LAKEVIEW GEOTHERMAL POWER GENERATION FACILITY FEASIBILITY STUDY

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APPENDIX

The Town of Lakeview retained Anderson Engineering & Surveying, Inc. to determine if low temperature geothermal power generation was feasible at the Town's North Geothermal Production Well. This report reviews alternatives and costs for generating power using the Town's low temperature geothermal resource.

Background

Geothermal water has been part of the Lakeview landscape since the beginning of the Town. Natural hot springs exist just south and north of Lakeview. Development of the resource has been limited to mostly space heating with limited success and use. A power generation project was started in the early 1980's but was not successful due to lack of foresight on disposal of the spent geothermal fluid, inadequate allowance for cooling water, and limited capital. Most of the past geothermal projects were done without adequate technical involvement.

A space heating project, developed in 2005, with the Town of Lakeview and the Oregon State Correctional Facility has been very successful with the facility saving $80,000 to $100,000 per year in energy costs. With the increasing cost of energy, power generation is the next viable project to utilize the resource available to Lakeview.

The Town of Lakeview drilled a geothermal production well in cooperation with the Oregon Department of Corrections in 2004. This well (Oregon Water Resources Log #51612) produces 206° water and is currently supplying the Warner Creek Correctional Facility with geothermal heat. Operation of this well is under Oregon Water Resources Permit Number G-15557, which allows a use of 300 gallons per minute (gpm). After the geothermal water is used for heating, the water is re-injected back into the aquifer via a re-injection well (Oregon Water Resources Log #52423). Please refer to the Site Plan in the Appendix showing the layout of the North Geothermal Production Well.

The current heating demand at the correctional facility is 30 to 40% (based on flow) of the well's geothermal capacity with an approximate average of 2 million BTU's (British Thermal Units – The amount of heat to raise 1 pound of water 1 degree) per hour with peak loads of up to 4 million BTU's per hour. In addition, a good possibility exists that power generation could occur before sending the geothermal water to the correctional facility making dual use of the water prior to re-injection. If water temperatures are reduced to an average of 150° after the electrical generation processes, it could still provide nearly 7 million BTU per hour at the 300 gpm flow as per the well permit. While this use is technically viable, the compatibility of the correctional facility equipment needs to be considered if the project moves forward to design. The prison heating system was designed for temperatures well above the effluent from the power plant. Experience with the existing system, however, indicates that it operates well below design capacity under most conditions. Evaluation of the heating system with respect to capacity under the power plant operating mode will be a key task in the course of project development. Multiple uses of the geothermal water are possible and sustainable.

In order to provide some redundancy and realizing the prior corrections facility requirements, the Town has also entered into an agreement with the Utley Family Trust to use another nearby geothermal well for backup purposes. This well is commonly called the greenhouse well, but for purposes of this report will be referred to as the Utley Well (Water Resources Log # Lake 2040). This well was pump tested in 1980 at 380 gpm with an approximate drawdown of 15'. An additional 150 to 300 gpm could easily be supplied from this well, providing a full backup source for the system. Additional water rights would be required for this well as the only rights are for the green house at approximately 13 gpm (Water Right Certificate 65564).

Cooling water for the generation operation is also available from the Town's North Water Well (Water Resources Log #50703 and Permit #G-13262) also in the proximity. Please see the Vicinity Map in the Appendix showing the project location and the water sources.

Marubeni Sustainable Energy, Inc. is planning a 13 megawatt biomass plant in Lakeview which will require 230 gpm of makeup water for the boilers. Currently the Town is planning to provide this water via the North Water Well which could be used for generator cooling purposes prior to sending the water to the biomass plant.

With major infrastructure in place, this project has advantages that many start up geothermal projects lack. This puts the Town in a good position to further develop the geothermal resources, and make multiple geothermal and cold water resource applications.

Small Geothermal Power Generation

Electricity has been commercially generated from geothermal resources in the United States since 1960, far longer than either wind or solar. The earliest plants tapped a very unique geothermal resource in California in which wells produced steam that fed directly to a turbine/generator, thereby simplifying the geothermal process. Since the 1980's, however, most geothermal power development has occurred at resource sites that produce pressurized hot water rather than steam, and these plants have used what the industry refers to as a "binary" or Organic Rankine Cycle (ORC) plant designs. In this type of plant a secondary fluid is circulated in a closed loop of components including a boiler, turbine, condenser, feed pump and interconnecting piping. Geothermal water is delivered to the boiler portion of the plant where its heat is transferred to the working fluid causing the fluid to boil. The resulting vapor is directed to the turbine where energy is converted to shaft power which is transmitted to an attached electrical generator. The vapor exiting the turbine is returned to the liquid state in the condenser where cooling water from an external source is used to absorb heat from the working fluid. Finally the liquid working fluid is delivered back to the boiler by the feed pump. The working fluid remains sealed in the packaged ORC unit and never comes into direct contact with the geothermal water.

Figure 1
Two 250 kW United Technologies ORC units located at Chena Hot Springs Alaska

Although several companies have provided Rankine cycle plants for geothermal applications; one company, Ormat Energy Systems of Sparks, NV has dominated the market, particularly in the smaller (<1MW) modular power plants. Recently United Technologies Corporation (UTC), a large manufacturer of refrigeration and air conditioning equipment, has entered the ORC market – cleverly taking advantage of the similarities between their refrigeration equipment and ORC units. UTC installed its first geothermal unit (Figure 1) in Alaska at Chena Hot Springs in 2006. The plant operates at the previously unheard of temperature of 165° Fahrenheit (F). Part of the reason this extremely low temperature operation is possible is that river cooling water is available in the summer at 40° F and in the winter air cooling of the plant allows for even lower cooling temperatures. Please see additional information on UTC Power in the Appendix.

ORC equipment available from both major vendors is far more highly developed and field proven than was the case with the SPS power generation equipment installed in Lakeview in the 1980's. Beyond this, careful management, adequate budget and professional oversight will assure that shortcomings associated with the early geothermal power generation effort are not repeated.

The ORC plant type offers both benefits and challenges with respect to geothermal power development. Most importantly it facilitates the generation of power from lower temperature geothermal resources by employing a cycle that permits the boiling of a fluid at lower temperature than steam can be generated. By using working fluids selected specifically for their low temperature performance characteristics, machines can be customized, to some degree, to the application. In the case of the geothermal temperature available here in the Lakeview area, it is possible that the working fluid of choice may be

R134A. This is the same non toxic, environmentally safe refrigerant used in modern auto air conditioning systems and home refrigerators.

The efficiency of the power plant is principally determined by the difference in the temperatures between which it operates; the temperature of the boiler and the temperature of the condenser. The larger the temperature difference, the higher the plant efficiency. Boiler temperature is determined by the geothermal resource temperature and the condenser temperature is determined by the cooling source water temperature. Both the geothermal resource and the cooling water temperatures are critical to plant performance. However, even with careful design; the overall plant efficiencies are low. The plant efficiency may be 10% or less in the temperature range likely at Lakeview. Stating it another way about 90% of the heat delivered to the machine is eventually rejected to the atmosphere and 10% converted to electricity. Efficiently rejecting the large amount of heat necessary requires careful design on the cooling side of the plant so as to minimize the electrical consumption by cooling towers, pumps and fans. The potential Lakeview project has several options available for cooling (well water, a cooling tower or a combination of the two) and selection of the best approach in terms of cost and net electricity production would constitute an important part of the design.

The development of a small geothermal power plant in Lakeview could take advantage of several key elements unavailable at other sites. The well providing geothermal water to the Warner Creek Correctional Facility has excess capacity and could provide the necessary heat source for the plant, thus eliminating the risk associated with resource development at an undeveloped site. The effluent from the power plant, likely in the 145° to 165°F range, would be used for the correctional facility heating. Cooling water from an existing well is available to meet at least part of the cooling needs of the plant, reducing or eliminating costs associated with cooling towers. Interconnection facilities with electric utility systems are in close proximity to the project site. Please see the Site Plan in the Appendix. All of these factors tend to result in a far more favorable development setting than is typically the case.

Power Capacity

A heat engine operating between two given temperatures is subject to a Carnot efficiency of, Efficiency =T1- T2/T1, with T1 our geothermal temperature of 206° F and T2 being our cooling water temperature from the Town's cold well at 59°F. Changing the temperatures to the Rankine scale and solving the equation gives Efficiency = 1- 519/666 or 22%. Since this does not include any losses, friction, etc. our efficiency will be less than the maximum possible of 22%. With lower water temperature resources such as the Town's (206°F) power generation efficiencies are generally found to be less than 10%. (Rafferty, 2000).

Assuming 7.0% efficiency, a binary plant would require 325 gpm of 206° resource water to generate 200 kilowatt hours of power.

As per the following:

((200KWH) X (3413BTU/KWH))/0.07 = 9,751,428 BTU/hour. The water requirement for this amount of BTU's assuming a 60 degree reduction in resource temperature would be 9,751,428/500(60Degrees) = 325 GPM. The 500 value is a conversion factor. (Rafferty 2000)

Therefore, generation of the 175 to 200 net kW at the Lakeview site would require approximately 300 gpm of 206°F water for the boiler portion of the cycle and between 600 to 800 gpm of 59°F water for the cooling of the plant. With the rather warm temperature of the cooling water available a larger flow is required to cool the generator. Further discussion of cooling needs follow in this report.

This amount is within the Town's resource capacity at this time, and plants are commercially available at the 200 kW capacities, so 175 to 200 kW will be the amount used as a basis in this study.

Contacts made with UTC Power of South Windsor, Connecticut, the manufacturer of Pure Cycle geothermal power plants, indicated that using their equipment with 300 gpm of 206°F water would produce 175KW of power with a cooling water requirement of 800 gpm at 59°F.

Contacts made with ORMatt of Sparks, Nevada showed very nearly the same figures.

Currently, the Town's North Water Well is not used for domestic water supply due to arsenic concentrations. The arsenic levels for drinking water standards were lowered by the Environmental Protection Agency in 2006. Therefore, this well is well suited for the cooling task of power generation.

Since cooling water is a large requirement for the project, alternate cooling methods or combined cooling methods may be applicable, and are further discussed in the next section.

Cooling Options

As in any low temperature power generation development, the cooling side of the cycle plays a key role in the design. Several options are available at the site. The Town's North Water Well with a permitted capacity of 400 gpm of 59°F water is available as one potential cooling source. There is some indication that the well capacity may be increased to a higher flow, if necessary. Cooling towers open or closed, are also a possible cooling source. Lakeview's relatively dry climate results in low wet bulb temperatures (temperature at which pure water will evaporate to saturate a given volume of air) on a year round basis making the tower option attractive.

This report explores the cost and performance issues associated with three options for cooling: 100% well water, 100% closed tower and 100% open tower cooling.

Weather Data

Cooling towers are devices that reject heat primarily by evaporating water into the air. As a result, the temperature of the cooling water exiting a cooling tower is a function of the wet bulb temperature of the air at the site. When evaluating cooling tower performance, key data is weather information for the site, particularly wet bulb temperatures throughout the year. Two cities for which appropriate data is available are Reno, NV and Klamath Falls, OR. In comparing Reno and Klamath Falls weather data, Klamath Falls was considered closer to conditions at Lakeview in terms of elevation, precipitation and dry bulb temperature. Bin type dry bulb data with mean coincident wet bulb temperature was used to generate mean monthly wet bulb temperatures for use in simulating cooling tower performance for the site. The following table summarizes both dry and wet bulb mean monthly data.

