

Appendix A

Existing and Proposed Wells and Well Pad Locations

UIC Permit R9UIC-HI5-FY16-1R

Footnotes (*) for the UIC Permit Application Form

*1 Puna Geothermal Venture (PGV) also conducts drilling activities, which are included under SIC Code 1781.

*2 PGV is currently operating six (6) Class V geothermal injection wells pursuant to:

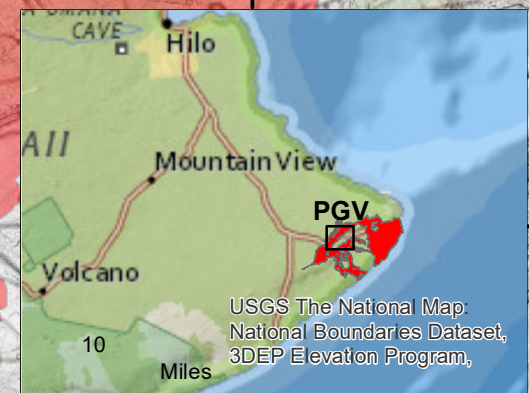
- a. U.S. EPA Region 9 UIC Permit #HI596002.
- b. A valid State of Hawaii UIC Permit #UH-1529 issued by the Hawaii Department of Health (HDOH).

EXISTING INJECTION WELL NO.	LOCATE ON WELL PAD	APPROXIMATE WELL HEAD ELEVATION ABOVE MEAN SEA LEVEL
KS-1A	A	617
KS-3	E	618
KS-11	A	617
KS-13	A	618
KS-15	B	743
KS-20	A	617

PROPOSED INJECTION WELL NO.	LOCATE ON WELL PAD	APPROXIMATE WELL HEAD ELEVATION ABOVE MEAN SEA LEVEL
KS-19	E	TBD
KS-21	TBD	TBD
KS-22	TBD	TBD
KS-23	TBD	TBD
KS-24	TBD	TBD
KS-25	TBD	TBD
KS-26	TBD	TBD
KS-27	TBD	TBD

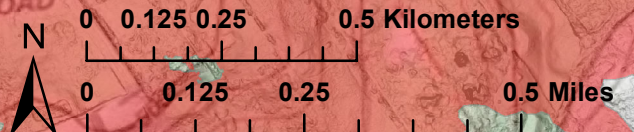
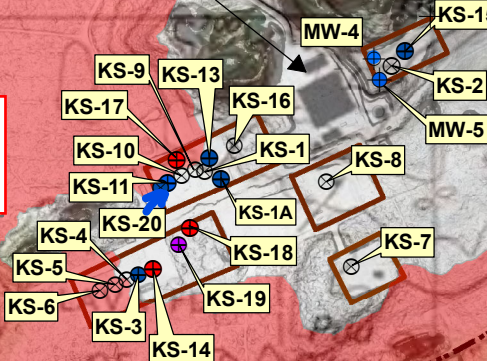
*3 The latitude and the longitude provided identifies the approximate center of the Area of Review and existing well locations as described in Attachment A.

Puna Geothermal Venture UIC Permit Application Area of Review Attachment B



KS-20 Coordinate
 $19^{\circ}28'36.6343'' / 154^{\circ}53'28.2182'$

- Legend**
- Water Well
 - Production Well
 - Injection Well
 - Planned Well
 - Observation Well
 - ⊗ Plugged or Covered Well
 - Well Pad
 - Lease Boundary
 - Area of Review
 - 2018 Eruption Lava Flow Extent

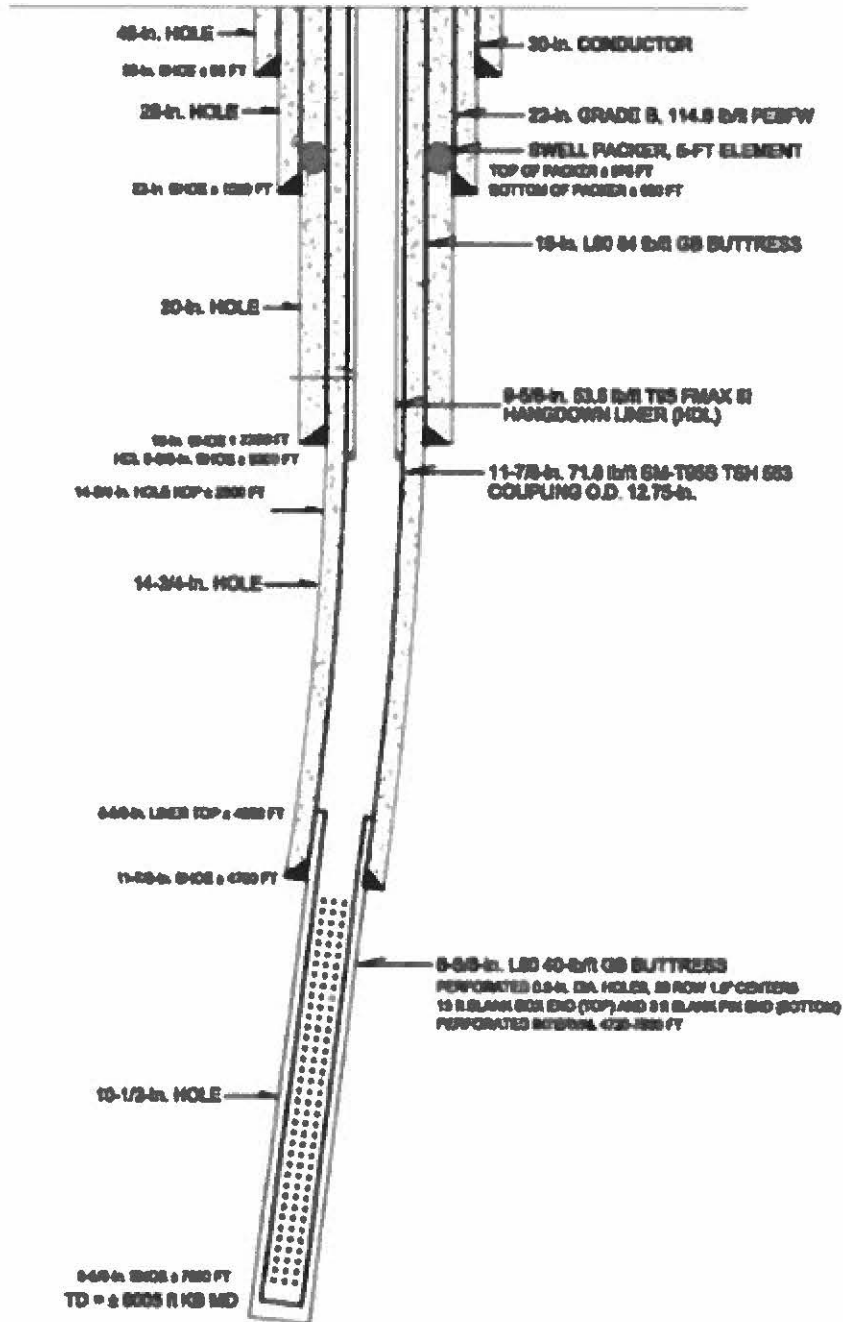


Appendix B

Injection Well Schematics

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PUNA GEOTHERMAL VENTURE STANDARD WELL DIAGRAM-INJECTION WELL



NOT TO SCALE
December 19, 2019

Appendix C

Approved Changes and Workover Program

UIC Permit R9UIC-HI5-FY16-1R

PUNA GEOTHERMAL VENTURE GENERIC CHEMICAL TREATMENT TO REMOVE WELLBORE SCALE

JANUARY 2, 2017

Objective

Dissolve wellbore scale formation with approved chemical: hydrochloric (HCl) acid for calcite; hydrofluoric (HF) acid or chelate (example: Nitrilotriacetate, C₆H₉NO₆) for silica; or a blend of nitric (N), phosphoric (H₃PO₄) and hydrofluoric (HF) acids for sulfate scale.

Safety

Before job commences, hold a safety meeting for all personnel who will be on location. Meeting will be conducted jointly by Operator (PGV) and Service Company supervisors. As a minimum, the following points will be covered in Pre-Job Safety Meeting (PJSM);

Procedure

- Review of applicable safety rules from common geothermal industry practice and site specific rules Puna Geothermal Venture
- Review evacuation plan
- Rules regarding mandatory use of face shields, gloves, hard hats and other personal protective equipment
- Rules regarding safe areas for non-essential personnel during pumping and displacement of acid (as a minimum, areas around high-pressure lines will be marked off with a tape barrier)
- Identify location(s) of eye wash station(s) per Pre-Job Safety Meeting (PJSM)
- Notify Central Station Control (CSC) for all emergency notifications
- Identify location all plant SDS's per PJSM
- Identify all procedures for neutralizing drips or minor spills on the ground
- Identify all procedures for containment and neutralizing of acid spill

Service Company will have to supply sodium carbonate (Na₂CO₃) or suitable substitute on location to neutralize minor acid spills.

Procedure

1. Shut in well by closing block valve on flow line. Shut master valve.
2. Rig up steel lines from pump truck to 3 inch casing head valve. Pressure test lines.

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3. Pump at least one wellbore volume of fresh water ahead at approximately 5 BPM. Do not exceed 400 psi injection pressure without authorization of Operator representative. Well is expected to take water and chemical on a vacuum.
 4. Pump chemical treatment with corrosion inhibitor, surfactant, and chelating agent as necessary to protect casing and prevent precipitation.
 5. Wait for treatment to dissolve scale.
 6. Displace acid with at least one wellbore volume of water.
 7. Rig down pumping unit.
 8. Return well to injection.

PUNA GEOTHERMAL VENTURE - GENERIC PROGRAM COILED TUBING CLEANOUT OF WELLBORE SCALE

JANUARY 2, 2017

Objective

Remove wellbore scale with coiled tubing wash tools or hydroblast to improve injection capacity.

Safety

Before job commences, hold a safety meeting for all personnel who will be on location. Meeting will be conducted jointly by Operator (PGV) and Service Company supervisors.

Procedure

1. Mobilize coiled tubing rig and associated equipment.
 - 1.1. Notify all applicable Local, State & Federal agencies prior to rig up.
 - 1.2. Comply with all GRP, NSP, DLNR & UIC permits that pertain to well work.
 - 1.3. Ensure that contractors and drilling related personnel have been provided with the required safety training including H2S training and operation of H2S abatement system.
2. Nipple up to well and function test BOPE.
3. Make up wash tool or hydroblast nozzle
4. Run in hole with tubing, pumping water through wash tool or hydroblast nozzle, to bottom of well or as deep as tubing will go.
5. Set up for flow if necessary to cleanout well
 - 5.1. Rig up flow line and muffler with H2S abatement system according to PGV H2S abatement procedures
 - 5.2. Pump nitrogen and run tubing and attempt to unload and flow well while pumping caustic according to PGV H2S abatement procedures. Throttle well to keep flow below 100 kph of steam and zero carry over from muffler.
 - 5.3. Once well is flowing switch back to fluid to wash casing
 - 5.4. Continue to flow well until returns are clean and free of solids.
6. Shut in well and rig down tubing unit.
7. Comply with all applicable local, state and federal permits prior to placing the well back in service.

**PUNA GEOTHERMAL VENTURE
GENERIC PROGRAM TO DRILL OUT
WELLBORE SCALE WITH RIG**

JANUARY 2, 2017

Objective

Clean scale out of wellbore to improve injection capacity.

Procedure

1. Mobilize suitable rig and associated equipment.
 - 1.1. Notify all applicable Local, State & Federal agencies prior to rig up.
 - 1.2. Install direct communications between rig floor, tool pusher and company man.
 - 1.3. Comply with all GRP, NSP, DLNR & UIC permits that pertain to drilling.
 - 1.4. Ensure that the applicable drilling contractors have current well control training.
 - 1.5. Ensure that additional drilling related personnel have been provided with the required safety training.
2. Nipple up BOPE.
3. Kill well and keep water going into hole during cleanout.
4. Pull hang down liner if there is one.
5. Clean out scale.
 - 5.1. Run in hole with bit and stabilizer to fit I.D. of casing. Rotate and circulate as necessary to drill out scale.
 - 5.2. Run in hole with bit and stabilizer to fit I.D. of liner and/or open hole. Rotate and circulate as necessary to drill out scale
6. Rerun hang down liner, if applicable.
7. Secure well and rig down.
8. Comply with all applicable local, state and federal permits prior to placing the well back in service.

PUNA GEOTHERMAL VENTURE - GENERIC PROGRAM TO REMOVE AND/OR INSTALL PERFORATED LINER

JANUARY 2, 2017

Objective

Remove damaged liner and/or install new liner to improve injection capacity and wellbore stability.

