ATTACHMENT L

Construction Procedures

Note: This is a draft plan for the construction of the proposed Class I injection wells. Some specifications are not complete.

CONTENTS

SECTIONS

APPENDICES

SECTION 1 INTRODUCTION AND SUMMARY

The PEC proposes the installation of four Class I, non-hazardous deep injection wells (IWs) at the locations shown on Figures B1 and B2, Attachment B.

The proposed injection wells are to be drilled to a depth of approximately 5,600 feet below ground surface (bgs). The wells are to be constructed in two phases. One well will be completed and tested prior to drilling of the second well. The first IW will provide valuable and essential information on the hydrogeological conditions and operating parameters that would assist in the design and installation of the second IW.

Injection Well Construction

Maximum use will be made of current technology and expertise. Contractor selection will be made with regard to prior relevant experience, commercial terms, quality and safety procedures.

Provisional well construction information is provided in a general form in this section. Final well construction may vary depending on geologic conditions encountered at the PEC site.

Three activities, to be performed synchronously with the construction of the well are:

1. Cementation
2. Geophysical well logging and;
3. The collection of soil and water samples.

Components of the various construction materials and equipment will be assembled, completed, tested and commissioned to the maximum extent possible.

Appendices

Details of the provisional design are provided in Appendix A, the material specifications are listed in Appendix B, and the geophysical logging in Appendix C. Details for performing well alignment logging is shown in Appendix D. The methods to be used for the collection of water and soil samples and mechanical integrity tests, are described in Appendices E and F, respectively.

SECTION 2 GENERAL WELL CONSTRUCTION INFORMATION

A pilot hole of a nominal twelve (12") or less in diameter will be drilled for the first well. The pilot-hole boring will be drilled to approximately 5,600 feet depth, subject to adjustments depending on field observations.

A reamed borehole of a nominal seventeen-inches (17") diameter is required for the twelve-inches (12") diameter conductor casing, provisionally designed to be installed to a depth of 1,600 feet bgs. A long-string casing of between 10 and 7 inches is to be installed from surface to a depth of approximately 4,240 feet bgs. Shutter screen of a nominal diameter of between 5 1/5 and 8 inches is to be installed from 4,240 to approximately 5,600 feet bgs. Finally, between 5 and 7 inch diameter tubing is to be run from surface to approximately 4,230 feet bgs. The final depths are to be determined by the field conditions, pilot boring cuttings sieve analysis, well logs, and input from the drilling consultant and hydrogeologist.

The screened interval(s) will be placed entirely beneath the Kreyenhagen Shale that serves as an aquitard.

The applicant anticipates a final bore depth of approximately 5,600 feet, with at least 1,600 feet of 12 inch diameter K55 conductor casing, 4,240 feet of seamless K55 blank 9 5/8 inch ‘long string’ casing, and a total of approximately 600 feet of 5.5 inch diameter 316 stainless steel shutter screen, through the injection zones.

SECTION 3 SURFACE CASING SETTING

A minimum seventeen-inch (17") diameter surface casing will be set plumb and centered in an augured hole not less than six inches (6") greater in diameter than the surface casing. The surface casing setting will be approximately twenty feet (20’) below ground surface; however, the applicant may order the setting at a greater depth if found advisable. A continuous, unbroken concrete grout envelope of as uniform a thickness as practical will be placed in the annular space between the borehole wall and the surface casing. The grout envelope will ensure the surface casing is entirely sealed against infiltrating surface waters.

SECTION 4 PILOT HOLE

Well drilling will be by the rotary process, with bentonite, clay, mud or other additives appropriate for the return of the drill cuttings.

After emplacement of the surface casing and sanitary seal, the pilot hole for the well will be drilled to a nominal twelve inches (12") or less in diameter to approximately 5,600 feet deep.