Table 1
Mean Monthly Wet Bulb and Dry Bulb Temperature Data

	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
DB	28.7	34.5	38.0	41.9	53.5	54.2	67.4	65.7	59.2	45.6	37.1	28.7
WB	26.6	30.7	32.2	35.0	43.1	45.8	53.3	50.1	48.6	38.9	33.5	26.7

Methodology

Using the monthly average wet bulb temperature from Table 1, it was assumed the cooling towers could produce an average cooling water temperature exiting the tower of 5°F (open towers) to 7°F (closed towers) above the available wet bulb temperature of the air. A value of 20°F above this temperature was taken as the condenser leaving water temperature. Power plant performance was adjusted based on this leaving water temperature using the known performance at base conditions (175 kW net at 206°F/147°F 300 gpm and 59°F/70°F 800 gpm condensers). Plant output was calculated at each condenser temperature by a direct ratio of the Carnot efficiency at the base conditions to the Carnot efficiency at the monthly condenser temperature. Cooling system parasitic loads for pumps and fans were deducted from the machine output to arrive at an average net power production for each month. They were then totaled for the year to arrive at annual net electricity production values.

Cooling tower performance and sizing for peak conditions were based on manufacturer's (Baltimore Air Coil) selection software.

For the well water approach, pump power requirements were based on the assumption of 100 pounds per square inch (psi) delivery pressure and a 100' lift in the well. Of the total power, it was assumed that 300 gpm was to be delivered in any event to other users and pumping power requirements for this flow were deducted to arrive at a net well pumping power for cooling purposes assigned to the geothermal power plant.

Option 1 – 100% Closed Cooling Towers

Closed cooling towers, sometimes referred to as fluid coolers, are characterized by the isolation of the process cooling water flow from the air. The water to be cooled passes through a piping circuit within the tower and water is sprayed over the outside of the piping providing the cooling effect – thus the “closed” term describing these towers. As a result of this arrangement it is necessary to have separate cooling water pumps in the tower to circulate the water through spray nozzles which distribute the water over the piping. Just as in open type towers, fans are used to move large volumes of air though the tower to carry away the evaporated water and provide the cooling effect. Closed type cooling towers are often used in applications where it is important to limit cooling water chemistry problems that might occur if the process water was exposed to the air. These towers are also useful in very cold climates as the water circulation can be discontinued under freezing conditions and the tower operated in a dry mode to produce low temperature cooling water.

Due to the presence of the auxiliary spray pumps, electric power requirements for closed towers under peak conditions are higher than for open towers. Fan power is also higher for closed towers due to the resistance to air flow imposed by the piping through which the process water flows.

To employ a cooling tower of any kind with a small power plant, a pump is required to circulate the cooling water from the plant condenser, to the cooling tower and back to the condenser. In the calculations for both open and closed towers it has been assumed that the flow in the condenser circuit is 800 gpm and the cooling water pump is sized for a total head of 40’ resulting in a brake horse power (bhp) of 12.4 and an electrical load of 10.5 kW assuming a motor efficiency of 90%.

One of the advantages of using cooling towers in comparison to a fixed temperature cooling source, such as well water, is the towers are able to produce lower temperature cooling water in the colder portions of the year. To some extent this colder water can compensate for the higher electricity usage of tower pumps and fans by allowing the power plant to operate at higher output in the colder portions of the year. Normal practice is to limit exit cooling water from the tower to a minimum of 45°F. The calculations here assume a minimum 38°F water temperature to maximize power plant performance. This lower temperature operation would require somewhat greater care and oversight in cold weather to prevent freezing.

On the negative side, the towers, in addition to increased electricity requirements, also incur higher maintenance costs. These costs result from both mechanical maintenance on the equipment and water treatment necessary for the avoidance of corrosion and scaling in the towers.

The following table outlines the annual performance calculations for the closed tower approach. The tower was selected for a two cell arrangement with each cell equipped with a 37.5 hp fan and a 7.5 hp spray pump for a total electricity load at peak conditions of 90hp (74.6kW). This two cell tower would be capable of producing exiting cooling water of 68°F at the peak conditions (62°F WB air).

Table 2
Closed Tower Cooling Annual Performance Summary

	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
WB (F)	26.6	30.7	32.2	35.0	43.1	45.8	53.3	50.1	48.6	38.9	33.5	26.7
Cooling Water (F)	38.0	38.0	39.2	42.0	50.1	52.8	60.3	57.1	55.6	45.9	40.5	38.0
Plant Output (kW)	201	201	198	192	174	168	151	158	161	183	195	201
CW pump (kW)	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3
Tower fans (kW)	25	25	30	45	62.2	62.2	62.2	62.2	62.2	45	30	25
Tower Pumps (kW)	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4
Net Capacity (kW)	153	153	146	124	89	83	66	73	76	116	143	153
Monthly kWh x10,000	9.70	8.76	9.21	7.61	5.61	5.06	4.15	4.62	4.68	7.31	8.73	9.70

Notes: 1.) Tower fans assume variable speed – reduced power in colder months
2.) Cooling water temperatures limited to minimum of 38°F to eliminate freezing
3.) Annual total electricity production 851,000 kWh

Total net annual electricity production for this option would amount to approximately 851,000 kWh. Capital costs for the implementation of the closed tower approach are summarized below:

Cooling towers (2)	$85,000
Tower electrical (drives and motor connections)	15,000
Cooling water pump	16,000
Cooling water piping (8” steel, grooved end, 250’)	30,000
Subtotal	146,000
Contingency	30,000
Engineering	14,000
Total	**$190,000**

Annual estimated maintenance costs associated with the use of the closed tower cooling systems is $5,450 for the equipment and piping, and $3,000 for water treatment.

Option 2 – 100% Open Tower Cooling

Open cooling towers are simpler and less costly than closed towers and are distinguished primarily by the fact that the process cooling water is circulated through the tower in direct exposure to the air. In contrast to the closed tower approach this makes for more efficient cooling in terms of both achievable temperature and power requirements necessary for tower operation. On the negative side the exposure of the process cooling water directly to the air results in the need for greater cooling water chemical treatment in most cases.

The open tower fan power calculations were based on 75% of the power requirements of the closed tower. Since the process water is used directly in the tower, no spray pump power requirements are necessary for the open tower option. Cooling water temperatures leaving the open tower are slightly lower; but as in the case of the closed tower option are limited to 38°F to avoid freezing problems. Normal practice is to limit exit cooling water from the tower to a minimum of 45°F. The calculations assume a minimum 38°F water temperature to maximize power plant performance. This lower temperature operation would require greater care and oversight in cold weather to prevent freezing.

Table 3 summarizes the results of the open tower option. Total net annual electricity production for this option would amount to approximately 1,050,000 kWh.

Table 3
100% Open Tower Cooling Summary

	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
WB (F)	26.6	30.7	32.2	35.0	43.1	45.8	53.3	50.1	48.6	38.9	33.5	26.7
Cooling Water (F)	38.0	38.0	38.0	40.0	48.1	50.8	58.3	55.1	53.6	43.9	38.5	38.0
Plant Output (kW)	201	201	201	197	178	172	155	162	166	188	200	201
CW pump (kW)	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3
Tower fans (kW)	18.7	18.7	22.5	33.7	46.6	46.6	46.6	46.6	46.6	33.7	22.	18.7
Tower Pumps (kW)	0	0	0	0	0	0	0	0	0	0	0	0
Net Capacity (kW)	172	172	168	152	121	115	98	105	109	144	167	172
Monthly kWh x10,000	10.88	9.82	10.64	9.33	7.67	7.04	6.21	6.67	6.67	9.09	10.22	10.88

Notes: 1.) Tower fans assume variable speed – reduced power in colder months
2.) Cooling water temperatures limited to minimum of 38°F to eliminate freezing.
3.) Annual total electricity production 1,050,000 kWh
4.) WB temperatures are mean monthly values. Design WB is approximately 62°F to 63° F

Capital costs for the open tower cooling option are summarized below.

Open towers (2)	$45,000
Tower electrical (drives and motor connections)	12,000
Cooling water pump	16,000
Cooling water piping (8”, grooved end steel, 250 ft)	30,000
Subtotal	103,000
Contingency	20,000
Engineering	10,000
Total	**$133,000**

Annual estimated maintenance costs associated with the use of the open tower cooling systems are $3,450 for the equipment and piping, and $5,000 for water treatment.

Option 3 – 100% Well Water Cooling

Well water cooling offers the simplest and lowest cost approach to providing cooling for the geothermal power plant. It eliminates the need for a stand alone cooling water loop, cooling water pump, and cooling towers. Elimination of cooling towers of any kind also eliminates the maintenance costs and water treatment costs associated with the towers. On the negative side the 59°F temperature available is higher in some portions of the year than the cooling water temperatures available from the cooling tower approach. However, in peak conditions neither tower would be capable of approaching the 59°F well water temperature.

For purposes of this report the well water cooling system assumes a flow of 700 gpm of 59°F water. Base power plant performance from the manufacturer assumed 800 gpm of cooling water to the condenser. While it has not been confirmed with the manufacturer that the reduced flow is acceptable, calculations do incorporate the reduced output expected as a result of this reduced cooling flow rate. The existing well to be used for the cooling water flow has a capacity of 400 gpm based primarily upon the current well pump. However, the well has a higher capacity. In view of the uncertainty about the available maximum capacity, 700 gpm has been used to reflect the possibility that the full 800 gpm may not be possible.

A summary of the results for the well water cooling appear in the following table. Total annual net electricity production for this option would amount to approximately 884,000 kWh.

Table 4
Well Water Cooling Annual Performance Summary

	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
WB (F)	26.6	30.7	32.2	35.0	43.1	45.8	53.3	50.1	48.6	38.9	33.5	26.7
Cooling Water (F)	59	59	59	59	59	59	59	59	59	59	59	59
Plant Output (kW)	142	142	142	142	142	142	142	142	142	142	142	142
CW pump (kW)	0	0	0	0	0	0	0	0	0	0	0	0
Tower fans (kW)	0	0	0	0	0	0	0	0	0	0	0	0
Well Pump (kW)	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6
Net Production (kW)	119	119	119	119	119	119	119	119	119	119	119	119
Monthly kWh x10,000	7.51	6.78	7.51	7.26	7.51	7.26	7.51	7.51	7.26	7.51	7.26	7.51

Notes: 1.) Well pump power based on net of 350 gpm @ 230' TDH assignable to geothermal plant
2.) Total annual net electricity production 884,000 kWh

Costs associated with the well water cooling option consist of removal of the existing pump and replacement of a higher capacity pump with installation of the necessary piping to connect the source with the plant condenser. The cost estimate is based on the assumption that the well water is of sufficient quality to allow the direct use in the condenser without an isolation heat exchanger. A water quality analysis is strongly recommended with particular attention paid to potential scaling species. There are other costs associated with disposal of the cooling water not consumed by users such as the proposed biomass plant. These costs are not included below.

Capital costs for the well water cooling option are summarized below.

New well pump 700 GPM submersible	$15,000
Piping at power plant	30,000
Subtotal	45,000
Contingency	9,000
Engineering	5,000
Total	**$59,000**

Annual estimated maintenance costs associated with well water cooling systems is $1,050 for the pump and piping.

Conclusion on Cooling Options

A summary of the costs for the annual electricity production associated with the three options appear in the following table.

Table 5
Cooling Options – Summary Data

Option	Capital Cost	Maintenance Cost	Treatment Cost	Annual Electricity
Well Water	59,000	1,050	0	884,000
Open Towers	133,000	3,450	5,000	1,050,000
Closed Towers	190,000	5,450	3,000	851,000

The chemical treatment costs for the tower options shown in Table 5 are preliminary estimates. Actual water treatment costs would depend on water chemistry. Should tower options remain under consideration, a vendor quote will be secured based on actual water chemistry to determine treatment costs.

The open tower option offers the prospect of approximately 19% greater annual electricity production than the well water option but this must be judged against the other factors associated with the option. The table data suggests a simple payback on the capital cost for the open tower option would be approximately 24.3 years [($133,000-$59,000)/((166,000 x 0.0629$/kWh)-($8450-$1050))] using the year one electricity rate of 0.0629 $/kWh.

In addition to cost considerations, elimination of cooling towers also eliminates concerns associated with vapor plume and visibility issues along with the potential for legionella growth and dispersion from the towers. These are secondary issues in most applications but can have a substantial impact on potential liability for the owner depending on tower placement with respect to roads and population groups.

