UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105-3901

Mr. Conrad Spencer, Plant Manager
Cholla Power Plant
P.O. Box 188, MS 7668
Joseph City, Arizona 86032

Re: Class V Experimental Injection Well Permit No. AZ50800004
Arizona Public Service Company, Cholla Power Plant

Dear Mr. Spencer:

This letter is to inform you that the enclosed permit was issued by the United States Environmental Protection Agency, Region IX (EPA) for a period of one (1) year beginning on March 19, 2009. The comment period for the subject permit closed on March 13, 2009. EPA's Ground Water Office received no comments on the draft permit during the public comment period and, accordingly, no changes to the draft permit were made.

Any underground injection activities at Arizona Public Service Company, Cholla Power Plant must adhere to all permit conditions. Please note that there are several permit conditions that must be addressed before authorization to construct or operate is granted. Please call Nancy Rumrill at (415) 972-3293 if you have any questions regarding this letter, the permit, or any other Underground Injection Control Program issue.

Sincerely,

David Albright
Manager, Ground Water Office
Date March 19, 2009

Enclosure

Cc w/enc: Michele Robertson, Arizona Department of Environmental Quality
John Beyer, Lawrence Berkeley National Laboratory

United States Environmental Protection Agency
Underground Injection Control Program

FINAL PERMIT

Class V Experimental Injection Well

Permit No. AZ50800004

Arizona Utilities CO_2 Storage Pilot Test

Cholla Power Plant

Navajo County, Arizona

Issued to:

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

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Part I. AUTHORIZATION TO OPERATE AND INJECT

Pursuant to the Underground Injection Control (UIC) regulations of the U.S. Environmental Protection Agency (EPA) codified at Title 40 of the Code of Federal Regulations (CFR), §§124, 144, 145, 146, 147, and 148,

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

is hereby authorized, contingent upon Permit conditions, to construct and operate a Class V Experimental injection well. The proposed well is to be located in Section 30, Township 18N, Range 20E. Exact location of the proposed well will be established and approved as outlined within this permit.

EPA will grant authorization to inject after the requirements of Part II Sections A-C of this permit have been met. Operation of the well will be limited to maximum volume and pressure as stated in this permit. Total amounts must not exceed specified limits.

If approved, injection will be authorized 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. This well is to be completed for the purpose of injecting approximately 2,000 metric tons of food-grade CO_2 over an expected duration of 14-20 days to allow the West Coast Regional Carbon Sequestration Partnership to gather information on the geology and suitability of the location for sequestration of CO_2.

All conditions set forth herein are based on Title 40 §§124, 144, 145, 146, 147 and 148 of the Code of Federal Regulations.

This permit consists of **twenty-five (25) pages** plus the appendices, and includes all items listed in the Table of Contents. Further, it is based upon representations made by Arizona Public Services Company (Permittee) and on other information contained in the administrative record. It is the responsibility of the Permittee to read, understand, and comply with all terms and conditions of this permit.

This permit and the authorization to construct, test, and inject are issued for a period of one (1) year unless terminated under the conditions set forth in Part III, Section B.1 of this permit.

This permit is issued and becomes effective on 19 March 2009.

Alexis Strauss

Alexis Strauss, Director
Water Division, EPA Region IX

Part II. SPECIFIC PERMIT CONDITIONS

Prior to each demonstration required in the following sections A through C, the Permittee shall submit plans for procedures and specifications to the U.S. Environmental Protection Agency Region IX Ground Water Office ("EPA") for discussion and approval. The submittal address is provided in Section D, paragraph 5. No demonstration in these sections may proceed without prior written approval from EPA. The Permittee shall submit results of each demonstration required in this section to EPA within sixty (60) days of completion.

A. WELL CONSTRUCTION

1. Requirement for Prior Written Permission to Drill, Test, Construct, or Operate

   (a) Financial Assurance

   The Permittee has supplied evidence of financial assurance prior to commencing Injection Well Drilling and Construction, a requirement of the UIC program regulations. See Section F of this part.

   (b) Pre-notification

   After approval for any of the approved field demonstrations is provided, notification to EPA at least 30 days prior to performing the demonstration is required, to allow EPA to arrange to witness if so elected.

2. Location of Injection Well

   The injection well authorized under this permit will be located on the Arizona Public Service Company Cholla Power Plant property east of the fly ash pond, near Joseph City, Arizona. The proposed location for the well is found in Appendix A.