Procedure

1. Mobilize suitable rig and associated equipment.
 - 1.1. Notify all applicable Local, State & Federal agencies prior to rig up.
 - 1.2. Install direct communications between rig floor, tool pusher and company man.
 - 1.3. Comply with all GRP, NSP, DLNR & UIC permits that pertain to drilling.
 - 1.4. Ensure that the applicable drilling contractors have current well control training.
 - 1.5. Ensure that additional drilling related personnel have been provided with the required safety training.
2. Nipple up BOPE.
3. Kill well and keep water going into hole while working in hole.
4. Pull hang down liner if there is one.
5. Clean out scale.
 - 5.1. Run in hole with bit and stabilizer to fit I.D. of casing. Rotate and circulate as necessary to drill out scale.
 - 5.2. Run in hole with bit and stabilizer to fit I.D. of liner and/or open hole. Rotate and circulate as necessary to drill out scale as deep as necessary.
6. Pull liner, if necessary.
 - 6.1. If only part of liner is to be pulled, RIH with casing cutter and cut off liner at appropriate depth.
 - 6.2. RIH with casing spear, spear and pull liner.
7. Install liner, if necessary.
 - 7.1. Make up liner and run to TD.
8. Rerun hang down liner, if applicable.
9. Secure well and rig down.
10. Comply with all applicable local, state and federal permits prior to placing the well back in service.

PUNA GEOTHERMAL VENTURE - GENERIC PROGRAM TO SQUEEZE CEMENT

JANUARY 2, 2017

Objective

Squeeze cement into formation to seal off undesired injection zone.

Procedure

1. Mobilize suitable rig and associated equipment.
 - 1.1. Notify all applicable Local, State & Federal agencies prior to rig up.
 - 1.2. Install direct communications between rig floor, tool pusher and company man.
 - 1.3. Comply with all GRP, NSP, DLNR & UIC permits that pertain to drilling.
 - 1.4. Ensure that the applicable drilling contractors have current well control training.
 - 1.5. Ensure that additional drilling related personnel have been provided with the required safety training.
2. Nipple up BOPE.
3. Kill well and keep water going into hole while working in hole.
4. Pull hang down liner if there is one.
5. Clean out scale.
 - 5.1. Run in hole with bit and stabilizer to fit I.D. of casing. Rotate and circulate as necessary to drill out scale to below area to be cemented.
 - 5.2. If necessary, run in hole with bit and stabilizer to fit I.D. of liner and/or open hole. Rotate and circulate as necessary to drill out scale below area to be cemented.
6. Establish plug below area to be cemented.
 - 6.1a Run bridge plug and set below area to be cemented,
 - 6.1b or pump cement plug below area to be cemented
 - 6.1c or fill hole with sand and cinders to below area to be cemented.
 - 6.2 Check plug back depth and pump cement plug
7. Squeeze cement.
 - 7.1. Pump squeeze cement across area to be cemented.
 - 7.2. Pressure up as necessary to squeeze cement.
 - 7.3. Wait for cement to set and then run in with bit and clean out cement and plug.
9. Rerun hang down liner, if applicable.
10. Secure well and rig down.
11. Comply with all applicable local, state and federal permits prior to placing the well back in service.

PUNA GEOTHERMAL VENTURE - GENERIC PROGRAM TO SQUEEZE CEMENT AND INSTALL CASING PATCH OR CEMENTED LINER

JANUARY 2, 2017

Objective

Squeeze cement into undesirable injection zone and cover with casing patch or cemented liner.

Procedure

1. Mobilize suitable rig and associated equipment.
 - 1.1. Notify all applicable Local, State & Federal agencies prior to rig up.
 - 1.2. Install direct communications between rig floor, tool pusher and company man.
 - 1.3. Comply with all GRP, NSP, DLNR & UIC permits that pertain to drilling.
 - 1.4. Ensure that the applicable drilling contractors have current well control training.
 - 1.5. Ensure that additional drilling related personnel have been provided with the required safety training.
2. Nipple up BOPE.
3. Kill well and keep water going into hole while working in hole.
4. Pull hang down liner if there is one.
5. Clean out scale.
 - 5.1. Run in hole with bit and stabilizer to fit I.D. of casing. Rotate and circulate as necessary to drill out scale to below area to be cemented.
 - 5.2. If necessary, run in hole with bit and stabilizer to fit I.D. of liner and/or open hole. Rotate and circulate as necessary to drill out scale below area to be cemented.
6. Establish plug below area to be cemented.
 - 6.1a. Run bridge plug and set below area to be cemented,
 - 6.1b. or pump cement plug below area to be cemented
 - 6.1c. or fill hole with sand and cinders to below area to be cemented.
 - 6.2. Check plugback depth and pump cement plug.
7. Squeeze cement.
 - 7.2. Pump squeeze cement across area to be cemented.
 - 7.3. Pressure up as necessary to squeeze cement.
 - 7.4. Wait for cement to set and then run in with bit and clean out cement.

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- 8a. Install casing patch, if necessary
 - 8a.1 Clean out cement and fill to TD
 - 8a.2 Make up casing patch and set across cemented area

 - 8b. or Install liner, if necessary
 - 8b.1 Clean out cement and fill to bottom of liner installation
 - 8b.2 Make up and run liner
 - 8b.3 Cement liner in place, wait for cement to set
 - 8b.4 Clean out cement and fill to TD

 9. Rerun hang down liner, if applicable.

 10. Secure well and rig down.

 11. Comply with all applicable local, state and federal permits prior to placing the well back in service.
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PUNA GEOTHERMAL VENTURE - GENERIC PROGRAM TO PLUG BACK WELLBORE

JANUARY 2, 2017

Objective

Plug back well to seal off undesirable injection zone at bottom of well.

Procedure

1. Mobilize suitable rig and associated equipment.
 - 1.1. Notify all applicable Local, State & Federal agencies prior to rig up.
 - 1.2. Install direct communications between rig floor, tool pusher and company man.
 - 1.3. Comply with all GRP, NSP, DLNR & UIC permits that pertain to drilling.
 - 1.4. Ensure that the applicable drilling contractors have current well control training.
 - 1.5. Ensure that additional drilling related personnel have been provided with the required safety training.
2. Nipple up BOPE.
3. Kill well and keep water going into hole while working in hole.
4. Pull hang down liner if there is one.
5. Clean out scale.
 - 5.1. Run in hole with bit and stabilizer to fit I.D. of casing. Rotate and circulate as necessary to drill out scale as deep as necessary for plug back.
 - 5.2. If necessary, run in hole with bit and stabilizer to fit I.D. of liner and/or open hole. Rotate and circulate as necessary to drill out scale as deep as necessary for plug back.
6. Plugback.
 - 6.1a. Run bridge plug and set below new TD
 - 6.1b. or pump cement plug below new TD
 - 6.1c. or fill hole with sand and cinders to below new TD
 - 6.2. Check plugback depth and pump cement plug above.
9. Rerun hang down liner, if applicable.
10. Secure well and rig down.
11. Comply with all applicable local, state and federal permits prior to placing the well back in service.

Appendix D

Casing Monitoring Program

UIC Permit R9UIC-HI5-FY16-1R

Puna Geothermal Venture

Production and Injection Well Casing Monitoring Program

1. Introduction

1.2 Purpose

The purpose of this CMP is to specify the observations, tests, and drilling operations required to insure that the integrity of production and injection casing remains intact throughout the drilling, testing, and operations of PGV wells. The cemented and hung casing strings that are used in the PGV wells are designed to prevent contamination of shallow aquifers by either reservoir fluid in production wells or power plant effluent in injection wells. Contamination of the shallow aquifers might occur if the casing strings are breached due to corrosion or mechanical failure thus allowing the escape of geothermal brine or injectate to the formation. The casing monitoring program described below is designed to indicate the presence of casing leaks and accurately define their location.

1.3 Scope

This CMP covers all production and injection wells drilled by PGV and all existing wells that were drilled by previous operators on the PGV site which to date have not been plugged and abandoned.

1.4 Hydro geologic Basis for the Casing Monitoring Program

The hydro geologic basis for the CMP is derived from data available from the drilling of wells to depths ranging to 8300' and by three shallow monitoring wells drilled to depths of 640' and 720'. Based on the static temperature profiles, well testing, and behavior of drilling fluid during drilling, it is possible to divide the hydrologic regime in the project area into five major horizontally extensive zones. These zones are reflected in the typical temperature-depth profiles measured in the deep production wells.

- 1.4.1 The shallowest zone extending from surface to about 6' above sea level is unsaturated and consists of a highly permeable sequence of subareal basalt flows and interflow breccias. Within the project area this zone varies in thickness from 600' to 720' depending on the surface elevation. Numerous cracks with widths of up to 2' traverse the area. These cracks are vertical or very steeply dipping and reach from the surface to at least the top of the warm unconfined aquifer described below. This is evidenced by the discharge of warm, moist air from many of these cracks. The cracks trend parallel to the major structures and lineaments of the Lower East Rift Zone.
- 1.4.2 The zone below the unsaturated surface rock consists of an unconfined aquifer which contains relatively fresh ground water with varying degrees of natural contamination from the underlying geothermal system. This zone is approximately 1400' thick with the water surface elevation controlled by sea level according to the Ghyben-Herzberg model. The unconfined aquifer surface in the project area is approximately 7' above mean sea level. Based on that model, the thickness of the low salinity lens is therefore about 280'. This constitutes the USDW. The salinity of the underlying water will probably approach that of sea water. The temperature of this zone ranges from 95 to 130 deg. F in the project area and tends to be nearly isothermal throughout the entire interval indicating good vertical mixing.

1.4.3 The interval from 1400' below sea level to 2400' below sea level is characterized by an extremely steep thermal gradient in the range of 30 deg. F / 100' or more. The steep temperature gradient is characteristic of conductive heat transfer and indicates the zone has essentially zero vertical permeability. The zone appears to be an effective aquitard separating the high temperature geothermal fluid below from the low temperature unconfined aquifer overlying it. Locally the aquitard exhibits natural leakage as in the area of MW-2 and GTW-III where anomalously high shallow ground water temperatures and salinities are observed.

1.4.4 Between the depth interval 2400' and 4300' below sea level, the temperature profile indicates the existence of a transition zone which consists of alternating permeable and impermeable strata. Within this zone are two more alternating zones of high thermal gradients and isothermal intervals. The high average thermal gradient through this zone indicates that vertical fluid circulation is very limited.

1.4.5 Below a depth of 4300' below sea level, the temperature profile becomes nearly isothermal. This intervals within the geothermal reservoir in which significant vertical movement of fluid is taking place at temperatures above 620 deg. F.

The casing program planned for the production and injection wells calls for cemented casing to reach from ground surface to a depth below 3400' below sea level. This allows the casing to be anchored securely within the transition zone described in 1.4.4 and to fully isolate the geothermal reservoir from the shallow aquifer with a cemented interval through the aquitard. Within the shallow aquifer, two cemented casing strings are installed. Three cemented strings pass through the top of the shallow aquifer and the unsaturated zone. The production and injection casing programs are designed to prevent leakage of geothermal fluid from the wellbore into the shallow aquifer above a depth of 1400' below sea level. The CMP discussed below provides the methods and procedures to detect any leakage.

2. Production and injection well casing monitoring program

2.1 Pressure testing during drilling.

Each well is completed with three casing strings cemented to the surface. Immediately upon completion of cementing each string of casing and prior to drilling out the cement shoe, the casing is pressure tested. 30CFR Section 250.55 requires as test of 70% of the casing minimal internal yield pressure or as otherwise approved or required by the District Supervisor. After drilling out the shoe, 30 CFR Section 250.427 requires a pressure integrity test below the surface casing or liner and all intermediate casings or liner. You must test to either the formation leak-off pressure or to an equivalent drilling fluid weight if identified in an approved APD. For PGV, the equivalent drilling fluid weight specified in our drilling programs is the 0.65 psi/ft mud pressure gradient. This is designed to stay below the leak-off pressure in order to avoid weakening the formation. PGV uses the terminology "shoe test" or just simply a "Formation Integrity Test" (FIT). A leak off test (LOT) is different than the FIT, as the LOT tests formation until failure, while the FIT tests the formation up to a predetermined pressure before formation failure. The FIT is the preferred term for wells tests in geothermal fields. The FIT is not a "leak off test" unless it fails and there is leak off. The FIT procedure is performed after the casing has been cemented and the cement drilled out a few feet below the casing shoe. Pressure is applied to the cement and formation below the casing shoe at a pressure gradient that is below any likely fracture pressure gradient. This assures the integrity of the formation and cement at the shoe. During subsequent operations, injection pressure is limited to the same pressure, which ensure that injectate will not go up behind the casing to shallower depths where the fracture pressure is lower or where protected aquifers might be located. PGV does not establish a specific fracture pressure for the basalt formations, because injection pressures during operations are kept well below fracture pressures. Establishing a fracture pressure gradient is generally not necessary in geothermal areas where the formation fluids are at hydrostatic pressure gradient, over-pressured zones do not exist, and high mud weights are not used.

2.2 Monitoring during injection testing

Upon completion of each well an injection test may be performed to give an initial indication of reservoir permeability. The injection test consists of pumping cool fresh water into the wellbore at several controlled rates while monitoring downhole and wellhead pressure. Pressure temperature logs are also run during the test. These logs can be used to locate leaks in the casing by noting a sudden rise in temperature with depth within the casing string. Also a temperature reversal within the casing string that remains after injection is stopped may be indicative of leakage.