Cooling Water

The 100% well water cooling may be the best option even though the power quantity is lower. Final design considerations may result in different power outputs due to further analysis of the generators.

The Town's North Well could provide the cooling water for this option. The well was constructed in 1998 and designed with screens. Initial pumping tests during well construction by Anderson Engineering and Surveying, Inc. showed up to 585 gpm with a continuous test done at 400 gpm. An analysis of the original pumping tests show the well has a transmissitivity capacity of 1980 square feet per day with a well efficiency of 91%. This is excellent efficiency so pumping rates of 700 gpm should be available at increased well drawdown.

Additional analysis of these tests by Dale Bugenig, hydro-geologist, of Eco:Logic in Reno, Nevada using a continuous pumping rate of 700 gpm resulted in a drawdown of 192' below land surface allowing 22' for seasonal interference from other wells. This analysis assumed no recharge or re-injection back into the aquifer of the used water. This is within the well capacity as the screens and water bearing strata used are at 222' below land surface.

If 230 gpm is diverted after cooling the generator to the proposed biomass plant, this leaves an amount of 470 gpm of water for reuse. Some agreements may be possible with irrigators in the vicinity to use the water and reduce the demand on their existing wells. However, this would take piping and would only be viable in the summer months. Re-injection of the remaining water is the only viable alternative as the water will recharge the aquifer in the well vicinity and result in only a 230 gpm net use of groundwater for the project.

Re-injection is possible on the Town's property near the area of Rabbit Hills Road and Geyser View Lane. Re-injection will greatly reduce the drawdown in the well at the 700 gpm pumping requirement to approximately 92 feet below land surface with the net water demand on the aquifer of 230 gpm. Re-injection will allow the aquifer to reach a steady state. This will also reduce pumping costs and require a minimum of return piping from the generator site to the re-injection well site.

A re-injection well will require additional up-front capital cost. Using the existing re-injection well and mixing the cold and hot water is not advisable. Maintenance on a properly designed re-injection well will be minor cost factor over the life of the project. A comparative analysis of costs is covered in the Appendix under Profit (Loss) Calculations.

Power Sales

The project has the source wells, cooling water piping to the generator site, a cooling water source, and adequate property for the related improvements. All that remains is to sell the generated power. Two power providers are available to the Town; Surprise Valley Electric, located in Alturas, California (a rural cooperative), and PacifiCorp of Portland, Oregon. PacifiCorp's service area is located east of the Rabbit Hills Road while Surprise Valley Electric's service is west of the area.

During the meetings with representatives of both power companies the topics discussed included the options and probable costs, and the rates for the generated power. Surprise Valley Electric was somewhat disinterested in the project and could offer only a rate of 0.03$ per kWh. They are currently servicing the Oregon Department of Corrections Facility, and indicated that if some cost support from the State of Oregon could be obtained possible higher power rates could be obtained.

The Town's proposed yearly generation output of approximately 1,000 megawatt hours is roughly the amount the correctional facility uses in a year. This is an interesting note with the heat provided to the facility by the Town, and if the Town generation could offset the power usage, the Correctional Facility could become a "Truly Green" facility. Further exploration of this concept is needed with the Department of Corrections. However this would probably result in the corrections facility paying the difference to increase the rate and long term agreements could be difficult to obtain.

Meeting with PacifiCorp personnel resulted in current power sales in the 0.060 to 0.065$ range. PacifiCorp is interested in the power and has purchase procedures in place to contract with the Town. Long term twenty year agreements are required, with rate increases during the time of the agreement. The PacifiCorp option will be utilized for the analysis of this report, as it allows a definite rate which allows a cost analysis of the project. Prices paid by PacifiCorp are based on avoided costs on a fixed rate or avoided costs based on the natural gas market index.

The projected peak prices based on the natural gas price index per kWh are $0.055 in 2012 to $0.069 per kWh in 2028. The peak prices are paid from the peak times of 6:00 AM to 10:00 PM Monday through Saturday except holidays. Off peak hour prices are slightly lower. These costs of course are subject to change depending on the natural gas market and may change in favor of the generator.

The projected fixed avoided cost rates for purchasing power are illustrated in Table 6:

Table 6 - Power Rate Calculations

Avoided Fixed Cost Rates (cents per kWh)

Year	On Peak	Off Peak	Weighted Average
2007	6.65	5.56	6.29
2008	7.06	5.70	6.61
2009	7.11	5.62	6.61
2010	7.21	5.59	6.67
2011	7.16	5.42	6.58
2012	7.68	5.86	7.07
2013	7.72	5.86	7.10
2014	7.96	6.06	7.32
2015	8.25	6.32	7.61
2016	8.40	6.44	7.75
2017	8.55	6.55	7.88
2018	8.69	6.67	8.02
2019	8.86	6.78	8.17
2020	9.03	6.91	8.32
2021	9.01	6.86	8.29
2022	9.03	6.83	8.30
2023	9.06	6.82	8.31
2024	9.53	7.14	8.73
2025	9.67	7.27	8.87
2026	9.83	7.40	9.02
2027	9.99	7.53	9.17
2028	10.13	7.64	9.30
2029	10.25	7.70	9.40
2030	10.39	7.80	9.53
2031	10.52	7.88	9.64
2032	10.65	7.96	9.75
2033	10.79	8.06	9.88
2034	10.94	8.16	10.01
2035	11.10	8.26	10.15
2036	11.25	8.37	10.29
2037	11.41	8.48	10.44

The rates for 2007 – 2023 are fixed by PacifiCorp. A straight line projection was used to predict the rates from 2024 - 2037.

With society's appetite for energy and the continuing need for declining fossil fuels, the Town may be at an advantage with the prices tied to the gas index. Since energy prices will only go up and PacifiCorp was probably conservative in the projections of natural gas prices, this may be an option for the Town to consider at the time of contract negotiations. However, it is beyond this report to speculate and analyze this type of risk.

As part of the contract requirements for PacifiCorp an interconnection study is required. This is performed by PacifiCorp and estimated at $15,000 for this facility. A firm number was not available from PacifiCorp other than they require a $50,000 deposit and refund what is not used. Since the $50,000 includes larger facilities PacifiCorp gave an off-the-record estimate of $15,000.

Construction

Construction of the facility involves the generator and related equipment for required power production. With PacifiCorp purchasing the power the geothermal production well site is the preferred site due to existing power transmission lines. A layout of the site is noted in the Appendix.

The generator can be purchased directly from UTC Power with a lead time of 16 weeks to delivery. The generator would require a concrete pad with a roof and some passive sound proofing to keep noise levels within Town Standards. An electrical transformer and switching interface will be required to tie into the power grid. A transformer is required since the generator produces power at three phase / 440 volts.

The production well is on site as is the pipeline supplying the cooling water. The only piping required is a cooling water return line to the cold water re-injection well/biomass point and back up supply piping from the Utley Well. Pipelines will be located on public right-of-way.

New well pumps will be required for the geothermal wells and the cooling water wells due to changes in the new pumping rates and performance.

A construction schematic is included in the Appendix.

Table 7 - Development Costs

Equipment Costs	**Open Tower Cooling**	**Well Water Cooling**
Generator Unit	$ 370,000.00	$ 370,000.00
Pump Replacement in North Well	$ 8,000.00	$ 8,000.00
Pump Replacement Geothermal Well	$ 30,000.00	$ 30,000.00
Pump for Utley Well	$ 15,000.00	$ 15,000.00
Supply Piping from Utley Well to Production Well	$ 50,000.00	$ 50,000.00
Cooling Water Return Line	$ 60,000.00	$ 60,000.00
Open Cooling Tower	$ 133,000.00	$ -
Re-injection Well (Cold Water)	$ -	$ 150,000.00
Site Work	$ 10,000.00	$ 10,000.00
Electrical Tie-in/Switching Transformer	$ 20,000.00	$ 20,000.00
Total Equipment Costs:	$ 696,000.00	$ 713,000.00
Design Costs		
Engineering	$ 52,000.00	$ 42,000.00
Intertie / Connection Study	$ 15,000.00	$ 15,000.00
Administration	$ 5,000.00	$ 5,000.00
Total Design Costs	$ 72,000.00	$ 62,000.00
Total Costs	**$ 768,000.00**	**$ 775,000.00**

Funding

Currently the Town has $200,000 in federal funds available for geothermal development. In addition The Business Energy Tax Credit Program through the State of Oregon allows money to be used for renewable energy in lieu of tax payments by private companies. The Town utilized this source of funding when installing the geothermal system to the Department of Corrections facility. This funding is available up to 35% of project costs. The tax credits are a good option for the Town and a $200,000 value will be used for the cost analysis.

Other funding is available from the Energy Trust of Oregon, U.S. Department of Agriculture, U.S. Department of Energy, Oregon Economic Development Renewable Energy Program and others.

Private funding may be available from organizations such as The Climate Trust, which are interested in renewable energy and carbon reduction.

The Town, being a municipal organization, has many options for funding that is otherwise not available to the private sector. Agency funding of grants and low interest loans will be the best alternative for the Town. Lakeview is familiar with working with these agencies and has a track record of success with them.

Interest Rates

Current loan possibilities from USDA, Oregon Economic Development, and others indicate a rate between 4.5 and 5% for loans termed at 20 to 30 years. In the 2005 Report "Factors Affecting Costs of Geothermal Power Development" the Geothermal Energy Association cited 5.5% as the most common for 100% financing of municipal owned utilities. For the financial analysis of this report a 5% rate will be used as it is within the state funding agency requirements.

Cost Analysis

The cost analysis is based on a 20 year financial life of the equipment. Longer loan periods are available to the Town, but may run past the life of the equipment. Projected electricity costs are noted by PacifiCorp within this timeline. A cost analysis showing profits was prepared for Option # 3, the 100% well water cooling, and Option # 2, the open tower alternative.

Gross income from power sales was projected using a power output of 1,000,000 kWh per year for open tower cooling and 884,000 kWh per year for well water cooling. This is a conservative estimate to allow for down time and variations in power output. The gross income projections are illustrated in Table 8 and Table 9.

Table 8

Gross Income Projections - Open Tower

1,000,000.00 Annual kWh

Year	Rate	Income
2008	0.0661	$ 66,066.67
2009	0.0661	$ 66,133.33
2010	0.0667	$ 66,700.00
2011	0.0658	$ 65,800.00
2012	0.0707	$ 70,733.33
2013	0.0710	$ 71,000.00
2014	0.0732	$ 73,240.00
2015	0.0761	$ 76,066.67
2016	0.0775	$ 77,466.67
2017	0.0788	$ 78,833.33
2018	0.0802	$ 80,153.33
2019	0.0817	$ 81,666.67
2020	0.0832	$ 83,233.33
2021	0.0829	$ 82,933.33
2022	0.0830	$ 82,966.67
2023	0.0831	$ 83,133.33
2024	0.0873	$ 87,341.96
2025	0.0887	$ 88,683.35
2026	0.0902	$ 90,247.53
2027	0.0917	$ 91,690.17
2028	0.0930	$ 93,019.48
2029	0.0940	$ 93,984.59
2030	0.0953	$ 95,265.56
2031	0.0964	$ 96,372.30
2032	0.0975	$ 97,517.12
2033	0.0988	$ 98,815.94
2034	0.1001	$ 100,142.79
2035	0.1015	$ 101,501.82
2036	0.1029	$ 102,894.98
2037	0.1044	$ 104,356.43

Table 9

Gross Income Projections - Well Water

884,000.00 Annual kWh

Year	Rate	Income
2008	0.0661	$ 58,402.93
2009	0.0661	$ 58,461.87
2010	0.0667	$ 58,962.80
2011	0.0658	$ 58,167.20
2012	0.0707	$ 62,528.27
2013	0.0710	$ 62,764.00
2014	0.0732	$ 64,744.16
2015	0.0761	$ 67,242.93
2016	0.0775	$ 68,480.53
2017	0.0788	$ 69,688.67
2018	0.0802	$ 70,855.55
2019	0.0817	$ 72,193.33
2020	0.0832	$ 73,578.27
2021	0.0829	$ 73,313.07
2022	0.0830	$ 73,342.53
2023	0.0831	$ 73,489.87
2024	0.0873	$ 77,210.29
2025	0.0887	$ 78,396.08
2026	0.0902	$ 79,778.82
2027	0.0917	$ 81,054.11
2028	0.0930	$ 82,229.22
2029	0.0940	$ 83,082.37
2030	0.0953	$ 84,214.76
2031	0.0964	$ 85,193.11
2032	0.0975	$ 86,205.14
2033	0.0988	$ 87,353.30
2034	0.1001	$ 88,526.22
2035	0.1015	$ 89,727.61
2036	0.1029	$ 90,959.16
2037	0.1044	$ 92,251.09

Financing payment calculations were prepared using a 5% annual interest rate for both 20 year and 30 year loans. The payment amounts for each cooling option are illustrated in Table 10.