The hydrogeologist will provide personnel to collect representative drill cuttings from a sample catcher or splitter, every five feet (5') of depth and at every change of formation, throughout the drilling program. The Contractor will maintain logs that accurately indicate depth, type and composition of formation and drilling rate. The drill rig will be equipped with a continuous drilling recorder (Geolograph or equivalent) with a minimum of two pens to record penetration rate and hook load. The drilling logs will be annotated regularly with the weight applied to the drill bit as noted on the indicator, rotary revolutions per minute, bit changes and comments on rig action. The logs from the drilling-time recorder will be turned over to the Hydrologist at the completion of the drilling. During the drilling, the Contractor will check for deviation of the pilot hole, using a method considered appropriate by industry. The Contractor will note the time and angular deviation on the drilling time recorder chart when deviation surveys are conducted and will supply the hydrologist with a copy of the alignment information at the completion of the pilot hole.

SECTION 5 GEOPHYSICAL LOGS

The proposed injection wells will be geophysically logged according to specifications stated under "Geophysical Logging Specifications" (Appendix D). The work required to drill and construct the wells under these Specifications also includes work as outlined in State Code §146.12 for Class I, Deep Injection Wells (Appendix G), or as modified by the Director, UIC, California (Director). Materials used in construction will be in accordance with AWWA, API, and ASTM specifications, unless approved by the Director.

Open-hole logs of the pilot hole will be run, before casing is installed. The down-hole logs will include: spontaneous potential; resistivity; natural gamma-ray; and caliper. Before conductor and long-string casing is installed, compensated density and/or neutron porosity log, and dipmeter/fracture finder logs will be run.

After casing installation and cementing, a cement bond/variable density log and a temperature log will be run on all casing strings. In addition, after cementing, a casing inspection log will be run and an inclination survey will be performed on the conductor and long-string casing.

Geophysical logging of the hole will be done as indicated herein under "Geophysical Logging Specifications" (Appendix D).

Reaming Pilot Hole

The pilot hole will be reamed to at least seventeen-inches (17") to a depth of approximately 1,600 feet bgs. The hydrologist and logging consultant will determine the depth of reaming for the installation of the conductor casing of the well after examining geologic and logging data obtained from pilot hole logs.

This subsection of the rules requires that all logs and tests be interpreted by the service company which processed the logs or conducted the test, or by other qualified persons.

Pilot Hole Deviation Checks

Deviation checks must be conducted at sufficiently frequent intervals to assure that avenues for fluid migration in the form of diverging holes are not created during drilling.

The Contractor warrants the hole will deviate less than six degrees and less than three degrees over a hundred-foot interval. An adequate casing centralizer program will be designed and implemented to promote optimal cementing results.

SECTION 6 CONDUCTOR AND LONG STRING WELL CASING

Well casing and screen will be selected according to manufactured specifications such that the tensile, column and collapse strengths are sufficient to withstand column loads during installation and bore hole pressures anticipated for the proposed wells.

The welding sequence followed will meet the American Welding Society (AWS) Specifications. Welders shall be certified and be qualified in accordance with the latest revision of the ASME Boiler Construction Code, Section titled “Welding Procedures”, or AWS Standard Qualification Procedure.

The preliminary design is for the installation of approximately 1,600 feet of 12 inch diameter K55 conductor casing, followed by approximately 4,240 feet of 8 inch diameter seamless K55 blank casing. Approximately 1,860 feet of blank stainless steel casing and 500 feet of shutter screen will be installed between 4,240 and 5,600 feet bgs.

SECTION 7 CEMENTING

The wells will be constructed with two concentric grout sealed annuli as shown in Figure L2, Appendix L, in accordance with State Code #146.12.

Methods of Cementing

The pump and plug method (or other method approved by the Underground Injection Control Program (UIC) executive director) must be used to cement the injection well casings. This method uses rubber wiper plugs to separate mud, cement, and displacement fluid while being pumped down the casing. A “bottom plug” is pumped down ahead of the cement and is caught on a restriction designed for that purpose in a device called the “float collar” which is positioned near the bottom of the casing.

