A Research Observatory for a Sustainable Future

Newberry Geothermal Energy

Establishment of the Frontier Observatory for Research in Geothermal Energy (FORGE) at Newberry Volcano, Oregon

Appendix K

Environmental, Safety and Health Plan

April 27, 2016

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Acronyms and Abbreviations

BLM	U.S. Bureau of Land Management
CO	carbon monoxide
DOE	U.S. Department of Energy
DOGAMI	(Oregon) Department of Geology and Mineral Industries
DOT	U.S. Department of Transportation
EGS	Enhanced Geothermal System(s)
EMS	Emergency Management Services
ES&H	Environmental, Safety and Health
FORGE	Frontier Observatory for Research in Geothermal Energy
ft	foot (feet)
GE	General Electric Global Research
H_2S	hydrogen sulfide
JHA	Job Hazard Analysis
JSA	Job Safety Analysis
lb	pound(s)
MPa	megapascal(s)
mph	mile(s) per hour
MSDS	Material Safety Data Sheet
NEWGEN	Newberry Geothermal Energy
NNVM	Newberry National Volcano Monument
O_2	oxygen
OSU	Oregon State University
PNNL	Pacific Northwest National Laboratory
PPE	personal protective equipment
psi	pounds per square inch
R&D	research and development
USFS	U.S. Forest Service

Appendix K

Environmental, Safety and Health Plan

K.1 Summary

Safeguarding the health of personnel and the environment is the highest priority of NEWGEN FORGE and the Core Consortium members.

The Environmental, Safety and Health (ES&H) Plan contains the ES&H policies and procedures associated with operating the proposed Frontier Observatory for Research in Geothermal Energy (FORGE) site at Newberry Volcano in Oregon. The site is being developed by the Newberry Geothermal Energy (NEWGEN) Core Consortium, led by Pacific Northwest National Laboratory (PNNL) in collaboration with AltaRock Energy, Inc. (AltaRock), General Electric Global Research (GE), Statoil, and Oregon State University (OSU). NEWGEN is committed to using the experience and depth of ES&H resources of the Core Consortium members to build and sustain a strong safety culture for protection of FORGE participants and the environment.

ES&H considerations will be integrated into planning and executing all work on the NEWGEN FORGE, creating a strong safety and environmental compliance culture (Figure K.1) to minimize accidents and incidents. The ES&H Plan for the NEWGEN FORGE builds on policies and procedures that were successfully implemented for both the U.S. Department of Energy (DOE)-sponsored Enhanced Geothermal Systems (EGS) demonstration project at Newberry Volcano and the Integrated Field Research Challenge project for the DOE Office of Science at the Hanford Site. Both of these projects were executed with outstanding safety and environmental compliance records.

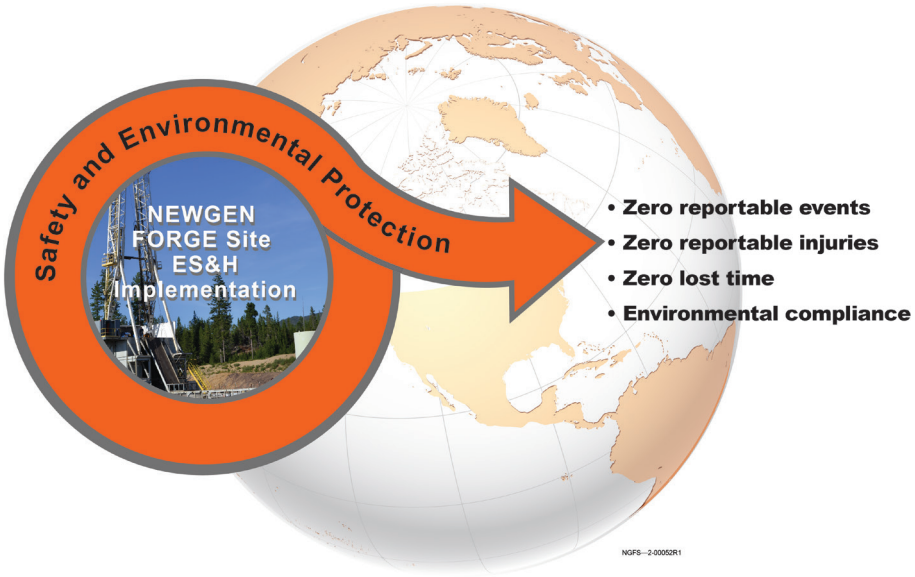

Figure K.1. NEWGEN safety and environmental protection.

Elements of an integrated safety management system are incorporated into the NEWGEN approach to ES&H. Engineering solutions and industry-developed programs like Stop Work Authority and Job Safety Analysis (JSA) will be used to mitigate risks to people and the environment. This document is organized

to meet the general requirements of an ES&H Plan as specified in the scope of work for the *Statement of Work for the Frontier Observatory for Research in Geothermal Energy – Newberry Volcano, Oregon*.

K.2 Introduction

The NEWGEN FORGE site will enable research and development of the technologies needed to develop EGS to extract energy from hot, impermeable rock. NEWGEN will provide infrastructure and a physical site where competitively selected research and development (R&D) projects can develop and test EGS innovative technologies. This document provides the ES&H planning for the project.

The NEWGEN Core Consortium brings together the scientific research and management horsepower of a DOE national laboratory with the highest level (STAR) Voluntary Protection Program; the research, educational, and outreach experience of the host state's preeminent public research university; the industrial experience of world leaders in energy research and oil exploration; and the geothermal industrial management experience of a commercial geothermal company. Each of the Core Consortium members brings experience and a proven track record of managing large field facilities with safe and environmentally compliant operations. Each Core Consortium member also will be able to reach into their respective organizations to engage subject matter experts with depth in ES&H. The experience of the Core Consortium includes safe development and testing of EGS technologies and geological characterization at Newberry Volcano for DOE, as well as successful management of two Integrated Field Research Challenge project sites at Hanford Site, in southeastern Washington, and Rifle, Colorado, for the DOE Office of Science. The NEWGEN Consortium includes the only DOE national laboratory to safely site, design, and permit the first ever Class VI carbon sequestration injection well for the FutureGen 2.0 project and to safely complete carbon sequestration injection into a basalt formation at Wallula, Washington.