Table 10 - Financing Calculation

	Open Tower Cooling	Well Water Cooling
Total Development Costs	$ 768,000.00	$ 775,000.00
Town Geothermal Fund	$ 200,000.00	$ 200,000.00
Business Energy Tax Credits	$ 200,000.00	$ 200,000.00
Amount of Loan	**$ 368,000.00**	**$ 375,000.00**

Open Tower Cooling

	20 Year Loan	30 Year Loan
Annual Interest Rate	5%	5%
Number of Years	20	30
Present Value of Loan	$ 368,000.00	$ 368,000.00
Annual Payment	**($29,529.27)**	**($23,938.93)**

Well Water Cooling

	20 Year Loan	30 Year Loan
Annual Interest Rate	5%	5%
Number of Years	20	30
Present Value of Loan	$ 375,000.00	$ 375,000.00
Annual Payment	**($30,090.97)**	**($24,394.29)**

Operating costs were calculated for both cooling options. The projections are illustrated in Table 11.

Table 11 - Annual Operating Costs

	Open Tower Cooling	Well Water Cooling
Oversight/Monitoring Maintenance	$ 18,450.00	$ 10,000.00
Cold Water Pumping	$ -	$ 9,600.00
Administration	$ 1,000.00	$ 1,000.00
Total Operating Costs	**$ 19,450.00**	**$ 20,600.00**

Operating Cost Projections (increase of 1.5% per year)

Year	Open Tower Cooling	Well Water Cooling
2008	$ 19,450.00	$ 20,600.00
2009	$ 19,741.75	$ 20,909.00
2010	$ 20,037.88	$ 21,222.64
2011	$ 20,338.44	$ 21,540.97
2012	$ 20,643.52	$ 21,864.09
2013	$ 20,953.17	$ 22,192.05
2014	$ 21,267.47	$ 22,524.93
2015	$ 21,586.48	$ 22,862.81
2016	$ 21,910.28	$ 23,205.75
2017	$ 22,238.94	$ 23,553.83
2018	$ 22,572.52	$ 23,907.14
2019	$ 22,911.11	$ 24,265.75
2020	$ 23,254.77	$ 24,629.73
2021	$ 23,603.60	$ 24,999.18
2022	$ 23,957.65	$ 25,374.17
2023	$ 24,317.01	$ 25,754.78
2024	$ 24,681.77	$ 26,141.10
2025	$ 25,052.00	$ 26,533.22
2026	$ 25,427.78	$ 26,931.22
2027	$ 25,809.19	$ 27,335.19
2028	$ 26,196.33	$ 27,745.21
2029	$ 26,589.27	$ 28,161.39
2030	$ 26,988.11	$ 28,583.81
2031	$ 27,392.94	$ 29,012.57
2032	$ 27,803.83	$ 29,447.76
2033	$ 28,220.89	$ 29,889.47
2034	$ 28,644.20	$ 30,337.82
2035	$ 29,073.86	$ 30,792.88
2036	$ 29,509.97	$ 31,254.78
2037	$ 29,952.62	$ 31,723.60

The cost analysis shows the project to be profitable for both cooling options. Please refer to the Profit (Loss) Calculation with 20 and 30 Year Loans in the Appendix for detailed profit projections. Thirty year loans were noted for cost comparisons.

Permitting

A self certified status or a qualifying facility permit is required from the Federal Energy Regulatory Commission. The form for self certifying is included in the Appendix.

A Small Power Production Facility is a generating facility whose primary energy source is renewable (hydro, wind, solar, etc.), biomass, waste, or geothermal resources, and that otherwise meets the requirements of 18 C.F.R. §§ 292.203(a), 292.203(c) and 292.204. Small power production facilities are limited in size to 80 MW, with the exception of certain types of facilities certified prior to 1995 and designated as "eligible" under section 3(17)(E) of the Federal Power Act.

An owner or operator of a generating facility may obtain QF (Qualifying Facility) status by either submitting a self-certification or applying for and obtaining a Commission certification of QF status. The choice of whether to certify a facility through a self-certification or Commission certification is up to the applicant. In some instances, negotiations with a lender or utility purchaser may proceed more smoothly if the facility has been certified by the Commission.

A completed Form No. 556 must be submitted with each self-certification or application for Commission certification of QF status.

A self-certification of QF status under 18 C.F.R. § 292.207(a) must include the following:

- A cover letter that announces the self-certification of QF status of the applicant's facility and references the enclosures (Form No. 556; draft *Federal Register* notice, as applicable). If a docket number already exists for your facility, you should clearly identify it in the cover letter.
- Original and 14 copies of a completed Form No. 556.

There is no fee for filing a self-certification. Self certification is the recommended option for the town. Complete filing instructions are available on the Federal Energy Regulatory Agencies website.

Permits will also be required from the Oregon Water Resources Department for additional water use on the Town's cold water well, and the Utley Well. The cold water well will need an additional water right of 300 gpm with the Utley Well also requiring 300 gpm. The re-injection well for cold water needs to be a part of the cold water application as they work together to result in a smaller net water use.

Filing the Water Resources permit applications is straight forward with an estimated cost of $2,500. These applications should be submitted soon due to the Water Resources Department work loads.

Local planning jurisdiction for the area is under Lake County. A Conditional Use will be required at the generator site.

Timeline

Please review the Timeline in the Appendix. The proposed timeline for the project assumes 4 to 6 months for equipment delivery. Please note a seven month window is shown for funding finalization.

Conclusions

This project is feasible and has significant profits for the Town. The cooling Tower will probably be the best option; however, final considerations will need to be evaluated in the final design of the facility. Table 12 shows the net present value of the projected profits.

Table 12 - Net Present Value of Profits

Open Cooling Tower	$508,643.27
Well Water Cooling	$337,829.55

The next step is to move into project development. This includes securing funding and proceeding into detailed design. Detailed design will also allow further value engineering comparisons of the options for maximum power production. Permitting should be started immediately; along with the interconnection study required with PacifiCorp. These items can effect design parameters and need to be completed first. Securing funding should also be completed during the permitting phase. This report will assist agency funding requests.

Renewable energy will only become more valuable in the future and more incentives will occur for development. This project alone produces 3.4 billion BTU per year; that is equivalent to 3 million cubic feet of natural gas. In a time of carbon awareness even a small project like this one can be significant. The power output can supply electricity for 41 homes for one year. Continued development of small projects will help our society as a whole achieve a more sustainable energy base.

The Lakeview area has additional geothermal resources for development. This project could be a pilot for more energy production in the future.

LAKEVIEW GEOTHERMAL POWER GENERATION FACILITY FEASIBILITY STUDY REFERENCES

Geo-Heat Center. (2000). *Geothermal Power Generation – A Primer On Low-Temperature, Small Scale Applications.* Klamath Falls, OR: Rafferty, Kevin.

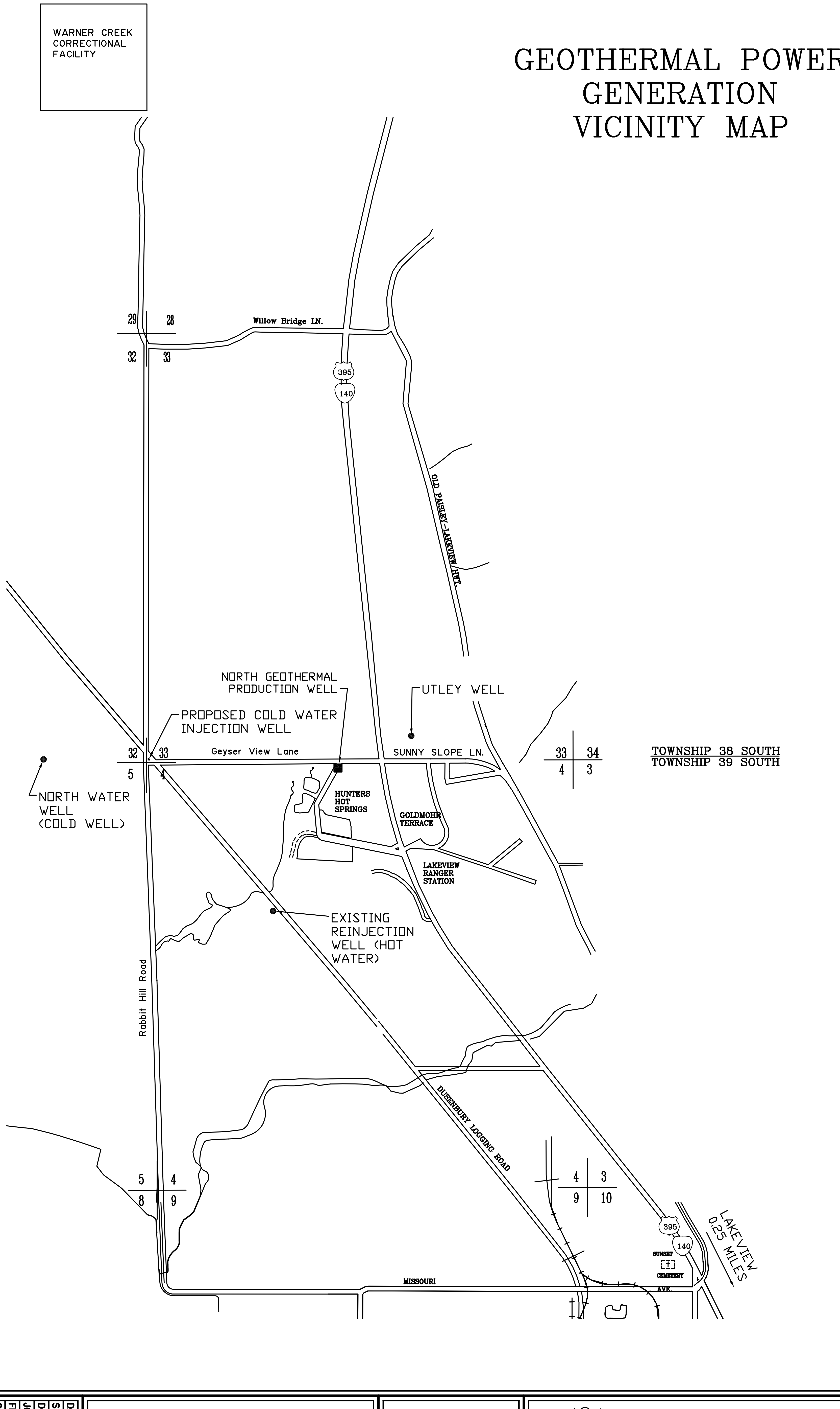
Geothermal Energy Association. (2005). *Factors Affecting Costs of Geothermal Power Development.* Washington, D.C.: Hance, Cedric Nathanael.

Cooling option information was provided by Kevin Rafferty of Tripower.