Classes of Cement and Types of Additives

The API has established eight classes of cement based upon suitability for use at various depths and temperatures (Lehr, 1986). The Contractor will design the appropriate cement mixtures. A number of special cements, including pozzolan-lime, sulfate-resistant, latex, and epoxy-resin cements, for which the API standards have not been established, have applications in disposal wells. These include accelerators, retarders, light-weight additives, heavy-weight additives, loss-circulation control additives, water-loss control additives, and friction reducers.

Volumes of Cement

The cement pumped will be of a volume equivalent to at least 120% of the volume calculated necessary to fill the annular space between the hole and casing and between casing strings to the surface of the ground. A caliper tool with two or more arms will be used to measure the hole diameter. With regard to any interval of the drilled hole greater than or equal to the maximum readable diameter of the caliper tool, the minimum amount of cement for that interval will be a volume calculated to be equivalent to or greater than 150% of the space between the casing and the maximum measurable diameter of the caliper. If lost circulation zones or other subsurface conditions are anticipated and/or encountered, which could result in less than 100% filling of the annular space between the casing and the borehole or between the casings, the Contractor will implement a contingency plan approved by the hydrologist.

The Contractor will incorporate additional measures to optimize the quality of the cementing, including the installation of a “guide shoe” and multiple cement stage tools or DV (differential valve) tools in a casing string. These tools allow the casing to be completely cemented in stages. In many situations, use of such tools may be advisable to prevent downhole formations from being subjected to a single-stage cement slurry hydrostatic pressure sufficient to cause formation fracturing in the wellbore. The stage tool may also be used to place different types of cement outside the same casing. In addition “centralizers” and “scratchers” may be installed on the outside of the casing wall. “Parasite air strings” may also be affixed to the exterior of the surface casing.

The Contractor will consider reducing the drilling mud's 10-minute gel strength and casing wiper plugs ahead of and behind the cement slurry to enable a more efficient sweeping of mud from the annulus outside the casing, to minimize mud contamination of the cement.

The cement work will meet the USEPA performance standard State Code # 146.8

SECTION 8 INSTALLATION OF SHUTTER SCREEN

The dimensions and preliminary depth of installation of the shuttered screen sections across the proposed injection zones is shown in Figure L2 (Appendix L). Centralizers will not be welded to any part of the shutter screen material. The casing string will be supported by casing clamps or hangers welded to both the casing and surface casing prior to releasing tension. All of the casing and screen sections will be joined by continuous welds. The welding work will meet American Welding Society (AWS) Specifications.

The fully assembled casing/screen will be suspended just off the bottom of the hole to ensure that it is installed plumb.

SECTION 9 INSTALLATION OF GRAVEL PACK

Clean gravel will be placed in the annular space between the screen and borehole wall. The gravel will be composed of sound, durable, highly spherical, well-rounded siliceous particles, containing no silt, clay, organic matter or deleterious materials. The selection of the grade of gravel and appropriate shutter screen will be determined by the hydrologist on completion of soil sample sieve analyses.

A permanent two and one half inch (2 1/2”) diameter gravel feed tube will be installed to approximately 10 feet above the top of the screen. The casing assembly will be installed in accordance with the specifications as noted in "Well Construction Detail" (Appendix B). Centering Guides (centralizers) will be used to ensure the casing is centered in the hole. Centralizers will be installed on sixty- (60) foot spacing

During gravel placement, a continuous stream of water will be airlifted from the well at a rate of approximately 300 gpm to remove suspended sediments. Clean water will be added to the well though the gravel feed tube and to the inside of the surface casing, such that water level in the annulus is not allowed to fall below the bottom of the surface casing during placement of gravel pack and cement seal.

The method of gravel placement will be by hydraulic feed through the temporary tremie pipe initially placed at the bottom of the screened interval in the annular space between the open borehole and the screen. To prevent bridging of the gravel pack, no more than forty feet (40’) of tremie pipe will be pulled back at a time, during gravel placement.

An accurate log of the amount of gravel tremied into the borehole over each forty-foot (40’) length of screen will be maintained during installation. The gravel placement will proceed until the height of the gravel pack is approximately ten (10) feet above the bottom of the permanent gravel feed tube (twenty (20) feet above the top of the screen). The Contractor will then place ten 10 feet of clean, fine silica sand in the well annulus by hydraulic feed through the temporary tremie.

A permanent two-and-one-half-inch (2-1/2”) diameter gravel feed tube with the bottom extending through the sand and cement grout intervals into the gravel pack will be installed. The top of the gravel feed tube will extend through the surface casing and terminate as a 2-1/2 -inch threaded end with a cap to permit the addition of gravel.

SECTION 10. COMPLETION

Formation Water Sample

The well will be flushed to clean up any mud and loose silt in the injection zone until a representative sample of formation water from the injection interval is obtained prior to injectivity and mechanical integrity testing (MIT).

The volume of representative formation water produced (~ 5 gallons) will be sufficient to determine injection zone characteristics and compatibility with the planned waste stream(s).

Injection Tubing

The installation of injection tubing will include setting packers to provide a mechanical seal between the injection tubing and the surrounding long-string casing. When the packer is set inside the casing at or near the top of the injection zone, the annular space above the packer between the injection tubing and the long-string casing becomes isolated from the injection zone. This annular space will be filled with a corrosion inhibiting brine or other suitable non-reactive liquid (eg. diesel). The wellhead will include an access tube to the annular space with a high pressure seal to permit the monitoring of the pressure of the inert fluid by a wellhead gauge, and a continuous recorder. A fluid-level sight gauge will be installed at the wellhead to detect leaks in tubing, casing, or packer. The annulus fluid will have sufficient density to control static reservoir pressures when a release of the packer and removal of tubing become necessary for remedial workovers.

Retrievable packers will be set with a work string or wire line before installation of tubing into the packer sealing assembly, or be made up into the tubing string and set at pre-determined packer depths.

SECTION 11. AIRLIFT DEVELOPMENT

Airlift development of the well will commence a minimum of twelve (12) and no more than twenty-four (24) hours after completion of grout placement in the well annulus. Airlift development will begin at the bottom of the screen and proceed opposite the entire screen section. Airlift development will be achieved using a swab tool that allows airlift pumping to be conducted through a perforated section of drill pipe between two tight fitting surge blocks located on the end of the development pipe string.

Airlift development will be conducted by vigorous surging (raw hiding) while producing a continuous flow of formation water at approximately three hundred (300) gpm through the long string casing. Swabbing at a rate of 30 to 40 strokes per hour will be achieved for the airlift development.

As the gravel pack settles during development, more gravel will be added to maintain the top of gravel above the bottom of the gravel feed tube at as minimal a level as practical to avoid bridging. Airlift development will continue until there is no further settling of the gravel, all sand and mud has been washed from the well as determined by the Hydrologist. The Contractor will maintain a flow of clear potable water through the gravel feed tube during well development activities to avoid bridging of the gravel.

Upon completion of airlift development, the Contractor will pump the well to remove all rock, sand, mud and foreign material. Airlift pumping will again be used during this phase of the well installation and will continue until the water is clean and free of sand and silt.

SECTION 12. WELLHEAD

The wellhead will be completed, ready for installation of surface monitoring equipment, including pressure, flow and temperature gauges.

The wellhead slab will be at least 6-foot by 6 foot, with the edges aligned east west and north south, finished 6 inches above finished grade. The 6-foot by 6-foot slab will extend to 3 foot below finished grade, and the bottom will slope downward toward the top of the surface casing seal grout so that it forms a continuous seal with the grout. The central pedestal will be 3 foot by 3 foot square, finished level and flush with the top of the well casing 2 feet above the top of the wellhead slab (2.5 feet above finished grade). The wellhead slab and central pedestal will be poured as one unit from 3000 psi concrete.