2.2.1 Injectivity testing procedure

- Keep constant pumping rates during the entire test.
- Pump at 1/3 maximum pump rate while setting up.
- Run open ended drillpipe into well close to the injection zone and set in pipe rams.
- Rig up slick line unit on drillpipe with a safety valve and lubricator.
- Run sinker bar to maximum reachable depth. Continue pumping at 1/3 max pump rate.
- Run high temperature Kuster PT tool to 10 feet above sinker bar set down depth.
- Pull up to middle of lost circulation zones.
- Wait for 30 minutes.
- Increase pump rate to 2/3 maximum pump rate and pump for 1 hour.
- Increase pump rate to maximum pump rate and pump for 1 hour.
- Stop pumping and wait for 1 hour to record pressure drop off.
- Run PT tool in to 10 feet above sinker bar set down depth, pull PT out of hole at 100 ft/min.

An estimated injectivity index can be calculated into gallons per psi by dividing the maximum flow rate by drop off pressure.

2.3 Monitoring during routine injection

Once annually tests and surveys are conducted on each injection well to verify mechanical integrity of the injection casing and the hangdown liner. Pressure temperature surveys are taken to include a flowing well profile, pressure drop off and static conditions. The resulting pressure and temperature profiles are used to confirm all the injected fluid is exiting at the shoe with no inter formational flows behind the casing. Yearly surveys are kept on file and cross referenced to previous years to verify if any changing or abnormal conditions arise, indicating a loss of integrity of the casing. All testing is sent to an offsite Hydro geologic Service for review. Upon review a report of each well's condition is generated and submitted to agencies including, DLNR, Hawaii Department of Health, and Federal EPA.

2.4 Monitoring of injection liners

Continuous monitoring is performed by purging the annular space between the injection casing and the hangdown liner. Purge pressure and flow rate will be monitored for any change indicative of a casing leak. Leakage in the casing will cause a drop in annular nitrogen pressure. Pressure on the annular space is kept to a calculated pressure to maintain a fluid level below 2000'. Maintaining calculated pressure to depress the fluid level to 2000' insures that injectate will not leak out of the hang down casing, rather nitrogen will leak into any possibly casing leak. Once annually tests and surveys are also conducted to verify mechanical integrity of the casing and hangdown liner.

- 2.4.1 An annual pump down test is performed to depress the fluid level to 3000'. Surface pressure on the annulus and hangdown liner are monitored and recorded for 5 hours with initial readings every 10 minutes for the first hour, followed by 30 minute readings for 4 hours. The maximum allowable leak off rate is 10% during the testing period.
- 2.4.2 An additional test using an Echometer is performed during the pump down test to verify fluid level in the annulus is at 3000'
- 2.4.3 Logging tools are run into the injection well to the maximum depth or a predetermined depth below 3000'. A pressure temperature survey is taken with the well flowing under normal conditions. The well is then shut in with the PT tool below 3000' to record pressure drop off and an initial static profile. A second PT is completed 12 hours after the well has been shut in to identify fluid levels in the wellbore, a pressure profile and temperature build up. This data will identify any abnormal conditions such as fluid communication outside the casing or unusual thermal recovery after injection is stopped.
- 2.4.4 Additional testing such as a camera run or a caliper survey to check for integrity can also be completed to obtain further information if more testing is deemed necessary or desired.

Appendix E

Chemical and Physical Analysis Plan for Injectate Testing

UIC Permit R9UIC-HI5-FY16-1R

EPA will accept analyses and reports as required under Hawaii Department of Health Permit No. UH-1529.

B. MONITORING AND REPORTING CONDITIONS:

1. Injectant and Injection Well Monitoring

(a) Injectant samples, measurements, and analyses taken or conducted as required by this permit shall be valid and representative of the volume and nature of the injectant. Pursuant to the monitoring and reporting conditions of this permit, detailed records of the operation of the injection wells shall be kept by the permittee. When applicable, records shall include at a minimum the following information:

- (1) Type of injectant;
- (2) Quantity of injectant;
- (3) The method of injection;
- (4) Injection pressure;
- (5) The rate of injection;
- (6) The operational status of the injection well;
- (7) The exact date and time of the measurement or sampling;
- (8) The person(s) who performed the measurement or sampling;
- (9) The dates the analyses were performed;
- (10) The person(s) who performed the analyses;
- (11) The analytical techniques or methods used;
- (12) The results of all required analyses and permit limits; and
- (13) Chain of Custody.

(b) A daily record of the injectant quantity (gpd) being discharged into each injection well shall be kept. Injectant quantity recordings shall be continuously made through a direct measurement of the wastestream or by a method approved by the Director. A per month summary giving the daily amounts of injectant for each well shall be submitted **every month** to the Department.

A continuous recording of the injection pressure (psig) and annular pressure at the well head shall be kept. Pressure recordings shall be documented on a graphical chart, such as a strip chart or circular chart, or log that shows the relationship between pressure and elapse time. A per-month summary giving the daily injection and annular pressures for each well shall be submitted **every month** to the Department. The annular pressures shall be compared against the calculated required pressure to maintain the proper depth of the nitrogen/water interface.

A daily record of the injectant temperature being discharged into each injection well shall be maintained. Injectant temperature recordings shall be continuously monitored and recorded. A per-month summary giving the daily average injection temperature for each well shall be submitted **every month** to the Department.

The use of injection supplemental water discharged into the injection wells shall be recorded. The recording shall be directly and continuously made to measure the flow of supplemental water. A per-month summary giving the daily amounts of supplemental water used shall be submitted **every month** to the Department.

Chemical additions being used for corrosion, scale, and biofouling control shall be recorded. The record shall account for the daily, weekly, and monthly consumptive amounts of each chemical. A per-month summary giving the monthly consumptive amount of each chemical shall be submitted **every month** to the Department.

- (c) Representative grab samples (three types: Types I, III, and IV) of the injectant shall be collected from a collection point to be established by the permittee and approved by the Director. The permittee shall collect and analyze the samples and report the analytical results according to the conditions and the Monitoring and Reporting Schedule of this permit. The collection and analysis of the samples shall be conducted by a laboratory acceptable to the Director. If the laboratory is unable to perform the sample collection, the Director may allow the permittee to collect the sample under the direction of the laboratory.

All samples shall be collected, transported, preserved, stored, documented, analyzed, and reported in accordance with EPA or EPA equivalent methods or standards, and all such activities shall be performed properly and satisfactorily in order to produce valid samples and analytical results. The falsification, fabrication, tampering, or improper handling and management of the samples, chain-of-custody form, or analytical results shall be a violation of this permit.

Methods of analysis shall be as stated herein or approved by the Director. The frequency of sample collection and the type of analyses are as described:

Type I Sample:

- (1) Type I sample shall be collected and analyzed at least **once every two months**. A monitoring and reporting schedule is attached that outlines the schedule of analyses and reportings.
- (2) Type I sample shall be analyzed for the test parameters listed in **Table No. 2**.
- (3) Type I sample shall be collected between the hours of 9 a.m. and 3 p.m.
- (4) The analytical results (Type I) shall be submitted to the Department and a copy shall be kept on file at the facility. Analytical results are due within 60 days from the sampling date.

**TABLE NO. 2
 TEST PARAMETERS FOR TYPE I SAMPLE**

Parameter	EPA Method	TCLP Related Action Level (mg/l)
Arsenic (As)	6010/206	5.0
Barium (Ba)	6010/208	100.0
Boron (B)	200	
Cadmium (Cd)	6010/213	1.0
Copper (Cu)	6010/220	
Iron (Fe)	6010/236	
Lead (Pb)	6010/239	5.0
Lithium (Li)	6010/7430	
Magnesium (Mg)	6010/242	
Manganese (Mn)	6010/243	
Mercury (Hg)	7470/245	0.2
Nickel (Ni)	6010/200	
Potassium (K)	6010/258	
Selenium (Se)	6010/270	1.0
Silver (Ag)	6010/272	5.0
Sodium (Na)	6010/273	
Vanadium (V)	6010/286	
Zinc (Zn)	6010/289	
Bromide	320	
Bicarbonate (HCCO3)	310	
Carbonate (CO3)	310	
Chloride	325	
Fluoride	340	
Nitrate (as N)	352	
Nitrite (as N)	354	
Silica, Dissolved (as SiO2)	370	
Sulfate (SO4)	375	
Total Sulfur (S)	various	

Total Alkalinity	310	
Total Dissolved Solids (TDS)	160.1	
Total Suspended Solids (TSS)	160.2	
Oil and Grease	1664	
Specific Conductance	120	
Field pH	150.1	≤ 2 or ≥ 12.5
Field Temperature	170	

Gas Parameter
Ammonia (NH3)
Argon (Ar)
Carbon Dioxide (CO2)
Hydrogen (H2)
Hydrogen Sulfide (H2S)
Methane (CH4)
Nitrogen (N2)
Oxygen (O2)
Radon
N-Pentane

All methods listed are EPA or EPA equivalent, unless otherwise noted.

Type III Sample:

- (1) Type III sample shall be collected and analyzed at least once every six months in conjunction with Type I sample. A monitoring and reporting schedule is attached that outlines the schedule of analyses and reportings.
- (2) Type III sample shall be analyzed for Ignitability, Corrosivity, Reactivity, and Method 1311: Toxicity Characteristic Leaching Procedure (TCLP) as described in 40 CFR, Part 261, Appendix II. Refer to **Table No. 3** which lists the test parameters for which the analysis shall be conducted under Method 1311. Regulatory levels of the chemical parameters are listed for reference.
- (3) Type III samples shall be collected between the hours of 9 a.m. and 3 p.m.
- (4) The analytical results (Type III) shall be submitted to the Department and a copy shall be kept on file at the facility. Analytical results are due within 60 days from the sampling date.

**TABLE NO. 3
 TEST PARAMETERS FOR TYPE III SAMPLE**

Parameter	Regulatory Level	EPA Method
Ignitability		As described in 40 CFR (2012), Part 261.21
Corrosivity		As described in 40 CFR (2012), Part 261.22
Reactivity		As described in 40 CFR (2012), Part 261.23
Inorganics:		Method 1311 (TCLP), with appropriate methods of analyses contained in SW-846
arsenic	5.0	
barium	100.0	
cadmium	1.0	
chromium	5.0	
lead	5.0	
mercury	0.2	
selenium	1.0	
silver	5.0	
Organics:		
benzene	0.5	
carbon tetrachloride	0.5	
chlorobenzene	100.0	
chloroform	6.0	
o-cresol	200.0	
m-cresol	200.0	
p-cresol	200.0	
1,4-dichlorobenzene	7.5	
1,2-dichloroethane	0.5	
1,1-dichloroethylene	0.7	
2,4-dinitrotoluene	0.13	
hexachlorobenzene	0.13	
hexachloro-1,3-butadiene	0.5	
hexachloroethane	3.0	
methyl ethyl ketone	200.0	
nitrobenzene	2.0	
pyridine	5.0	
tetrachloroethylene	0.7	
trichloroethylene	0.5	

2,4,5-trichlorophenol	400.0	
2,4,6-trichlorophenol	2.0	
vinyl chloride	0.2	

Type IV Sample:

- (1) Type IV sample shall be collected and analyzed at least once every six months in conjunction with Type I and III sample. A monitoring and reporting schedule is attached that outlines the schedule of analyses and reportings.
- (2) Type IV sample shall be analyzed for volatile organic compounds as described in 40 CFR, Part 136, Appendix A, Method 624. Refer to **Table No. 4** which lists the test parameters and the analytical methods.
- (3) Type IV sample shall be collected between the hours of 9 a.m. and 3 p.m.
- (4) The analytical results (Type IV) shall be submitted to the Department and a copy shall be kept on file at the facility. Analytical results are due within 60 days from the sampling date.

**TABLE NO. 4
 TEST PARAMETERS FOR TYPE IV SAMPLE**

Parameter	EPA Method	TCLP Related Action Level (mg/l)
Volatile Organics		
Acetone		
Benzene		0.5
Bromodichloromethane		
Bromoform		
Bromomethane		
Carbon Tetrachloride	524/ 624/ 8240/ 8260	0.5
Chlorobenzene		100.0
Chloroethane		
2-Chloroethylvinyl ether		
Chloroform		6.0
Chloromethane		
Dibromochloromethane		
1,2-Dichlorobenzene		
Volatile Organics		
1,3-Dichlorobenzene		
1,4-Dichlorobenzene		7.5
1,1-Dichloroethane		
1,2-Dichloroethane		0.5
1,1-Dichloroethylene	524 /624/ 8240/ 8260	0.7
Trans-1, 2-Dichloroethene		
1,2-Dichloropropane		
cis-1,3-Dichloropropene		
trans-1,3-Dichloropropene		
Ethyl benzene		
Methylene chloride		

Methyl Ethyl Ketone		200.0
1,1,2,2-Tetrachloroethane		
Tetrachloroethene		
Toluene		
1,1,1-Trichloroethane		
1,1,2-Trichloroethane		
Trichloroethene		
Trichlorofluoromethane		
Vinyl Chloride		
Xylene		
Semi-Volatile Organics		
o-cresol		200.0
m-cresol	8270	200.0
p-cresol		200.0
hexachlorobenzene		0.13
Semi-Volatile Organics		
2,4-dinitrotoluene		0.13
hexachloro-1,3-butadiene		0.5
hexachloroethane	8270	3.0
nitrobenzene		2.0
pyridine		5.0
2,4,5-trichlorophenol		400.0
2,4,6-trichlorophenol		2.0

- (d) The collection of Type III and Type IV samples shall be witnessed by DOH personnel unless a waiver to this condition is granted by the Director. The permittee shall notify the DOH at least seven (7) days prior to the date of sample collection for this phase of analysis. Any Type III and Type IV samples that are collected without the acknowledgment and inspection by DOH personnel, unless waived by the Director, will not serve to comply with the monitoring and reporting conditions of this permit.
- (e) Every exceeding of a Regulatory Level concentration shall prompt an immediate (within five days from the time of knowledge of the initial analytical results) resampling for and reanalysis of the particular exceeding test parameter. If a TCLP-related action level is

exceeded, the reanalysis shall be conducted by using Method 1311: TCLP as described in 40 CFR, Part 261, Appendix II. If a TCLP regulatory level is exceeded, the reanalysis shall be conducted by using the same method.