APPENDIX

VICINITY MAP

GEOTHERMAL POWER GENERATION VICINITY MAP



DATE:	FEB. 2008
SCALE:	NO SCALE
DWG. BY:	J.E.H.
JOB:	2007-078
FILE:	2007-078
SHEET:	1

VICINITY MAP

LAKEVIEW GEOTHERMAL POWER GENERATION

FACILITY FEASIBILITY STUDY

FOR:
TOWN OF LAKEVIEW
525 NORTH 1ST ST.
LAKEVIEW OR. 97630
(541) 947-2029

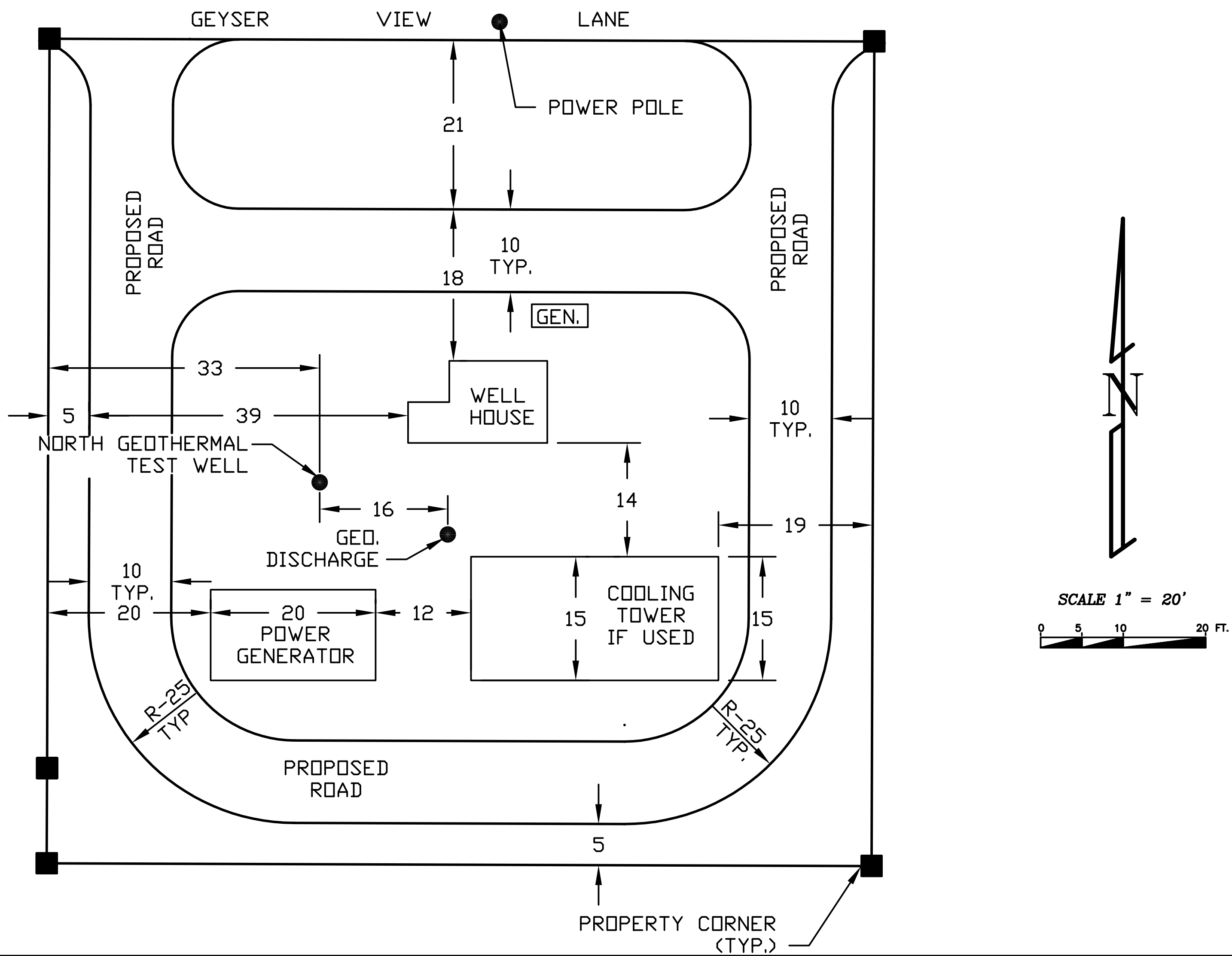
ANDERSON ENGINEERING AND SURVEYING, INC.
P.O. BOX 28
LAKEVIEW, OREGON
97630
(541) 947-4407
FAX: 947-2321

REVISION | BY

SITE PLAN

GEOTHERMAL POWER GENERATION SITE PLAN

LOCATED IN TAX LOT 201, IN GOVERNMENT LOT 3 IN THE NORTHEAST ONE–QUARTER OF THE NORTHWEST ONE–QUATER OF SECTION 4, TOWNSHIP 39 SOUTH, RANGE 20 EAST, WILLAMETTE MERIDIAN IN LAKE COUNTY, OREGON.



ANDERSON ENGINEERING AND SURVEYING, INC.
P.O. BOX 28
LAKEVIEW, OREGON 97630
(541) 947–4407
FAX 947–2321

SITE PLAN
LAKEVIEW GEOTHERMAL POWER GENERATION FACILITY FEASIBILITY STUDY

DATE: 2/11/2008
SCALE: 1"=20'
JOB: 2007–078
DWG. BY: J.E.H.
FILE: SITEPLAN
SHEET 1 OF 1

UTC POWER PURECYCLE GEOTHERMAL POWER SYSTEMS

UTC Power
A United Technologies Company

In Development

PureCycle® Geothermal Power System
Model 225

PureCycle® Power System

The Product

The PureCycle® power system is a closed-cycle process that uses geothermal water to generate 225 kW of electrical power. The system, currently under development, is driven by a simple evaporation process and is entirely enclosed, which means it produces no emissions. The only byproduct is electricity, and the fuel -hot water- is a renewable resource. In fact, after the heat is extracted for power, the water is returned to the earth for reheating, resulting in the ultimate recycling loop. Free fuel, coupled with low operating and maintenance costs, ensure this system will have an extremely attractive payback.

PureCycle® Geothermal Power System installation in Chena, Alaska

The PureCycle® power system can operate on a wide range of geothermal resource temperatures starting as low as 165°F(74°C). By operating at lower temperatures than conventional geothermal systems, The PureCycle® Solution enables wells deemed non-productive because they are below 300°F(149°C) to become viable solutions once again. The system can be used for either liquid or air cooling to meet your site-specific needs.

While the PureCycle® system is new, it draws upon the decades of United Technologies Corporation innovation, operating experience and real world expertise. In fact, key components of the system are derived from products of Carrier Corporation, a world leader in air conditioning and refrigeration systems and a member of the UTC business family. Having this unique combination of resources makes UTC Power a highly reliable source for your power generation needs – today and for years to come.

Features

- Powered by geothermal resource
- Renewable energy
- No system emissions
- Remote control and system monitoring
- Factory assembled and tested
- Operates on geothermal resource temperatures as low as 165°F(74°C)

Benefits

- Free fuel
- Federal & State incentives
- Environmental stewardship
- Optimize performance; maximize uptime
- High reliability and system availability
- Makes unproductive wells viable

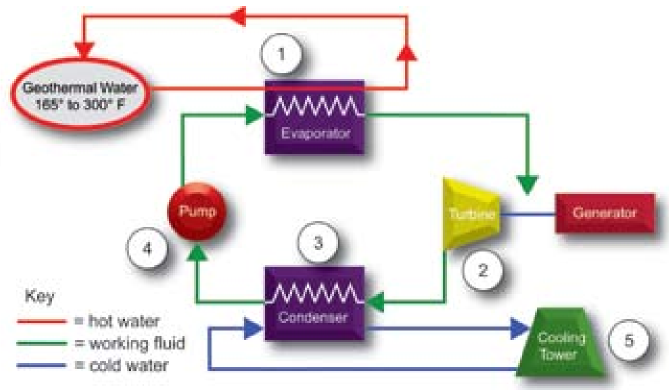
This System Not Released For Commercial Sale

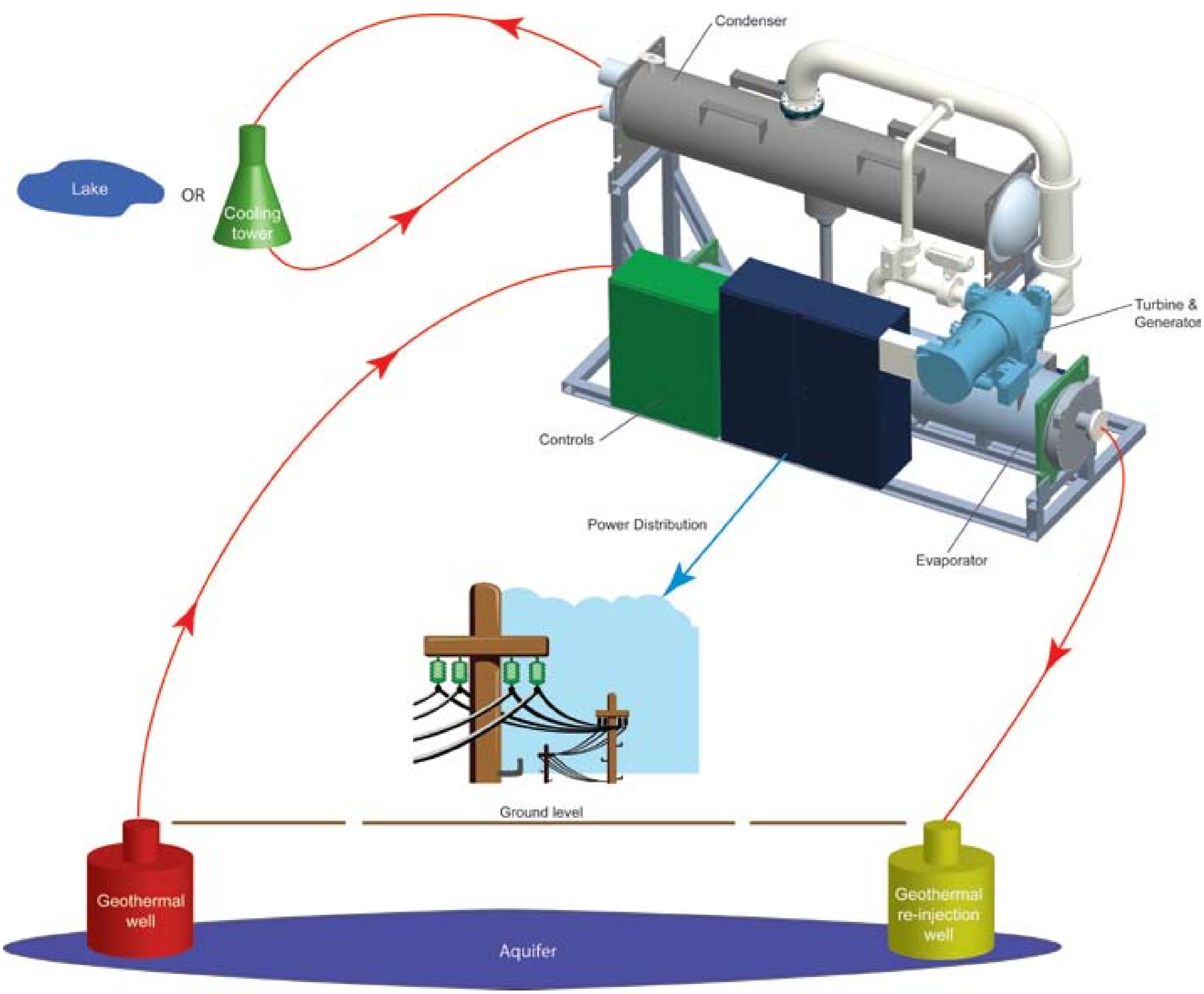
System Description

- **Geothermal Resource Water from 165°F to 300°F (74°C to 149°C)**
  - geothermal wells
  - oil and gas well hot water
- **Liquid or Air Cooling**
  - streams and rivers
  - evaporative cooling towers
  - air-cooled condensers
- **System Flexibility**
  - interconnect up to 40 individual units
- **Electrical Output**
  - 280kW gross - 225kW net
  - 480V 3 phase
- **Site Support**
  - no personnel required on site
- **Communication**
  - analog phone or internet

How the PureCycle® 225 Power System Works

Geothermal water enters the evaporator (1) and heats the working fluid until it is vaporized and is then reinjected into the ground. Hot vapor then enters the power module and drives a turbine (2) to create electrical power. The expanded vapor cycles through a condenser (3) where it is cooled and condensed to liquid form. The cooled liquid re-enters the power module, where it is pumped (4) and sent back to the evaporator. The system described and shown here is cooled with a wet cooling-tower (5). UTC Power's closed-loop Organic Rankine Cycle (ORC) is designed to generate 280 kW gross power.



