ORMAT®

September 20, 2013

California Energy Commission
DOCKETED
13-IEP-1D
TN 71986
SEP 20 2013

California Energy Commission
Dockets Office, MS-4
Re: Docket No.11-RPS-01
RPS Proceeding
1516 Ninth Street
Sacramento, CA 95814-5512

RE: Definition of Station Service Load at Eligible Renewable Facilities

Ormat Technologies, Inc. (NYSE: ORA) appreciates the opportunity to provide comments on the staff-issued white paper regarding the definition of station service and hopes these comments will be used to inform those considering revisions to future editions of the RPS Guidebook. Ormat has been engaged throughout this process filling comments on March 25 and April 25 of this year with the California Energy Commission regarding Docket Nos. 11-RPS-01; 02-REN-1038. Ormat has also filed comments with WREGIS regarding the WREGIS Operating Rules. This issue is of particular importance to Ormat as we operate 202 MW of geothermal generation in California and approximately 400 MW of geothermal generation throughout the WECC region.

We commend the energy commission staff for agreeing *"that energy use for offsite fuel transportation –for fuel delivery from the source to the electric generation facility-should not be considered station service. Consequently, if geothermal brine is in fact a fuel for geothermal facilities, then the delivery of that fuel to the geothermal facility should not be considered station service, consistent with other renewable technologies."*[1]

However, the staff's unusual classification of geothermal brine as a "heat transfer fluid" and not as a "fuel" results in subsequent treatment of geothermal production pump load as station service and not as an offsite fuel transportation. This is discriminatory towards geothermal generators, inconsistent with existing government policies, and harmful to operators of geothermal generating facilities in California.

1. **Staff's approach discriminates against geothermal power plants that use geothermal brine as the energy source.**

The CEC is allowing other technologies to treat the energy that is required to bring the renewable energy source into the power plant (such as the energy consumed in order to haul biomass or the compression energy used to transport bio-methane into the generating facility) as an offsite fuel transportation system that does not need to be netted out of the plant's meter for the purpose of REC creation. However, staff is suggesting not to define geothermal brine as an offsite fuel even though this is the energy source used to generate electricity at a geothermal generating facility. As it stands, geothermal brine is considered a heat transfer fluid. The power consumed in order to pump geothermal fluids from its reservoir to the generating facility will therefore be treated as station service rather than an offside fuel transportation system that does not need to be netted out.

ORMAT TECHNOLOGIES, INC.
6225 Neil Road • Reno, NV 89511-1136 • Phone : (775) 356-9029 • Fax : (775) 356-9039
E-mail: ormat@ormat.com Web site:www.ormat.com

As explained below, staff's statement that "brine is not a fuel" is based on flawed logic.

a. **Staff's proposed definition that *"Fuels are substances that are burned or otherwise modified to produce energy"* is inaccurate.**

The first law of thermodynamics holds that energy cannot be produced or destroyed, it can only change form. A fuel does not "produce energy," it transports it to a place where it can change form. A power plant changes the energy in geothermal water and steam (or oil, gas, coal, sunlight, wind, uranium, etc.) into electricity. Any burned fuel undergoes irreversible chemical and physical changes and is therefore non-renewable on time scales other than geologic. In chemistry and physics, fuels are any material that store potential energy in a form that can be released and used as heat energy.[2] Fossil fuels such as oil or natural gas are commonly used in conventional power plants because they are easily transported forms of potential energy that can be released by combustion to yield thermal energy (heat) that is converted into mechanical energy to drive electrical generators. By the limited non-renewable definition, energy is released by breaking chemical bonds during fuel combustion.

b. **Staff's claim that *"Brine, unlike a biofuel, does not undergo any chemical reaction or other modification to release its energy; it is simply a fluid with a high thermal potential that is allowed to expand, or, in binary systems, is exposed to a low thermal potential (as in a heat exchanger) allowing it to dissipate heat"* is wrong.**

Geothermal fluids undergo many chemical changes in the process of modifying temperature, pressure and enthalpy during production.[3][4] For example, minerals precipitate from the brine and produce scale. The geothermal brine changes temperature and density as a result of the heat transfer that takes places at the power plant. Controlling complex temperature/pressure dependent liquid/solid chemical equilibria is a fundamental part of managing a geothermal reservoir, sustaining well productivity and managing fluid quality within a producing geothermal system. Further, limiting the discussion to chemical change ignores the physical changes inherent in "…other modification to release its energy."