K.3 NEWGEN ES&H Approach

NEWGEN will provide the physical infrastructure and ES&H protocols for competitively selected R&D projects to safely develop and test innovative EGS technologies. All participants in the NEWGEN FORGE project are expected to protect themselves and others, in keeping with the philosophy that all accidents and incidents are preventable. An accident- and incident-free work environment will be achieved through careful planning, close attention to hazard and environmental controls, worker involvement in task planning, and stopping work in the face of uncertainty. NEWGEN FORGE will promote safety and environmental compliance in all aspects of the project, as described in the Project Management Plan.

K.3.1 Work Location: La Pine, Oregon

The proposed NEWGEN FORGE site is approximately 37 km (23 miles) south of Bend, Oregon, and the nearest small community, Newberry Estates, is about 11 km (7 miles) away; the nearest town, La Pine, is about 16 km (10 miles) away (Figure K.2). The project site is on land leased from the U.S. Bureau of Land Management (BLM), and the surface is controlled by the BLM and the U.S. Forest Service (USFS). The leased land lies adjacent to the Newberry National Volcano Monument (NNVM), which was created in 1990 to preserve the volcanic features inside the Newberry Volcano caldera, while providing for geothermal development and other uses on adjacent lands. Land that had been leased for geothermal development inside the caldera was exchanged for land outside the NNVM boundaries, with the proviso that the presence of the NNVM would not preclude development of geothermal projects outside its boundary.

High-quality, graded dirt forest roads provide vehicle access to all three well pads and each of the monitoring station locations. Road access is granted under a USFS Road Use Permit, which will be renewed and revised during Phase 2 of the project. Access to the site will be managed year-round with planned snow removal during winter months.

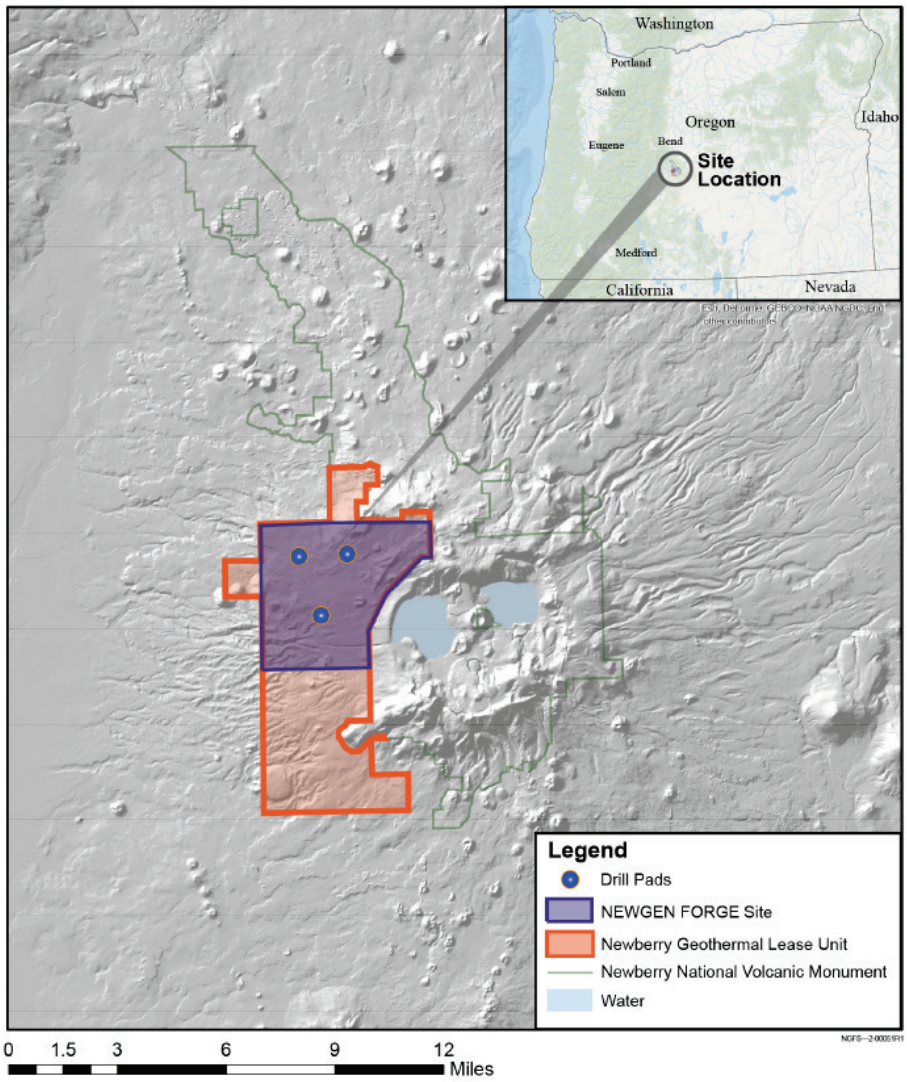

Figure K.2. Location map for the proposed NEWGEN FORGE site, showing the NNVM, geothermal leases, and the communities of Bend, Sunriver, Three Rivers, and La Pine, Oregon.

K.3.2 Roles and Responsibilities

The Principal Investigator, Dr. Alain Bonneville (PNNL), serves as Executive Director of NEWGEN FORGE and is responsible for oversight of the technical progress on the project, including regular communications with the NEWGEN Consortium, as well as other NEWGEN directors (Figure K.3). The Director of Research and Operations, Dr. Trenton Cladouhos (AltaRock), oversees management of the NEWGEN FORGE site and research operations.

The Deputy Director of Site Operations, Laura Nofziger (AltaRock), has operational responsibility for ES&H and will manage and coordinate field activities related to lease operations between subcontractors,

visiting scientific teams, R&D performers, the BLM, the USFS, and State of Oregon agencies, ensuring compliance with ES&H requirements, identifying hazards, and implementing controls. NEWGEN is responsible for obtaining and maintaining appropriate permits for conducting field work at the FORGE site and coordinating with the Site Lease Holder, Davenport Newberry Holdings for any ongoing field research activities. The Deputy Director of Site Operations will ensure that each site visitor has signed an acknowledgment that they have read and understood the ES&H Plan and the site access requirements. Subcontractors will provide documentation of company-specific safety training documentation to the Deputy Director of Site Operations in advance of the initial site visit. The Deputy Director for Site Operations will be responsible for keeping logs of all visits to the site.

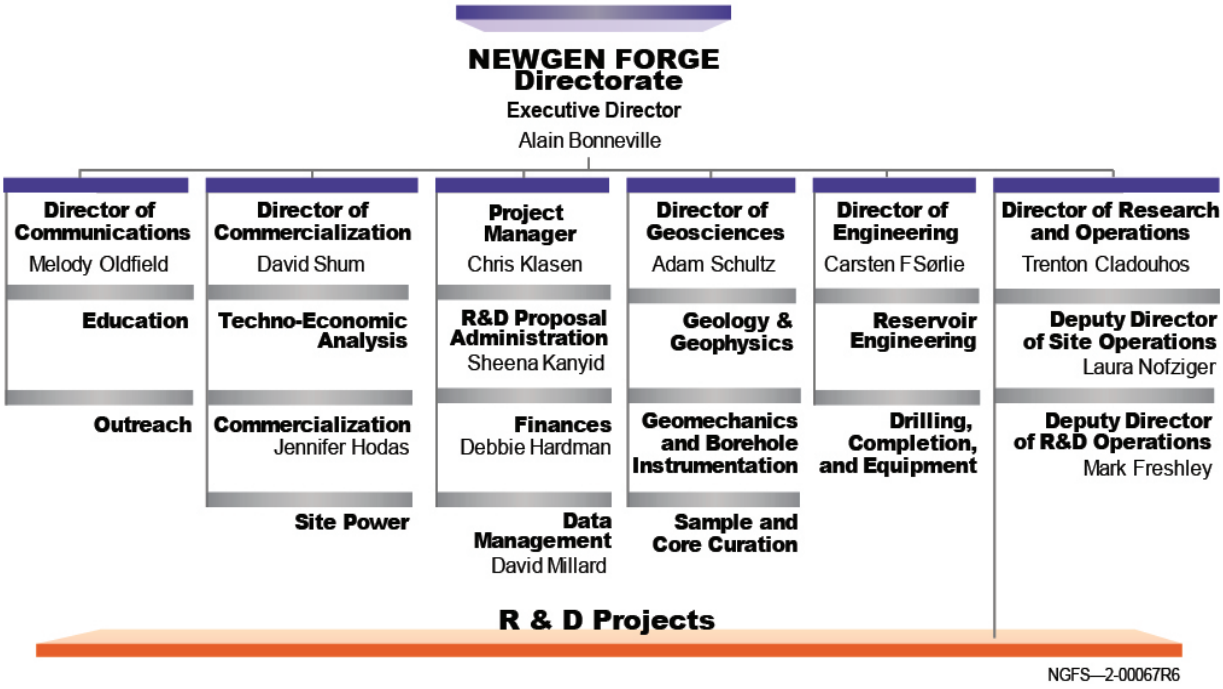

Figure K.3. NEWGEN FORGE directorate organization.

The Deputy Director of R&D Operations, Mark Freshley (PNNL), in close cooperation with the Deputy Director of Site Operations, will oversee NEWGEN R&D activities, including preparing and implementing specific work plans, evaluating ES&H requirements, identifying hazards, implementing controls, and ensuring that proper training has been completed. The Deputy Director for R&D Operations will ensure that R&D performers have read and understood the ES&H Plan and the site access requirements prior to accessing the NEWGEN FORGE site. Documentation of all training will be provided to the Deputy Director of Site Operations in advance of the initial site access.

K.3.3 Reporting Supervision and Chain of Command

As the project lead, PNNL has established subcontracts with AltaRock, OSU, GE, and Statoil for the work they perform. The reporting supervision/chain of command for NEWGEN is provided in Table K.1.

Table K.1. Reporting supervision and chain of command.

CONTACT NAME	TELEPHONE NUMBER		RESPONSIBILITY
Laura Nofziger AltaRock	**Land line:** 206-729-2400	**Cell:** 541-668-0867	Deputy Director of Site Operations
Mark Freshley PNNL	**Land line:** 509-372-6094	**Cell:** 509-205-8435	Deputy Director of R&D Operations
Trenton Cladouhos AltaRock	**Land line:** 206-729-2400, ext. 204	**Cell:** 206-605-1948	Director of Research and Operations
Alain Bonneville	**Land line:** 509-371-7263	**Cell:** 509-713-0659	Executive Director of NEWGEN FORGE
Robert Vagnetti DOE National Energy Technology Laboratory	**Land line:** 304-285-1334		DOE FORGE Project Manager
Steve Storo	**Land line:** 541-295-0871		BLM Designated Contact
Bart Wills	**Land line:** 541-480-6194		USFS Designated Contact
Robert Houson	**Land line:** 541-619-4653		Oregon Department of Geology and Mineral Industries (DOGAMI) Designated Contact
Bill Mason	**Land line:** 541-687-7427		Oregon Department of Environmental Quality, Designated Contact

K.3.4 Training Requirements

NEWGEN employs personnel who are knowledgeable and possess adequate technical, managerial, or professional skills to perform their assigned tasks. The Director of Research and Operations, together with the Deputy Director of Site Operations and the Deputy Director of R&D Operations, will identify any additional specific project-related processes that require project staff training and qualification. Documentation of on-the-job training of staff will be maintained at the NEWGEN FORGE site.

All project staff will be trained on the requirements of this ES&H Plan and applicable JSA plans in addition to specific requirements of the BLM Geothermal Resources Lease and the USFS special use and road use permits before beginning work and are required to sign the acknowledgment form included in Section K.4. Safety tailgate meetings will be held a minimum of every 10 days on specific subjects. A daily safety meeting will be held to cover the tasks for that particular day and to ensure that all affected personnel are adequately trained and prepared to accomplish the day's tasks safely. All training will be documented. If the scope of work changes, or serious hazards are recognized, a hazard analysis will be performed and training will be conducted before proceeding.