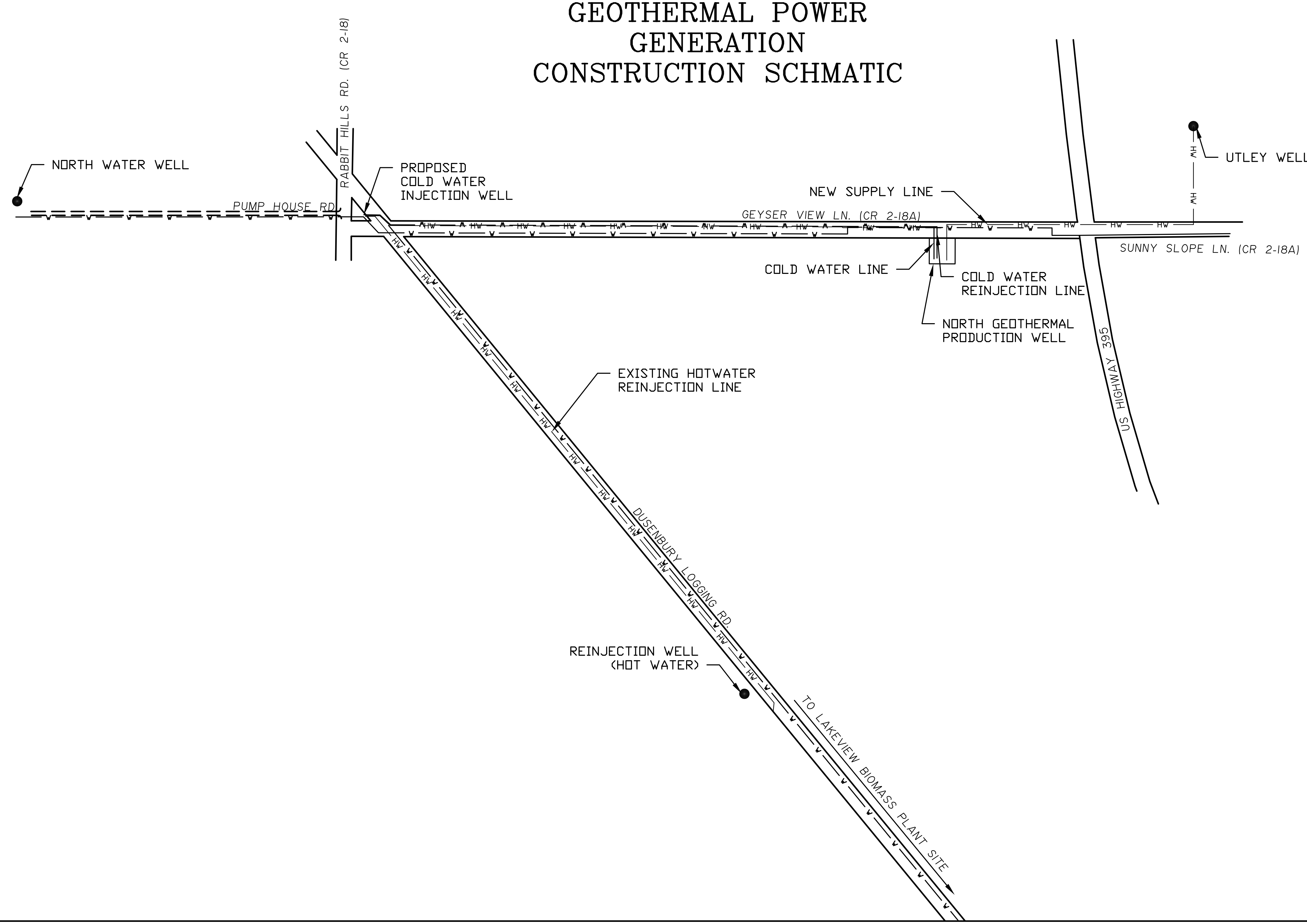


UTC Power
A United Technologies Company

195 Governor's Highway South Windsor, CT 06074 Phone: 866.900.POWER Fax: 860.727.2319 www.utcpower.com

CONSTRUCTION SCHEMATIC

GEOTHERMAL POWER GENERATION CONSTRUCTION SCHMATIC



REVISION	BY

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FOR:
TOWN OF LAKEVIEW
525 NORTH 1ST ST.
LAKEVIEW OR. 97630
(541) 947-2029

CONSTRUCTION SCHEMATIC

LAKEVIEW GEOTHERMAL POWER GENERATION

FACILITY FEASIBILITY STUDY

DATE:	FEB. 2008
SCALE:	NO SCALE
DWG. BY:	J.E.H.
JOB:	2007
FILE:	2007
SHEET:	1

PROFIT / (LOSS) CALCULATIONS

Lakeview Geothermal Power Generation Facility
Feasibility Study

Profit/(Loss) Calculation with 20 Year Loan

Well Water Cooling

Year	Income	Operating Expenses	Loan Payment	Total Expenses	Net Profit/(Loss)
2008	$ 58,402.93	$ 20,600.00	$30,090.97	$ 50,690.97	$ 7,711.96
2009	$ 58,461.87	$ 20,909.00	$30,090.97	$ 50,999.97	$ 7,461.90
2010	$ 58,962.80	$ 21,222.64	$30,090.97	$ 51,313.61	$ 7,649.19
2011	$ 58,167.20	$ 21,540.97	$30,090.97	$ 51,631.94	$ 6,535.26
2012	$ 62,528.27	$ 21,864.09	$30,090.97	$ 51,955.06	$ 10,573.21
2013	$ 62,764.00	$ 22,192.05	$30,090.97	$ 52,283.02	$ 10,480.98
2014	$ 64,744.16	$ 22,524.93	$30,090.97	$ 52,615.90	$ 12,128.26
2015	$ 67,242.93	$ 22,862.81	$30,090.97	$ 52,953.78	$ 14,289.16
2016	$ 68,480.53	$ 23,205.75	$30,090.97	$ 53,296.72	$ 15,183.82
2017	$ 69,688.67	$ 23,553.83	$30,090.97	$ 53,644.80	$ 16,043.86
2018	$ 70,855.55	$ 23,907.14	$30,090.97	$ 53,998.11	$ 16,857.44
2019	$ 72,193.33	$ 24,265.75	$30,090.97	$ 54,356.72	$ 17,836.62
2020	$ 73,578.27	$ 24,629.73	$30,090.97	$ 54,720.70	$ 18,857.56
2021	$ 73,313.07	$ 24,999.18	$30,090.97	$ 55,090.15	$ 18,222.92
2022	$ 73,342.53	$ 25,374.17	$30,090.97	$ 55,465.14	$ 17,877.40
2023	$ 73,489.87	$ 25,754.78	$30,090.97	$ 55,845.75	$ 17,644.12
2024	$ 77,210.29	$ 26,141.10	$30,090.97	$ 56,232.07	$ 20,978.22
2025	$ 78,396.08	$ 26,533.22	$30,090.97	$ 56,624.19	$ 21,771.90
2026	$ 79,778.82	$ 26,931.22	$30,090.97	$ 57,022.19	$ 22,756.63
2027	$ 81,054.11	$ 27,335.19	$30,090.97	$ 57,426.16	$ 23,627.95
2028	$ 82,229.22	$ 27,745.21	$0.00	$ 27,745.21	$ 54,484.01
2029	$ 83,082.37	$ 28,161.39	$0.00	$ 28,161.39	$ 54,920.98
2030	$ 84,214.76	$ 28,583.81	$0.00	$ 28,583.81	$ 55,630.94
2031	$ 85,193.11	$ 29,012.57	$0.00	$ 29,012.57	$ 56,180.54
2032	$ 86,205.14	$ 29,447.76	$0.00	$ 29,447.76	$ 56,757.38
2033	$ 87,353.30	$ 29,889.47	$0.00	$ 29,889.47	$ 57,463.82
2034	$ 88,526.22	$ 30,337.82	$0.00	$ 30,337.82	$ 58,188.41
2035	$ 89,727.61	$ 30,792.88	$0.00	$ 30,792.88	$ 58,934.73
2036	$ 90,959.16	$ 31,254.78	$0.00	$ 31,254.78	$ 59,704.38
2037	$ 92,251.09	$ 31,723.60	$0.00	$ 31,723.60	$ 60,527.49

Lakeview Geothermal Power Generation Facility
Feasibility Study

Profit/(Loss) Calculation with 20 Year Loan

Open Tower Cooling

Year	Income	Operating Expenses	Loan Payment	Total Expenses	Net Profit/(Loss)
2008	$ 66,066.67	$ 19,450.00	$29,529.27	$ 48,979.27	$ 17,087.39
2009	$ 66,133.33	$ 19,741.75	$29,529.27	$ 49,271.02	$ 16,862.31
2010	$ 66,700.00	$ 20,037.88	$29,529.27	$ 49,567.15	$ 17,132.85
2011	$ 65,800.00	$ 20,338.44	$29,529.27	$ 49,867.72	$ 15,932.28
2012	$ 70,733.33	$ 20,643.52	$29,529.27	$ 50,172.79	$ 20,560.54
2013	$ 71,000.00	$ 20,953.17	$29,529.27	$ 50,482.45	$ 20,517.55
2014	$ 73,240.00	$ 21,267.47	$29,529.27	$ 50,796.74	$ 22,443.26
2015	$ 76,066.67	$ 21,586.48	$29,529.27	$ 51,115.76	$ 24,950.91
2016	$ 77,466.67	$ 21,910.28	$29,529.27	$ 51,439.55	$ 26,027.11
2017	$ 78,833.33	$ 22,238.94	$29,529.27	$ 51,768.21	$ 27,065.13
2018	$ 80,153.33	$ 22,572.52	$29,529.27	$ 52,101.79	$ 28,051.54
2019	$ 81,666.67	$ 22,911.11	$29,529.27	$ 52,440.38	$ 29,226.29
2020	$ 83,233.33	$ 23,254.77	$29,529.27	$ 52,784.05	$ 30,449.29
2021	$ 82,933.33	$ 23,603.60	$29,529.27	$ 53,132.87	$ 29,800.47
2022	$ 82,966.67	$ 23,957.65	$29,529.27	$ 53,486.92	$ 29,479.75
2023	$ 83,133.33	$ 24,317.01	$29,529.27	$ 53,846.29	$ 29,287.05
2024	$ 87,341.96	$ 24,681.77	$29,529.27	$ 54,211.04	$ 33,130.92
2025	$ 88,683.35	$ 25,052.00	$29,529.27	$ 54,581.27	$ 34,102.09
2026	$ 90,247.53	$ 25,427.78	$29,529.27	$ 54,957.05	$ 35,290.48
2027	$ 91,690.17	$ 25,809.19	$29,529.27	$ 55,338.46	$ 36,351.70
2028	$ 93,019.48	$ 26,196.33	$0.00	$ 26,196.33	$ 66,823.15
2029	$ 93,984.59	$ 26,589.27	$0.00	$ 26,589.27	$ 67,395.31
2030	$ 95,265.56	$ 26,988.11	$0.00	$ 26,988.11	$ 68,277.45
2031	$ 96,372.30	$ 27,392.94	$0.00	$ 27,392.94	$ 68,979.37
2032	$ 97,517.12	$ 27,803.83	$0.00	$ 27,803.83	$ 69,713.29
2033	$ 98,815.94	$ 28,220.89	$0.00	$ 28,220.89	$ 70,595.06
2034	$ 100,142.79	$ 28,644.20	$0.00	$ 28,644.20	$ 71,498.59
2035	$ 101,501.82	$ 29,073.86	$0.00	$ 29,073.86	$ 72,427.96
2036	$ 102,894.98	$ 29,509.97	$0.00	$ 29,509.97	$ 73,385.01
2037	$ 104,356.43	$ 29,952.62	$0.00	$ 29,952.62	$ 74,403.81