   (a) Prior to drilling the well, the Permittee must submit proposed field coordinates (Section, Township, Range, with latitude/longitude in decimal format) for the well.

   (b) After drilling is completed, the Permittee must submit final field coordinates (Section, Township, Range, with latitude/longitude) of the well constructed under this permit with the Final Well Construction Report required under paragraph 11 of this section. If final well coordinates differ from the proposed coordinates

submitted under paragraph (a), justification and documentation of any communication with and approval by EPA shall be included.

3. Information and Data Collection during Drilling and Construction

Two injection zones were identified in the permit application as possible 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 Naco formation meets regulatory and operational requirements, the well will be completed at the shallower depth. The Proposed Well Schematic submitted with the application is hereby incorporated by reference into this permit as Appendix B.

Logs and other tests conducted during drilling and construction shall include, at a minimum, deviation checks, cased hole logs, and injection formation tests as outlined in 40 CFR §146.12(d). An outline of the permittee's proposed testing program submitted with the application is provided in Appendix C of this permit. Open Hole logs, including mud cuttings logs, shall be conducted over the entire open hole sequence.

4. Injection Formation Testing

Injection formation information for the well, as described in 40 CFR 146.12 (e), shall be determined through well logs and tests and shall include porosity, permeability, static formation pressure, and effective thickness of the injection zone. A summary of results shall be submitted to EPA with the Final Construction Report required in paragraph 11 of this section.

(a) Ground Water Testing and Information Gathering

During construction of the well, information relating to ground water at the site shall be obtained and submitted to EPA. This information shall include direct Total Dissolved Solids ("TDS") analysis of target injection formation water to demonstrate either the presence and characteristics of, or the lack of, any Underground Sources of Drinking Water ("USDW" as defined in 40 CFR §§144.3, 146.3). Permittee shall also analyze water samples from the Coconino Aquifer obtained from offset Well 125.

(b) The Permittee shall provide well logs and representative ground water sample analyses from the targeted injection aquifer using method(s) approved in advance by EPA as evidence. These analyses shall be sufficient to confirm compatibility of the injectate with the injection formation.

(i) EPA may require minor alterations to the construction requirements based upon the information obtained during well drilling and related operations if the proposed casing setting depths will not completely cover the base of the USDWs and the confining formation located immediately above the injection zone.

(ii) The Permittee may produce water from the saline injection interval, filter it, and then use it for the step-rate injectivity test. Rhodamine dye may be added to the reinjected water.

(c) Step-Rate Test ("SRT")

The SRT will be conducted on the well before injection is authorized, to establish maximum injection pressure. Refer to Society of Petroleum Engineering ("SPE") paper #16798 for test design and analysis. The SRT will be used to establish the injection pressure limitation, in accordance with section C, paragraph 3 of this part. Permittee must submit detailed plans for conducting the SRT allowing sufficient time for EPA review and approval before the SRT will be allowed to be conducted.

(i) Prior to testing, shut in the well long enough so that the bottom-hole pressure approximates shut-in formation pressure.

(ii) Measure pressures with a down-hole pressure transducer to measure bottom hole injection pressure and synchronize with data from a surface injection pressure recorder. Data sampling rate must be sufficient to allow observation and analysis of the pressure transient behavior during each stepped rate as well as the final pressure falloff (see item (v)).

(iii) Use equal-length time step intervals throughout the test; these should be sufficiently long to overcome well bore storage and to achieve radial flow. Typically, use at least thirty (30) minute intervals.

(iv) Record at least five (5) time steps (data points on pressure vs. flow plot) before reaching the anticipated maximum pressure.

(v) At the end of the test, shut down pumps and record the instantaneous shut in pressure and the falloff.

(vi) Permittee shall report the results to EPA within 45 days of conducting the SRT. The results shall include analyses of the pressures versus rate and the transmissivity for the stepped rates throughout the SRT by analyzing the pressure transient data.

5. Drilling, Work-over, and Plugging Procedures

Drilling, work-over, and plugging procedures must comply with the Arizona Oil and Gas Conservation Commission of the Arizona Administrative Code, found in Title 12, Natural Resources, Chapter 7, Article I, R12-7-108 to R12-7-127. The proposed drilling procedures submitted with the permit application are hereby incorporated into this 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. Changes to the construction plans during construction are considered 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 (40 CFR §144.41(f)). Drilling procedures shall also include the following:

(a) During drilling through the Regional C-Aquifer, the permittee will add a small quantity of Optitrak 600 blue dye to the drilling mud so that when water samples are obtained, the amount of mud filtrate in the samples can be determined.