Only employees who have been trained in how to perform on-the-job tasks and how to use the equipment they will operate are permitted to perform those tasks or use the equipment. Employees will have training in their company's Injury and Illness Prevention Program or Voluntary Protection Program, Personal Protective Equipment (PPE), and job-specific hazards for their assigned tasks. All training records will be maintained at the NEWGEN FORGE site, with duplicates at PNNL; records will be available upon request.

K.3.5 Work Processes

NEWGEN FORGE work processes include elements of the DOE Safety Management System Policy (DOE P 450.4), which lists five core safety management functions that provide structure for any work activity that could potentially affect the public, workers, and the environment. The functions are intended to be applied with the degree of rigor appropriate to address hazards involved in work activities. The five functions include:

- **Define the scope of work.** All proposed work activities and R&D projects will include identification and review of ES&H requirements so that they can be conducted in a manner that fully protects the environment and the health and safety of all NEWGEN participants. The work activities will be defined using a JSA that will be reviewed by Deputy Director of Site Operations prior to new tasks commencing at the site. The JSA form is attached to this plan and requires the team to identify all hazards associated with the given job scope and to mitigate those risks through engineering, administrative, PPE, and/or design changes, and operational procedures. As part of the proposal solicitation and selection process described in the R&D Implementation Plan (Appendix L), R&D performers will be required to submit a detailed work plan for activities that will be conducted at the NEWGEN FORGE site, including identification of any ES&H hazards and their mitigation. The work plans will be reviewed by the Deputy Directors of R&D Operations and Site Operations for compliance with the ES&H Plan, the BLM Geothermal Resources Lease, the USFS road use and special use permits and for specific requirements and training that must be met before work is allowed to proceed.
- **Analyze the hazards.** The JSA forms will be reviewed the Deputy Director of Site Operations to evaluate the identified hazards. Similarly, R&D proposals will be reviewed by the Deputy Director of R&D Operations and the Deputy Director of Site Operations to ensure that the hazards are appropriately identified. Subject matter experts from the NEWGEN Core Consortium organizations will be included in the hazard analysis step.
- **Develop and implement hazard controls.** Before work is conducted, the performer, Deputy Director for Site Operations, the Deputy Director for R&D Operations (for R&D projects), and any subcontractors agree to a set of ES&H requirements and controls. Subject matter experts from the NEWGEN Core Consortium organizations will be included in defining the controls for hazards that are identified. Planned work on tasks and the designated hazard controls will be discussed at plan of the day meetings prior to starting work each day and tailgate safety meetings prior to initiating work on new tasks.
- **Perform work within controls.** Once the appropriate hazard controls have been identified and agreed upon, work will be performed safely.
- **Provide feedback and continuous improvement.** As part of NEWGEN FORGE operations, the practice of questioning and improving approaches to work activities will be encouraged. All participants in field operations will be encouraged to voice concerns or differing opinions about project activities and new approaches will be discussed. Lessons learned from completed tasks or operations will be discussed and recorded. The Director of Research Operations will conduct annual assessments of the NEWGEN ES&H program to identify opportunities for improvement.

As a first step of implementing safety management, all NEWGEN staff and R&D performers testing and evaluating technologies at the site are required to review and sign this ES&H Plan.

K.3.6 Buddy System

At all times when NEWGEN staff or R&D performers are accessing the site, the buddy system will be used. More than one person will be required for access to the site.

K.3.7 Stop Work Authority

All project participants regardless of their position or the company for which they work have the right and the responsibility to stop any work activities if deemed necessary to prevent a potential accident from happening due to an unsafe condition or unsafe work practice. All project participants are required to report unsafe conditions or unsafe work practices to their immediate supervisor and/or the Deputy Director of Site Operations as soon as practical. Work will not be authorized to resume until all related safety issues have been fully addressed (e.g., Figure K.4) by all workers directly involved with the reported unsafe condition or unsafe work practice until the condition or practice is corrected along with full documentation.

All incidents including, but not limited to the following, must be reported by the project participants to their supervisor and/or the Deputy Director of Site Operations as soon as possible:

- personal injuries
- fires
- spills
- vehicle accidents
- property damage
- unsafe work or site condition
- faulty or defective equipment.

NEWGEN will emphasize compliance with the anti-retaliation (whistle-blower protection) provisions of the Occupational Safety and Health Act under which workers can stop work without fear of reprisal or retaliation. Similarly, these efforts will ensure that workers can voice concerns or differing opinions about project activities and new approaches without fear of reprisal or retaliation. Compliance with this act starts with a commitment of the NEWGEN FORGE Core Consortium members to implement an anti-retaliation culture. The project will respond to any reports of retaliation if they arise and conduct anti-retaliation training during plan of the day meetings. The effectiveness of our efforts to comply with the anti-retaliation provisions will be evaluated during the annual assessment of the ES&H program by the Director of Research Operations.

Figure K.4. Field team discussing a safety topic.

K.3.8 Hazard Identification and Control

This section of the plan describes activities and associated hazards that are anticipated at NEWGEN FORGE. As conditions arise that require activities that are outside of this list or for hazards that have not been identified, work will cease until a hazard evaluation has been performed and control measures added to the applicable JSA. The work plan and hazard controls will be discussed at a plan of the day or tailgate meeting before work can be initiated or resumed.

Heat and Cold Stress

During the fall, winter, and spring seasons, cold temperatures, rain, and snow are common. In summer, temperatures may reach 100ºF. Safety meetings will include information about weather conditions and predictions, and wearing layered clothing for dressing up or down to provide appropriate protection against weather.

Personal Protective Equipment

The hazardous nature of work at the NEWGEN FORGE site will require the use of PPE. Hard hats, safety glasses, hard-toed boots, and gloves will be worn to minimize potential injuries. Hearing protection is required in loud noise areas such as near mechanical equipment and venting steam and air. Fall protection shall be worn when employees are working above heights of 6 ft. Three-gas monitoring devices will be implemented near wellheads for monitoring levels of hydrogen sulfide (H_2S), oxygen (O_2), and carbon monoxide (CO). Gas monitors will be required to be worn by personnel when manipulating well valves.