The permittee shall immediately notify the DOH of every exceeding and shall submit the original and follow-up analytical results. The DOH may impose additional conditions.

- (f) A periodic recorded inspection of the injection well system at least once every week shall be conducted by the permittee. The inspection shall include the recordation of the operational status of the injection well system to detect any deterioration of the injection well system and associated operations that might lead to an injection well failure, and provide the opportunity to correct any occurrence of prohibited discharge activity. The person conducting the periodic inspection shall be knowledgeable of what is unlawful disposal of chemical compounds, petroleum products and other hazardous substances into the injection well. If such activities are encountered, the permittee shall take immediate action to alleviate, correct, clean up, and record such disposal incidents. The recorded inspection including any disposal incidents shall be kept at the facility and be made available for inspection by DOH personnel.
- (g) A periodic status report shall be completed at least once every 3 months regarding the condition and performance of the injection well system. The status report shall be made by a professional consultant, engineer, or geologist proficient in injection well performance. The status report shall document the condition and performance of the injection well system in accordance with the DOH's guidelines for an injection well status report. Field inspections and observations for the status report shall be performed at least during the last month of the 3-month monitoring period. A Monitoring and Reporting Schedule is attached that designates the last months of the monitoring periods. The status report shall be submitted to the DOH for review within one month after the end of the designated monitoring period.
- (h) Under applicable conditions, the Director shall have the right to order and direct the permittee to collect and analyze special or unscheduled samples of the injectant or substance in the injection well, or to perform injection well performance or mechanical integrity assessments. Applicable conditions consist of, but are not limited to, accidental discharges, malicious discharges, and undefined discharges into the injection well, as well as indications that the injection well may be under performance or mechanical integrity deterioration. The permittee is required to maintain records of the sample collection, analysis, and assessment in conformance with Part B.1.(a) of this permit.
- (i) Summary reports, results of scheduled chemical analyses, inspection reports, mechanical integrity reports, or hydrologic monitoring reports shall be submitted to the Department within 60 days after the end of the designated monitoring period for which the submittal applies. Submittals taking longer than 60 days are noncompliant with the 60 day time limit unless a time extension is granted by the Director based on circumstances for the delay.

Appendix F

Well Testing and Logging

UIC Permit R9UIC-HI5-FY16-1R

TITLE: Mechanical Integrity Testing

Revision #: 3
Date of Current Rev:
By: GD
Last Rev: 7/2/21

Procedure Mechanical Integrity Testing

Possible means of proving mechanical integrity of a geothermal well:

1. Make a sinker bar run using a sinker bar with a larger o.d. than p/t tools.
 - a. Run In Hole (RIH) to ~ 3000' to ensure that well bore is open.
 - b. RIH @ a slow rate ~ 100'/min. to minimize the chance of getting hung up.

2. Perform pressure temperature (p/t) survey to desired depth ~3000'.
 - a. This will determine static fluid level in the well bore.
 - b. This will also identify abnormal bottom hole pressures and temperatures.

- 2a. Schedule for running MIT's.
 - a. Run tools into well at 120 feet per minute. Hang tool 10' above set down or at pre-determined setting.
 - b. Wait on bottom 90 minutes after all injection has been stopped after shut-in, to record pressure drop off. Pull tools out of hole at 120 feet per minute to record initial static conditions.
 - c. Include all relevant well information into the log header, including well name, location, elevation, survey name, shut in time and logging speed. Include a column for the pressure gradient throughout the well.
 - d. Run 2nd log 12 hours after shut-in to record temperature build up and pressure stabilization.
 - e. In areas of the survey that show any anomalies, include a chart of the specific area to determine any changes more easily in the well.
 - f. If abnormal conditions are observed on second log, run 3rd log 36 hours after shut-in.
 - g. If an abnormal condition is noted with the third log utilize the N2 drop test for further evaluation and refer to step 4 for further well diagnostics.
 - h. Reference Lithology logs and previous surveys for changes in well conditions

3. Perform Nitrogen (N2) pressure test on well bore casing after well is returned to service following well surveys.
 - a. Use specific well calculation sheet for pressure needed to depress fluid to 3000'.
 - b. Use pressure gauge and chart recorder to monitor pressure losses.
 - c. Pump nitrogen into the annular space between the production casing and hang down liner.
 - d. When calculated pressure is achieved complete 5 hour drop test per written Operations procedure.
 - e. Check all surface equipment for leaks during this evolution.

Note: If the above tests pass satisfactorily, it may be considered by some to have acceptable integrity. If not, additional testing could possibly be as follows but not limited to.

4. Further evaluation or abnormal conditions from MIT
 - a) RIH with a gauge ring and allow ~ 1” clearance to Inner Diameter (ID) of casing. Note: Bottom hole temperatures must be within the ratings of the tools, utilize fresh water into the well to maintain temperature limits.
 - b) Cool well down with water, relieve nitrogen pressure from hang down liner annulus and change over water from the hang down liner to the annulus to keep well cool and remove cascading water inside the liner. Run a temperature survey to confirm well temperatures are within the range of the tools. Run a camera to the extent of the liner.
 - c) RIH with a multi finger caliper to desired depth and log ID of casing while Pulling Out of Hole (POOH). Include a casing collar locator.
 - d) Run a bond log to ensure the cement on the back side of the casing has good integrity.
 - e) Additional logging using BAT may be performed to obtain further information if so desired,

Note: For all logging evolutions refer to the P.G.V. procedure for “Logging Wells”

Appendix G

Hydrologic Monitoring Program

UIC Permit R9UIC-HI5-FY16-1R

PUNA GEOTHERMAL VENTURE
HYDROLOGIC MONITORING PROGRAM

June 2021

Sampling Locations: The following wells will be monitored.

<u>Well Name</u>	<u>Elevation (MSL)</u>	<u>Completion Depth (MSL)</u>
MW-4	716.93	-3.42
MW-5	716.93	-3.42
MW-6 (Lippe Well)	300	-2

Frequency: Regular sampling shall occur twice a year, once in January and once in July.

Water Level Measurements: Prior to bailing or pumping the well and sampling, water level measurements will be taken and recorded. The permittee can use an Echo Meter or similar device, or an electronic direct contact detection probe with a calibrated cable/tape for direct measurement at the top of the well casing. Calibrated cable/tape length shall be sufficient to measure water levels in the deepest wells. The metering device shall be equipped with an audible signal and light to indicate water level contact.

Quality Assurance/Quality Control: Quality assurance/quality control procedures will follow standards of practice for similar programs relative to the acquisition, reduction, verification, and validation of the site data. At each location, standardized equipment cleaning will be conducted prior to obtaining each sample.

Prior to ground water sampling, the well will be bailed or pumped at least three times the wellbore volume.

All samples will be taken, and field analyses conducted in accordance with standard protocols approved by the EPA. An EPA or State of Hawaii certified laboratory will be used to conduct the analyses for samples submitted. Samples will be transferred from the sampling device directly to appropriately prepared containers supplied by the laboratory. Samples will be labeled, stored, and transported in a chilled state in insulated containers to the laboratory.

In the analyses, detection limits will be used that are below maximum contaminant levels. If they are not, the sampling and analyses will be repeated using the proper detection limits.

The contractor will provide a copy of their Quality Assurance program to DOH and EPA for review and approval.

Physical and Chemical Parameters:

Field analyses will include:

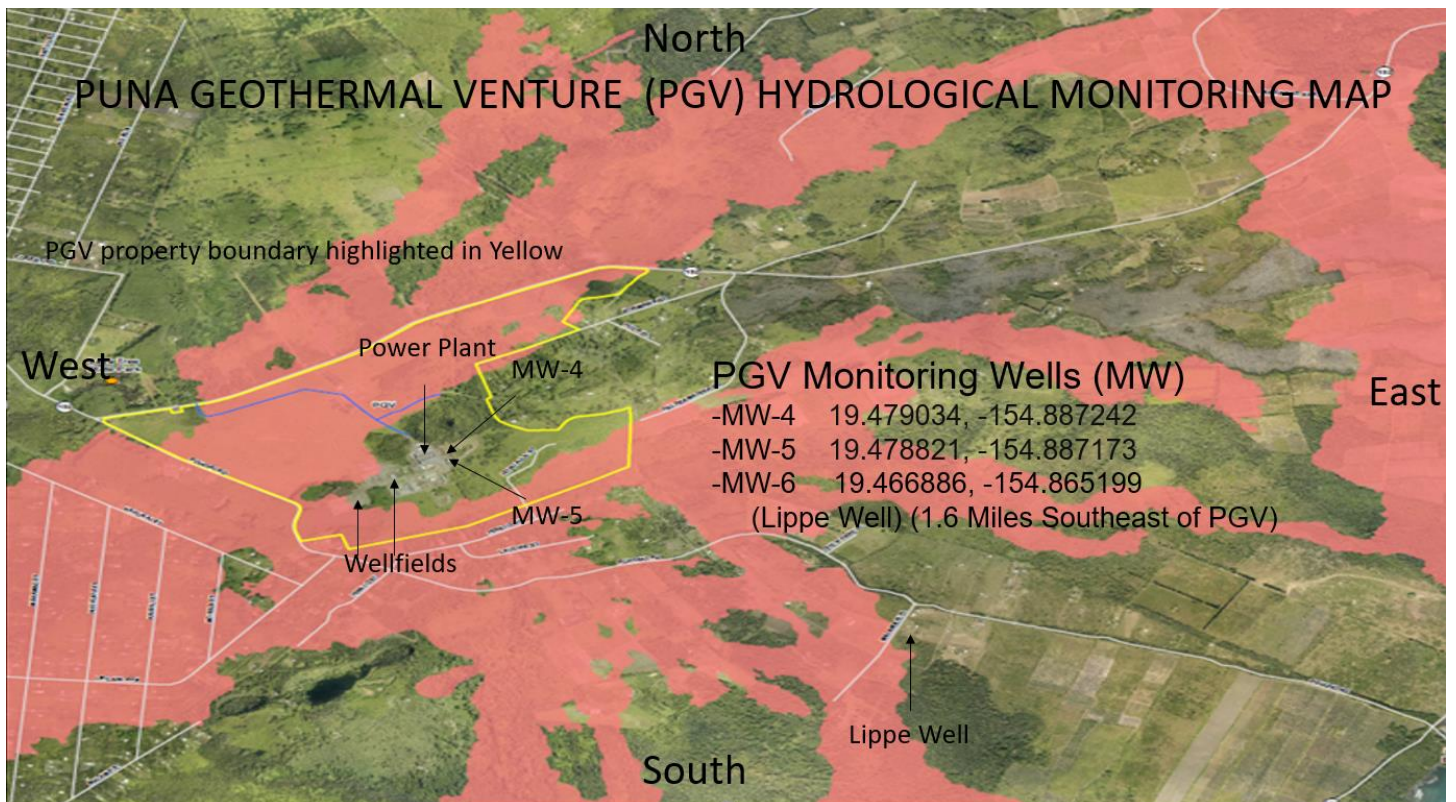
General and Physical Parameters
Temperature
Salinity
Bicarbonate
Inorganic Compounds
Arsenic
Barium
Alkalinity
Boron
Bromide
Cadmium
Calcium
Chloride
Chromium
Copper
Cyanide
Fluoride
Iron
Lead
Lithium
Magnesium
Mercury
Nickel
Nitrate Nitrogen
Potassium
Selenium
Silica
Silver
Sodium
Sulfate
Sulfur, Total
Sulfide, Reactive
Vanadium
Zinc
Conductivity ($\mu\text{S}/\text{cm}$)
Ignitability ("F)
pH (units)
TDS
Organic Compounds
Benzene
Carbon Tetrachloride
Chlorobenzene
1,2-Dichloroethane
Cis-1,2 Dichloroethene
Trans-1,2 Dichloroethene
1,2 Dichloropropane
1,1-Dichloroethylene
Ethylbenzene
hexachlorobenzene
Pentane
Isopropanol

These measurements will be obtained by using calibrated instruments specifically designed to directly measure these physical and chemical parameters within the operational constraints dictated by site conditions.