Profit/(Loss) Calculation with 30 Year Loan

Well Water Cooling

Year	Income	Operating Expenses	Loan Payment	Total Expenses	Net Profit/(Loss)
2008	$ 58,402.93	$ 20,600.00	$24,394.29	$ 44,994.29	$ 13,408.65
2009	$ 58,461.87	$ 20,909.00	$24,394.29	$ 45,303.29	$ 13,158.58
2010	$ 58,962.80	$ 21,222.64	$24,394.29	$ 45,616.92	$ 13,345.88
2011	$ 58,167.20	$ 21,540.97	$24,394.29	$ 45,935.26	$ 12,231.94
2012	$ 62,528.27	$ 21,864.09	$24,394.29	$ 46,258.38	$ 16,269.89
2013	$ 62,764.00	$ 22,192.05	$24,394.29	$ 46,586.34	$ 16,177.66
2014	$ 64,744.16	$ 22,524.93	$24,394.29	$ 46,919.22	$ 17,824.94
2015	$ 67,242.93	$ 22,862.81	$24,394.29	$ 47,257.09	$ 19,985.84
2016	$ 68,480.53	$ 23,205.75	$24,394.29	$ 47,600.04	$ 20,880.50
2017	$ 69,688.67	$ 23,553.83	$24,394.29	$ 47,948.12	$ 21,740.55
2018	$ 70,855.55	$ 23,907.14	$24,394.29	$ 48,301.43	$ 22,554.12
2019	$ 72,193.33	$ 24,265.75	$24,394.29	$ 48,660.04	$ 23,533.30
2020	$ 73,578.27	$ 24,629.73	$24,394.29	$ 49,024.02	$ 24,554.24
2021	$ 73,313.07	$ 24,999.18	$24,394.29	$ 49,393.47	$ 23,919.60
2022	$ 73,342.53	$ 25,374.17	$24,394.29	$ 49,768.46	$ 23,574.08
2023	$ 73,489.87	$ 25,754.78	$24,394.29	$ 50,149.07	$ 23,340.80
2024	$ 77,210.29	$ 26,141.10	$24,394.29	$ 50,535.39	$ 26,674.90
2025	$ 78,396.08	$ 26,533.22	$24,394.29	$ 50,927.51	$ 27,468.58
2026	$ 79,778.82	$ 26,931.22	$24,394.29	$ 51,325.51	$ 28,453.31
2027	$ 81,054.11	$ 27,335.19	$24,394.29	$ 51,729.47	$ 29,324.63
2028	$ 82,229.22	$ 27,745.21	$24,394.29	$ 52,139.50	$ 30,089.72
2029	$ 83,082.37	$ 28,161.39	$24,394.29	$ 52,555.68	$ 30,526.69
2030	$ 84,214.76	$ 28,583.81	$24,394.29	$ 52,978.10	$ 31,236.66
2031	$ 85,193.11	$ 29,012.57	$24,394.29	$ 53,406.86	$ 31,786.26
2032	$ 86,205.14	$ 29,447.76	$24,394.29	$ 53,842.05	$ 32,363.09
2033	$ 87,353.30	$ 29,889.47	$24,394.29	$ 54,283.76	$ 33,069.53
2034	$ 88,526.22	$ 30,337.82	$24,394.29	$ 54,732.10	$ 33,794.12
2035	$ 89,727.61	$ 30,792.88	$24,394.29	$ 55,187.17	$ 34,540.44
2036	$ 90,959.16	$ 31,254.78	$24,394.29	$ 55,649.07	$ 35,310.10
2037	$ 92,251.09	$ 31,723.60	$24,394.29	$ 56,117.89	$ 36,133.20

Lakeview Geothermal Power Generation Facility
Feasibility Study

Profit/(Loss) Calculation with 30 Year Loan

Open Tower Cooling

Year	Income	Operating Expenses	Loan Payment	Total Expenses	Net Profit/(Loss)
2008	$ 66,066.67	$ 19,450.00	$23,938.93	$ 43,388.93	$ 22,677.74
2009	$ 66,133.33	$ 19,741.75	$23,938.93	$ 43,680.68	$ 22,452.66
2010	$ 66,700.00	$ 20,037.88	$23,938.93	$ 43,976.80	$ 22,723.20
2011	$ 65,800.00	$ 20,338.44	$23,938.93	$ 44,277.37	$ 21,522.63
2012	$ 70,733.33	$ 20,643.52	$23,938.93	$ 44,582.45	$ 26,150.88
2013	$ 71,000.00	$ 20,953.17	$23,938.93	$ 44,892.10	$ 26,107.90
2014	$ 73,240.00	$ 21,267.47	$23,938.93	$ 45,206.40	$ 28,033.60
2015	$ 76,066.67	$ 21,586.48	$23,938.93	$ 45,525.41	$ 30,541.26
2016	$ 77,466.67	$ 21,910.28	$23,938.93	$ 45,849.21	$ 31,617.46
2017	$ 78,833.33	$ 22,238.94	$23,938.93	$ 46,177.86	$ 32,655.47
2018	$ 80,153.33	$ 22,572.52	$23,938.93	$ 46,511.45	$ 33,641.89
2019	$ 81,666.67	$ 22,911.11	$23,938.93	$ 46,850.03	$ 34,816.63
2020	$ 83,233.33	$ 23,254.77	$23,938.93	$ 47,193.70	$ 36,039.63
2021	$ 82,933.33	$ 23,603.60	$23,938.93	$ 47,542.52	$ 35,390.81
2022	$ 82,966.67	$ 23,957.65	$23,938.93	$ 47,896.58	$ 35,070.09
2023	$ 83,133.33	$ 24,317.01	$23,938.93	$ 48,255.94	$ 34,877.39
2024	$ 87,341.96	$ 24,681.77	$23,938.93	$ 48,620.70	$ 38,721.26
2025	$ 88,683.35	$ 25,052.00	$23,938.93	$ 48,990.92	$ 39,692.43
2026	$ 90,247.53	$ 25,427.78	$23,938.93	$ 49,366.70	$ 40,880.83
2027	$ 91,690.17	$ 25,809.19	$23,938.93	$ 49,748.12	$ 41,942.05
2028	$ 93,019.48	$ 26,196.33	$23,938.93	$ 50,135.26	$ 42,884.22
2029	$ 93,984.59	$ 26,589.27	$23,938.93	$ 50,528.20	$ 43,456.38
2030	$ 95,265.56	$ 26,988.11	$23,938.93	$ 50,927.04	$ 44,338.52
2031	$ 96,372.30	$ 27,392.94	$23,938.93	$ 51,331.86	$ 45,040.44
2032	$ 97,517.12	$ 27,803.83	$23,938.93	$ 51,742.76	$ 45,774.36
2033	$ 98,815.94	$ 28,220.89	$23,938.93	$ 52,159.82	$ 46,656.13
2034	$ 100,142.79	$ 28,644.20	$23,938.93	$ 52,583.13	$ 47,559.66
2035	$ 101,501.82	$ 29,073.86	$23,938.93	$ 53,012.79	$ 48,489.03
2036	$ 102,894.98	$ 29,509.97	$23,938.93	$ 53,448.90	$ 49,446.08
2037	$ 104,356.43	$ 29,952.62	$23,938.93	$ 53,891.55	$ 50,464.89

FEDERAL ENERGY REGULATORY COMMISSION FORM #556

Form Approved
OMB Control No. 1902-0075
Expires 7/31/2009

FERC Form No. 556
18 C.F.R. § 131.80

CERTIFICATION OF QUALIFYING FACILITY STATUS FOR AN EXISTING OR A PROPOSED SMALL POWER PRODUCTION OR COGENERATION FACILITY

INFORMATION ABOUT COMPLIANCE

Compliance with the information collection requirements established by the FERC Form No. 556 is required to obtain and maintain status as a qualifying facility. *See* 18 C.F.R. § 131.80 and Part 292. An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number.

SUBMITTING COMMENTS ON PUBLIC REPORTING BURDEN

The estimated burden for completing FERC Form No. 556, including gathering and reporting information, is 4 hours for self-certifications and 38 hours for applications for Commission certification. Send comments regarding this burden estimate or any aspect of this collection of information, including suggestions for reducing this burden, to the following: Michael Miller, Office of the Executive Director (ED-34), Federal Energy Regulatory Commission, 888 First Street NE., Washington, DC 20426; and Desk Officer for FERC, Office of Information and Regulatory Affairs, Office of Management and Budget, Washington, DC 20503 (oira_submission@omb.eop.gov). Include the Control No. 1902-0075 in any correspondence.

GENERAL INSTRUCTIONS

Complete this form by replacing bold text below with responses to each item, as required.

PART A: GENERAL INFORMATION TO BE SUBMITTED BY ALL APPLICANTS

1a. Full name of applicant: [Note: Applicant is the legal entity submitting this form, not the individual employee making the filing. Generally, the Applicant will be a company, corporation or organization, unless the facility is owned directly by an individual or individuals.]

[insert name of applicant]

Docket Number assigned to the immediately preceding submittal filed with the Commission in connection with the instant facility, if any:

[insert Docket Number QF__-___-___ or “none”]

Purpose of instant filing (self-certification or self-recertification [18 C.F.R. § 292.207(a)(1)], or application for Commission certification or recertification [18 C.F.R. §§ 292.207(b) and (d)(2)]):

[insert “Self-certification,” “Self-recertification,” “Application for Commission certification,” or “Application for Commission recertification”;

if this is a recertification, also describe the reason for the recertification]

1b. Full address of applicant:

[insert text]

1c. Indicate the owner(s) of the facility (including the percentage of ownership held by any electric utility or electric utility holding company, or by any persons owned by either) and the operator of the facility.

[insert ownership information, including (1) identification of each direct owner; (2) identification of whether or not each owner is an electric utility or electric utility holding company, or is owned by either; and (3) identification of the percentage ownership held by each direct owner that is an electric utility or electric utility holding company, or is owned by either]

[insert operator information]

Additionally, state whether or not any of the non-electric utility owners or their upstream owners are engaged in the generation or sale of electric power, or have any ownership or operating interest in any electric facilities other than qualifying facilities.

[for each direct owner that is not an electric utility, state whether such owners or their upstream owners are engaged in the generation or sale of electric power, or have any ownership or operating interest in any electric facilities other than qualifying facilities]

In order to facilitate review of the application, the applicant may also provide an ownership chart identifying the upstream ownership of the facility. Such chart should indicate ownership percentages where appropriate.

1d. Signature of authorized individual evidencing accuracy and authenticity of information provided by applicant: [Note: A signature on a filing shall constitute a certificate that (1) the signer has read the filing and knows its contents; (2) the contents are true as stated, to the best knowledge and belief of the signer; and (3) the signer possesses full power and authority to sign the filing. A person submitting a self-certification electronically via eFiling may use typed characters representing their name to show that the person has signed the document. *See* 18 C.F.R. § 385.2005.]

[insert signature; for electronic filings, typed characters representing the name of the signer may be used as signature]

2. Person to whom communications regarding the filed information may be addressed:

Name: **[insert text]**

Title: **[insert text]**

Telephone number: **[insert text]**

Mailing address: **[insert text]**

3a. Location of facility to be certified:

State: **[insert text]**

County: **[insert text]**

City or town: **[insert text]**

Street address (if known): **[insert text]**

3b. Indicate the electric utilities that are contemplated to transact with the qualifying facility (if known) and describe the services those electric utilities are expected to provide:

[insert text]

Indicate utilities interconnecting with the facility and/or providing wheeling service [18 C.F.R. §§ 292.303(c) and (d)]:

[insert text]

Indicate utilities purchasing the useful electric power output [18 C.F.R. §§ 292.101(b)(2), 292.202(g) and 292.303(a)]:

[insert text]

Indicate utilities providing supplementary power, backup power, maintenance power, and/or interruptible power service [18 C.F.R. §§ 292.101(b)(3), (b)(8), 292.303(b) and 292.305(b)]:

[insert text]

4a. Describe the principal components of the facility including boilers, prime movers and electric generators, and explain their operation. Include transmission lines, transformers and switchyard equipment, if included as part of the facility.