Nuclear materials are generally considered the fuel – commonly referred to as "fuel rods" for nuclear power generation stations. Nuclear fission as a usable heat source is the result of a physical, rather than chemical, process because it alters the fundamental structure of an atom instead of interconverting chemical species through breaking or creating chemical bonds.[5][6] Nevertheless, under staff's proposed definition of fuel, a nuclear fuel rod is not a fuel either.

Geothermal brine is "modified" in many physical ways in the process of electricity generation. Throughout a geothermal production system, fluid flow is entirely dependent on induced changes in the thermodynamic condition of the fluid. Geothermal flash plants exploit a phase change from liquid to vapor to produce the steam that ultimately spins turbines. Binary geothermal systems exploit the thermodynamic characteristics of secondary working fluids to exchange heat and change phase from fluid to vapor. These phase changes are reversible and, as heat is lost, the steam or secondary working fluid vapors are condensed and changed back into a liquid phase. Gases exsolve from the geothermal fluid throughout production processes because pressure changes induce changes in liquid/gas equilibria. Non-condensable gases represent an irreversible part of the production process and are commonly ejected from production systems irreversibly changing the fluid/gas balance of geothermal brines.

c. **Staff's claim that *"it is reasonable to conclude that a geothermal facility is powered by the internal heat of the earth and not by the geothermal brine,…"* has no merit. Geothermal power plants are powered by natural geothermal fluids, not by the heat of the earth**

While heat is certainly a necessary element of the geothermal resource base, it is by no means a sufficient condition for a viable geothermal system. By definition, a viable conventional geothermal system has long been considered to require heat, permeability and water. [7] [8] [9] [10] [11] [12] [13] [14] [15] [16] [17] [18] [19] It would be ideal if the earth's heat could simply be recovered by conductive or radiative heat transfer but unfortunately there are no viable processes to collect radiated heat from molten or even solid hot rock. Despite the tremendous geothermal temperatures at depth, the earth's surface is occupiable because conduction is a slow, inefficient heat transfer mechanism and the earth's crustal rocks are very efficient insulators.[20] [21] [22] Convection, the circulation of fluid through hot permeable crustal rocks, is the most fundamental and efficient heat transfer mechanism to actually use the earth's available heat. [23] [24] [25] [26] [27] [28] [29] The convecting fluid is an intrinsic part of the potential energy distribution within a geothermal system. Because of its extremely high heat capacity, water (either liquid or vapor) conveys the greatest part of the heat content of a geothermal system on a per-volume basis.

Staff's claim leads one to believe that a geothermal power plant could be developed anywhere in the world, since heat can be found anywhere on earth, as long as one drills deep enough into the earth's crust. But the reality is that geothermal developers spend millions of dollars exploring for those rare and hard-to-find locations where hot geothermal **fluids** can be found and transported into a power plant, for the purpose of electricity generation.

Using staff's logic, if geothermal power plants are powered by the heat of the earth and not by geothermal brine – with the brine being merely a "heat transfer fluid" – then a wind turbine is not powered by the wind but rather by the heat of the sun that creates changes in atmospheric pressure and by the rotation of the earth, with the air acting merely as a "motion transfer fluid."

Furthermore, fossil fuels are also a means of storing the earth's potential heat. Hydrocarbons (such as coal, oil and natural gas) are the result of anaerobic decomposition of organic matter buried to great depths in the earth. The geothermal temperature and pressure gradients at depth alter the organic matter into kerogens, and with even more geothermal heat, eventually into liquid and gaseous hydrocarbons. Exploitable volumes of mobile hydrocarbons commonly require some means of isolation and concentration in traps that form as the result of large-scale deformation of the earth's crust. Geologic deformation is driven by plate tectonic processes that result from the differential distribution of geothermal heat driving convection in the earth's mantle. By staff's definition "Geothermal is defined as "of, relating to, or produced by the internal heat of the earth. Thus, it is reasonable to conclude that a geothermal facility is powered by the internal heat of the earth and not by the geothermal brine,…", hydrocarbons would not be considered fuels because their potential energy is the result of the internal heat of the earth and not the unaltered properties of the material.

