

DETAILED TECHNICAL INFORMATION ABOUT THE UPPER BASALT DRILLING PROJECT

SLIM HOLE DRILLING AND MONITORING

Slim holes are data-gathering holes used to confirm preliminary information concerning the underground geology and temperatures inferred from the geophysical surveys. Each slim hole drilling site will be approximately 60 feet by 60 feet.

Slim Hole Drilling: Each slim hole would be drilled with a small, truck-mounted rotary drill rig or coring rig similar to those used for water well drilling. The rigs would be equipped with diesel engines, storage tanks, mud pumps, and other typical auxiliary equipment. During drilling, the top of the drill rig derrick would be approximately 30 to 40 feet above the ground surface. Drilling is typically conducted 24-hours per day, 7-days per week.

The drilling program involves a sequence of drilling or “coring” a hole to a selected depth, cementing a steel casing of smaller diameter into the drilled hole, then repeating the process with progressively smaller holes and cemented casings. This is done at progressively greater depths until the design depth of 1,500 feet (or the depth selected by the project geologist) is reached. The initial casing is approximately 8-5/8 inches in diameter.

The hole is drilled or “cored” using special, non-toxic drilling mud composed of a bentonite clay-water or polymer-water mix. The drilling mud helps to circulate the rock cuttings to the surface where they are removed by the surface equipment. The drilling mud or other drilling fluids would then be recirculated. Compressed air may be used to reduce the weight of the drilling mud in the hole and assist in carrying the cuttings to the surface in some circumstances. The air, drilling mud, cuttings, and any reservoir fluids brought to the surface would then be diverted through a separator/muffler to separate and discharge the air and water vapor to the air and the drilling mud and cuttings to a plastic-lined reserve pit.

Once drilled to the final depth, the drilling mud in the hole would be circulated out using water. Steel tubing, typically 2-3/8 inches in diameter and perforated at the bottom, would be hung in the hole. The water in the hole would be “bailed” by either lifting with a mechanical bailer (basically a small diameter bucket) or by lifting the water out with air pumped into the hole so that a sample of the geothermal fluid in the reservoir can be obtained for chemical analysis.

Slim Hole Monitoring: Following completion of drilling and bailing, all of the drilling equipment is removed from the site. The surface facilities remaining on the site will likely consist only of several valves on top of the surface casing, covered by a locked steel canister approximately three feet in diameter and up to six feet high which provides protection for the valves. The



surface facilities/wellhead monitoring equipment would not be visible from Highway 395 or State Route 203, and would be screened by vegetation and painted in a color to blend with the landscape.

GEOHERMAL WELL DRILLING, TESTING AND MONITORING

The geothermal wells are designed to drill into and flow test the geothermal reservoir to confirm the characteristics of the geothermal reservoir and determine if the geothermal resource is commercially viable. Each geothermal well drilling site would be approximately 200 feet by 150 feet.

Geothermal Well Drilling: Each geothermal well would be drilled with a large rotary drill rig essentially identical to those used to drill oil and gas wells. During drilling, the top of the drill rig derrick would be as much as 140 feet above the ground surface, and the rig floor could be 20 to 30 feet above the ground surface. The typical drill rig and associated support equipment (rig floor and stands; draw works; derrick; drill pipe; trailers; mud, fuel and water tanks; diesel generators; air compressors; etc.) would be brought to the prepared site on trucks. The typical drilling process takes approximately 20 days; however, difficulties encountered during the drilling process, including the need to re-drill the hole, could double the time required to successfully complete a geothermal well. Drilling is typically conducted 24-hours per day, 7-days per week.

Like the slim hole drilling process, the geothermal well drilling program involves a sequence of drilling a hole to a selected depth, cementing a steel casing of smaller diameter into the drilled hole, then repeating the process with progressively smaller holes and cemented casings to progressively greater depths until the design depth of 1,500 feet (or the depth selected by the project geologist) is reached. However, the size of the geothermal well holes and casing are substantially larger than the slim hole and slim hole casing, typically ranging from a 22-inch casing at the surface, to a 13-3/8-inch slotted liner at the bottom of the well. During drilling operations, a minimum of 20,000 gallons of cool water and 6 tons of inert, nontoxic, non-hazardous barite (barium sulfate) would be stored at the well site for use, if required, in preventing well flow.

