



## Glossary of HFR geothermal energy terms

### Drilling related terms

**bit changes:** replacing the worn drilling bit (the end piece of the drill string that cuts and penetrates the earth) with a new bit.

**bottom hole assembly (BHA):** the BHA is approximately 200m long and comprises the drill bit, stabilisers and heavy drill collars.

**bridge plug:** a down-hole tool that is located and set to isolate the lower part of the well bore.

**casing:** the steel piping used to line the wall of the well to provide structural integrity.

**christmas tree:** a set of valves, spools and fittings connected to the top of the well to direct and control the flow of fluids from the well.

**draw works:** the engine that lifts the blocks and drill string vertically.

**drill collars:** heavy sections of drill pipe that provide weight to the bit.

**drill pipe (string):** transmits the torque from the surface to the drill bit down-hole and provides a conduit for the drilling mud.

**drilling bits:** the end piece of the drill string that cuts and penetrates the earth.

**drilling mud:** provides lubrication and cooling at the drill bit and carries the cuttings back to surface.

**grit arrestors :** device to remove particles of sand and granite from brine to avoid damage to the pump.

**fishing:** retrieving equipment from down hole.

**managed pressure drilling:** exactly balancing the pressure from the well with a combination of heavy weight drilling fluid and back pressure.

**mud pumps:** pump the mud down the drill string.

**packing off:** spalling of material from the wellbore around the drill pipe and drill bit.

**positive displacement motor:** the motor rotates the drill bit and is powered by drilling fluid pumped through the tool. Vibration is minimised as surface rotation of the drilling string can be limited.



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**rate of penetration (ROP)** : distance drilled each hour.

**re-injection pump**: multi stage centrifical pump of 450HP to pump brine back to hot granite structure.

**sampling instrumentation**: to measure various chemical components of brine. An addition to temperature pressure and flow rate.

**snub assist**: a unit that can be installed on a drilling rig to allow the drill pipe to be both pushed or pulled when there is pressure from the well.

**spud**: to start the well drilling process by removing rock, dirt and other sedimentary material with the drill bit.

**threads**: drill pipe (string) that transmits the torque from the surface to the drill bit down-hole and provides conduit for the drilling mud.

**top drive**: a motorised drive suspended in the derrick of the drill rig that rotates the drill pipe and is used in the actual process drilling the well.

**underbalanced drilling**: drilling whilst there is pressure from the well at surface.

**valves**: special high temperature and pressure valves for control of brine flows.

**vibration sensor**: down-hole monitoring tool to detect excessive drilling vibration.

**well head**: the surface termination of a well bore that incorporates facilities for installing casing hangers during the well construction phase.

**well head cellar**: a concreted pit at the surface that contains the well head.

## Geothermal testing, power plant and energy production

**air cooled heat exchangers**: reject heat from the brine to simulate the heat loss of a generating plant and reduce the brine to a temperature acceptable to re-injection pumping.

**boiling point**: temperature at which a single substance, such as water, changes from a liquid to a gas (steam) under normal atmospheric pressure. The boiling point at which water transitions to steam is 212°F (100°C). Some liquids boil at a lower temperature than water -- a principle utilised in binary power plants. Boiling point is also affected by pressure. The greater the pressure, the higher the boiling point. This

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principle is put to work in geothermal (flash) power plants when superheated (hotter than boiling) geothermal water is brought up wells. The hot water flashes to steam when the pressure is released as it reaches the surface. This phenomenon also occurs naturally, resulting in such features as geysers.

**chemical energy:** energy inherent in the chemical bonds which hold molecules together. Examples are coal and oil, which have energy potential that is released upon combustion.

**combustion:** the burning of gas, liquid, or solid, in which the fuel is oxidized, producing heat and often light.

**condense:** to change from a gas to drops of liquid. Water-cooled geothermal power plants use cooling towers to cool the used steam and condense it back to water for injection back to the edge of the reservoir. In binary power plants, an organic liquid is first vaporized (with heat from geothermal water) to drive a turbine, then cooled and condensed back to a liquid and recycled again and again in a closed loop.

**conduction:** the transfer of heat as a result of the direct contact of rapidly moving molecules through a medium or from one medium to another, without movement of the media. The heat from geothermal water, for instance can be conducted through metal plates or pipes to heat other water for district heating systems or a second organic liquid for use in binary power plants.

**density:** the amount of mass in a given volume of something. Two objects can be the same size, but have different densities because one of the objects has more mass "packed" into the same amount of space. Objects are smaller when they are cold, larger when hot.