Chemicals or Flammables

Chemicals may be used during operations that are not associated with stimulation activities. Material Safety Data Sheets (MSDSs) will be available for all chemicals and hazard communication training will occur during safety meetings prior to use of chemicals. PPE necessary for the chemical will be used, including chemically resistant gloves, goggles, and face and body protection, as required by the manufacturer's MSDS or as site conditions warrant. Personal air monitoring will be considered if high hazard volatile chemicals are used, such as gasoline or diesel fuel, compressed gases, and lubricants.

Employees must inform others working nearby of chemical hazards to which they might be exposed. Only employees who have been trained and properly fit-tested shall wear respiratory protection equipment. Respiratory protection equipment shall be worn as required by atmospheric conditions and as specified in the MSDS for the chemicals being used.

Berms will be installed around each chemical tank or storage area to prevent offsite flow of potential chemical releases. The bermed area will have a volumetric capacity capable of holding at least 110% of the stored volume (or per appropriate regulatory permit conditions). The condition of these containment berms will be inspected daily. The amount of chemicals onsite will be kept to a minimum, and a documented and current inventory record will be maintained. If a release occurs, trained AltaRock and PNNL employees will respond by determining the source, identifying the material involved, isolating the area, and denying entry to others. All spills will be contained and remedied if it is safe to do so in accordance with the MSDS and by trained employees. Cleanup supplies for spills of fuel, chemicals, or flammables will be available. In the event of a spill beyond incidental that cannot be readily cleaned up by onsite employees, 911 will be called and the BLM and USFS contacts will be notified (Table K.1).

All project participants operating onsite will be familiar with the chemical properties, hazards, and emergency response requirements for all chemicals they use. Diesel fuel spill kits will be provided by Bend Oil for diesel fuel spills. A copy of all applicable MSDSs will be kept onsite at all times.

Decontamination Procedures

All employees onsite will be trained to decontaminate if using chemicals before leaving the site. Decontamination includes: cleaning shoes, removing contaminated clothing, and washing laundry separately from family clothing. Employees will wash with soap and water before beginning breaks, eating, drinking, smoking, and going home for the day. If specialized PPE is used for testing chemicals it will be bagged for proper disposal.

Hazardous Materials Packaging and Shipping

Hazardous material packaging and transportation performed for NEWGEN will be in compliance with applicable U.S. Department of Transportation (DOT) requirements unless otherwise exempted or authorized. The requirements for packaging and shipping hazardous materials include the following:

- Complete any required training prior to performing hazardous materials packaging or transportation activities.
- Verify that a Hazardous Material Transportation Officer or other qualified shipper has classified the hazardous material and selected an appropriate packaging using appropriate DOT labeling guidelines.
- Perform hazardous materials functions in accordance with the written procedure, exhibit, operator aid, guideline, or other authorization approved by the Hazardous Materials Transportation Program subject matter expert, including the following functions:
  - packaging functions (e.g., fabricating, testing/qualifying, maintaining, repairing)
  - pre-transportation functions (e.g., filling, closing, marking or labeling a package; preparing a shipping paper; certifying/offering that hazardous material is in proper condition for transport)
  - transportation functions (e.g., loading, segregating, securing, transporting).

High Pressure and Steam

Special well testing may involve high-pressure pumping and steam generation. These operations will require specific tailgate meetings with personnel trained and qualified for high-pressure pumping and steam generation systems. All connections that are part of operations will be secured by restraints to prevent piping movement in case of connection failure. Employees not necessary for a particular operation will be kept from the work area. High-pressure or steam generation areas will be clearly marked and roped off to prevent unnecessary exposure to personnel.

High-pressure or steam operations and potential hazards will be discussed during daily safety meetings. Additional tailgate safety meetings will be held prior to all well stimulation or testing operations and repeated if shift changes occur during the test.

For the previous EGS stimulation performed at the site (Figure K.5), no special permits for pressure were required beyond drilling permits, which included those for testing a blow-out preventer after installation and injection pressures governed by the Underground Injection Control and the Oregon Department of Geology and Mineral Industries **(**DOGAMI) permits. The blow-out preventer test must be witnessed by BLM.

Figure K.5. Pumps assembled for the Newberry EGS Demonstration project.

Respiratory Hazards

Hydrogen sulfide, a toxic gas, is produced naturally in steam from geothermal wells, along with other gases such as carbon dioxide (CO_2) and hydrocarbons. Solids produced with the steam or precipitating from the steam may include heavy metals such as arsenic, mercury, and lead. Gas samples from the wells have been analyzed in the past for heavy metals and results show they do not exist in hazardous concentrations. Four-gas monitoring devices will be available onsite for monitoring levels of H_2S, O_2, CO, and CO_2 at wellheads. Respiratory protection will be available onsite at all times; during the previous EGS demonstration project, two personal respiratory packs were onsite during an atmospheric flow test in case hazardous concentrations of gas were measured and an alarm sounded. No incidents of hazardous gas concentrations have been observed at the site.

NEWGEN will follow an established AltaRock respiratory protection program, and appropriate personnel will have medical approval to wear respirators, have written fit test certifications, and be trained in proper use of the provided respirators.

Pinch Points

When working around equipment and handling or moving equipment and materials, pinch points represent a potential hazard. In most situations, guards for equipment and pinch points will be in place, but areas where guarding is not present or feasible will be posted. All pinch point hazards should be properly documented and discussed using a JSA.

Walking/Working Surfaces

Work areas and walkways will be kept clear and cleaned during daily housekeeping efforts. Where possible, walkways/routes will be designated and problem areas flagged or posted. Tools will be kept in proper storage areas to avoid tripping hazards. Wiring and hoses will be routed away from walkways, if possible, or flagged and covered.

Vehicle Safety and Traffic Control

Vehicle safety includes all aspects of vehicle operation, including observing speed limits, passing safely, obeying traffic signs, using seatbelts, yielding the right-of-way to emergency vehicles and heavy equipment, remaining at the scene of an accident, and following restricted travel and foul weather procedures.

