

US EPA ARCHIVE DOCUMENT

## STATEMENT OF BASIS

**U.S. ENVIRONMENTAL PROTECTION AGENCY, REGION 9  
DRAFT CLASS V EXPERIMENTAL UNDERGROUND INJECTION CONTROL PERMIT  
# AZ50800004 TO THE ARIZONA PUBLIC SERVICE COMPANY  
NAVAJO COUNTY, ARIZONA**

**Location:**

Arizona Public Service Company  
Cholla Power Plant  
4801 Frontage Road  
Joseph City, AZ 86032

**Permittee Contact:**

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**I. Purpose of the Statement of Basis**

The U.S. Environmental Protection Agency, Region 9 (EPA) has prepared this Statement of Basis for the draft permit to be issued to the Arizona Public Service Company (APS). Pursuant to the Underground Injection Control (UIC) regulations in Title 40, §124.7 of the Code of Federal Regulations (CFR), the purpose of the Statement of Basis is to briefly describe the derivation of the permit conditions and the reasons for them. To meet these objectives, this Statement of Basis contains background information on the permit process, a description of the project, a brief discussion of the permit conditions, and the reasons for these permit conditions.

**II. Permit Process**

The EPA Water Division Director has authority to issue permits for underground injection activities under 40 CFR §144.31. APS submitted an application to the EPA on August 7, 2008, for a UIC permit. The APS's application proposed to conduct a pilot test to evaluate the geologic storage of

carbon dioxide (CO<sub>2</sub>) with the overall goal being to gain practical experience with and demonstrate the potential for safe CO<sub>2</sub> storage in deep underground geologic formations in a location with large CO<sub>2</sub> sources, such as the Cholla Power Plant, and large CO<sub>2</sub> storage potential. In consideration of EPA UIC Program Guidance No. 83, (titled "Using the Class V Experimental Technology Well Classification for Pilot Geologic Sequestration Projects," March 1, 2007), and due to the experimental nature of APS's proposed pilot test, EPA has classified the proposed UIC well as a Class V experimental injection well.

On September 10, 2008, EPA notified APS that their application was administratively complete. Following this, EPA conducted a technical review of the application. Based on the technical review, EPA drafted a Class V Experimental UIC permit that would authorize one injection well for injection of approximately 2,000 metric tons of at least 99.5% pure CO<sub>2</sub> into either the Martin Formation (in the Mississippian and Devonian carbonates) or the Naco Formation beneath the confining Supai Formation, whichever demonstrates that it meets permit requirements. The draft permit contains construction, operation, maintenance, monitoring, reporting, and abandonment requirements.

Based on our review of the proposed well construction, operation standards, monitoring requirements, and the existing geologic setting, EPA believes the activities allowed under the proposed draft permit are protective of Underground Sources of Drinking Water as required by the Safe Drinking Water Act.

#### *Public Participation*

The public has thirty (30) days to review and comment on the draft Class V UIC permit (40 CFR §124.10). The draft permit, this Statement of Basis, and APS's permit application are available at the following locations:

Holbrook Public Library  
403 Park St.  
Holbrook, AZ 86025  
(928)524-3732

U.S. Environmental Protection Agency, Region 9  
Ground Water Office  
Attn: Nancy Rumrill, Mail Code: WTR-9  
75 Hawthorne Street  
San Francisco, CA 94105  
(415) 972-3293

The draft permit and Statement of Basis are also available on the EPA Region 9 web page:

<http://www.epa.gov/region09/water/groundwater/uic-permits.html>

The public comment period begins on February 11, 2009 and ends on March 13, 2009. During this period, all written comments on the draft permit can be mailed, faxed, or e-mailed to Nancy Rumrill

using the contact information listed on the first page of this Statement of Basis. Ms. Rumrill is also available by phone to address any questions regarding the permit process or the draft permit.

### **III. Description of Project**

The injection project is a CO<sub>2</sub> storage pilot test proposed by the Arizona Public Service (APS) Company, the Lawrence Berkeley National Laboratory, and a Department Of Energy (DOE)-funded research consortium called West Coast Regional Carbon Sequestration Partnership (WESTCARB). WESTCARB consists of western US universities, agencies, and industry partners investigating CO<sub>2</sub> sequestration. APS will own the test well, but DOE is funding the project through the WESTCARB partnership for research to test and monitor CO<sub>2</sub> injection into a deep underground rock formation. The research project site is located near the Cholla Power Plant between Holbrook and Joseph City, Navajo County, AZ, immediately north of Interstate 40 (on property owned by APS).

The project entails drilling and constructing one injection well for the CO<sub>2</sub> storage pilot test. The proposed well is an experimental technology well to allow WESTCARB to gather information on the geology and suitability of the location for sequestration of CO<sub>2</sub>. The injection of CO<sub>2</sub> is one step in “Carbon Capture and Storage”, an experimental technology being evaluated as a method to reduce emissions of greenhouse gases into the atmosphere.