Reporting: Sampling results and measurements will be submitted during the February following the January sampling, and the August following the July sampling. Original laboratory reports will be included with a cover letter. Reporting units shall be specified. The laboratory shall not use text descriptions, such as "Below Regulatory Limits" or "BRL", in its reporting, but rather, the actual numerical results will be reported. If the actual numerical results are not reported, the sampling and analysis will be redone until numerical results are reported.

Further Monitoring: If leakage of the injectate into the USDW is suspected, the ground water sampling may be modified and sampling for certain analytes and more frequent sampling will be performed.

PGV Map of Monitoring Wells



Appendix H

Chemical Additives

UIC Permit R9UIC-HI5-FY16-1R

Note: Some of these generic products may not be currently used but are approved for use if needed.

Appendix H- Chemical Additives

<u>Product Function</u>	<u>Active Chemical Ingredient</u>	<u>Maximum Injection Concentration(ppm)</u>
<u>Corrosion Inhibitor/Oxygen Scavenger</u>	<u>Sodium Sulfite Salt (10% solution)</u>	<u>15</u>
<u>Corrosion Inhibitor</u>	<u>Filming Amine (<30% solution)</u>	<u>30</u>
<u>Corrosion Inhibitor</u>	<u>Filming Amine Chloride Salt (<30% solution)</u>	<u>30</u>
<u>Corrosion Inhibitor</u>	<u>Filming Amine Acid (<30% solution)</u>	<u>30</u>
<u>Corrosion Inhibitor</u>	<u>Soya Amine Poly (<30% solution)</u>	<u>30</u>
<u>Anti-Scalant/pH adjustor</u>	<u>Sulfuric Acid</u>	<u>3</u>
<u>Anti-Scalant</u>	<u>Phosponate (<30% solution)</u>	<u>15</u>
<u>pH adjustor and H2S Abator</u>	<u>Sodium Hydroxide</u>	<u>3</u>
<u>Microbiocide</u>	<u>Isothiazoline</u>	<u>1</u>
<u>Barrier Oil</u>	<u>Lubricant Oil</u>	<u>1</u>

Appendix I

Plugging and Abandonment Plans

UIC Permit R9UIC-HI5-FY16-1R

United States Environmental Protection Agency



WELL REWORK RECORD, PLUGGING AND ABANDONMENT PLAN, OR PLUGGING AND ABANDONMENT AFFIDAVIT

Name and Address, Phone Number and/or Email of Permittee

Puna Geothermal Venture
 14-3860 Kapoho Paho Road, Paho, HI 96778
 Jordan Hara jhara@ormat.com 808-896-8551

Permit or EPA ID Number HI596002	API Number 	Full Well Name Kapoho State (KS) 1A
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State Hawaii	County Hawaii
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Locate well in two directions from nearest lines of quarter section and drilling unit

Latitude Longitude

Surface Location

1/4 of 1/4 of Section Township Range

ft. from (N/S) Line of quarter section
 ft. from (E/W) Line of quarter section.

Well Class	Timing of Action (pick one)	Type of Action (pick one)
<input type="checkbox"/> Class I <input type="checkbox"/> Class II <input type="checkbox"/> Class III <input checked="" type="checkbox"/> Class V	<input checked="" type="checkbox"/> Notice Prior to Work Date Expected to Commence <input type="text" value="TBD"/> <input type="checkbox"/> Report After Work Date Work Ended <input type="text"/>	<input type="checkbox"/> Well Rework <input checked="" type="checkbox"/> Plugging and Abandonment <input type="checkbox"/> Conversion to a Non-Injection Well

Provide a narrative description of the work planned to be performed, or that was performed. Use additional pages as necessary. See instructions.

Plug and Abandonment Plan.

1. Move in suitable rig and associated equipment.
2. Install BOPE suitable for maximum expected pressures.
3. Remove any tubing or hang-down liner.
4. Fill high permeability injection zone with rocks, gravel and sand.
5. Place 200 linear feet of 15 ppg geothermal cement on top of sand. Wait on cement, tag cement, and place more cement if necessary for 200 foot cement plug.
6. Fill hole with 9 ppg bentonite mud from top of cement to next casing shoe.
7. Place 200 linear feet of 15 ppg geothermal cement across each casing shoe with 9 ppg bentonite mud between cement plugs.
8. Place 15 ppg geothermal cement from 170 feet to surface.
9. Remove BOPE.
10. Cut off casing below casing head.
11. Weld plate on casing with well name and date.
12. Rig down.

Certification

I certify under the penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. (Ref. 40 CFR § 144.32)

Name and Official Title (Please type or print) Jordan Hara, Plant Manager	Signature 	Date Signed 1-16-2020
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United States Environmental Protection Agency



WELL REWORK RECORD, PLUGGING AND ABANDONMENT PLAN, OR PLUGGING AND ABANDONMENT AFFIDAVIT

Name and Address, Phone Number and/or Email of Permittee

Puna Geothermal Venture
 14-3860 Kapoho Pahoa Road, Pahoa, HI 96778
 Jordan Hara jhara@ormat.com 808-896-8551

Permit or EPA ID Number HI596002	API Number 	Full Well Name Kapoho State (KS) 3
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State Hawaii	County Hawaii
------------------------	-------------------------

Locate well in two directions from nearest lines of quarter section and drilling unit Latitude

Surface Location Longitude

1/4 of 1/4 of Section Township Range

ft. from (N/S) Line of quarter section

ft. from (E/W) Line of quarter section.

Well Class	Timing of Action (pick one)	Type of Action (pick one)
<input type="checkbox"/> Class I <input type="checkbox"/> Class II <input type="checkbox"/> Class III <input checked="" type="checkbox"/> Class V	<input checked="" type="checkbox"/> Notice Prior to Work Date Expected to Commence <input type="text" value="TBD"/> <input type="checkbox"/> Report After Work Date Work Ended <input type="text"/>	<input type="checkbox"/> Well Rework <input checked="" type="checkbox"/> Plugging and Abandonment <input type="checkbox"/> Conversion to a Non-Injection Well

Provide a narrative description of the work planned to be performed, or that was performed. Use additional pages as necessary. See instructions.

Plug and Abandonment Plan.

1. Move in suitable rig and associated equipment.
2. Install BOPE suitable for maximum expected pressures.
3. Remove any tubing or hang-down liner.
4. Fill high permeability injection zone with rocks, gravel and sand.
5. Place 200 linear feet of 15 ppg geothermal cement on top of sand. Wait on cement, tag cement, and place more cement if necessary for 200 foot cement plug.
6. Fill hole with 9 ppg bentonite mud from top of cement to next casing shoe.
7. Place 200 linear feet of 15 ppg geothermal cement across each casing shoe with 9 ppg bentonite mud between cement plugs.
8. Place 15 ppg geothermal cement from 170 feet to surface.
9. Remove BOPE.
10. Cut off casing below casing head.
11. Weld plate on casing with well name and date.
12. Rig down.

Certification

I certify under the penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. (Ref. 40 CFR § 144.32)

Name and Official Title (Please type or print) Jordan Hara, Plant Manager	Signature 	Date Signed <input type="text" value="1-16-2020"/>
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United States Environmental Protection Agency



WELL REWORK RECORD, PLUGGING AND ABANDONMENT PLAN, OR PLUGGING AND ABANDONMENT AFFIDAVIT

Name and Address, Phone Number and/or Email of Permittee

Puna Geothermal Venture
14-3860 Kapoho Paho Road, Paho, HI 96778
Jordan Hara jhara@ormat.com 808-896-8551

Permit or EPA ID Number HI596002	API Number	Full Well Name Kapoho State (KS) 11
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State Hawaii	County Hawaii
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Locate well in two directions from nearest lines of quarter section and drilling unit

Latitude

Surface Location

1/4 of 1/4 of Section Township Range

Longitude

ft. from (N/S) Line of quarter section

ft. from (E/W) Line of quarter section.

Well Class	Timing of Action (pick one)	Type of Action (pick one)
<input type="checkbox"/> Class I <input type="checkbox"/> Class II <input type="checkbox"/> Class III <input checked="" type="checkbox"/> Class V	<input checked="" type="checkbox"/> Notice Prior to Work Date Expected to Commence <input style="width: 100px;" type="text" value="TBD"/> <input type="checkbox"/> Report After Work Date Work Ended <input style="width: 150px;" type="text"/>	<input type="checkbox"/> Well Rework <input checked="" type="checkbox"/> Plugging and Abandonment <input type="checkbox"/> Conversion to a Non-Injection Well

Provide a narrative description of the work planned to be performed, or that was performed. Use additional pages as necessary. See instructions.

Plug and Abandonment Plan.

1. Move in suitable rig and associated equipment.
2. Install BOPE suitable for maximum expected pressures.
3. Remove any tubing or hang-down liner.
4. Fill high permeability injection zone with rocks, gravel and sand.
5. Place 200 linear feet of 15 ppg geothermal cement on top of sand. Wait on cement, tag cement, and place more cement if necessary for 200 foot cement plug.
6. Fill hole with 9 ppg bentonite mud from top of cement to next casing shoe
7. Place 200 linear feet of 15 ppg geothermal cement across each casing shoe with 9 ppg bentonite mud between cement plugs.
8. Place 15 ppg geothermal cement from 170 feet to surface.
9. Remove BOPE.
10. Cut off casing below casing head.
11. Weld plate on casing with well name and date.
12. Rig down.

Certification

I certify under the penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. (Ref. 40 CFR § 144.32)

Name and Official Title (Please type or print) Jordan Hara, Plant Manager	Signature 	Date Signed <input style="width: 100px;" type="text" value="1-16-2020"/>
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United States Environmental Protection Agency



WELL REWORK RECORD, PLUGGING AND ABANDONMENT PLAN, OR PLUGGING AND ABANDONMENT AFFIDAVIT

Name and Address, Phone Number and/or Email of Permittee

Puna Geothermal Venture
 14-3860 Kapoho Paho Road, Paho, HI 96778
 Jordan Hara jhara@ormat.com 808-896-8551

Permit or EPA ID Number HI596002	API Number 	Full Well Name Kapoho State (KS) 13
--	-----------------------	---

State Hawaii	County Hawaii
------------------------	-------------------------

Locate well in two directions from nearest lines of quarter section and drilling unit

Latitude Longitude

Surface Location

1/4 of 1/4 of Section Township Range

ft. from (N/S) Line of quarter section
 ft. from (E/W) Line of quarter section.

Well Class	Timing of Action (pick one)	Type of Action (pick one)
<input type="checkbox"/> Class I <input type="checkbox"/> Class II <input type="checkbox"/> Class III <input checked="" type="checkbox"/> Class V	<input checked="" type="checkbox"/> Notice Prior to Work Date Expected to Commence <input type="text" value="TBD"/> <input type="checkbox"/> Report After Work Date Work Ended <input type="text"/>	<input type="checkbox"/> Well Rework <input checked="" type="checkbox"/> Plugging and Abandonment <input type="checkbox"/> Conversion to a Non-Injection Well

Provide a narrative description of the work planned to be performed, or that was performed. Use additional pages as necessary. See instructions.

Plug and Abandonment Plan.

1. Move in suitable rig and associated equipment.
2. Install BOPE suitable for maximum expected pressures.
3. Remove any tubing or hang-down liner.
4. Fill high permeability injection zone with rocks, gravel and sand.
5. Place 200 linear feet of 15 ppg geothermal cement on top of sand. Wait on cement, tag cement, and place more cement if necessary for 200 foot cement plug.
6. Fill hole with 9 ppg bentonite mud from top of cement to next casing shoe.
7. Place 200 linear feet of 15 ppg geothermal cement across each casing shoe with 9 ppg bentonite mud between cement plugs.
8. Place 15 ppg geothermal cement from 170 feet to surface.
9. Remove BOPE.
10. Cut off casing below casing head.
11. Weld plate on casing with well name and date.
12. Rig down.

Certification

I certify under the penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. (Ref. 40 CFR § 144.32)

Name and Official Title (Please type or print) Jordan Hara, Plant Manager	Signature 	Date Signed <input type="text" value="1-16-2020"/>
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United States Environmental Protection Agency



WELL REWORK RECORD, PLUGGING AND ABANDONMENT PLAN, OR PLUGGING AND ABANDONMENT AFFIDAVIT

Name and Address, Phone Number and/or Email of Permittee
 Puna Geothermal Venture
 14-3860 Kapoho Paho Road, Paho, HI 96778
 Jordan Hara jhara@ormat.com 808-896-8551

Permit or EPA ID Number HI596002	API Number 	Full Well Name Kapoho State (KS) 15
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State Hawaii	County Hawaii
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Locate well in two directions from nearest lines of quarter section and drilling unit

Latitude Longitude

Surface Location

1/4 of 1/4 of Section Township Range

ft. from (N/S) Line of quarter section
 ft. from (E/W) Line of quarter section.

Well Class	Timing of Action (pick one)	Type of Action (pick one)
<input type="checkbox"/> Class I <input type="checkbox"/> Class II <input type="checkbox"/> Class III <input checked="" type="checkbox"/> Class V	<input checked="" type="checkbox"/> Notice Prior to Work Date Expected to Commence <input type="text" value="TBD"/> <input type="checkbox"/> Report After Work Date Work Ended <input type="text"/>	<input type="checkbox"/> Well Rework <input checked="" type="checkbox"/> Plugging and Abandonment <input type="checkbox"/> Conversion to a Non-Injection Well

Provide a narrative description of the work planned to be performed, or that was performed. Use additional pages as necessary. See instructions.