- Drivers shall observe all posted speed limits and adjust speed according to conditions.
- Passengers and drivers in any vehicle equipped with seatbelts are required to wear them while operating or riding in that vehicle.
- Vehicle occupant(s) should intervene if any of the driving safety rules are not being followed.
- Headlights shall be illuminated whenever the vehicle is being driven.
- All vehicle accidents shall be investigated. If persons are involved in an accident, they shall immediately notify local authorities and their supervisors as soon as possible.
- A valid driver's license is required to operate any vehicle or equipment that would require such a license to be operated on public roadways.
- Personnel are not allowed to ride on/in truck beds.
- No equipment shall be operated unless the operator has received proper training and is qualified to operate that equipment.
- All vehicles and equipment shall be positioned in a manner that ensures exhaust does not enter buildings or vent intakes.
- Parking should be done in an organized fashion in designated parking areas.
- Every time drivers park and leave a vehicle, they must conduct a 360° walk-around before moving it again.
- All drivers accessing the NEWGEN FORGE site will be required to have a copy of the USFS Road Use Permit in their vehicle at all times.

Safe driving rules are to be followed, including:

- Most vehicle accidents at field sites are related to backing up. Drivers should park to minimize the need to back up. Spotters are required when visibility is limited such that a safe backing path cannot be determined.

- Vehicles should safely yield to wildlife without creating additional road hazards.
- It is the driver's responsibility to assure loads, equipment, and other items transported inside a vehicle are secure and/or positioned to eliminate/minimize safety risks to the occupants.
- Loads, equipment, and other items shall be tied down or secured and the total weight should not exceed the manufacturer's specifications and legal limits for the vehicle.
- All road signs shall be observed. Construction signs may change frequently, and traffic patterns may have been altered.
- Drivers shall not follow other vehicles too closely.
- Drivers shall signal their intentions and allow other drivers time to react.
- Drivers shall keep their turn signal lights, brake lights, headlights, and windows clean.
- Drivers should keep fuel tanks at least half full. (If you get stuck and have to wait for help, you will use approximately one gallon of fuel per hour to idle the engine and keep the heater running.)
- Everyone will be alert to the restrictions imposed by clothing, and will remove hoods or head gear that may impair vision.
- Drivers will keep vehicles in good condition.
- Drivers are prohibited from initiating or acknowledging cell phone calls while the vehicle is in motion. Drivers must bring vehicles to a full stop in a safe location off the roadway to engage in cell phone communication.
- The use of headsets for cell phones or personal entertainment is prohibited during vehicle use.
- During winter, NEWGEN participants will carry cold-weather gear such as warm clothing suitable for survival.
- All drivers meeting or being overtaken by emergency vehicles must yield the right-of-way, pull over, and stop until the emergency vehicle has passed.
- Drivers meeting or passing working heavy equipment must slow to 15 mph on the access road. For the public roadways, adhere to posted speed limits.
- Drivers must slow to 5 mph when personnel, vehicles, and/or equipment are staged on the access road.
- A helmet must be worn when traveling by four-wheeler or snow machine.
- Cones, barricades, and flaggers will be used to control traffic hazards at the NEWGEN FORGE site.
- All vehicle usage will be subject to local USFS requirements which may vary depending on the time of year.
- Carpooling will be encouraged to minimize road damage and assist in dust control, which is a particular concern during summer months.

Noise

Hearing protection is required in areas of loud noise such as near mechanical equipment and venting steam and air. Hearing protection will be required during drilling or other rig-related activities. Installation of sound walls or other noise abatement equipment may also be necessary depending on the type of operation and scope of work. Signs will be posted where required to designate areas of loud noise. Personnel who are not actively working with equipment inside the high noise area will be kept away.

Personnel will be advised in the proper use of hearing protection during regular safety training and at the daily safety meeting. Noise abatement procedures should be considered when JSAs are performed.

Lifting

All lifting hazards should be properly documented and discussed using a JSA. Personnel will be encouraged to use proper lifting techniques and to always use the right tool for the job. The buddy system will be required for awkward loads and for lifting a load above 50 lb. A mechanical lifting device will be required for loads over 100 lb or above 5 ft in height.

Overhead

When a rig is onsite or a well is in flowing condition, certain overhead hazards may exist. All rig or well activities with equipment placed higher than 6 ft above ground level will be roped off to avoid unnecessary hazards to personnel. Walkways should be routed around and outside any overhead hazards. Overhead hazards will be reviewed in JSAs and during the daily safety meetings. Hard hats are required PPE and must be worn by all personnel onsite at all times. The hard hat is the last line of defense against overhead hazards.

Confined Space Entry

Only employees trained in confined space entry are to enter confined spaces at the NEWGEN FORGE site. All confined spaces will be monitored for acceptable atmospheric conditions prior to and during entry. If conditions warrant, forced air ventilation may be used to ensure acceptable entry conditions. A rescue plan, Job Hazard Analysis (JHA), and a confined space entry permit shall be in place where required. Gas-monitoring devices will be available onsite to monitor levels of H_2S, O_2, and CO. Gas monitors will be required to be worn by personnel during confined space entry (i.e., the wellhead container).

Electrical Safety

Company-specific lockout/tagout requirements shall be followed when controlling hazardous energy. Ground-fault circuit interrupter outlets shall be used in outdoor/wet locations. Grounding of equipment shall be done where required. All tools and cords are to be in good working condition and inspected weekly. Cords are to be protected in traffic areas and all exposed wiring guarded or covered. Only trained employees, subcontractors, and R&D performers will be authorized to hang lockout tagout devices. Energy sources are to be locked out and tagged out during maintenance or other activities when workers are exposed to the unexpected release of hazardous energy. Operation of electrical systems (e.g., geophysics) requires notification of project participants and a signal system used to indicate live energy sources.

Fire Hazards

Good housekeeping will be followed to prevent accumulation of combustible materials. All welding, cutting, and grinding require a hot work permit prior to beginning the job. Equipment and vehicles must be parked on paved or graveled locations, not on grassy areas. All trucks and equipment will be equipped with fire extinguishers and all employees are required to have the basic training to operate them to stop incipient fires provided it is safe to do so. Employees will not respond to fires beyond the incipient stage and will call 911.