For the test, 2,000 metric tons of CO<sub>2</sub> (at least 99.5% pure) as a gas will be injected into the completed well. As the CO<sub>2</sub> injectate proceeds down the injection well, the CO<sub>2</sub> gas will undergo a phase change to a liquid due to pressure and temperature changes below ground surface. The target injection zone will be at an approximate depth of 3,500 to 4,000 feet and is expected to contain highly saline formation water. The actual injection duration is expected to be less than three weeks whereas monitoring of the CO<sub>2</sub> plume in the formation will continue for three to five months after the end of CO<sub>2</sub> injection.

The 2,000 metric tons of CO<sub>2</sub> used in the test is the amount of CO<sub>2</sub> generated by a typical 1,000-megawatt coal-fired power plant in approximately 2.2 hours. The pilot-scale project will test the injectivity of this relatively small amount of CO<sub>2</sub> into the geologic formation, test numerical modeling codes that estimate the growth and extent of the CO<sub>2</sub> plume, measure changes in water chemistry within the formation, and test methods for monitoring the location of the CO<sub>2</sub> plume to demonstrate and estimate the amount of the injected CO<sub>2</sub> that dissolves in the reservoir water or becomes immobilized in the formation. Modeling simulations predict that the CO<sub>2</sub> plume will become immobilized (or dissolved) within a few months after the end of injection. Upon completion of the testing, the injection well will be plugged and abandoned in accordance with rules adopted by the Arizona Oil and Gas Conservation Commission.

Research results of this small-scale project will add critical data to our scientific understanding and help to more accurately predict the effectiveness of large-volume CO<sub>2</sub> sequestration. In addition, it is expected that the results will promote greater public awareness and understanding of future full-scale projects. An important goal of pilot projects such as this one is to gather, evaluate, and share data on appropriate technologies and approaches for CO<sub>2</sub> injection. The capture and injection of CO<sub>2</sub> produced by human activities for long-term storage is one of a

portfolio of options that can reduce CO<sub>2</sub> emissions to the atmosphere and help to mitigate climate change.

#### **IV. Brief Summary of Specific Permit Conditions**

The conditions specified in the draft permit are for the construction and operation of the injection well, monitoring, reporting, and plugging and abandonment of the well. The following summary briefly describes the permit conditions and the reasons for them. These conditions will ensure the protection of Underground Sources of Drinking Water (USDW), while advancing the WESTCARB research objectives.

##### Well Construction and Site Geology

Two injection zones were identified in the permit application as possible injection targets, a primary target and a secondary target in the case where the primary target does not meet project objectives. The deeper Martin formation will be tested first, and if the zone meets regulatory and operational requirements, the well will be completed at that depth. Alternatively, the Naco formation overlying the Martin formation is the secondary target. As the secondary target, the Naco formation will be tested if the primary target does not meet requirements. If the Martin formation is not suitable and the Naco formation meets regulatory and operational requirements, the well will be completed at the shallower depth.

The draft permit allows injection well drilling, testing, construction, or operation to commence after written approval from EPA.

Well design specifications in the draft permit include a Conductor casing (13-3/8 inch diameter) to approximately 25 feet below ground surface (bgs), Surface casing (9-5/8 inch diameter) from ground surface to approximately 950 ft bgs, Long String casing (5-1/2 inch diameter) from ground surface to approximately 3,985 feet bgs, and tubing (2-3/8 inch diameter) from the surface to approximately 3,645 ft bgs at the top of the primary target injection zone of the Martin Formation. The conductor pipe, surface casing, and long string casing are all designed to be cemented to the surface. The injection apparatus additionally includes the installation of a 5-1/2 inch by 2-3/8 inch inflatable packer or equivalent. The completed well schematic is included in Appendix B of the draft permit. The Permittee will follow this planned construction to case and cement the injection well which allows several layers of protection to prevent the movement of fluids into or between any USDW.

The Martin formation is expected to occur at depths estimated from about 3,445 feet to about 3,645 feet bgs, providing a 200-foot injection interval. Alternatively, the Naco formation, at depths estimated from about 2,945 feet to about 3,445 feet bgs would provide a 500-foot interval. Minor alterations of the depths of injection zone intervals and, therefore, the casing setting depths are expected to be realized upon drilling. EPA considers these alterations and other rework operations that may occur later in the course of operation of the well to be minor for the proposed permit, but EPA requires in the draft permit that these changes to be properly reported using EPA Form 7520-12.

EPA also includes in the draft permit procedures for drilling, work-over, and plugging to comply with the Arizona Oil and Gas Conservation Commission requirements of the Arizona Administrative Code. The proposed drilling procedures were submitted with the permit application and incorporated into the draft permit as Appendix C, and shall be binding on the Permittee to the extent that the basic construction scheme is accurate pending the exact depths of the targeted geology encountered during the drilling process. EPA will consider changes to the construction plans during construction minor modifications provided that the Permittee notifies and receives approval from EPA, and that the changes comply with the requirements of 40 CFR §§144 and 146.

EPA's draft permit also requires logs and other tests to be conducted during drilling and construction. These include, at a minimum, deviation checks, cased-hole logs, and injection formation tests. An outline of the permittee's proposed testing program submitted with the application is provided in Appendix C of the draft permit. The draft permit also requires open hole logs, including mud cuttings logs over the entire open hole sequence.