The gravel tube will project 6 inches above the wellhead slab, at an angle of 30 degrees from vertical through the well slab, and have a screw-on cap marked with a "G". Two 2 inch galvanized vent pipes will penetrate the well casing and project at a 45 degree angle from vertical, positioned so that they project from the side of the pedestal, or the top of the wellhead slab. The two vents will each have a threaded coupler so that the extensions can be removed below the level of the top of the central pedestal. The vent pipes will be seal welded to the casing so that no portion of the vent pipes protrudes into the casing interior. One of the vent pipes will terminate in an elbow with its opening downward, and screened to prevent entry of insects. The opening will be at least 18 inches above finished grade. The other vent pipe will be terminated with a screw on cap at least 18 inches above finished grade.

SECTION 13. PLUMBNESS AND ALIGNMENT

The well will be constructed in such vertical alignment that a line drawn from the center of the well casing at the ground surface will not deviate from the vertical more than three (3) inches in one hundred (100) feet of length unless otherwise authorized by the hydrologist. To verify that the well is sufficiently straight and plumb, the Contractor will either run a gyrocompass alignment survey as noted in the “Gyrocompass Alignment Survey Specifications” (Appendix E), or pass a full length stabilizer down the length of the pilot hole.

APPENDICES

APPENDIX A

WELL CONSTRUCTION DETAIL

Alternative Drilling and Casing Program

- Drill 24 inch hole to ~20 feet bgs for surface casing.
- Install 18” 36# J-55 casing to ~20 feet bgs.
- Drill 12“ pilot hole from 0 to 5,600, the estimated final depth of hole.
- Run geophysical logs, collect water samples, and obtain 10 sidewall cores (SWCs).
- Ream 12” hole to 17 inches from 0 to an estimated depth of 1,600 feet bgs, using water-base drilling mud. The final depth to be determined by groundwater TDS value.
- Install 12“, K-55 grade conductor casing, from surface to 1,600 feet.
- Inject cement between formation and 12” conductor casing.
- Run logging tools to demonstrate the ‘cement is continuous’ behind the well bore.
- Install K-55 grade 9-5/8” long string casing from 0 to 4,240 feet bgs.
- Inject cement behind long string casing.
- Run logging tools to demonstrate continuity of cement behind casing.
- Circulate and condition hole. Pull out of hole.
- Install 5.5” 316 stainless steel louvered screen and blank sections from 4,240 to 5,600 feet bgs
- Install 5”, stainless steel hang-down tubing from approximately 0 to 4,230 feet bgs
- Install packers between long string casing and injection tubing for well annulus.
- Complete topside access piping, connect flow and pressure gauges, and erect housing for electronic monitoring equipment;
- Fill annulus with diesel or water with corrosion retardant, and pressure test wellhead seals and equipment.

APPENDIX B

MATERIAL AND EQUIPMENT SPECIFICATIONS

Grout specifications

- Mix proportions or standard specs
- Clay seal specs
- Material and form introduced

Casing specifications

- Thickness
- Material
- Certifications
- Condition delivered
- Surface casing specs

Screen specifications

The well screen will be a minimum 5.5-inch diameter shuttered 216 grade stainless steel well screen of sufficient collapse strength for the application.

Slot size will be 0.060 inches and open space in the screen will comprise at least 15% of the screened interval.

Gravel Pack Specifications

The gravel-pack material used will be Colorado Silica or equivalent, with respect to Grain size distribution, roundness, and composition. The casing/well-screen assembly will be suspended in the borehole, just off the bottom during installation of the gravel pack and seal materials to ensure plumb installation. The gravel-pack material will be introduced into the annular space surrounding the casing/well-screen by use of a 3-inch diameter tremie pipe, the end of which will be suspended just above the interval being installed. The tremie pipe will be withdrawn during installation to keep its tip above the installed gravel pack. The gravel-pack material will be introduced as slurry made with water and disinfectant to avoid bridging in the pipe or in the borehole annular space. Circulation will be maintained in the hole to ensure proper gravel-pack development.

Gravel pack material will be continued 20 feet past the top of any screened interval.