All operations will follow the Industrial Fire Precaution Levels as specified by the USFS (Table K.2). As fire hazard levels change, notification of the change in fire hazard will be given to all personnel working on or offsite. A fire safety meeting will be held whenever the fire hazard level changes, as communicated by the USFS. The current fire safety procedures and requirements will be provided to all people working on the project at the time of entry to the lease area whether working on or off the NEWGEN FORGE site. The site pads will be designated as fire-safe areas. If evacuation is necessary all personnel will report to the site pad for evacuation instructions. If work off the pad is required during hazardous conditions, an exemption will be requested from the USFS. If an exemption is obtained, all activities off the site pad will be conducted in accordance with the terms of the exemption.

Table K.2. Industrial fire precaution levels designated by the USFS.

LEVEL	DESCRIPTION
Level I	**Closed Season** – Fire precautions are in effect. A **Fire Watch** is required at this and all higher levels unless otherwise waived.
Level II	**Partial Hootowl** – The following may operate only between the hours of 8 p.m. and 1 p.m. local time (no operation between 1 p.m. and 8 p.m.): • power saws except at loading sites • cable yarding • blasting • welding or cutting metal.
Level III	**Partial Shutdown** – The following are prohibited as indicated: • cable yarding – except gravity-operated systems employing non-motorized carriages operating between 8 p.m. and 1 p.m. when all blocks and moving lines are suspended 10 feet above the ground except the line between the carriage and the chokers. • power saws – except powers saws may be used at loading sites and on tractor/skidder operations between the hours of 8 p.m. and 1 p.m. local time. In addition, the following are permitted to operate between the hours of 8 p.m. and 1 p.m. local time (no operation between 1 p.m. and 8 p.m.): • tractor, skidder, feller-buncher, forwarder, or shovel logging operations where tractor, skidders, or other equipment with a blade capable of constructing firelines are immediately available to quickly reach and effectively **attack a fire start** • mechanical loading or hauling of any product or material for blasting • welding or cutting of metal • any other spark-emitting operation not specifically mentioned.
Level IV	**GENERAL SHUTDOWN – ALL OPERATIONS ARE PROHIBITED**

The **Closed Fire Season** designation means that fire season has been declared. Closed Fire Season depends on the drying of forest and rangeland fuels, rainfall, and time of year.

During the **Closed Fire Season**, the following requirements must be met:

- Fire tools must be onsite.
- A fire extinguisher and shovel must be with each chainsaw.
- Fire extinguishers must be in all vehicles.

- Chainsaws must have a .023-in. mesh screen installed in the exhaust.
- Only modified saws are to be used.
- Approved spark arresters must be on all internal combustion engines.
- Watchmen service must be provided for 3 hours after shutdown of power equipment for the day unless otherwise specified.
- No smoking is permitted while working in or traveling through any operations area on public land except while in a closed vehicles.
- No use of explosives is permitted unless approved in advance.
- Permits to burn are required unless they are waived in advance.

When a **Fire Watch** is required, a Watchman must be identified and be:

- physically capable and experienced in operating any firefighting equipment onsite
- on duty for 3 hours after the shutdown of the last power-driven equipment for the day unless otherwise specified
- furnished with adequate facilities for transportation and communications in order to summon help if needed
- patrolling and visually inspecting all sites where work was done during the day.

Attack a fire start:

- Oregon State Law requires that any operator on forest or range land take immediate action to control and extinguish a fire.
- The contractor shall take this action and notify the USFS and emergency response personnel identified in Section K3.8.

Under **General Shutdown** conditions, all operations are prohibited:

- No waivers will be issued.

Sanitation and Waste Management

Porta-potty and water for washing will be onsite. Housekeeping shall take place routinely to ensure a safe working environment. All wastes shall be properly labeled and handled in accordance with the manufacturers requirements. Hazardous waste stored in drums will undergo weekly documented inspections. Fuel tanks and used oil tanks will undergo documented daily inspections. Individuals and contractors are responsible for supplying their own potable water.

K.3.9 Communication and Conduct of Operations

All personnel participating in research and operations at the site will participate in plan of the day safety meetings before work is initiated. A sign-in sheet (Appendix B) will be passed around and signed by those attending, including company identification. If additional personnel arrive onsite after the initial safety meeting, they will receive safety training and will sign a safety training sheet provided by the Site Operations Manager or designee. Safety meetings will accomplish the following:

- Identify areas that are off limits.
- Discuss safety equipment needed onsite for those working on the project, including hard hats, hearing protection, steel-toed safety boots, and safety glasses.

- Review the planned operations, including maximum operating pressure of 21 MPa (3000 psi).
- Reiterate that personnel should continuously monitor for line leaks, equipment malfunctions, pressure, and induced seismicity to ensure a safe operation.
- Review evacuation procedures, wind sock location, and request that all personnel back-in their vehicles, upwind of the equipment, if possible.
- Designate evacuation vehicles.
- Review 911 and nearest hospital information.

K.3.10 Emergency Response Plan and Evacuation

For all emergency response situations, the following notifications will be required:

Medical & Fire: From a land line CALL 911
From a cell phone CALL (541) 593-8622 Sunriver Fire Department:

The appropriate Emergency Management Services (EMS) will be contacted to transport injured personnel. Maps to the local hospitals will be available onsite in case EMS are not available.

Medical Emergency: From a land line CALL 911
From a cell phone CALL (541) 382 4321 St. Charles Hospital

Fire: From a land line CALL 911
From a cell phone CALL (541) 593-8622 Sunriver Fire Station
(541) 536-2935 Lapine Fire Station

Police: From a land line CALL 911
From a cell phone CALL (541)-536-1758 Deschutes County Sheriff

The Hazardous Materials Response Team for Deschutes County is located at City of Redmond Fire: 341 West Dogwood, Redmond, Oregon.

The notification protocol includes the individuals in the reporting supervision and chain of command (Section K.3.3), starting with the Deputy Director of Site Operations and the Deputy Director of R&D Operations.