Finally, The hot water and steam from a geothermal system may be sold like any other fuel. In some geothermal projects, one company owns the geothermal well field while other companies own the power plants. For example, historically the Geysers producing field was developed and operated by separate companies including Unocal, Magma and Thermal Power who sold steam to PG&E to generate electricity. Similar arrangements still exist, for example, in the Imperial Valley, California, where a geothermal field company sells geothermal fluids to power plant owners under fluid supply agreements. The geothermal fluid was and is a commodity like any other fuel.

d. **Staff's claim that geothermal brine in a geothermal power plant is equivalent to synthetic oil in a SEGS power plant is flawed.**

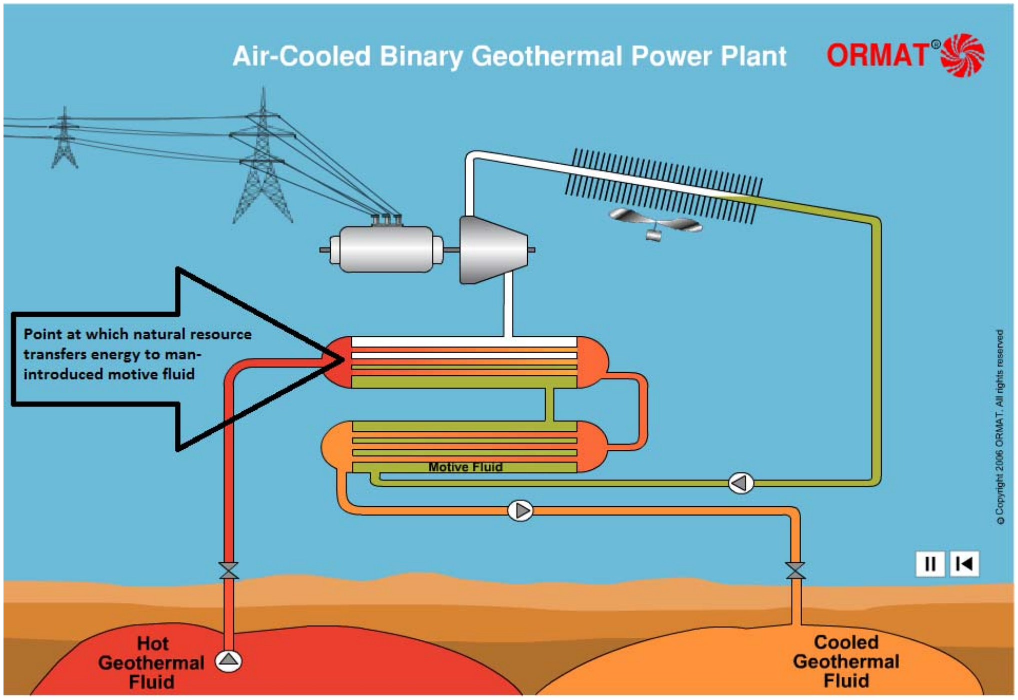
Staff asserts that *"If the brine is assumed to be a heat transfer fluid for all geothermal facilities, it may be more appropriate to compare binary geothermal facilities to other electric generating facilities using binary systems. For example, the Solar Electric Generating System (SEGS) power plants…use synthetic oils to collect energy from concentrated sunlight. The pumps used to move the synthetic oil through the solar collection field are considered station service."*

In this comparison a critical step is missing from the description of a binary geothermal system which might explain and resolve some of the confusion regarding the fuel. In a binary geothermal system a working fluid (often pentane or butane) is used to collect energy from the naturally occurring geothermal brine, which is the fuel. The pumps used to move that working fluid along with the fans used to cool it are and should be considered station service. However, the delivery of the geothermal fuel to that process is no different than the delivery of concentrated sunlight to the synthetic oil or delivery of biofuel to a biomass-fueled electric generation facility.