EPA will require injection formation information to be determined through well logs and tests and shall include a characterization of porosity, permeability, static formation pressure, and effective thickness of the injection zone. A step-rate test (SRT) will be conducted using formation water before injection is authorized, to establish maximum injection pressure.

Groundwater testing will be required during construction of the wells and shall include well logs and Total Dissolved Solids (TDS) analysis of target formation water to demonstrate either the presence and characteristics of, or the lack of, any USDW. The Permittee will also be required to collect Coconino aquifer water samples from Monitoring Well W-125 to confirm protection of the USDW. Well W-125, an existing monitoring well, is located 1,800 feet cross-gradient of the proposed injection well at a depth of 140 feet. Arizona Department of Environmental Quality proposed the location for sampling because it is between the proposed injection well and the nearest user of the drinking water aquifer.

The draft permit requires field information on the confining layer, the Supai formation, such as its characteristics, its thickness and its local structure to be obtained during drilling of the injection well. The Supai formation is expected to be approximately 2,000 feet thick and comprised of sediments, such as siltstone, mudstone, and evaporite minerals. Field information will be used to confirm that the confining layer is an effective seal that prevents upward migration of the CO<sub>2</sub> injection fluids.

#### Corrective Action

Corrective action in accordance with 40 CFR §§144.55 and 146.7 is a consideration for existing wells in the Area of Review, a ¼-mile radius around the proposed site, that penetrate the injection zone, or which may otherwise cause movement of fluids into USDWs. Based on information provided in APS's application, EPA determined that no corrective action plan is necessary, because no known wells located within the Area of Review penetrate the proposed zones of injection.

### Well Operation

After all casings are set and cementing is complete, the draft permit requires a spherically focused cement bond evaluation log to be run over the course of the entire cased-hole sequence to check for adequate cement bonding. Prior to receiving authorization to inject, the draft permit requires that the Permittee conduct mechanical integrity (MI) testing, step-rate testing, and injection zone parameter testing. The draft permit requires mechanical integrity testing as specified and also when EPA determines that such testing is justified to ensure that injection fluids are properly contained. Mechanical integrity must be demonstrated by means of an annular pressure test in the tubing/casing annulus, an evaluation of cement integrity in the casing/borehole annulus, and sufficient results from temperature logs and radioactive tracer testing, or other procedures as approved by EPA.

Maximum allowable injection volume and injection pressure limitations are subject to results of testing required under the draft permit. The draft permit will require a maximum injection pressure to ensure that the injection well will be operated below fracture pressure so as to not initiate or propagate physical fractures in the rock formation. Operating well below fracture pressure is also important to the WESTCARB research of the suitability of the site for CO<sub>2</sub> sequestration. A maximum injection pressure as measured at the bottom of the well or at the surface will be calculated based on the formation test data and incorporated into the proposed permit.

Injection fluids authorized by the draft permit will be limited to only food-grade CO<sub>2</sub> of at least 99.5% CO<sub>2</sub> by volume with small amounts of other gases. In addition, small quantities of krypton, xenon, and sulfur hexafluoride are allowed to be added to the injected CO<sub>2</sub> as tracers for the study of the movement of the CO<sub>2</sub>.

### Monitoring, Record Keeping, and Reporting

The draft permit will require the Permittee to continuously monitor injection rate, daily and total injection volume, injection pressure, annular pressure, and injection fluid temperature, as well as to keep various records and provide quarterly reports to EPA. The Permittee will share research results with EPA.

### Well Plugging and Abandonment

Upon completion of the pilot test, the injection well will be plugged and abandoned in accordance with rules adopted by the Arizona Oil and Gas Conservation Commission. The Plugging and Abandonment Program submitted as Attachment Q to the Permittee's permit application, and consistent with Arizona Oil and Gas Conservation Commission requirements and 40 CFR §146.10, has been incorporated into the draft permit in Appendix F.

In the draft permit, the Permittee is required to abandon the injection well according to the Plugging and Abandonment Plans submitted and incorporated into the permit. EPA reserves the right to change the manner in which a well will be plugged if the well is modified during its

permitted life or if the well is not consistent with EPA requirements for construction or mechanical integrity.

#### Financial Responsibility

Authority to drill and construct any well is not granted until financial resources sufficient to properly close, plug, and abandon the well are made available by a permit applicant. For this project, EPA has determined that the requirements for Financial Responsibility imposed under the Arizona Department of Environmental Quality's permitting program have been met by the Permittee, and that those requirements satisfy the EPA requirements. For purposes of the injection activity as authorized under this draft permit, EPA is not requiring duplicate submission of Financial Responsibility.

#### Duration of Permit

The permit and the authorization to inject would be issued for a period of one (1) year unless terminated under the conditions set forth in Part III, Section B.1 of the draft permit. EPA considered the duration of the permit to be set at a reasonable amount of time necessary to cover the estimated timetable of the research goals of the project. Currently, the Permittee does not have a plan to use the injection well past the research life of the well. However if circumstances changed, the proposed permit could be modified or reissued to extend the timetable or alter the goal of the permit in compliance with public notice and participation requirements in 40 CFR §124.