In case of an emergency or release at the NEWGEN FORGE site an evacuation assembly area will be established upwind of the prevailing wind direction. A windsock will be present onsite and as well as streamers tied to a drilling rig or tower to assist personnel in determining wind direction. All employees will be trained to know where the assembly areas are located and to proceed to the upwind area immediately in the event of high H_2S or other dangerous conditions such as forest fire. Supervisors are responsible for accounting for all personnel and for summoning appropriate emergency assistance from outside agencies. The global positioning system coordinates for emergency vehicles and Life Flight are:

- 43°43’34” N
- 121°18’57” W

K.3.11 Safe Transportation, Storage, and Shipping of Core Materials

In order for research quality samples to be provided for use by NEWGEN and R&D performers, samples will archived and stored according to the Sample and Core Curation Plan. That plan addresses handling

and distribution of physical samples, including cores, cuttings, and fluid samples. Samples and core materials shipped from the site to the sample storage facility in Bend, Oregon, as well as any samples shipped offsite will meet DOT transportation requirements.

K.3.12 Sample Disposal upon Project Completion

Samples including core, water samples, and other materials will be stored at the NEWGEN core curation facility during the life of the project. At the completion of the project, these materials will be retained by OSU for permanent storage, as part of an agreement being negotiated between DOGAMI and OSU.

K.3.13 Access and Control for Subcontractors and NEWGEN FORGE R&D Performers

All contractors working at the NEWGEN FORGE site or subcontractors working for other contractors, and R&D performers are required to follow all applicable federal, state, and local regulations and permit requirements. At a minimum, each company will have its Injury and Illness Prevention Program onsite and reviewed by the Deputy Director of Site Operations and the Deputy Director of R&D Operations. Other safety programs that address hazards to which their workers will be exposed, such as Code of Safe Practices, JSA programs, or JHA programs specific to their work tasks will also be onsite and reviewed by the Deputy Director of Site Operations and the Deputy Director of R&D Operations. All personnel will participate in the plan of the day safety meetings and are required to register at the site by signing in and out each day.

Contractors, subcontractors, and R&D performers are required to report the Site Operations Manager any recognized hazard that they cannot immediately correct. All incidents involving injury, fatalities, property damage, and significant near misses shall be reported to PNNL and AltaRock immediately. Contractors and R&D performers are required to perform incident investigations for incidents involving their employees and to provide a copy of the documentation to PNNL and AltaRock. Contractors and R&D performers will provide all necessary training, PPE, First-Aid supplies and treatment, and equipment for their employees' use.

K.4 Forms

ES&H Plan Training Acknowledgment Form

Authorized Workers *I have read the ES&H Plan, understand the hazards and controls associated with this work, and will implement the controls as indicated. I will inform the activity lead if there are changes to the hazards or if the controls appear to be inadequate.*		
Print Name	**Signature**	**Date**

Safety Meeting Log		
Print Name	**Signature**	**Date**

Job Safety Analysis Form

Job/Task: _____

Job Location: NEWGEN Site _____ Date: _____

Completed By: _____

Contractor: _____ Supervisor/Foreman: _____

NGE Representative: _____

Personal Protective Equipment required: _____

Sequence of Basic Job Steps	Potential Hazards of Each Job Step	Plan of Action to Control or Eliminate any Hazard(s)
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

Signatures of Employees Verifying the Review of Potential Hazards

Print Name	Signature	Print Name	Signature

IDENTIFY HAZARDS: Potential Examples: ●striking against, being struck by, or making harmful contact with an object; ● being caught in, by, or between objects; ● slipping, tripping, or falling; ●developing a strain from pushing, pulling, lifting, bending, or twisting; ● coming in contact with electricity or other power source; ●receiving a thermal or chemical burn; ●being exposed to a hazardous environment ●vehicles (placement, backing, etc.)

Instructions for Completing Job Safety Analysis Worksheet

	Potential Hazards of Each Job Step	Plan of Action to Control or Eliminate the Hazard(s)
Break the job down into steps. Each of the steps of a job should accomplish some major task. The task will consist of a set of movements. Look at the first set of movements used to perform a task, and then determine the next logical set of movements. For example, the job might be to move a box from a truck in the receiving area to a shelf in the storage area. How does that break down into job steps? Picking up the box from the truck and putting it on a hand truck is one logical set of movements, so it is one job step. Everything related to that one logical set of movements is part of that job step. The next logical set of movements might be pushing the loaded hand truck to the storeroom. Removing the boxes from the truck and placing them on the shelf is another logical set of movements. And finally, returning the hand truck to the receiving are might be the final step in this type of job. Be sure to list all the steps in a job. Some steps might not be done each time - checking the casters on a hand truck, for example. However, that task is a part of the job as a whole, and should be listed and analyzed. Number the steps. The number will provide a reference point for the hazards and procedures developed.	Identify the hazards associated with each step. Examine each step to find and identify hazards actions, conditions and possibilities that could lead to an accident. Number hazard list to correspond with your steps. It is not enough to look at the obvious hazards. It is also important to look at the entire environment and discover every conceivable hazard that might exist. Be sure to list health hazards as well, even though the harmful effect may not be immediate. Ex: the harmful effect of inhaling a solvent or chemical dust over a long period of time. It is important to list all hazards. Hazards contribute to accidents, injuries and occupational illnesses. In order to do Part 3 of a JHA effectively, you must identify potential and existing hazards. That is why it is important to distinguish between a hazard, an accident and an injury. Each of these terms has a specific meaning: HAZARD: A potential danger. Oil on the floor is a hazard. ACCIDENT: An unintended happening that may result in injury, loss or damage. Slipping on the oil is an accident. INJURY: The result of an accident. A sprained wrist from the fall would be an injury. Some people find it easier to identify possible accidents and illnesses and work back from them to the hazards. If you do that, you can list the accident and illness types in parentheses following the hazard. But be sure you focus on the hazard for developing recommended actions and safe work procedures.	Using the first two columns as a guide, decide what actions are necessary to eliminate, minimize or monitor the hazards that could lead to an accident, injury or occupational illness. Number the actions to correspond with the steps and identified hazards. Among the actions that can be taken are: (1) engineering the hazard out (2) providing personal protective equipment (3) job instruction training (4) good housekeeping (5) good ergonomics List recommended safe operating procedures on the form, and also list required or recommended personal protective equipment for each step of the job. Be specific. Say exactly what needs to be done to correct the hazard, such as “lift, using your leg muscles”. Avoid general statements like, “be careful”. Give a recommended action or procedure for every hazard. If the hazard is a serious one, it should be corrected immediately. The JHA should then be changed to reflect the new conditions.