[insert text]

4b. Indicate the maximum gross and maximum net electric power production capacity of the facility at the point(s) of delivery and show the derivation. [Note: Maximum gross output is the maximum amount of power that the facility is able to produce, measured at the terminals of the generator(s). Maximum net output is maximum gross output minus (1) any auxiliary load for devices that are necessary and integral to the power production process (fans, pumps, etc.), and (2) any losses incurred from the generator(s) to the point of delivery. If any electric power is consumed at the location of the QF (or thermal host) for purposes not related to the power production process, such power should not be subtracted from gross output for purposes of reporting maximum net output here.]

Gross output: **[insert maximum gross output in kW or MW]**

Net output: **[insert maximum net output at point of delivery in kW or MW]**

Derivation (assumptions about losses, auxiliary load or lack thereof, and calculation of gross and net output):

[insert text]

4c. Indicate the actual or expected installation and operation dates of the facility, or the actual or expected date of completion of the reported modification to the facility:

[insert text]

4d. Describe the primary energy input (e.g., hydro, coal, oil [18 C.F.R. § 292.202(l)], natural gas [18 C.F.R. § 292.202(k)], solar, geothermal, wind, waste, biomass [18 C.F.R. § 292.202(a)], or other). For a waste energy input that does not fall within one of the categories on the Commission's list of previously approved wastes, demonstrate that such energy input has little or no current commercial value and that it exists in the absence of the qualifying facility industry [18 C.F.R § 292.202(b)].

[insert text]

5. Provide the average annual hourly energy input in terms of Btu for the following fossil fuel energy inputs, and provide the related percentage of the total average annual hourly energy input to the facility [18 C.F.R § 292.202(j)]. For any oil or natural gas fuel, use lower heating value [18 C.F.R § 292.202(m)]:

Natural gas: **[insert average annual hourly energy input in Btu or “None”]**

Oil: **[insert average annual hourly energy input in Btu or “None”]**

Coal (applicable only to a small power production facility): **[insert average annual hourly energy input in Btu, “None,” or “N/A”]**

6. Discuss any particular characteristic of the facility which the cogenerator or small power producer believes might bear on its qualifying status.

[insert text or “None”]

PART B: DESCRIPTION OF THE SMALL POWER PRODUCTION FACILITY

Items 7 and 8 only need to be answered by applicants seeking certification as a small power production facility. Applicants for certification as a cogeneration facility may delete Items 7 and 8 from their application, or enter “N/A” at both items.

7. Describe how fossil fuel use will not exceed 25 percent of the total annual energy input limit [18 C.F.R §§ 292.202(j) and 292.204(b)]. Also, describe how the use of fossil fuel will be limited to the following purposes to conform to Federal Power Act section 3(17)(B): ignition, start-up, testing, flame stabilization, control use, and minimal amounts of fuel required to alleviate or prevent unanticipated equipment outages and emergencies directly affecting the public.

[insert text or “N/A”; if any fossil fuel will be used, this response must include a statement that the applicant will limit such fossil fuel use to the purposes listed above]

8. If the facility reported herein is not an eligible solar, wind, waste or geothermal facility, and if any other non-eligible facility located within one mile of the instant facility is owned by any of the entities (or their affiliates) reported in Part A at item 1c above and uses the same primary energy input, provide the following information about the other facility for the purpose of demonstrating that the total of the power production capacities of these facilities does not exceed 80 MW [18 C.F.R § 292.204(a)]: [*See* definition of an “eligible facility” below. Note that an “eligible facility” is a specific type of small power production facility that is eligible for special treatment under the Wind, Waste and Geothermal Power Production Incentives Act of 1990, as subsequently amended in 1991, and should not be confused with facilities that are generally eligible for QF status.]

Facility name, if any (as reported to the Commission):

[insert names of other facility or facilities or “N/A”]

Commission Docket Number:

[insert Docket Numbers (QF__-___-___) for the facilities listed above or "N/A"]

Name of common owner:

[insert text or "N/A"]

Common primary energy source used as energy input:

[insert text or "N/A"]

Power production capacity (MW):

[insert net power production capacity of each facility listed above or "N/A"]

An eligible solar, wind, waste or geothermal facility, as defined in Section 3(17)(E) of the Federal Power Act, is a small power production facility that produces electric energy solely by the use, as a primary energy input, of solar, wind, waste or geothermal resources, for which either an application for Commission certification of qualifying status [18 C.F.R § 292.207(b)] or a notice of self-certification of qualifying status [18 C.F.R § 292.207(a)] was submitted to the Commission not later than December 31, 1994, and for which construction of such facility commences not later than December 31, 1999, or if not, reasonable diligence is exercised toward the completion of such facility, taking into account all factors relevant to construction of the facility.

PART C: DESCRIPTION OF THE COGENERATION FACILITY

Items 9 through 15 only need to be answered by applicants seeking certification as a cogeneration facility. Applicants for certification as a small power production facility may delete Items 9 through 15 from their application, or enter "N/A" at each item.

9. Describe the cogeneration system [18 C.F.R §§ 292.202(c) and 292.203(b)], and state whether the facility is a topping-cycle [18 C.F.R § 292.202(d)] or bottoming-cycle [18 C.F.R § 292.202(e)] cogeneration facility.

[insert description or "N/A"]

[insert statement identifying cogeneration facility as a topping or bottoming-cycle or "N/A"]

10. To demonstrate the sequentiality of the cogeneration process [18 C.F.R § 292.202(s)] and to support compliance with other requirements such as the operating and efficiency standards (Item 11 below), provide a mass and heat balance (cycle) diagram depicting average annual hourly operating conditions. Also, provide:

Using lower heating value [18 C.F.R § 292.202(m)], all fuel flow inputs in Btu/hr., separately indicating fossil fuel inputs for any supplementary firing in Btu/hr. [18 C.F.R § 292.202(f)]:

> **[insert text and insert or attach mass and heat balance diagram, or insert "N/A"]**

Average net electric output (kW or MW) [18 C.F.R § 292.202(g)]:

> **[insert average annual hourly net electric output in kW or MW, or "N/A"]**

Average net mechanical output in horsepower [18 C.F.R § 292.202(g)]:

> **[insert average annual hourly net mechanical output in horsepower, or "N/A"]**

Number of hours of operation used to determine the average annual hourly facility inputs and outputs:

> **[insert number of hours or "N/A"]**

Working fluid (e.g., steam) flow conditions at input and output of prime mover(s) and at delivery to and return from each useful thermal application, including flow rates (lbs./hr.), temperature (deg. F), pressure (psia), and enthalpy (Btu/lb.):

> **[insert text here or include this data on diagram required above, or insert "N/A"]**

11. Compute the operating value [applicable to a topping-cycle facility under 18 C.F.R § 292.205(a)(1)] and the efficiency value [18 C.F.R §§ 292.205(a)(2) and (b)], based on the information provided in and corresponding to item 10, as follows:

Pt = Average annual hourly useful thermal energy output
Pe = Average annual hourly electrical output
Pm = Average annual hourly mechanical output
Pi = Average annual hourly energy input (natural gas or oil)
Ps = Average annual hourly energy input for supplementary firing (natural gas or oil)

Operating standard = 5% or more

Operating value = Pt / (Pt + Pe + Pm)

[insert calculation of topping-cycle operating value or "N/A"]

Efficiency standard applicable to natural gas and oil fuel used in a topping-cycle facility:

= 45% or more when operating value is less than 15%, or 42.5% or more when operating value is equal to or greater than 15%.

Efficiency value = (Pe + Pm + 0.5Pt) / (Pi + Ps)

[insert calculation of topping-cycle efficiency value or "N/A"]

Efficiency standard applicable to natural gas and oil fuel used for supplementary firing component of a bottoming-cycle facility:

= 45% or more

Efficiency value = (Pe + Pm) / Ps

[insert calculation of bottoming-cycle efficiency value or "N/A"]

<u>FOR TOPPING-CYCLE COGENERATION FACILITIES</u>

Items 12 and 13 only need to be answered by applicants seeking certification as a topping-cycle cogeneration facility. Applicants for certification as a small power production facility or bottoming-cycle cogeneration facility may delete Items 12 and 13 from their application, or enter "N/A" at each item.

12. Identify the entity (i.e., thermal host) which will purchase the useful thermal energy output from the facility [18 C.F.R § 292.202(h)]. Indicate whether the entity uses such output for the purpose of space and water heating, space cooling, and/or process use.

[insert text or "N/A"]

13. In connection with the requirement that the thermal energy output be useful [18 C.F.R § 292.202(h)]:

For process uses by commercial or industrial host(s), describe each process (or group of similar processes using the same quality of steam) and provide the average annual hourly thermal energy made available to the process, less process return. For a complex system, where the primary steam header at the host-side is divided into various sub-uses, each having different pressure and temperature characteristics, describe the processes associated with each sub-use and provide the average annual hourly thermal energy delivered to each sub-use, less process return from such sub-use. Provide a diagram showing the main steam header and the sub-uses with other relevant information such as the average header pressure (psia), the temperature (deg.F), the enthalpy (Btu/lb.), and the flow (lb./hr.), both in and out of each sub-use. For space and water heating, describe the type of heating involved (e.g., office space heating, domestic water heating) and provide the average annual hourly thermal energy delivered and used for such purpose. For space cooling, describe the type of cooling involved (e.g., office space cooling) and provide the average annual hourly thermal energy used by the chiller.

> **[insert text; if process engineering data required in Item 13 has not been provided in the diagram required in Item 10, then also insert or attach a diagram containing this required information]**

FOR BOTTOMING-CYCLE FACILITIES

> Item 14 only needs to be answered by applicants seeking certification as a bottoming-cycle cogeneration facility. Applicants for certification as a small power production facility or topping-cycle cogeneration facility may delete Item 14 from their application, or enter "N/A."

14. Provide a description of the commercial or industrial process or other thermal application to which the energy input to the system is first applied and from which the reject heat is then used for electric power production.

> **[insert text or "N/A"]**

FOR NEW COGENERATION FACILITIES

> Response to Item 15 is only required for certain applicants for qualified cogeneration facility status, as described below. Applicants for small power production facilities or for cogeneration facilities not meeting the criteria outlined below may delete Item 15 from their application, or enter "N/A." In addition, per 18 C.F.R. § 292.205(d)(4) all cogeneration facilities 5 MW and smaller are presumed to comply with the requirements of 18 C.F.R. § 292.205(d)(1) and (d)(2), and therefore need not respond to Item 15. For those applicants required to respond to Item 15, *see* 18 C.F.R. § 292.205(d) and Order No. 671 for more information on making the demonstrations required in Item 15.

15. For any cogeneration facility that had not filed a notice of self-certification or an application for Commission certification under 18 C.F.R. § 292.207 prior to February 2, 2006, also show:

(i) The thermal energy output of the cogeneration facility is used in a productive and beneficial manner [18 C.F.R §§ 292.205(d)(1), (d)(4) and (d)(5)]; and

(ii) The electrical, thermal, chemical and mechanical output of the cogeneration facility is used fundamentally for industrial, commercial, residential or institutional purposes and is not intended fundamentally for sale to an electric utility, taking into account technological, efficiency, economic, and variable thermal energy requirements, as well as state laws applicable to sales of electric energy from a qualifying facility to its host facility [18 C.F.R §§ 292.205(d)(2), (d)(3) and (d)(4)].

[insert text or "N/A"]

PROJECT TIMELINE

Lakeview Geothermal Power Generation Facility
Feasibility Study

Project Timeline