When the top of the last gravel packed interval is reached, the tremie pipe will be set down on top of the gravel pack material, filled with the same gravel pack material to the surface and left in the annular space as a gravel-tube. It will be capped and labeled “gravel” and terminated on its top end, so as to be accessible for gravel replenishment after completion of the well. The remainder of the annular space will be filled (around the gravel tube) with an appropriate seal material for the conditions present.

Sieve analysis

Roundness
Composition
Certifications

Pressure Test Pump Specifications

To be determined.

Injection Well Drilling and Casing, Provisional Data

Casing Material	Depth Interval (ft.)	Hole Diameter (in.)	Casing Diam. (in.)	WT (in)	Yield Strength (psi)*	Total Footage
K-55	0-20	24	17 1/2	0.375	974,138	20
K-55 Seamless	0-1,600	17 1/2	12 3/8	0.375	706,121	1,600
K-55 or Code 10 Seamless	0 to 4,240	12 ¼ (8 ¾)	9 5/8 (7)	0.375	381,408	4,240
316 Seamless S/S Blank	4,240 to 4,800 & 5,200 to 5,400	8 ¾ (7 7/8)	5 1/2	0.322	157,140	760
316 S/S Shutter Screen (full-flow)	4,800 to 5,200 & 5,400 to 5,600	8 ¾ (7 7/8)	5 1/2	0.304	66,792	600
316 S/S Tubing	0 to 4,230	8 (=ID of long string)	5	0.22	99,110	4,230

***** Roscoe Moss**,** Calculations and Specifications, http://www.roscoemoss.com/specs.html

APPENDIX C

GEOPHYSICAL LOGGING PROGRAM

SUMMARY
Dual induction, SP, gamma ray, and neutron density logs are to be run through the confining and injection zones after the IWs are drilled to total depth (TD). A cement bond log will be run from the top of the injection zone to surface after each section of casing is cemented in place. Ten sidewall samples will be acquired from the first well to be drilled for laboratory analysis.

A. Open Hole Logs

The geophysical logs will be run in the pilot hole immediately following its completion
The following geophysical logs will be run in the pilot hole:

- Natural Gamma;
- Short Normal (16-inch) Resistivity;
- Long Normal (64-inch) Resistivity;
- Sonic (borehole compensated, log presentation to include travel time and variable density);
- Caliper (four-arm);
- Electromagnetic Induction.

The geophysical logs will be run from the bottom of the boreholes to the bottom of surface casing. A set of backup tools should be on site, or accessible within a reasonable amount of time, to reduce downtime in case of tool failure and to minimize the amount of time that the hole stands open.

B. Logging through conductor/surface casing:

1. Before casing and cementing: resistivity, SP, gamma ray, neutron, caliper logs, etc.:
2. After casing and cementing: cement bond, temperature, gamma ray, neutron logs, etc.:

C. Logging through long string casing

1. Before casing and cementing: resistivity, SP, gamma ray, porosity, density, sonic, caliper logs, etc.:
2. Fracture locating logs:
3. After casing and cementing: cement bond, temperature, gamma ray, neutron logs, etc.:
4. Radioactive tracer, spinner and video logs.

APPENDIX D

GYROCOMPASS ALIGNMENT SURVEY SPECIFICATIONS

A. GENERAL INFORMATION

The injection wells will be surveyed with a high-speed gyrocompass and plumb-bob assembly equipped with a multi-shot camera and full gauge centralizers.

Well orientation measurements will be conducted every twenty (20) feet for the entire depth of the hole. A repeat survey of the first two hundred (200) feet of each cased well will be conducted to ensure precision of the survey. The precision of the measurements will be plus or minus two and one half (+ 2-1/2) minutes for inclination (drift angle) and plus or minus one (+ 1) degree for azimuth (drift direction) and plus or minus one (+ 1) foot for true vertical depth.

The hydrologist will be present during the plumbness and alignment surveys.