(b) During drilling through the primary injection interval, the permittee will add fluorescein fluorescent dye to the drilling mud.

6. Casing and Cementing Specifications

Notwithstanding any other provisions of this permit, the Permittee shall case and cement the well to prevent the movement of fluids into or between USDWs. Cement evaluation analyses shall be performed as described in Section C paragraph 2(a)(iv) of this part. Casings shall be maintained throughout the operating life of the well. The following approximate specifications from the permit application apply to the proposed well:

(a) Conductor casing: 13-3/8 inch outside diameter ("OD") (48 lb/ft, Grade H-40) from ground surface to approximately 25 feet below ground surface ("bgs"), cemented to surface.

(b) Surface casing: 9-5/8 inch OD (36 lb/ft, Grade J-55) from ground surface to approximately 950 feet bgs, cemented to surface.

(c) Long String Casing: 5-1/2 inch OD (15.5 lb/ft, Grade J-55) from ground surface to approximately 3985 feet bgs, cemented to surface.

7. Tubing and Packer Specification

Injection will take place through tubing strings and packer, subject to the following approximate specifications from the permit application:

(a) Tubing: 2-3/8 inch OD (4.7 lb/ft, Grade J-55) from ground surface to approximately 3,645 feet bgs.

(b) Packer: Proposed 5-1/2 inch by 2-3/8 inch inflatable packer or equivalent set at approximately 3,445 feet (approximately 10 ft above the uppermost perforations in the Martin Formation). If the secondary target formation is used, the perforations in the Martin Formation will be cemented shut, and the packer set at a shallower depth in the Naco formation.

8. Injection Intervals

Injection shall be permitted for either the Martin formation, expected to occur at depths estimated from about 3,445 feet bgs to about 3,645 feet (200 feet) or, alternatively, for the Naco formation, at depths estimated from about 2,945 feet bgs to about 3,445 feet bgs (500 feet). Minor alterations of the depths of injection zone intervals and therefore, the casing setting depths are expected to be realized upon drilling. These alterations and other rework operations that may occur later in the course of operation of the well are considered minor for this permit and must be properly reported (use EPA Form 7520-12 in Appendix D), and the Permittee must demonstrate that the well has mechanical integrity, in accordance with Section C paragraphs 1 and 2 of this part, before any initial injection or recommencing after repair.

9. Confining Layer

Field information on the confining layer (the Supai formation), such as its characteristics, its thickness and its local structure will be obtained during

drilling of the injection well and shall be included in the Final Well Construction Report required in paragraph 11 of this section.

10. Monitoring Devices

The Permittee shall install and maintain in good operating condition devices to continuously measure and record injection pressure, annulus pressure, flow rate, and injection volumes, subject to the following:

(a) Pressure gauges shall be of a design to provide:

(i) A full pressure range of 50 percent greater than the anticipated operating pressure; and

(ii) A certified deviation accuracy of five (5) percent or less throughout the operating pressure range.

(b) Flow meters shall measure cumulative volumes and be certified for a deviation accuracy of five (5) percent or less throughout the range of injection rates allowed by the permit.

11. Final Well Construction Report and Completion of Construction Notice

(a) The Permittee must submit a final well construction report, including logging, coring, and other results, with a schematic diagram and detailed description of construction, including driller's log, materials used (i.e., tubing and casing tallies), and cement (and other) volumes, to EPA within sixty (60) days after completion of Injection Well.

(b) The Permittee must also submit a notice of completion of construction to EPA (see EPA Form 7520-9 in Appendix D). Injection operations may not commence until EPA has inspected or otherwise reviewed the injection well and notified the Permittee that it is in compliance with the conditions of the permit.

12. Proposed Changes and Workovers

The Permittee shall give advance notice to EPA, as soon as possible, of any planned physical alterations or additions to the permitted injection well. Any changes in well construction require prior approval of EPA and may require a permit modification under the requirements of 40 CFR §§144.39 and 144.41. In addition, the Permittee shall provide all records of well workovers, logging, or other subsequent test data, including required mechanical integrity testing, to EPA within sixty (60) days of completion of the activity. Appendix D contains samples of the

appropriate reporting forms. Demonstration of mechanical integrity shall be performed within thirty (30) days of completion of workovers or alterations and prior to resuming injection activities, in accordance with Section C paragraphs 1 and 2 of this part.