Plug and Abandonment Plan.

1. Move in suitable rig and associated equipment.
2. Install BOPE suitable for maximum expected pressures.
3. Remove any tubing or hang-down liner.
4. Fill high permeability injection zone with rocks, gravel and sand.
5. Place 200 linear feet of 15 ppg geothermal cement on top of sand. Wait on cement, tag cement, and place more cement if necessary for 200 foot cement plug.
6. Fill hole with 9 ppg bentonite mud from top of cement to next casing shoe.
7. Place 200 linear feet of 15 ppg geothermal cement across each casing shoe with 9 ppg bentonite mud between cement plugs.
8. Place 15 ppg geothermal cement from 170 feet to surface.
9. Remove BOPE.
10. Cut off casing below casing head.
11. Weld plate on casing with well name and date.
12. Rig down.

Certification

I certify under the penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. (Ref. 40 CFR § 144.32)

Name and Official Title (Please type or print) Jordan Hara, Plant Manager	Signature 	Date Signed <input type="text" value="1-16-2020"/>
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United States Environmental Protection Agency



**WELL REWORK RECORD, PLUGGING AND ABANDONMENT PLAN,
OR PLUGGING AND ABANDONMENT AFFIDAVIT**

Name and Address, Phone Number and/or Email of Permittee
 Puna Geothermal Venture
 14-3860 Kapoho Pahoa Road, Pahoa, HI 96778
 Jordan Hara jhara@ormat.com 808-896-8551

Permit or EPA ID Number HI596002	API Number	Full Well Name Kapoho State (KS) 17
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State Hawaii	County Hawaii
------------------------	-------------------------

Locate well in two directions from nearest lines of quarter section and drilling unit Latitude

Surface Location Longitude

1/4 of 1/4 of Section Township Range

ft. from (N/S) Line of quarter section

ft. from (E/W) Line of quarter section.

Well Class	Timing of Action (pick one)	Type of Action (pick one)
<input type="checkbox"/> Class I	<input checked="" type="checkbox"/> Notice Prior to Work Date Expected to Commence <input type="text" value="TBD"/>	<input type="checkbox"/> Well Rework
<input type="checkbox"/> Class II		<input checked="" type="checkbox"/> Plugging and Abandonment
<input type="checkbox"/> Class III	<input type="checkbox"/> Report After Work Date Work Ended <input type="text"/>	<input type="checkbox"/> Conversion to a Non-Injection Well
<input checked="" type="checkbox"/> Class V		

Provide a narrative description of the work planned to be performed, or that was performed. Use additional pages as necessary. See instructions.

Plug and Abandonment Plan.

1. Move in suitable rig and associated equipment.
2. Install BOPE suitable for maximum expected pressures.
3. Remove any tubing or hang-down liner.
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6. Fill hole with 9 ppg bentonite mud from top of cement to next casing shoe.
7. Place 200 linear feet of 15 ppg geothermal cement across each casing shoe with 9 ppg bentonite mud between cement plugs.
8. Place 15 ppg geothermal cement from 170 feet to surface.
9. Remove BOPE.
10. Cut off casing below casing head.
11. Weld plate on casing with well name and date.
12. Rig down.

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Name and Official Title (Please type or print) Jordan Hara, Plant Manager	Signature 	Date Signed <input type="text" value="1-16-2020"/>
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United States Environmental Protection Agency



WELL REWORK RECORD, PLUGGING AND ABANDONMENT PLAN, OR PLUGGING AND ABANDONMENT AFFIDAVIT

Name and Address, Phone Number and/or Email of Permittee

Puna Geothermal Venture
 14-3860 Kapoho Paho Road, Paho, HI 96778
 Jordan Hara jhara@ormat.com 808-896-8551

Permit or EPA ID Number HI596002	API Number 	Full Well Name Kapoho State (KS) 18
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State Hawaii	County Hawaii
------------------------	-------------------------

Locate well in two directions from nearest lines of quarter section and drilling unit Latitude

Surface Location Longitude

1/4 of 1/4 of Section Township Range

ft. from (N/S) Line of quarter section

ft. from (E/W) Line of quarter section.

Well Class	Timing of Action (pick one)	Type of Action (pick one)
<input type="checkbox"/> Class I <input type="checkbox"/> Class II <input type="checkbox"/> Class III <input checked="" type="checkbox"/> Class V	<input checked="" type="checkbox"/> Notice Prior to Work Date Expected to Commence <input type="text" value="TBD"/> <input type="checkbox"/> Report After Work Date Work Ended <input type="text"/>	<input type="checkbox"/> Well Rework <input checked="" type="checkbox"/> Plugging and Abandonment <input type="checkbox"/> Conversion to a Non-Injection Well

Provide a narrative description of the work planned to be performed, or that was performed. Use additional pages as necessary. See Instructions.

Plug and Abandonment Plan.

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7. Place 200 linear feet of 15 ppg geothermal cement across each casing shoe with 9 ppg bentonite mud between cement plugs.
8. Place 15 ppg geothermal cement from 170 feet to surface.
9. Remove BOPE.
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Name and Official Title (Please type or print) Jordan Hara, Plant Manager	Signature 	Date Signed <input type="text" value="1-16-2020"/>
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United States Environmental Protection Agency



WELL REWORK RECORD, PLUGGING AND ABANDONMENT PLAN, OR PLUGGING AND ABANDONMENT AFFIDAVIT

Name and Address, Phone Number and/or Email of Permittee

Puna Geothermal Venture
 14-3860 Kapoho Paho Road, Paho, HI 96778
 Jordan Hara jhara@ormat.com 808-896-8551

Permit or EPA ID Number HI596002	API Number 	Full Well Name Kapoho State (KS) 19
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State Hawaii	County Hawaii
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Locate well in two directions from nearest lines of quarter section and drilling unit Latitude

Surface Location Longitude

1/4 of 1/4 of Section Township Range

ft. from (N/S) Line of quarter section

ft. from (E/W) Line of quarter section.

Well Class	Timing of Action (pick one)	Type of Action (pick one)
<input type="checkbox"/> Class I <input type="checkbox"/> Class II <input type="checkbox"/> Class III <input checked="" type="checkbox"/> Class V	<input checked="" type="checkbox"/> Notice Prior to Work Date Expected to Commence <input type="text" value="TBD"/> <input type="checkbox"/> Report After Work Date Work Ended <input type="text"/>	<input type="checkbox"/> Well Rework <input checked="" type="checkbox"/> Plugging and Abandonment <input type="checkbox"/> Conversion to a Non-Injection Well

Provide a narrative description of the work planned to be performed, or that was performed. Use additional pages as necessary. See instructions.

Plug and Abandonment Plan.

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2. Install BOPE suitable for maximum expected pressures.
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7. Place 200 linear feet of 15 ppg geothermal cement across each casing shoe with 9 ppg bentonite mud between cement plugs.
8. Place 15 ppg geothermal cement from 170 feet to surface.
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Name and Official Title (Please type or print) Jordan Hara, Plant Manager	Signature 	Date Signed <input type="text" value="1-16-2020"/>
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United States Environmental Protection Agency



WELL REWORK RECORD, PLUGGING AND ABANDONMENT PLAN, OR PLUGGING AND ABANDONMENT AFFIDAVIT

Name and Address, Phone Number and/or Email of Permittee

Puna Geothermal Venture
14-3860 Kapoho Pahoia Road, Pahoia, HI 96778
Jordan Hara jhara@ormat.com 808-896-8551

Permit or EPA ID Number

HI596002

API Number

Full Well Name

Kapoho State (KS) 20

State

Hawaii

County

Hawaii

Locate well in two directions from nearest lines of quarter section and drilling unit

Latitude 19°28'36.6343"N

Surface Location

Longitude 154°53'28.2182"W

 1/4 of 1/4 of Section Township Range
 ft. from (N/S) Line of quarter section

 ft. from (E/W) Line of quarter section.

Well Class

Timing of Action (pick one)

Type of Action (pick one)

 Class I Notice Prior to Work Well Rework Class II

Date Expected to Commence TBD

 Plugging and Abandonment Class III Report After Work Conversion to a Non-injection Well Class VDate Work Ended

Provide a narrative description of the work planned to be performed, or that was performed. Use additional pages as necessary. See instructions.

Plug and Abandonment Plan.

1. Move in suitable rig and associated equipment.
2. Install BOPE suitable for maximum expected pressures.
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8. Place 15 ppg geothermal cement from 170 feet to surface.
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Name and Official Title (Please type or print)

Jordan Hara, Plant Manager

Signature

Date Signed

11-6-2020

United States Environmental Protection Agency



WELL REWORK RECORD, PLUGGING AND ABANDONMENT PLAN, OR PLUGGING AND ABANDONMENT AFFIDAVIT

Name and Address, Phone Number and/or Email of Permittee

Puna Geothermal Venture
 14-3860 Kapoho Paho Road, Paho, HI 96778
 Jordan Hara jhara@ormat.com 808-896-8551

Permit or EPA ID Number HI596002	API Number 	Full Well Name Kapoho State (KS) 21
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State Hawaii	County Hawaii
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Locate well in two directions from nearest lines of quarter section and drilling unit Latitude

Surface Location Longitude

1/4 of 1/4 of Section Township Range

ft. from (N/S) Line of quarter section

ft. from (E/W) Line of quarter section.

Well Class	Timing of Action (pick one)	Type of Action (pick one)
<input type="checkbox"/> Class I <input type="checkbox"/> Class II <input type="checkbox"/> Class III <input checked="" type="checkbox"/> Class V	<input checked="" type="checkbox"/> Notice Prior to Work Date Expected to Commence <input type="text" value="TBD"/> <input type="checkbox"/> Report After Work Date Work Ended <input type="text"/>	<input type="checkbox"/> Well Rework <input checked="" type="checkbox"/> Plugging and Abandonment <input type="checkbox"/> Conversion to a Non-Injection Well

Provide a narrative description of the work planned to be performed, or that was performed. Use additional pages as necessary. See instructions.

Plug and Abandonment Plan.

1. Move in suitable rig and associated equipment.
2. Install BOPE suitable for maximum expected pressures.
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12. Rig down.

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Name and Official Title (Please type or print) Jordan Hara, Plant Manager	Signature 	Date Signed 1-16-2020
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United States Environmental Protection Agency



WELL REWORK RECORD, PLUGGING AND ABANDONMENT PLAN, OR PLUGGING AND ABANDONMENT AFFIDAVIT

Name and Address, Phone Number and/or Email of Permittee

Puna Geothermal Venture
14-3860 Kapoho Paho Road, Paho, HI 96778
Jordan Hara jhara@ormat.com 808-896-8551

Permit or EPA ID Number HI596002	API Number 	Full Well Name Kapoho State (KS) 22
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State Hawaii	County Hawaii
------------------------	-------------------------

Locate well in two directions from nearest lines of quarter section and drilling unit Latitude

Surface Location Longitude

1/4 of 1/4 of Section Township Range

ft. from (N/S) Line of quarter section

ft. from (E/W) Line of quarter section.

Well Class	Timing of Action (pick one)	Type of Action (pick one)
<input type="checkbox"/> Class I <input type="checkbox"/> Class II <input type="checkbox"/> Class III <input checked="" type="checkbox"/> Class V	<input checked="" type="checkbox"/> Notice Prior to Work Date Expected to Commence <input type="text" value="TBD"/> <input type="checkbox"/> Report After Work Date Work Ended <input type="text"/>	<input type="checkbox"/> Well Rework <input checked="" type="checkbox"/> Plugging and Abandonment <input type="checkbox"/> Conversion to a Non-Injection Well

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Plug and Abandonment Plan.

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8. Place 15 ppg geothermal cement from 170 feet to surface.
9. Remove BOPE.
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12. Rig down.

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Name and Official Title (Please type or print) Jordan Hara, Plant Manager	Signature 	Date Signed 1-16-2020
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United States Environmental Protection Agency



WELL REWORK RECORD, PLUGGING AND ABANDONMENT PLAN, OR PLUGGING AND ABANDONMENT AFFIDAVIT

Name and Address, Phone Number and/or Email of Permittee

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 14-3860 Kapoho Paho Road, Paho, HI 96778
 Jordan Hara jhara@ormat.com 808-896-8551

Permit or EPA ID Number HI596002	API Number 	Full Well Name Kapoho State (KS) 23
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State Hawaii	County Hawaii
------------------------	-------------------------

Locate well in two directions from nearest lines of quarter section and drilling unit Latitude

Surface Location Longitude

1/4 of 1/4 of Section Township Range

ft. from (N/S) Line of quarter section

ft. from (E/W) Line of quarter section.

