QUARTERLY PROGRESS REPORT

PREPARED FOR THE ALASKA ENERGY AUTHORITY
BY
CHENA POWER COMPANY

PROJECT TITLE: Chena Power Geothermal Power Plant

COVERING PERIOD: October 1st through December 30th, 2005

DATE OF REPORT: January 25, 2006

GRANT RECIPIENT: Chena Power, LLC
P.O. Box 58740
Fairbanks, AK 99711

AWARD NAME: Alaska Energy Cost Reduction Solicitation

AWARD AMOUNT: $246,288

PROJECT PARTNERS: United Technologies Corporation
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PROJECT OBJECTIVE:

The objective of this project is to install a 400kW Organic Rankine Cycle (ORC) geothermal power plant at Chena Hot Springs, Alaska. This will be the first power plant operated off fluid from a geothermal resource in the State of Alaska, and will serve as a demonstration of the technology in this state. Additionally, the geothermal power plant will replace a 200kW diesel Caterpillar genset, displacing $241,812 of diesel fuel annually[1].

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[1] Based on October 2005 fuel cost of $2.50 per gallon, and current rate of use. This number has been revised upward since 2003 by 150%.

EXECUTIVE SUMMARY

Work on the 400kW geothermal power plant to be installed by Chena Power Company has focused on five main areas during the last quarter. These include:

1. Assembly of the 1st unit at UTC in Hartford, CT
2. Erecting the new power plant building
3. Modification to existing electric infrastructure and hookup to UPS system
4. Designing layout for cold and hot water distribution systems
5. Testing proposed injection wells and production wells

This report will provide an update on each of these areas of focus, organized as Part 1-5.

The project is proceeding on schedule, with installation of the first unit planned for June, 2006, as outlined in the last Quarterly report. United Technologies Corporation (UTC), based in Hartford Connecticut, was selected as the manufacturer of the Chena Power system, using components from Carrier Refrigeration chillers. The power plant is being built as two 200kW ORC modules at the UTC Research Center in Hartford, CT, operated at the facility for 1000 hours, then disassembled and shipped to Chena Hot Springs in two separate installations planned for June and November, 2006.

Assembly of the first unit is nearing completion at UTC and qualification testing is expected to commence in early February. Photos of the unit are included in Section 1. The project budget is on track from the previous Quarter, with a total project budget of $2,462,145. $176,081 was spent on the project during this report period, as a combination of in-kind and cash contributions.

PART 1: ASSEMBLY OF FIRST 200kW UNIT AT UTC

The design work for the Chena Power geothermal power plant was completed in October, 2005, and construction of the first unit will be completed in early February. Qualification testing will take place during February and March, with planned unit operation of 1000 hours at United Technologies before installation at Chena Hot Springs in June 2006. A second unit will be installed in November 2006.

UTC will be closely involved in operation for the first two years in order to validate operation and maintenance costs. Local and remote monitoring will be applied for both operation and data collection.

