SYSTEM AND METHOD FOR AQUIFER GEO-COOLING

CROSS REFERENCE TO RELATED APPLICATIONS

This application claims priority from U.S. provisional application No. 61/049,295, entitled "SYSTEM AND METHOD FOR AQUIFER GEO-COOLING," filed on Apr. 30, 2008, which is incorporated by reference in its entirety, for all purposes, herein.

FIELD OF TECHNOLOGY

The present application is directed to systems and methods for exchanging heat between a fluid and a subterranean formation.

BACKGROUND

Conventional geothermal heat recovery systems are employed to extract thermal energy from subterranean heated formations through heat exchange with rock using water as the heat exchange medium. In the same way, fluids from the high temperature side of any thermal process can be cooled through heat exchange with cooling water from cool subterranean formations.

Heat exchangers are used in industrial processes to cool heated process fluids before discharging the fluids to the environment. For instance, heat exchangers are used in thermal cycle power plants to decrease the discharge temperature of working fluid exiting a turbine that drives an electrical generator. The efficiency of the thermal cycle increases as the discharge temperature of the working fluid decreases. Water is commonly used in wet cooling cycles because water has a high heat capacity. However, water is not always available and is often allocated for other uses including irrigation, drinking and/or other industrial uses. Water is particularly scarce for cooling uses in projects located in arid areas.

Current wet cooling cycles used in thermal cycle power plants include once through cooling cycles and evaporative cooling cycles. Once-through cooling involves circulating water from a water body or an aquifer through the cooling cycle and then disposing of the heated water into the same or other water body. Evaporative cooling involves circulating cooling water between the cooling cycle and an evaporative cooling tower where the water is cooled.

In once-through cooling cycles, water is not usually consumed and water temperature generally increases less than 10° C. However, large volumes of water are necessary for cooling. Once through cooling cycles require between four and twelve gallons of cool water per minute per kilowatt electricity generated. Heated water is returned to surface water bodies which can adversely impact plant and animal life that is sensitive to minor variations in water temperature.

Evaporative cooling cycles result in approximately 70 to 80 percent water loss on an annual basis, which is equivalent to one to three gallons per minute per kilowatt electricity generated. Recirculation of cooling water through the evaporative cooling tower increases the concentration of dissolved solids and minerals that are common in water and brine produced from geothermal wells. Scale and corrosion inhibiters and other chemicals are required to prevent scale, corrosion and growth of organisms such as algae in the oxygen rich cooling cycle. This water, if disposed of to surface water bodies, can cause environmental damage.

Current cooling systems and methods that are used in industrial processes including, but not limited to, flash steam power plants, binary power plants and solar thermal power plants are inefficient, require large volumes of water and are harmful to the environment.

SUMMARY

A geo-cooling system of specified cooling capacity for cooling a known heat load is disclosed. The system includes a cool water aquifer, a cool water production well and a heated water injection well. The cool water production well is open to the cool water aquifer and in hydrologic communication with a subterranean heat exchange area that provides requisite cooling capacity to a known heat load. The heated water injection well is in hydrologic communication with the subterranean heat exchange area and open to the cool water aquifer at a prescribed distance from the cool water production well. The prescribed distance between the cool water production well and the heated water injection well is at least based on the available size of a subterranean heat exchange area including a portion of the cool water aquifer that hydrologically communicates between the heated water injection well and the cool water production well.

The foregoing and other objects, features and advantages of the present disclosure will become more readily apparent from the following detailed description and figures of exemplary embodiments as disclosed herein.

DEFINITIONS

The term "aquifer" is defined herein as a formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield economical quantities of water to wells and springs.

The term "aquifer stimulation" is defined herein as a type of development in semiconsolidated and completely consolidated formations to alter the formation physically to improve its hydraulic properties.

The term "aquitard" is defined herein as a saturated, but poorly permeable bed, formation or group of formations that does not yield water freely to a well or spring. However, an aquitard may transmit appreciable water to or from adjacent aquifers.

The term "confined aquifer" is defined herein as a formation in which the groundwater is isolated from the atmosphere at the point of discharge by impermeable geologic formations; confined groundwater is generally subject to pressure greater than atmospheric.

The term "permeability" is defined herein as the property or capacity of a porous rock, sediment, or soil for transmitting a fluid and a measure of the relative ease of the fluid flow under unequal pressure.

The term "transmissivity" is defined herein as the rate at which water is transmitted through a unit width of an aquifer under a unit hydraulic gradient.

The term "unconfined aquifer" is defined herein as an aquifer wherein the water table is exposed to the atmosphere through openings in the overlaying materials.

The term "well screen" is defined as a filtering device used to keep sediment from entering the well.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the present application are described, by way of example only, with reference to the attached Figures, wherein: