

## PROPOSAL

We propose to install a high-temperature geothermal power plant on the Oregon Institute of Technology campus. Technical support would be provided by the Geo-Heat Center. The power plant would be approximately 1.2 megawatt (MW) in generating capacity and most likely be a flash steam type. This plant would use high-temperature geothermal water/steam from a proposed 5,000 to 6,000 feet deep geothermal well to be drilled into the fault along the east side of campus. The plant would be housed adjacent to the existing heat exchange building on the south east corner of campus near the geothermal production wells. Cooling water would be supplied from the nearby cold water wells to a cooling tower. The plant would provide 100% of the electricity demand on campus saving approximately \$400,000 annually, with any excess electricity sold into the grid through a net metering system. This would be the first flash steam geothermal power plant in Oregon and would serve as a demonstration site and as an educational training facility. If sufficient temperature and flows were obtained from the deep well, not only could energy be generated from a flash power plant, but the “waste” water could also be run through a low-temperature binary power plant in what is called a “bottoming cycle” to produce additional energy. And, finally this “waste” water would be used for space heating on campus or sold for a fee to adjacent land owners, as the flow would supplement our existing wells used for space heating.

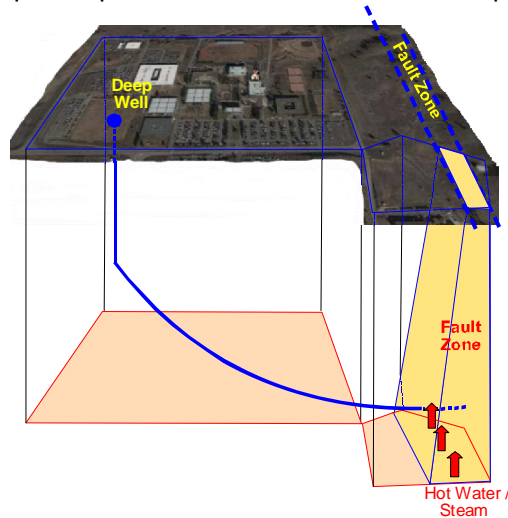
## THE GEOLOGIC SETTING

The geothermal resources in Klamath Falls were used by the Indians and early settlers. Today more than 600 wells are used to heat homes, businesses, churches, public and governmental facilities, including swimming pools and for sidewalk snow melting. A greenhouse facility is also heated that grows tree seedlings. The OIT campus has been heated entirely with geothermal energy since the early 1960s from three wells drilled on the south east corner of campus. The hot water is gravity fed to all the buildings on

campus, and provides heating and domestic hot water to the entire campus. Geologically, the geothermal water is heated through deep circulation within the earth and then upwells along the fault on the east side of campus where the OIT wells tap into this water as shown in the figure. This geothermal water has been used for over 45 years with no change in temperature or flow rate. Based on investigations from geothermal geologists there is a high probability of a higher temperature geothermal resource at depth in excess of 300°F based on chemical analysis of well water. Temperatures above 300°F are suitable for flash steam power generation, whereas those below this temperature are best suited for binary (organic Rankine cycle) power generation.

## THE WELL

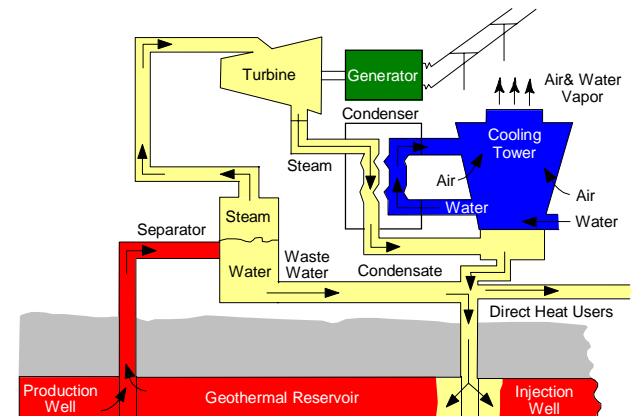
A deep, 5,000 to 6,000 foot, geothermal well would be drilled on campus to tap the expected high temperature (above 300°F) geothermal water that is estimated to be available upwelling along the fault system on the east side of campus. This well would be deviated from vertical in order to intersect the fault close to right angles as illustrated in the figure below. The high-temperature geothermal fluids would then be pumped from the well, run through a separator where the pressure is reduced to approximately 100 psi producing steam. The steam is sent to the power plant which is illustrated in the power



plant diagram below. The exact location of the well has yet to be determined, but would be on campus property.

## THE PLANT

The proposed 1.2 megawatt (MW) flash steam or binary power plant uses proven technology that has been used with geothermal fluids in many parts of the world. Geothermal fluid, under pressure, would be pumped from depth; the pressure is then reduced producing steam at 100 psi which would be used to turn the turbine-generator set. The steam is finally condensed by cold water from the cooling tower to improve the efficiency of the energy output by causing a “driving force” across the turbine. Only a small part of the fluid, around 15%, would be consumed in the process, thus the remainder could be used for a bottoming cycle power plant, and/or to supplement the campus heating system, or provide heat to adjacent users for a fee. The plant would most likely be located near the existing well field adjacent to the present heat exchanger building.



## THE BENEFITS

The installation of this power plant would provide a number to benefits:

- A showcase for interested developers in conjunction with tours of campus.
- A realistic laboratory for our engineering students to study, gather data and report

their findings, and making this information available to other potential users

- Monitoring the operation of the plant through a web-based controls such as SCADA (Supervisory Control & Data Acquisition System) where anyone could log on to a computer and see how the plant is operating – temperatures, flow rates, energy produced, etc. This could be done anywhere in the world, by grade schools, high schools, universities and other interested persons.
- Saving the campus approximately \$400,000 annually in our electricity costs
- Making the campus a “**Net Zero**” energy user.
- Making OIT and Oregon a leader in developing and using renewable, green energy.
- Providing additional income to the campus by selling the excess hot water to adjacent users for an income of approximately \$330,000.
- Generating additional electricity with a bottoming cycle power plant (binary cycle) using the “waste” water after flashing.

### THE COSTS

The well would cost approximately \$2,500,000; the plant would cost approximately \$2,700,000; and the cooling tower; piping, engineering and installation expense would add approximately \$300,000 for a total cost of \$5,500,000. The gross saving would be approximately \$400,000 annually in the campus electricity cost. The plant itself would have approximately \$145,000 annual operation and maintenance cost, for a net savings of \$255,000 annually. Additional income from the selling of hot water to adjacent users could provide \$330,000 annually for a total income of \$585,000. These costs and incomes would provide a simple payback of under ten years.

### THE CONCLUSIONS

The design installation of this plant is dependent upon the temperature of the fluid produced from the deep production well. The entire process from start of drilling to plant completion would take approximately one to two years. We have had interest expressed by several plant manufacturers, thus, providing a power plant should not be a problem, and the suppliers may help with some of the expenses as their product will be “on display”. The lead time on obtaining a drilling rig is unknown at this point.

Geothermal exploration is generally associated with high-risk ventures. While this may be true, the proposed well has some “fall-back” options to reduce risk. These options include using the well, if actual temperatures are lower than expected, for binary power plant and/or direct-use heating or cooling of the campus.



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*Oregon Institute of Technology*

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*High-Temperature Power  
Generation Proposal*