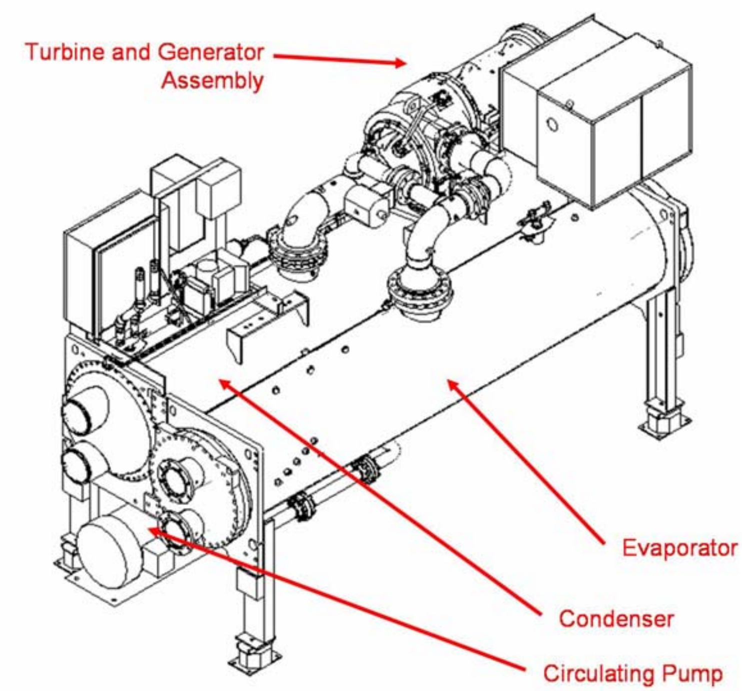

Figure 1. *Schematic of First 200kW ORC Unit*

Based on reservoir modeling and measured temperatures in the existing production well at Chena, the design point numbers for the first unit were chosen to be:

Flow rate = 1060 gpm,
Inlet Temperature = 164°F entering
Outlet Temperature = 130°F leaving

R134a will be the working fluid for the system, which is a readily available refrigerant. It is also the working fluid in Carrier's 19XR line of water-cooled centrifugal chillers, upon which the design of the Chena ORC is based. The tube-and-shell heat exchangers of the Carrier 19XR product line are being used as ORC evaporators and condensers, which is keeping the upfront cost of the unit down and enabling installation and any future maintenance to be performed from an existing pool of mechanical refrigeration contractors.

A number of pictures of the actual unit taken in mid-January at UTC have been included on Pages 12-24 of this report.

PART 2: POWER PLANT BUILDING

In preparation for installation of the first ORC unit, a new power plant building is being constructed. The building is a pre-manufactured steel building with two 3 ton overhead cranes – one for each ORC unit, and a separate control room. Large overhead garage doors will be installed to accommodate equipment needed for installation of the ORC units and possibly for future maintenance. The new building is adjacent to an existing maintenance equipment hanger and in close proximity to the current power plant, which will simplify hookup to existing electric infrastructure.

The foundation and a heated 6in pad for the building were laid in September, 2005. The building components were moved onsite in November, and erection of the building is underway at the time of writing of this report.

Photos of the site preparation work were included in the last Quarterly report.

PART 3: MODIFICATION TO EXISTING ELECTRIC INFRASTRUCTURE AND HOOKUP TO UPS SYSTEM

Battery Bank/ UPS System

As mentioned in the previous Quarterly report, installation of a 1500kVA battery bank and UPS system are necessary for two reasons. Firstly, this will allow power production from multiple sources (primarily the ORC units and the paralleled generators) to smoothly and continually provide power to customers, via the inverters which are part of the battery/UPS system. Secondly, the ORC unit uses an induction generator, which requires a stable input voltage and frequency for startup, which can be provided by the inverter output. UTRC has previously tested this type of system. The 480V inverter which is part of the UPS system can provide voltage and frequency to the induction generator as it extracts current. This type of system, with batteries for startup and load balancing, allows for the grid-independent operation required by Chena Power.

The battery bank and UPS system were purchased and moved onsite in June, 2005. The manufacturer of the system is MGE, and the model is the EPS 6000 UPS Module[2]. The system has been installed in four Conex units and has been wired to the UPS system by Chena Power. The UPS system was hooked into the Chena Power grid as scheduled in November under the supervision of an MGE representative, and the diesel generators are now charging the UPS.

Paralleling of Diesel Generators

In preparation for the installation of the ORC geothermal power plant, the three existing generators for Chena Power are being paralleled. Originally, they were configured in series with only one of the three Caterpillar 3306 200kW providing grid power at any one time. Paralleling the existing generators is necessary for a number of reasons. The ORC geothermal power plant will have some parasitic load associated with it, due primarily to pumps for the hot and cold water supply, as well as reinjection of the geothermal fluid. Internal system loads are accounted for and the net output of each unit will be 200kW, however the grid requirement will almost certainly average over 200kWhr once the geothermal plant is on line. Therefore, parallel operation will be required during high load timeperiods. Once the ORC units come online, they will take the place of the paralleled generators. The existing diesel generators will remain in place and paralleled with the ORC units to provide emergency backup.

