrective Action
  - Testing and Monitoring
  - Injection Well Plugging
  - Post-Injection Site Care and Closure
  - Emergency and Remedial Response

Class VI Unique Requirements

- Clarifies and expands financial responsibility (FR) requirements (40 CFR 146.85)
  - FR for all phases and for the life of the GS project
  - Expanded requirements ensure funds are available for:
    - Project Operation
    - Corrective Action
    - Well Plugging
    - Emergency and Remedial Response (ERR)
    - Post Injection Site Care and Site Closure

Class VI Unique Requirements

- Injection depth waiver for Class VI wells (40 CFR 146.95)
  - Available to O/O applying for permit to inject in saline fms. above USDWs or between USDWs
  - Additional requirements to ensure protection of USDWs above and <u>below</u> the injection zone
  - Accommodates varied geologic settings and uses avaliable GS capacity at range of depths

Class VI Unique Requirements

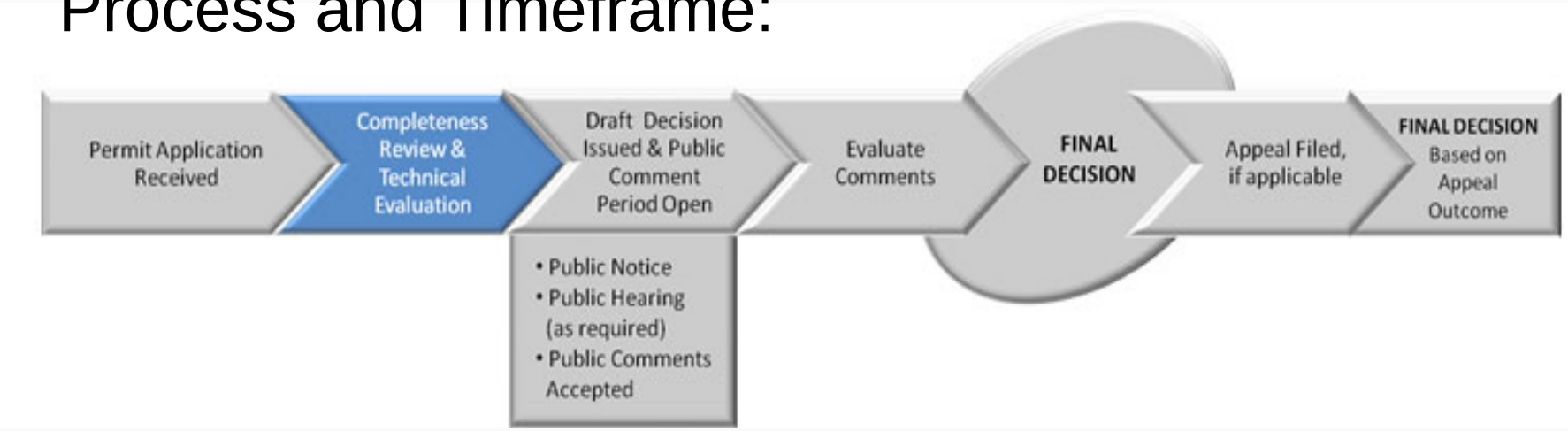
- Post Injection Site Care monitoring and site closure (146.93)
- Class V for GS prohibited, unless truly and experimental technology well
- Includes considerations for wells transitioning from Class II to Class VI (40 CFR 144.19)

Class VI Requirements: 40 CFR 146.82 – 146.95

- 146.82: Required Class VI permit information
- 146.83: Minimum criteria for siting
- 146.84: Area of Review and corrective action
- 146.85: Financial Responsibility
- 146.86: Injection Well Construction
- 146.87: Logging, Sampling, and Testing (prior to operation)
- 146.88: Injection Well Operation
- 146.89: Mechanical Integrity
- 146.90: Testing and Monitoring
- 146.91: Reporting and Recordkeeping
- 146.92: Injection Well Plugging
- 146.93: Post-Injection Site Care and Site closure
- 146.94: Emergency and Remedial Response
- 146.95: Injection Depth Waiver requirements

Class VI Permitting

Process and Timeframe:



- 40 CFR 146.82
- Iterative and flexible
- Accommodates new information
- *Remember: This is a new process for everyone*

Permit Applications

- Region 5:
  - Archer Daniels Midland: Decatur, Illinois
    - Two Class VI permit applications (CCS #1 and #2) received in December and July 2011, respectively
    - Injection formation: Mount Simon sandstone
    - Proposed injection volume and duration: approximately 4.75 million tons of CO_2 over 5 years
  - Tenaska: Taylorville, Illinois
    - Two Class VI permit applications received in September 2011
    - Proposed injection volume and duration: 63 million tons of CO_2 over 30 years