B. CORRECTIVE ACTION

Corrective action in accordance with 40 CFR §§144.55 and 146.7 may be necessary for existing wells in the Area of Review ("AOR", defined in 40 CFR §146.6) that penetrate the injection zone, or which may otherwise cause movement of fluids into USDWs. No corrective action plan is currently required, since no known wells located within the AOR penetrate the proposed zones of injection.

C. WELL OPERATION

1. Demonstrations Required Prior to Injection

Injection operations may not commence until construction is complete and the Permittee has complied with paragraphs (2) through (5) below.

2. Mechanical Integrity Tests ("MITs")

(a) Mechanical integrity testing shall conform to the following requirements throughout the life of the injection well:

(i) Casing/tubing annular pressure (internal MIT)

A demonstration of the absence of significant leaks in the casing, tubing and/or packer shall be made by performing a pressure test on the annular space between the tubing and long string casing. This test shall be for a minimum of thirty (30) minutes at a pressure equal to or greater than the maximum allowable injection pressure. In the submittal of plans (see paragraph at Part II) to conduct this demonstration, the Permittee may propose a pressure less than the maximum allowable injection pressure with a justification for EPA's consideration. This demonstration may be satisfied at a lesser pressure if EPA provides prior written approval. A well passes the MIT if there is less than a five (5) percent change in pressure over the thirty (30) minute period. A well also passes the MIT if there is a five (5) to ten (10) percent change in pressure over the thirty (30) minute period and EPA provides concurrence.

(ii) Continuous pressure monitoring

The tubing/casing annulus pressure and injection pressure shall be monitored and recorded continuously to an accuracy of 0.1% of full gauge pressure, or +/-5 psi for 5,000 psi gauges. The average, maximum, and minimum results shall be included in the quarterly report to EPA unless more detailed records are requested by EPA.

(iii) Injection profile survey (external MIT)

A demonstration that the injectate is confined to the proper zone shall be conducted and presented by the Permittee and subsequently approved by EPA. This demonstration shall consist of a radioactive tracer and a temperature log (as specified in Appendix E), or other diagnostic tool or procedure as approved by EPA. Permittee must submit detailed plans for conducting the external MIT allowing sufficient time for EPA review and approval prior to conducting the demonstration.

(iv) Cement Evaluation Analysis

After casing is installed, the Permittee shall submit cementing records and cement evaluation logs that demonstrate the isolation of the injection interval and other formations from underground sources of drinking water by means of cementing the surface casing and the long string casing well bore annuli to surface. The analysis shall include a spherically-focused tool, run after the long-string protection casing is set and cemented, which enables the evaluation of the bond between cement and casing as well as of the bond between cement and formation. The Permittee may not commence injection until it has received written notice from EPA that such a demonstration is satisfactory.

(b) Subsequent MITs

It is the Permittee's responsibility to arrange and conduct MITs. An MIT shall be conducted following completion of any work-over, if the packer is unseated, if the seal is broken in the tubing-casing annulus, if the seal is broken at the wellhead assembly, if a modification of the well compromises integrity, or when any loss of mechanical integrity becomes evident during operation. In

addition, EPA may require that a MIT be conducted at any time during the permitted life of the well.

(c) Loss of Mechanical Integrity

The Permittee shall notify EPA, in accordance with Part III, Section E paragraph 10 of this permit, under any of the following circumstances:

(i) The well fails to demonstrate mechanical integrity during a test, or

(ii) A loss of mechanical integrity becomes evident during operation, or

(iii) A significant unexpected change in the annulus or injection pressure occurs during normal operating conditions.

Furthermore, in the event of (i), (ii), or (iii), injection activities shall be terminated immediately and operation shall not be resumed until the Permittee has taken necessary actions to restore mechanical integrity to the well and EPA gives approval to recommence injection.

(d) Prohibition without Demonstration

After the permit effective date, injection into the well may continue only if:

(i) The well has passed an internal pressure MIT in accordance with paragraph 2(a) of this section; and

(ii) The Permittee has received written notice from EPA that the internal pressure MIT demonstration is satisfactory.

3. Injection Pressure Limitation

Maximum allowable injection pressure measured at the bottom-hole shall be based on the results and analysis of the Step-Rate Test conducted under this part. As a backup to the bottom-hole gauge, the injection pressure may be calculated with a surface gauge. The Permittee shall provide calculations to support the maximum injection pressure determination for the CO_2 injectate as measured at the bottom-hole or at the surface. EPA will provide the Permittee written notification of the maximum allowable injection pressure for the injection well constructed and operated under this permit, along with a minor modification of the permit under 40 CFR

§144.41(e). In no case shall pressure in the injection zone during injection initiate new fractures or propagate existing fractures in the injection zone or the confining zone. In no case shall injection pressure cause the movement of injection or formation fluids into or between underground sources of drinking water.

4. Injection Volume Rate Limitation

The injection rate which is directly related to the injection pressure limitation shall not exceed the volume determined appropriate through the demonstrations conducted in this section and justified by the measured friction factors. EPA will provide written notification of the maximum daily injection rate allowed under this permit prior to any injection activities, after the SRT.

5. Injection Fluid Limitation

(a) The Permittee shall not inject any hazardous waste, as defined by 40 CFR Part 261, at any time.

(b) Injection fluids authorized by this permit shall be limited to only food-grade Carbon Dioxide (CO_2) of at least 99.5% CO_2 by volume with small amounts of other gases. Small quantities of krypton, xenon, and sulfur hexafluoride may be added to the injected CO_2 as tracers.

(c) Any well stimulation, such as treating formation damage from drilling mud or other shall be performed at the discretion of the operator, shall be proposed and submitted for approval from EPA prior to implementation.

6. Tubing/Casing Annulus Requirements

Corrosion inhibiting annular fluid shall be used and maintained during well operation. A complete description and characterization shall be submitted to EPA. A minimum pressure of 100 psi at shut-in conditions shall be maintained on the tubing/casing annulus.

7. Experimental Objectives - Monitoring, Analysis and Application

This Class V Experimental Project will provide a sophisticated level of investigation and analyses of complex mechanical operations and in situ processes that are expected to evaluate and verify theoretical projections related to the injection of carbon dioxide (CO_2) at supercritical conditions. Progress is likewise expected throughout this project regarding theoretical predictive analysis and application techniques as new data are acquired

and various reservoir and geological characteristics and properties are obtained and confirmed. Reports addressing these objectives shall be made as outlined in Part II. Section D. 4.

D. MONITORING, RECORDKEEPING, AND REPORTING OF RESULTS

1. Injection Well Monitoring Program

Samples and measurements shall be representative of the monitored activity. The Permittee shall utilize applicable analytical methods described in Table I of 40 CFR §136.3, or in EPA Publication SW-846, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," unless other methods have been approved by EPA.

2. Monitoring Devices

(a) Continuous monitoring devices

Temperature and annular pressure shall be measured at the wellhead using equipment of sufficient sensitivity and accuracy. Injection pressure shall be measured at bottom-hole or the surface using equipment of sufficient sensitivity and accuracy. Injection rate shall be measured in the supply line immediately before the wellhead. The Permittee shall continuously monitor and record the following parameters:

Monitoring Parameter	Frequency	Instrument
Injection rate (gallons per minute)	Continuous	digital recorder
Daily Injection Volume (reservoir conditions) Cumulative total volume (gallons)	Continuous	digital totalizer
Injection pressure (psig)	Continuous	digital recorder
Annular pressure (psig)	Continuous	digital recorder
Injection fluid temperature (degrees Fahrenheit)	Continuous	digital recorder

(b) Calibration and Maintenance of Equipment

All monitoring and recording equipment shall be calibrated and maintained on a regular basis to ensure proper working order of all equipment.

3. Recordkeeping

The Permittee shall retain the following records and have them available at all times for examination by an EPA inspector:

(a) All monitoring information, including required observations, calibration and maintenance records, recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the permit application; and

(b) Information on the nature and composition of all injected fluids;

(c) Records and results of MITs, any other tests required by EPA, and any well workovers completed.

(d) The Permittee shall maintain copies (or originals) of all records described in paragraphs (a) through (c) above during the operating life of the well and shall make such records available at all times for inspection at the facility.

(e) The Permittee shall only discard the records described in paragraphs (a) through (c) if:

(i) the records are delivered to the Regional Administrator, or

(ii) written approval from the Regional Administrator to discard the records is obtained.

4. Reporting of Results

Quarterly for the life of the well, the Permittee shall submit accurate reports to EPA containing, at minimum, the following information:

(a) Daily average, maximum, and minimum values for the continuously monitored parameters specified in paragraph 2(a) of this section, unless more detailed records are requested by EPA;

(b) Cumulative total volume for the monitored parameter specified in paragraph 2(a) of this section, report in gallons and metric tons;

(c) To be included with the next quarterly report immediately following completion, results of any additional MITs or other tests required by EPA, and any well workovers completed;