This work was expected to be completed in November, 2005, but has been delayed until February.

Restraping Diesel Generators to 480VAC Output

Because the ORC Geothermal Power Plant is designed to produce an output voltage of 480VAC, it was necessary to switch the entire primary grid for Chena Power to 480VAC output. This was completed in November, 2005 in conjunction with bringing the UPS system online.

[2] The original grant application includes technical specification for the MGE UPS system

Purchase of New 400kW Diesel Generator
In late December, 2005, Chena Power purchased a new 3456 Caterpillar Generator (455EKW, 480V) to supplement the existing 200kW 3306 Caterpillar Gensets. While this is not directly related to the geothermal power plant project, it was necessary to increase fuel efficiency for the diesel power generation and replace the aging 3306 Gensets.

Figure 2. *New 3456 Cat Generator*

PART 4: DESIGNING LAYOUT FOR COLD AND HOT WATER DISTRIBUTION SYSTEMS

The distribution system for both the cold and hot water supply and discharge systems have been designed for maximum flexibility. The layout of the distribution system has been superimposed upon an aerial photo of the site on the following page.

Hot Water Supply Layout

The hot water supply line for the power plant will extend approximately 2000ft from the well TG#8, past the main production well site Well#6, and well TG#7 before turning north and reaching the power plant site. Spur lines will be connected to each of these well sites, which means all the possible production zones are being incorporated to allow maximum flexibility in production strategy. Fluid can be extracted from any or all well sites depending on long term reservoir reaction to the withdrawal of the fluid. Initially, water will be pumped from Well#6 using a 40hp submersible pump rated for the higher temperatures found in the Chena wells.

The pipeline will be constructed from insulated 8in HDPE pipe and will follow an existing road which follows the southern boundary of the property. The pipeline will be installed on supports 1ft above ground level. The pipeline will cross spring creek two times, and be attached to the supports of existing bridges.

Hot Water Supply Layout

80% of the fluid extracted from the wells will be reinjected into the reservoir, with the remaining 20% being used to supply hot water to the resort and pools. The water will be injected into 3 wells at rates of 200-400gpm based upon reservoir modeling completed by David Faulder, P.E., SAIC[3]. 8in HDPE will be used for the reinjection lines. Based on injectivity tests of the wells, the wellheads will not need to be pressurized, but 5-10hp pumps will be required to move the water to the wellheads from the power plant.

Cold Water Supply and Return Layout

The power plant will be water cooled, and as such will require 1500gpm per unit of 40°F water. Cold water will be supplied from either a cooling water well or an infiltration gallery located along the runway and to the northeast of the geothermal area. Preliminary water chemistry indicates that this area is not connected to the geothermal reservoir. The water will be supplied via an 18in insulated steel pipeline. Discharge to Monument Creek will be through an existing drainage ditch which runs underneath the runway through a 24in culvert. A permit is required from DEC for the discharge, however the water quality, including temperature, meets the most stringent requirements for discharge under state DEC regulations.