**district heating system:** a heating system that provides heat to a large number of buildings all from a central facility. In geothermal district heating systems, one or more wells can serve entire districts.

**doublet:** the injection and production wells used in a circulation test.

**electric current:** the continuous flow of electrons; often referred to as electricity.

**electrical energy:** energy of electric charges or electric currents.

**electron:** the smallest part of an atom (atoms are the tiny particles of which all substances are made). Electrons may be freed from atoms to produce an electric current.

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**energy conversion** the changing of energy from one form to another. One of the many examples are heat energy being converted into mechanical energy, and then mechanical energy into electrical energy, as is done in steam-driven electric power plants.

**energy efficiency:** the measure of the amount of energy which any technology can convert to useful work; technology with a higher energy efficiency will require less energy to do the same amount of work.

**energy resource:** a source of useable power which can be drawn on when needed. Energy resources are often classified as renewable or non-renewable.

**energy:** the ability to do work, such as making things move and heating them up. Energy can take many forms, including electrical, chemical, radiant, mechanical and heat.

**generator:** a machine that converts mechanical power into electricity by spinning copper wires (conductors) within a magnetic field.

**geothermal (ground source) heat pump:** a space heating/cooling system which moves heat from and to the earth, as opposed to making heat using a fuel source. Geothermal heat pumps take advantage of the almost constant temperature just a few feet underground -- usually warmer than the air in winter and cooler than the air in summer.

**geothermal reservoir:** a large volume of underground hot water and steam in porous and fractured hot rock. The hot water in geothermal reservoirs occupies only 2 to 5% of the volume of rock, but if the reservoir is large enough and hot enough, it can be a powerful source of energy. Geothermal reservoirs are sometimes overlain by a layer of impermeable rock. While geothermal reservoirs usually have surface manifestations such as hot springs or fumaroles, some do not.

**geothermal power plant:** a facility which uses geothermal steam or heat to drive turbine-generators to produce electricity. Three different types make use of the various temperature ranges of geothermal resources: dry steam, flash and binary.

**geothermal resource:** the natural heat, hot water, and steam within the Earth

**geothermal water:** water heated by the natural heat inside the Earth.

**heat exchanger:** a device in which heat is transferred by conduction through a metal barrier from a hotter liquid or gas, to warm a cooler liquid or gas on the other side of the metal barrier. Types of heat exchangers include "shell and tube," and "plate."



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**heat transfer:** the transmission of heat. There are three forms of heat transfer: "conduction," "convection," and "radiation." See these terms.

**high pressure brine pipeline:** special grade high strength pipe to suit high pressure temperature brine circulation from production well to re-injection well.

**injection well:** a well through which geothermal water is returned to an underground reservoir after use. Geothermal production and injection wells are constructed of pipes layered inside one another and cemented into the earth and to each other. This protects any shallow drinking water aquifers from mixing with deeper geothermal water.

**mechanical energy:** the energy an object has because of its motion or position and the forces acting on it.

**megawatt (MW):** a unit of power, equal to a thousand kilowatts (kW) or one million watts(W). The watt is a unit of power (energy/time), the rate energy is consumed or converted to electricity.

**permeable:** able to transmit water or other liquids; for example, rock with tiny passageways between holes, fractured rock, and gravel are permeable.

**power plant:** a central station where electricity is produced using turbines and generators.

**steam:** the vapor form of water that develops when water boils. Steam is made of very tiny heated water particles (molecules) which are bouncing around and bumping into each other at very high speeds. These heated water molecules are also spreading out and expanding in every direction they can. If we confine or trap water in a container, with a pipe as an opening, and heat the water to steam, it will create great pressure in the container and will rush out the pipe with a great deal of force. This force (the "power" of steam) can be put to work turning a turbine connected to an electricity generator.

**transmission lines:** wires that transport electricity over long distances.

**turbine:** a machine with blades that are rotated by the forceful movement of liquid or gas, such as air, steam or water or a combination.

**vaporize:** to change into the gas form anything which is normally a liquid or a solid; the term is most commonly is used in reference to water (which vaporizes to steam).

**voltage:** the measure of the amount of force that "pushes" an electric current



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**water phases:** the change of water from one state to another. The change from ice to liquid is melting; the reverse process is freezing. The change from liquid to gas is evaporation and the product is water vapor; the change from water vapor to liquid is called condensation. Evaporation and condensation are both important functions in geothermal phenomena and in geothermal technology.

**Watt (W):** the measure of the amount of current flowing through a wire at a given time.