A written report will be submitted, in triplicate, within five (5) days of the survey. The report will contain a drawing of the horizontal projection of the well and the following tabulated survey data:

- Depths of measurements
- Course length
- Drift angle
- Vertical depth
- True vertical depth
- Drift direction
- North-south and east-west coordinate differences
- North-south and east-west rectangular coordinates
- Degree of dogleg per one hundred (100) feet
- Degree of dogleg per twenty (20) foot course length.

The data will be supplied in digital format along with any special readers required to view the data unless in Microsoft Word, Excel, or PDF format.

APPENDIX E

WATER AND CORE SAMPLING

Water Sampling for Chemical Analysis

Sample bottles and directions for taking samples will be obtained from the laboratory. Arrangements will be made to coordinate the collection, transportation, and testing of the samples so as to minimize delay in testing form pH, bacteria, and other constituents where time of standing may affect results.

When taking bacteriological samples, the bottles will be sterile and care will be exercised not to contaminate either the bottle or sample. The sample tap will be allowed to flow smoothly for at least one (1) minute before collection of a sample.

Samples for mineral analysis will be taken in clean bottles with plastic (non-metal) caps.

The temperature will be taken of all water samples, to provide a clue as to the average depth of the producing aquifers. The thermometer will have a scale engraved on the glass and the graduations will be such that an estimate will be possible of the reading to the nearest degree F.

Samples for dissolved oxygen will have the following equipment and reagents available:

- A ¼" O.D. polyethene tube that can be connected to the sample tap.
- A special sample bottle with a tapered ground-glass stopper. It should have a capacity of approximately 250ml.
- Three small (35 to 100ml) bottles equipped with screw-on rubber bulb dispensing pipettes. The pipettes should discharge approximately 0.5ml when the bulb is squeezed(an ordinary eye dropper is satisfactory).
- The first bottle contains a 40% solution of manganous sulfate MnSO42H2O.
- The second bottle contains alkaline iodine reagent consisting of 70gm of KOH and 150gm KI diluted to 100ml.
- The third bottle will contain concentrated sulfuric acid.

The sample bottle will be filled with water, using the plastic tube immersed almost to the bottom of the special bottle. It will be allowed to overflow, to displace 4 to 10 volumes. The eye dropper containing the manganous sulfate will be immersed under the surface of the water and one ml (two squirts) of manganese sulfate reagent added. Next one ml of alkaline iodide reagent will be added, with no air bubbles entrapped. The floc of manganese hydroxide will be allowed to settle for three (3) or four (4) minutes, before removing the stopper. One ml of concentrated sulfuric acid will be added, and the stopper inserted and solution mixed by inverting the bottle. The solution will be transported to the laboratory for exact oxygen determination.

APPENDIX F

MECHANICAL INTEGRITY TEST

A Mechanical Integrity Test, or MIT, is a pressure test performed on every injection well to determine that no significant fluid is leaking through the well casing, tubing or packer into formations which may be sources of drinking water. The MIT is designed to test the entire system including the tubing, packer, and well head. The test is performed by applying pressure to the space between the casing and the tubing for a period of 30 minutes. If a pressure drop is observed that causes the well to fail the test, then the casing, tubing or packer, or wellhead has developed a leak. The leak must be fixed and the test retaken

MIT Test Procedure

1. Give forty-five (45) day advance notice to EPA so an inspector can be scheduled. EPA will send out a certified letter to the operator with the time and date of the test. The letter will have contacts and phone numbers.
2. Insure the packer is properly set in casing at the depth specified in the permit. Fill annular space with fluid. Air should be totally displaced.
3. Check all valves, secure tubing, and insure all leaks are repaired.
4. With inspector on location, apply pressure on tubing annular space (usually with nitrogen-N2). Oxygen should not be used because of safety concerns.
5. Apply a minimum 300-pound pressure on tubing annulus for 30 minutes. The EPA representative will monitor pressure variations at the time of the test. Pressure changes cannot exceed 3% above or below the applied pressure (9 pounds per 300 pounds of applied pressure).