The hole would be drilled using special, non-toxic, temperature-stable, drilling mud composed of a bentonite clay-water or polymer-water mix. Additional non-hazardous and non-toxic additives would be added to the drilling mud as needed to prevent corrosion, increase mud weight, and prevent mud loss. The drilling mud is cycled down the drill pipe, out the drill bit, up the outside of the drill pipe, through drill rig mud system, and back into the drill pipe. The drilling mud helps to cool and lubricate the drill bit, maintain the well bore, prevent the loss of drilling fluids into or out of the rock formations, and circulate the rock cuttings to the surface. The drill rig mud system acts to

remove the rock cuttings produced by the drill bit from the drilling mud, and discharges them, along with any waste drilling mud, into a plastic-lined reserve pit. Additional drilling mud would be mixed and added to the mud system as needed to maintain the required quantities.

In some circumstances, compressed air may be added to the drilling mud, or used instead of drilling mud, to reduce the weight of the drilling fluids in the hole and assist in carrying the cuttings to the surface. The air, any drilling mud, rock cuttings, and any reservoir fluids brought to the surface would then be diverted through a separator/muffler to separate and discharge the air and water vapor to the air and the drilling mud and cuttings to the reserve pit.

Geothermal Well Testing: Once the slotted liner has been set, and while the drill rig is still over the geothermal well, the residual drilling mud and cuttings would be flowed from the well bore and discharged to the reserve pit. This may be followed by one or more short-term flow tests, each lasting from two to four hours and also conducted while the drill rig is over the well. Each test would consist of flowing the geothermal well into portable steel tanks brought onto the well site while monitoring geothermal fluid temperatures, pressures, flow rates, chemistry and other parameters. An “injectivity” test may also be conducted by injecting the produced geothermal fluid from the steel tanks back into the well and the geothermal reservoir. The drill rig would likely be moved from the well site following completion of these short-term test(s).

One or more long-term flow test(s) of each geothermal well drilled would likely be conducted following the short-term flow test(s) to more accurately determine long-term well and geothermal reservoir productivity. The long-term flow test(s), each lasting approximately five days or more, would be conducted by either pumping the geothermal fluids from the well through onsite test equipment closed to the atmosphere, or allowing the well to flow naturally to the surface, where the produced steam and non-condensable gases, separated from the residual geothermal fluid, would be discharged into the atmosphere. In either case, a surface booster pump would then pump the residual produced geothermal fluid through a temporary pipeline to the other geothermal well, where it would be injected back into the geothermal reservoir. The temporary



pipeline would be laid on the surface on the disturbed shoulders of the access roads connecting the two geothermal exploration wells. The onsite test equipment would include standard flow metering, recording, and sampling apparatus.

Geothermal Well Monitoring: Following completion of geothermal well testing, all of the drilling and testing equipment would be removed from the site. The surface facilities remaining on the site would likely consist only of several valves on top of the surface casing, which would be chained and locked and surrounded by an approximately 12-foot by 12-foot by 6-foot high fence to prevent access and vandalism. Pressure and temperature sensors may be installed in the hole at fixed depths to monitor any changes in these parameters over time. This monitoring may be continued indefinitely.

ONCE DRILLING IS COMPLETE

After drilling operations are completed, the liquids from the plastic-lined reserve pit(s) would either be evaporated, pumped back down the well or hole, or disposed of in accordance with regulatory requirements.

The solid contents remaining in the reserve pit(s), typically consisting of non-hazardous, non-toxic drilling mud and rock cuttings, would be tested. It would then either be dried on the site and then buried in the on-site reserve pit in conformance with the applicable regulatory requirements, or removed and used as either construction material on private lands, or disposed of in an authorized waste disposal facility.

Upon the completion of well drilling and flow testing, a decision would be made by Mammoth Pacific regarding the commercial potential of each well. If a well is believed to have commercial potential, Mammoth Pacific would seek regulatory approvals to place the well into commercial service. If a well is judged to not have commercial potential, it may continue to be monitored, or it may be abandoned in conformance with the well abandonment regulatory requirements of the U.S. Bureau of Land Management and the U.S. Forest Service. Abandonment of either a slim hole or a geothermal well typically involves plugging the well bore (or hole) with cement. The well head (and any other equipment) is then removed, the casing cut off well below ground surface, and the well site reclaimed.

Environmental Mitigation

Mammoth Pacific has adopted extensive mitigation measures for the drilling project. A complete list can be found on our website at http://www.mammothpacific.com/pdf/UB_EA_V08-Compiled.pdf. Mammoth Pacific has instituted a noise monitoring program to monitor noise levels at the drilling site, Shady Rest Park and Shady Rest campground. The program is also designed to respond to noise complaints or inquiries. Questions or complaints about noise can be lodged at 760-934-4893 ext. 277 24 hours a day.

For answers to questions or comments about the Upper Basalt Exploration drilling program, please call Mammoth Pacific at 934-4893.