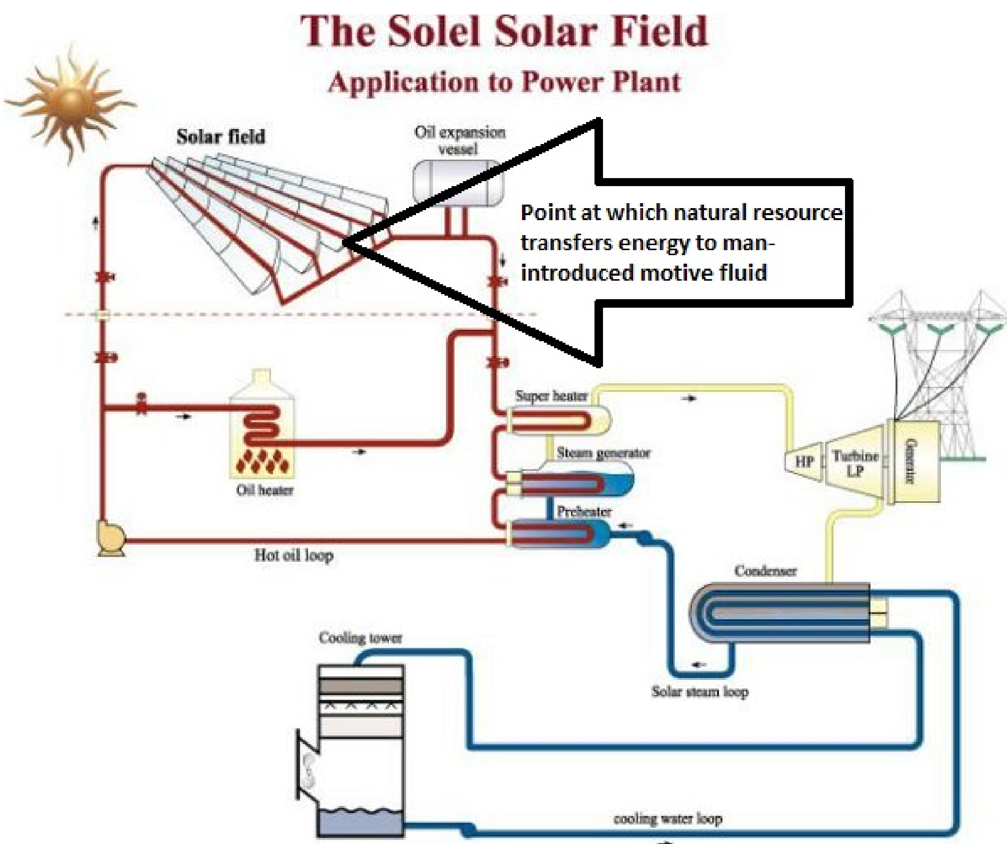
The engineers who design a SEGS power plant have the liberty to decide whether or not to use synthetic oil in the power generation process (as opposed to, for example, using solar flux on a central boiler making steam directly to run a turbine or using photovoltaic panels to directly convert solar energy to electricity) and to select the mass, volume, pressure and chemical composition of such a synthetic oil. This choice in design impacts the type of auxiliary systems that are required to pump and otherwise handle that synthetic oil. On the contrary, when designing a geothermal power project engineers have absolutely no control over the location, depth, pressure, volume or chemical composition of the geothermal fluid, because that fluid is a natural resource.

Staff's comparison of SEGS versus binary geothermal power plants is flawed. While a SEGS facility introduces two engineered cycles, the diagrams below demonstrate that the geothermal binary cycle is only engineered once the geothermal brine enters the heat exchanger transferring thermal energy into the motive fluid. Just like SEGS, once the thermal energy is transferred to the motive fluid station service has begun.

Ormat suggests that the line between what's a fuel and what's a secondary system as defined in staff's paper should not be concerned with the number of cycles in the process but rather the nature of the cycle. The natural energy source to which the power plant is tapping is the fuel and the system used to bring that fuel to the plant is an offsite fuel transportation system. Systems handling fluids that were artificially introduced to the power plant as part of the electricity generation process, should be treated as station service. Delivery systems of the natural energy source should not.