Project Discussions

- Region 5:
  - FutureGen 2.0: Illinois
    - Proposed injection formation: Mount Simon sandstone
    - Proposed injection volume: ~1.3 million tons/year
    - Proposed injection duration: ~30 years

Project Discussions

- Region 7:
  - Wellington, Kansas
    - Proposed formation: Arbuckle
    - Proposed injection volume: 40,000 tons saline + 30,000 for EOR
    - Proposed project duration: TBD
- Region 8:
  - Big Sky: Kevin Dome, Montana
    - Proposed injection formation: Kevin Dome
    - Proposed injection volume: 1 million tons
    - Proposed project duration: 8 year project

Class VI Implementation

- Currently, EPA HQ is providing extensive one-on-one assistance to Regions, permit applicants, and states on:
  - AoR delineation and modeling
  - Model-based post-injection site care timeframe determinations
  - Financial responsibility demonstrations
  - Injection well design and construction
  - Project plan development
  - Permit application information submittals and reviews
  - Permit condition development assistance

Class VI Guidance Documents

The final Class VI Rule identified technical guidance documents needed to facilitate safe, effective Class VI permitting and GS injection. Guidance documents focus on:

- Financial Responsibility
- Well Construction
- Project Plan Development
- Site Characterization
- Area of Review Evaluation and Corrective Action
- Testing and Monitoring
- Reporting
- Primacy
- Implementation
- Well Plugging, Post-Injection Site Care (PISC), and Site Closure
- Class II – Class VI Transition
- Injection Depth Waivers
- Recordkeeping

Status of Guidance Documents

- Released and Final:
  - Financial Responsibility (July 2011)
  - Well Construction (August 2012)
  - Project Plan Development (September 2012)

- Soon to be released as final documents:
  - Site Characterization
  - Area of Review Evaluation and Corrective Action
  - Testing and Monitoring
  - Primacy Manual
  - Implementation Manual

Status of Guidance Documents (cont.)

- Soon to be released for public comment:
  - Class II to Class VI Transition *DRAFT*
  - Well Plugging, Post-Injection Site Care and Site Closure *DRAFT*
  - Injection Depth Waivers *DRAFT*

- Future release of *draft* documents for public comment:
  - Reporting
  - Recordkeeping

Class VI Well Construction Guidance

- Contains information on requirements for:
  - Injection well construction (40 CFR 146.86)
  - Logging, sampling, and testing of injection wells (40 CFR 146.87)
  - Injection well operation (40 CFR 146.88)
  - Mechanical Integrity testing (40 CFR 146.89)
- Affords flexibility in:
  - Selection of well construction materials
  - Well design (e.g., staging cement; use of multiple surface casing strings)
  - Logging and mechanical integrity testing techniques

Flexibilities Addressed in Guidance

- Selection of injection site, formation type, and injection depth
- Use of *any* of a suite of computational, multi-phase fluid flow and transport modeling tools for AoR delineation
- Use of phased corrective action
- Selection of financial instruments for various phases of GS projects (e.g., operation, PISC)
- Demonstration and duration of the PISC timeframe
- Selection of monitoring technologies for plume and pressure front tracking and USDW protection

More on Class VI Implementation

- GS Data System development:
  - Alternatives Analysis Completed in January 2012
  - Management decisions will influence next steps
  - Currently collaborating with GWPC and DOE on GSDS phased development

- Continue Coordination with:
  - EPA Program Offices (OAR and OSWER) and Regions
  - State and Federal partners
  - Non-governmental organizations
  - Industry and other stakeholders
  - CCS Presidential Task Force Offices

Class VI Primacy for States

- Since Sept. 2011, EPA has been directly implementing the Class VI GS Program
- EPA is working with ~ 10 States seeking Class VI primacy
- There are several states (i.e. ND, LA, MS) that are preparing to submit primacy approval or revision packages in 2013

Additional Information

- Contacts
  - Regional UIC (Class VI) Program Directors
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  - Sherri Comerford, comerford.sherri@epa.gov
- References
  - http://water.epa.gov/type/groundwater/uic/wells_sequestration.cfm
  - http://www.gpo.gov/fdsys/pkg/FR-2010-12-10/pdf/2010-29954.pdf
  - http://www.gpo.gov/fdsys/pkg/FR-2011-09-15/pdf/2011-23662.pdf