Well Class	Timing of Action (pick one)	Type of Action (pick one)
<input type="checkbox"/> Class I <input type="checkbox"/> Class II <input type="checkbox"/> Class III <input checked="" type="checkbox"/> Class V	<input checked="" type="checkbox"/> Notice Prior to Work Date Expected to Commence <input type="text" value="TBD"/> <input type="checkbox"/> Report After Work Date Work Ended <input type="text"/>	<input type="checkbox"/> Well Rework <input checked="" type="checkbox"/> Plugging and Abandonment <input type="checkbox"/> Conversion to a Non-Injection Well

Provide a narrative description of the work planned to be performed, or that was performed. Use additional pages as necessary. See instructions.

Plug and Abandonment Plan.

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Name and Official Title (Please type or print) Jordan Hara, Plant Manager	Signature 	Date Signed 1-16-2020
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United States Environmental Protection Agency



WELL REWORK RECORD, PLUGGING AND ABANDONMENT PLAN, OR PLUGGING AND ABANDONMENT AFFIDAVIT

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 14-3860 Kapoho Pahoa Road, Pahoa, HI 96778
 Jordan Hara jhara@ormat.com 808-896-8551

Permit or EPA ID Number HI596002	API Number 	Full Well Name Kapoho State (KS) 24
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State Hawaii	County Hawaii
------------------------	-------------------------

Locate well in two directions from nearest lines of quarter section and drilling unit Latitude

Surface Location Longitude

1/4 of 1/4 of Section Township Range

ft. from (N/S) Line of quarter section

ft. from (E/W) Line of quarter section.

Well Class	Timing of Action (pick one)	Type of Action (pick one)
<input type="checkbox"/> Class I <input type="checkbox"/> Class II <input type="checkbox"/> Class III <input checked="" type="checkbox"/> Class V	<input checked="" type="checkbox"/> Notice Prior to Work Date Expected to Commence <input type="text" value="TBD"/> <input type="checkbox"/> Report After Work Date Work Ended <input type="text"/>	<input type="checkbox"/> Well Rework <input checked="" type="checkbox"/> Plugging and Abandonment <input type="checkbox"/> Conversion to a Non-Injection Well

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Name and Official Title (Please type or print) Jordan Hara, Plant Manager	Signature 	Date Signed <input type="text" value="1-16-2020"/>
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 Jordan Hara jhara@ormat.com 808-896-8551

Permit or EPA ID Number HI596002	API Number 	Full Well Name Kapoho State (KS) 25
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State Hawaii	County Hawaii
------------------------	-------------------------

Locate well in two directions from nearest lines of quarter section and drilling unit Latitude

Surface Location Longitude

1/4 of 1/4 of Section Township Range

ft. from (N/S) Line of quarter section

ft. from (E/W) Line of quarter section.

Well Class	Timing of Action (pick one)	Type of Action (pick one)
<input type="checkbox"/> Class I <input type="checkbox"/> Class II <input type="checkbox"/> Class III <input checked="" type="checkbox"/> Class V	<input checked="" type="checkbox"/> Notice Prior to Work Date Expected to Commence <input type="text" value="TBD"/> <input type="checkbox"/> Report After Work Date Work Ended <input type="text"/>	<input type="checkbox"/> Well Rework <input checked="" type="checkbox"/> Plugging and Abandonment <input type="checkbox"/> Conversion to a Non-Injection Well

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Name and Official Title (Please type or print) Jordan Hara, Plant Manager	Signature 	Date Signed <input type="text" value="1-16-2020"/>
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 Jordan Hara jhara@ormat.com 808-896-8551

Permit or EPA ID Number HI596002	API Number 	Full Well Name Kapoho State (KS) 26
--	-----------------------	---

State Hawaii	County Hawaii
------------------------	-------------------------

Locate well in two directions from nearest lines of quarter section and drilling unit Latitude

Surface Location Longitude

1/4 of 1/4 of Section Township Range

ft. from (N/S) Line of quarter section

ft. from (E/W) Line of quarter section.

Well Class	Timing of Action (pick one)	Type of Action (pick one)
<input type="checkbox"/> Class I <input type="checkbox"/> Class II <input type="checkbox"/> Class III <input checked="" type="checkbox"/> Class V	<input checked="" type="checkbox"/> Notice Prior to Work Date Expected to Commence <input type="text" value="TBD"/> <input type="checkbox"/> Report After Work Date Work Ended <input type="text"/>	<input type="checkbox"/> Well Rework <input checked="" type="checkbox"/> Plugging and Abandonment <input type="checkbox"/> Conversion to a Non-Injection Well

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Name and Official Title (Please type or print) Jordan Hara, Plant Manager	Signature 	Date Signed 1-16-2020
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United States Environmental Protection Agency



WELL REWORK RECORD, PLUGGING AND ABANDONMENT PLAN, OR PLUGGING AND ABANDONMENT AFFIDAVIT

Name and Address, Phone Number and/or Email of Permittee
 Puna Geothermal Venture
 14-3860 Kapoho Pahoa Road, Pahoa, HI 96778
 Jordan Hara jhara@ormat.com 808-896-8551

Permit or EPA ID Number HI596002	API Number 	Full Well Name Kapoho State (KS) 27
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State Hawaii	County Hawaii
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Locate well in two directions from nearest lines of quarter section and drilling unit Latitude

Surface Location Longitude

1/4 of 1/4 of Section Township Range

ft. from (N/S) Line of quarter section

ft. from (E/W) Line of quarter section.

Well Class	Timing of Action (pick one)	Type of Action (pick one)
<input type="checkbox"/> Class I <input type="checkbox"/> Class II <input type="checkbox"/> Class III <input checked="" type="checkbox"/> Class V	<input checked="" type="checkbox"/> Notice Prior to Work Date Expected to Commence <input type="text" value="TBD"/> <input type="checkbox"/> Report After Work Date Work Ended <input type="text"/>	<input type="checkbox"/> Well Rework <input checked="" type="checkbox"/> Plugging and Abandonment <input type="checkbox"/> Conversion to a Non-Injection Well

Provide a narrative description of the work planned to be performed, or that was performed. Use additional pages as necessary. See instructions.

Plug and Abandonment Plan.

1. Move in suitable rig and associated equipment.
2. Install BOPE suitable for maximum expected pressures.
3. Remove any tubing or hang-down liner.
4. Fill high permeability injection zone with rocks, gravel and sand.
5. Place 200 linear feet of 15 ppg geothermal cement on top of sand. Wait on cement, tag cement, and place more cement if necessary for 200 foot cement plug.
6. Fill hole with 9 ppg bentonite mud from top of cement to next casing shoe.
7. Place 200 linear feet of 15 ppg geothermal cement across each casing shoe with 9 ppg bentonite mud between cement plugs.
8. Place 15 ppg geothermal cement from 170 feet to surface.
9. Remove BOPE.
10. Cut off casing below casing head.
11. Weld plate on casing with well name and date.
12. Rig down.

Certification

I certify under the penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. (Ref. 40 CFR § 144.32)

Name and Official Title (Please type or print) Jordan Hara, Plant Manager	Signature 	Date Signed 1-16-2020
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United States Environmental Protection Agency



WELL REWORK RECORD, PLUGGING AND ABANDONMENT PLAN, OR PLUGGING AND ABANDONMENT AFFIDAVIT

Name and Address, Phone Number and/or Email of Permittee

Puna Geothermal Venture
14-3860 Kapoho Pahoehoe Road, Pahoehoe, HI 96778
Jordan Hara jhara@ormat.com 808-896-8551

Permit or EPA ID Number HI596002	API Number	Full Well Name Monitoring Well-4 (MW-4)
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State Hawaii	County Hawaii
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Locate well in two directions from nearest lines of quarter section and drilling unit

Latitude

Surface Location

1/4 of 1/4 of Section Township Range

Longitude

ft. from (N/S) Line of quarter section

ft. from (E/W) Line of quarter section.

Well Class	Timing of Action (pick one)	Type of Action (pick one)
<input type="checkbox"/> Class I <input type="checkbox"/> Class II <input type="checkbox"/> Class III <input type="checkbox"/> Class V <input checked="" type="checkbox"/> MW	<input checked="" type="checkbox"/> Notice Prior to Work Date Expected to Commence <input type="text" value="TBD"/> <input type="checkbox"/> Report After Work Date Work Ended <input type="text"/>	<input type="checkbox"/> Well Rework <input checked="" type="checkbox"/> Plugging and Abandonment <input type="checkbox"/> Conversion to a Non-Injection Well

Provide a narrative description of the work planned to be performed, or that was performed. Use additional pages as necessary. See instructions.

Plug and Abandonment Program

1. Run tubing to bottom of well. Notify DLNR if obstructions are encountered.
2. Pump 40 linear feet of sand-cement slurry in the open hole section and pull above expected top of cement.
3. After waiting for cement to harden, run in to tag top of cement and pump more slurry if necessary to fill up to bottom of louvered pipe.
4. If wellbore does not fill up due to cavernous or highly fractured formation, dump crushed aggregate (conforming to ASTM 10M) or concrete sand (conforming to ASTM C-33) to fill voids before continuing to grout. Notify DLNR if large amounts are required.
5. After open hole section is filled, run in to top of cement and pump 80 linear feet of neat cement in the louvered pipe section.
6. After waiting for cement to harden, run in to tag top of cement and pump more neat cement slurry if necessary to fill up above top of louvered pipe section.
7. After louvered pipe section is filled, run in to top of cement and pump sand-cement slurry from bottom of the solid casing to ground surface.
8. File a well abandonment/sealing report with DLNR within sixty days.

Certification

I certify under the penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. (Ref. 40 CFR § 144.32)

Name and Official Title (Please type or print) Jordan Hara, Plant Manager	Signature 	Date Signed 8-18-2021
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United States Environmental Protection Agency



WELL REWORK RECORD, PLUGGING AND ABANDONMENT PLAN, OR PLUGGING AND ABANDONMENT AFFIDAVIT

Name and Address, Phone Number and/or Email of Permittee

Puna Geothermal Venture
14-3860 Kapoho Pahoia Road, Pahoia, HI 96778
Jordan Hara jhara@ormat.com 808-896-8551

Permit or EPA ID Number HI596002	API Number	Full Well Name Monitoring Well-5 (MW-5)
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State Hawaii	County Hawaii
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Locate well in two directions from nearest lines of quarter section and drilling unit Latitude 19 28' 43.8492

Surface Location Longitude 154 53' 13.5636
 1/4 of 1/4 of Section Township Range

ft. from (N/S) Line of quarter section
 ft. from (E/W) Line of quarter section.

Well Class	Timing of Action (pick one)	Type of Action (pick one)
<input type="checkbox"/> Class I <input type="checkbox"/> Class II <input type="checkbox"/> Class III <input type="checkbox"/> Class V <input checked="" type="checkbox"/> MW	<input checked="" type="checkbox"/> Notice Prior to Work Date Expected to Commence <input type="text" value="TBD"/> <input type="checkbox"/> Report After Work Date Work Ended <input type="text"/>	<input type="checkbox"/> Well Rework <input checked="" type="checkbox"/> Plugging and Abandonment <input type="checkbox"/> Conversion to a Non-Injection Well

Provide a narrative description of the work planned to be performed, or that was performed. Use additional pages as necessary. See instructions.

Plug and Abandonment Program

1. Run tubing to bottom of louvered pipe. Notify DLNR if obstructions are encountered.
2. Pump 122 linear feet of neat cement and pull above expected top of cement. This may be done in several stages.
3. After waiting for cement to harden, run in to tag top of cement and pump more slurry if necessary to fill up above bottom of cemented casing at 700 feet.
4. If wellbore does not fill up due to cavernous or highly fractured formation, dump crushed aggregate (conforming to ASTM 10M) or concrete sand (conforming to ASTM C-33) to fill voids before continuing to grout. Notify DLNR if large amounts are required.
5. After louvered pipe section is filled, run in to top of cement and pump sand-cement slurry from top of cement to ground surface.
6. File a well abandonment/sealing report with DLNR within sixty days.

Certification

I certify under the penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. (Ref. 40 CFR § 144.32)

Name and Official Title (Please type or print) Jordan Hara, Plant Manager	Signature 	Date Signed 8.18.2021
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Appendix J

EPA Reporting Forms

UIC Permit R9UIC-HI5-FY16-1R



United States Environmental Protection Agency
COMPLETION REPORT FOR INJECTION WELLS

Name, Address, Phone Number and/or Email of Permittee

State	County
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Permit (or EPA ID) Number	API Number	Full Well Name
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Locate well in two directions from nearest lines of quarter section and drilling unit				Latitude
Surface Location	1/4 of	1/4 of Section	Township	Range
	ft. from (N/S)	Line of quarter section		
	ft. from (E/W)	Line of quarter section.		
				Longitude

Anticipated Daily Injection Volume (Bbls)		Injection Interval (Perforated/Open Hole Interval)	
Average	Maximum	Feet	to Feet

Depth to Bottom of Lowermost USDW (Feet)

Date Drilling Began	Name of Injection Zone
	Fracture Pressure of Injection Zone
Date Drilling Completed	Permeability of Injection Zone
	Porosity of Injection Zone
Date Well Completed	

Complete Attachments; See Instructions.

Certification

I certify under the penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. (Ref. 40 CFR § 144.32)

Name and Official Title <i>(Please type or print)</i>	Signature	Date Signed
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INSTRUCTIONS FOR FORM 7520-18

This form must be completed for each injection well. This form is appropriate for all injection well classes, and replaces the previous Form 7520-9 and Form 7520-10. While reports or other information developed by contractors or service companies may be attached, this form must be signed by a responsible entity as described at 40 CFR 144.32.

NAME, ADDRESS, PHONE AND/OR EMAIL OF PERMITTEE: Enter the name and street address, city/town, state, and ZIP code of the permittee. Also provide an email address (if available) and/or a phone number.

Enter the **STATE** and **COUNTY** where the well is located. For States that do not have counties, use the name of that State's equivalent jurisdiction at a more local level.

PERMIT OR EPA ID NUMBER: Enter the well identification number or permit number assigned to the injection well by the EPA or the permitting authority.

API NUMBER: Enter the number assigned by the local jurisdiction (usually a State Oil and Gas Agency) using the American Petroleum Institute standard numbering system.

FULL WELL NAME: Enter the full name of the well or project.

WELL LOCATION: Fill in the complete township, range, and section to the nearest quarter-quarter section. A township is north or south of the baseline, and a range is east or west of the principal meridian (e.g., T12N, R34W). Also include the distance, in feet, from the nearest north or south line and nearest east or west line of the quarter-section. Also, enter the **latitude** and **longitude** of the well in decimal degrees, to five or six places if possible; be sure to include a negative sign for the longitude of a well in the Western Hemisphere and a negative sign for the latitude of a well in the Southern Hemisphere.

ANTICIPATED DAILY INJECTION VOLUME: Enter the anticipated **average** and **maximum** daily volume of fluid to be injected, in barrels.

INJECTION INTERVAL: Enter the depths, in feet, to the top and bottom of the perforated hole/open interval of the well through which injected fluids will exit the well. (Note: this is different from the depth of the injection zone.) Provide information about how these were derived, e.g., by attaching a step-rate test or other test results. (See the description of attachments below.)

Enter the **DEPTH TO BOTTOM OF THE LOWERMOST USDW** (i.e., formation containing less than 10,000 mg/L total dissolved solids), in feet.

Enter the **DATE DRILLING BEGAN**, the **DATE DRILLING WAS COMPLETED**, and the **DATE THE WELL WAS COMPLETED** in the appropriate blanks.

Enter information about the permitted injection formation, including the **NAME OF THE INJECTION ZONE**, the calculated **FRACTURE PRESSURE**, and the **PERMEABILITY** and **POROSITY** of the injection zone in the appropriate blanks.

CERTIFICATION: This form must be signed and dated by either: a responsible corporate officer for a corporation, by a general partner for a partnership, by the proprietor of a sole proprietorship, or by a principal executive or ranking elected official for a public agency.

PAPERWORK REDUCTION ACT NOTICE: The public reporting and recordkeeping burden for this collection of information is estimated to average between 3.3 and 3.9 hours per response, depending on the injection well class. Burden means the total time, effort, or financial resource expended by persons to generate, maintain, retain, or disclose or provide information to or for a Federal Agency. This includes the time needed to review instructions; develop, acquire, install, and utilize technology and systems for the purposes of collecting, validating, and verifying information, processing and maintaining information, and disclosing and providing information; adjust the existing ways to comply with any previously applicable instructions and requirements; train personnel to be able to respond to the collection of information; search data sources; complete and review the collection of information; and, transmit or otherwise disclose the information. An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number. Send comments on the Agency's need for this information, the accuracy of the provided burden estimates, and any suggested methods for minimizing respondent burden, including the use of automated collection techniques to Director, Collection Strategies Division, U.S. Environmental Protection Agency (2822), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460. Include the OMB control number in any correspondence. Do not send the completed forms to this address.

INSTRUCTIONS FOR COMPLETING ATTACHMENTS TO FORM 7520-18

Please attach the following information to the completion report. Reports prepared by contractors or service companies may be submitted, provided they are clear and legible and the requested information is accessible. Please be sure to specify units as needed, e.g., of depth, pressure, temperature, etc.

I. Geologic Information

1. Provide a geologic description of the rock units penetrated by name, age, depth, thickness, and lithology of each rock unit penetrated.
2. Provide information about the injection formation that supports the information provided on the form, for example: (1) name; (2) depth (drilled); (3) thickness; (4) formation fluid pressure; (5) age of unit; (6) bottom hole temperature; (7) lithology; and (8) bottom hole pressure.
3. Provide chemical characteristics of formation fluid, including a chemical analysis.
4. Provide a description of all USDWs, including: (1) depth below ground surface to base of fresh water (less than 10,000 mg/L TDS); and (2) a geologic description of aquifer units with name, age, depth, thickness, lithology, and average total dissolved solids.

II. Well Design and Construction

1. Provide information on the surface, intermediate, and long string casing and tubing. Describe: the materials used; outside diameter size; weight/foot, grade, and whether new or used; and the depth to which each casing string is set (include appropriate units, e.g., below ground surface, below Kelly bushing, etc.).
2. Provide data on the holes drilled for each casing string, including the bit diameter and depth of hole.
3. Provide data on the well cement for each casing string, such as type/class, additives, amount, method of emplacement, and depth to top of cement.
4. Describe the packer (if used) such as type, name and model, setting depth, and type of annular fluid used.
5. Provide data on centralizers, including number, type, and depth.
6. Provide data on bottom hole completions, including the depth and diameter of the hole.

III. Monitoring Systems. Describe the recording and nonrecording injection pressure gauges, casing-tubing annulus pressure gauges, injection rate meters, temperature meters, and other meters or gauges. Also provide information on constructed monitoring wells such as location, depth, casing diameter, method of cementing, etc.

IV. Logging and Testing Results. Provide a report describing the types of geophysical logs, cores, and other tests performed; date of the logs; the intervals logged; and interpretation of the results. Include a description and the results of deviation checks run during drilling. If requested, provide a final print of all geophysical logs run.

V. As-built Schematic. Provide a diagrammatic sketch of the surface and subsurface construction details of the injection well as-built, showing casing, cement, tubing, packer, etc., with proper setting depths. The sketch should include the well head and gauges.

VI. Mechanical Integrity Testing. Provide data demonstrating mechanical integrity pursuant to 40 CFR 146.08. Describe the method and results of mechanical integrity testing.

VII. Report on the compatibility of injected wastes with fluids and minerals in both the injection zone and the confining zone.

VIII. Report the status of corrective action on deficient wells in the area of review.

IX. Include the anticipated maximum pressure and flow rate at which injection will operate.

X. Stimulation. Describe any stimulation performed, including the interval treated and the materials and amounts used.

United States Environmental Protection Agency



WELL REWORK RECORD, PLUGGING AND ABANDONMENT PLAN, OR PLUGGING AND ABANDONMENT AFFIDAVIT

Name and Address, Phone Number and/or Email of Permittee

Permit or EPA ID Number	API Number	Full Well Name
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State	County
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Locate well in two directions from nearest lines of quarter section and drilling unit

Latitude

Surface Location

1/4 of 1/4 of Section Township Range

ft. from (N/S) Line of quarter section

ft. from (E/W) Line of quarter section.

Well Class	Timing of Action (pick one)	Type of Action (pick one)
<input type="checkbox"/> Class I <input type="checkbox"/> Class II <input type="checkbox"/> Class III <input type="checkbox"/> Class V	<input type="checkbox"/> Notice Prior to Work Date Expected to Commence <input style="width: 100px;" type="text"/> <input type="checkbox"/> Report After Work Date Work Ended <input style="width: 100px;" type="text"/>	<input type="checkbox"/> Well Rework <input type="checkbox"/> Plugging and Abandonment <input type="checkbox"/> Conversion to a Non-Injection Well

Provide a narrative description of the work planned to be performed, or that was performed. Use additional pages as necessary. See instructions.

Certification

I certify under the penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. (Ref. 40 CFR § 144.32)

Name and Official Title <i>(Please type or print)</i>	Signature	Date Signed
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INSTRUCTIONS FOR FORM 7520-19

This form replaces forms 7520-12 and 7520-14. Use this form only when work is planned or has occurred that affects the well's construction or operation as an injection well, including work on the casing, tubing or packer (or for shallow Class V wells, the subsurface fluid emplacement network). Use one form per injection well. While reports or other information developed by contractors or service companies may be attached, this form must be signed by a responsible entity as described at 40 CFR 144.32. Note: operators closing Class V wells should use Form 7520-17.

NAME, ADDRESS, PHONE AND/OR EMAIL OF PERMITTEE: Enter the name and street address, city/town, state, and ZIP code of the permittee. Also provide an email address (if available) and/or a phone number.

PERMIT OR EPA ID NUMBER: Enter the well identification number or permit number assigned to the well by the EPA or the permitting authority.

API NUMBER: Enter the number assigned by the local jurisdiction (usually a State Oil and Gas Agency) using the American Petroleum Institute standard numbering system.

FULL WELL NAME: Enter the full name of the well or project.

Enter the **STATE** and **COUNTY** where the well is located. For States that do not have counties, use the name of that State's equivalent jurisdiction at a more local level.

WELL LOCATION: Fill in the complete township, range, and section to the nearest quarter-quarter section. A township is north or south of the baseline, and a range is east or west of the principal meridian (e.g., T12N, R34W). Also include the distance, in feet, from the nearest north or south line and nearest east or west line of the quarter-section. Also, enter the **latitude** and **longitude** of the well in decimal degrees, to five or six places if possible; be sure to include a negative sign for the longitude of a well in the Western Hemisphere and a negative sign for the latitude of a well in the Southern Hemisphere.

Enter the **WELL CLASS**, i.e., the class of injection well as defined in 40 CFR 144.6.

TIMING OF THE ACTION: Check *Notice prior to work* if the activity has not yet occurred (i.e., is planned). Check *Report after work* if the activity described has already occurred. As appropriate, include the date the activity is expected to start or the date the activity was completed. (Note this may not be available, e.g., for a plugging plan submitted with a permit application.)

TYPE OF ACTION: Check the appropriate box to describe the kind of activity being reported. Check *Well Rework* for work that was/will be performed on the well after it has already been in operation as an injection well. Check *Plugging and Abandonment* to report on plans for or descriptions of final closure/plugging after use as an injection well. Check *Conversion to a Non-Injection Well* if the well is to be converted to something other than an injection well.

Provide a **NARRATIVE DESCRIPTION** of the work planned to be performed, or that was performed. The narrative should include a description of the main procedures planned or that occurred during the work activity. A service company report, daily report, or similar document may be attached if it includes all the requested information and is clear and legible.

For well reworks, include the following information: The reason for the well rework; depths of activity; type of activity; changes to injection well configuration, well casing, or cement behind casing; any plug added to the well and its depth; any newly drilled interval and its depth; method(s) to demonstrate that the well has mechanical integrity (as applicable); and any deviations from the approved rework plan (as applicable).

For a well plugging plan, include the following information: Reason for the well plugging; number of plugs placed, and their depths; materials used as plugs (e.g., cast iron bridge plug, cement, cement retainer); method to set plugs; and wait-on-cement times, if any. Also provide one or more cost estimates from an independent firm in the business of plugging and abandoning wells to plug the well as described in the plan.

For well plugging affidavit, include the following information: Reason for the well plugging; number of plugs placed, and their depths; materials used as plugs (e.g., cast iron bridge plug, cement, cement retainer); method to set plugs; wait-on-cement times, if any; and any deviations from the approved plugging plan (if applicable).

For conversion to a non-injection well, include the following information: Depths of activity; type of activity; changes to injection well configuration, well casing, or cement behind casing; any plug added to the well and its depth; any newly drilled interval and its depth; depths of new perforations; and method(s) to demonstrate that the well has mechanical integrity (as applicable).

For all of the above activities, include a well sketch depicting the work, results of well tests/logging performed, service company tickets, and any other available information demonstrating how the work was/is to be performed. Also, specify whether depths are below ground surface, relative to Kelly bushing, etc.

CERTIFICATION: This form must be signed and dated by either: a responsible corporate officer for a corporation, by a general partner for a partnership, by the proprietor of a sole proprietorship, or by a principal executive or ranking elected official for a public agency.

PAPERWORK REDUCTION ACT NOTICE: The public reporting and recordkeeping burden for this collection of information is estimated to average between 6.0 and 7.9 hours per response, depending on the injection well class. Burden means the total time, effort, or financial resource expended by persons to generate, maintain, retain, or disclose or provide information to or for a Federal Agency. This includes the time needed to review instructions; develop, acquire, install, and utilize technology and systems for the purposes of collecting, validating, and verifying information, processing and maintaining information, and disclosing and providing information; adjust the existing ways to comply with any previously applicable instructions and requirements; train personnel to be able to respond to the collection of information; search data sources; complete and review the collection of information; and, transmit or otherwise disclose the information. An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number. Send comments on the Agency's need for this information, the accuracy of the provided burden estimates, and any suggested methods for minimizing respondent burden, including the use of automated collection techniques to Director, Collection Strategies Division, U.S. Environmental Protection Agency (2822), 1200 Pennsylvania Ave., NW., Washington, D.C. 20460. Include the OMB control number in any correspondence. Do not send the completed forms to this address.