Air-Cooled Binary Geothermal Power Plant
ORMAT
Point at which natural resource transfers energy to man-introduced motive fluid
Motive Fluid
Hot Geothermal Fluid
Cooled Geothermal Fluid
© Copyright 2006 ORMAT. All rights reserved



The Solel Solar Field
Application to Power Plant
Solar field
Oil expansion vessel
Point at which natural resource transfers energy to man-introduced motive fluid
Super heater
Steam generator
Preheater
Oil heater
Hot oil loop
HP
Turbine LP
Generator
Condenser
Cooling tower
Solar steam loop
cooling water loop

2. **Staff's approach is inconsistent with existing policies with regards to station service and geothermal power plants.**

Staff states:*"that energy use for offsite fuel transportation –for fuel delivery from the source to the electric generation facility-should not be considered station service. Consequently, if geothermal brine is in fact a fuel for geothermal facilities, then the delivery of that fuel to the geothermal facility should not be considered station service, consistent with other renewable technologies."* is consistent with existing FERC policy which states "*that neither pumping energy nor compression energy falls within our definition of station power, as articulated in the recent PJM II order. In that order, we defined station power as "the electric energy used for the heating, lighting, air conditioning, and office equipment needs of the buildings on a generating facility's site, and for operating the electric equipment that is on the generating facility's site."*[30]

However, when it comes to determining the nature of geothermal brine production pump load, staff's position is the exact opposite of FERC's. FERC has "*found that, consistent with the decision in Geo East Mesa Limited Partnership, the power for the extraction and transportation of geothermal brine is not a necessary and integral part of the production process and, therefore, not auxiliary load."*[31]

Staff's opinion is also inconsistent with the Nevada Legislature which recently introduced SB 252 stating: "*the amount of any electricity used by a portfolio energy system for its basic operations does not include the electricity used by a portfolio energy system that generates electricity from geothermal energy for the extraction and transportation of geothermal brine."*[32] The Nevada legislature introduced SB 252 to net out station service which previously counted toward REC production. This language was specifically added to align Nevada's and FERC's definitions of "basic operations" or station service.

By defining geothermal brine as a working fluid and not a fuel, staff is diverting from the industry standard, causing confusing to geothermal developers and power and REC purchasers instead of cohesion.

3. **Staff's position creates a significant harm to operators of binary geothermal power plants.**

By unfairly treating geothermal production pump load as station service and not as an offsite fuel transportation system, staff is causing a two-fold harm to all binary geothermal power plant operators who rely on pumping load to bring geothermal fluids to the power plant. Once, by reducing the total amount of RECs that the power plant is entitled to produce and sell; and again, by creating a major metering and REC reporting challenge.

Since geothermal brine *is* the fuel used to generate electricity, and that fuel is hard and expensive to discover and produce, it is common for a single well and production pump to supply geothermal fluids to more than one generating facility. If staff accepted the FERC and Nevada classification of geothermal production pump load as a fuel delivery system (referred to by staff as offsite fuel transportation system) then it would be a business decision made by the power plant operator and the well-field operator – who may not necessarily be the same entity – regarding how to power those production pumps. However, by classifying such load as station service, staff is forcing geothermal operators to allocate that load to all generating facilities that use brine and share that part of the station service, on a pro-rata basis, in order to comply with the WREGIS operating rules. This calls for a complicated real-time meter adjustment scheme that, as far as we know, no other technology is required to implement nor is it supported by CAISO. This will ultimately result in additional and unfair loss of RECs and revenues to the power plant operator.

In Summary

Ormat sincerely thanks the CEC Staff for sharing this concept paper on station service. We look forward to continuing dialogue that will treat all technologies fairly and define station service to ensure an equitable and transparent REC marketplace.

Ormat agrees with the policy that station service should not be eligible for the creation of a WREGIS certificate. Confusion arises with the advice letter issued May 2012 by the program administrator for WREGIS defining geothermal brine as a working fluid instead of a fuel. The discussion above highlights the need to define geothermal brine as a fuel which would immediately rectify any issues in the definitions of station service by WREGIS, the California Energy Commission, the Federal Energy Regulatory Commission and the Public Utilities Commission of Nevada.

Respectfully,

RM Sullivan

Bob Sullivan
VP, Business Development
bsullivan@ormat.com

---

[1] http://www.energy.ca.gov/portfolio/documents/2013-09-10_workshop/2013-09-10_Attachment_A-Station_Service.pdf p 10
[2] Chisholm, Hugh, ed., 1911, "Fuel". Encyclopedia Britannica (11th ed.). Cambridge University Press.
[3] Ellis, A.J., and Mahon, W.A.J., 1977, Chemistry and Geothermal Systems. Academic Press.
[4] Grant, M.A., Donaldson, I.G. and Bixley, P.F., 1982, Geothermal Reservoir Engineering. Academic Press
[5] White, D.F., 1968, Geothermal energy reservoirs. Am Assoc. of Pet. Geol. V.52, no. 3 p 568
[6] Muffler, L.J.P., 1979, Assessment of Geothermal Resources of The United States. USGS Circ. 790.
[7] White, D.F., 1968, Geothermal energy reservoirs. Am Assoc. of Pet. Geol. V.52, no. 3 p 568
[8] White, D.F., 1973, Characteristics of geothermal resources. in Kruger and Otte, Geothermal Energy: Resources, Production, Stimulation. Stanford Univ. Press
[9] White, D.F. and Williams, D.L., 1975, Assessment of Geothermal Resources of the United States. USGS Circ. 726.
[10] Ellis, A.J., and Mahon, W.A.J., 1977, Chemistry and Geothermal Systems. Academic Press.
[11] Muffler, L.J.P., 1979, Assessment of Geothermal Resources of he United States. USGS Circ. 790.
[12] Kestin, J. (ed), 1980, Sourcebook on the Production of Electricity from Geothermal Energy. US DOE 1980-0-35-585.
[13] Grant, M.A., Donaldson, I.G. and Bixley, P.F., 1982, Geothermal Reservoir Engineering. Academic Press
[14] Duffield, W. and Sass, J.H., 2003, Geothermal Energy – Clean Power from the Earth's Heat. USS Cir. 1249.
[15] Geothermal Energy Association, http://geo-energy.org/basics.aspx
[16] International Geothermal Association, http://www.geothermal-energy.org/geothermal_energy/what_is_geothermal_energy.html#c313
[17] US Department of Energy, National Renewable Energy Lab, http://www.nrel.gov/learning/re_geothermal.html

[18] US Department of Energy, Geothermal Technologies Office, http://www1.eere.energy.gov/geothermal/geothermal_basics.html

[19] US Department of Energy, Lawrence Berkeley National Lab, Earth Sciences Division, http://esd.lbl.gov/research/programs/er/research_areas/geothermal_energy.html

[20] Ellis, A.J., and Mahon, W.A.J., 1977, Chemistry and Geothermal Systems. Academic Press.

[21] Grant, M.A., Donaldson, I.G. and Bixley, P.F., 1982, Geothermal Reservoir Engineering. Academic Press

[22] Duffield, W. and Sass, J.H., 2003, Geothermal Energy – Clean Power from the Earth's Heat. USS Cir. 1249.

[23] White, D.F., 1968, Geothermal energy reservoirs. Am Assoc. of Pet. Geol. V.52, no. 3 p 568

[24] White, D.F., 1973, Characteristics of geothermal resources. in Kruger and Otte, Geothermal Energy: Resources, Production, Stimulation. Stanford Univ. Press

[25] White, D.F. and Williams, D.L., 1975, Assessment of Geothermal Resources of the United States. USGS Circ. 726.

[26] Ellis, A.J., and Mahon, W.A.J., 1977, Chemistry and Geothermal Systems. Academic Press.

[27] Muffler, L.J.P., 1979, Assessment of Geothermal Resources of the United States. USGS Circ. 790.

[28] Kestin, J. (ed), 1980, Sourcebook on the Production of Electricity from Geothermal Energy. US DOE 1980-0-35-585.

[29] Grant, M.A., Donaldson, I.G. and Bixley, P.F., 1982, Geothermal Reservoir Engineering. Academic Press

[30] Norton Energy Storagea, LLC, 95 FERC 61,476 (2001)(June Order, p. 9)

[31] Ormesa LLC, 108FERC 61,200 [Docket No. QF86-681-006], Order Denying Rehearing (September 2004)

[32] https://nelis.leg.state.nv.us/77th2013/App#/77th2013/Bill/Overview/SB252