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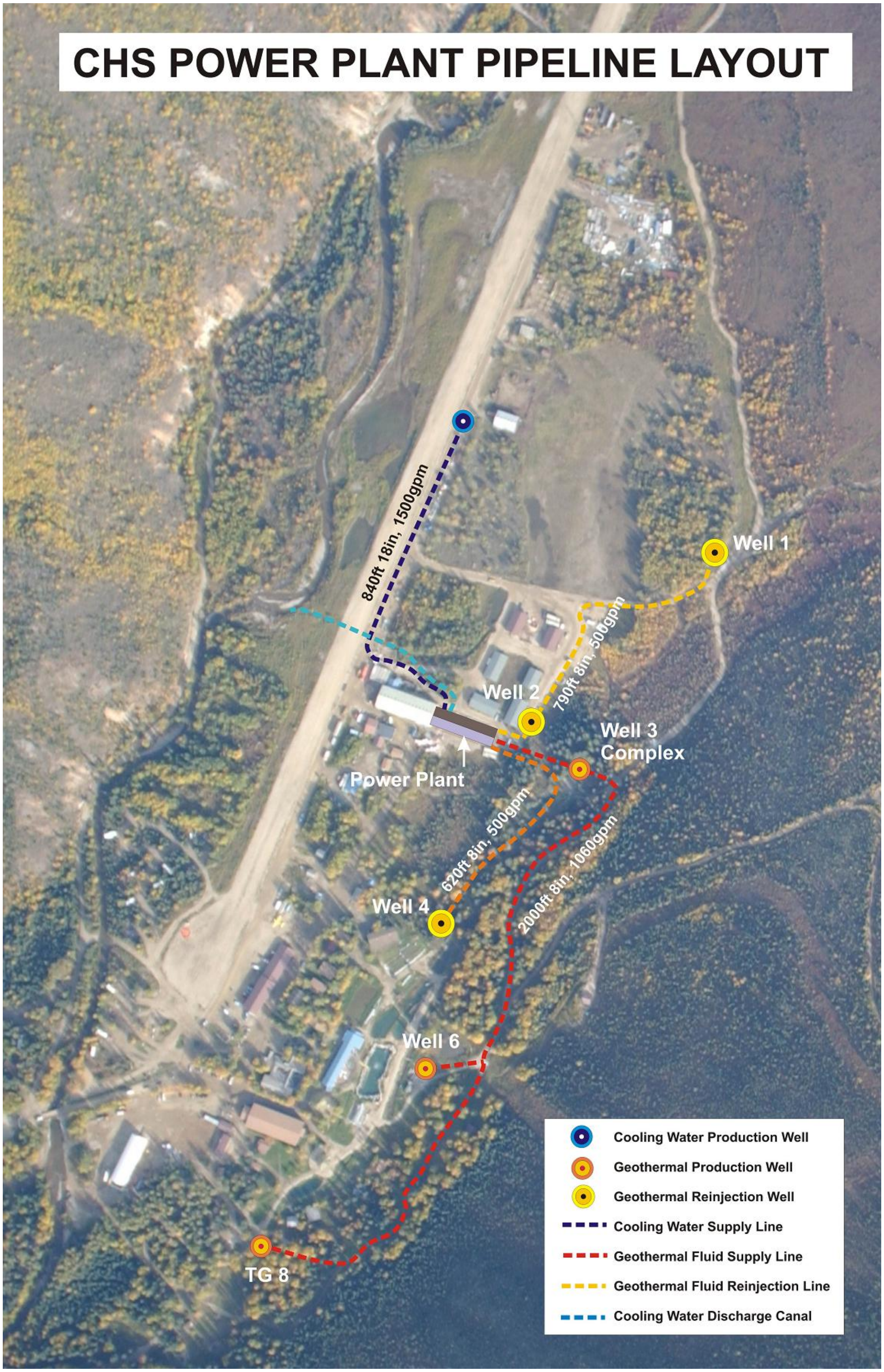
[3] Based on the '*Chena Hot Springs Initial Geothermal Resource Evaluation*' prepared by David D. Faulder, P.E., SAIC, in May, 2004.


CHS POWER PLANT PIPELINE LAYOUT
840ft 18in, 1500gpm
Well 1
790ft 8in, 500gpm
Well 2
Well 3
Complex
Power Plant
620ft 8in, 500gpm
2000ft 8in, 1060gpm
Well 4
Well 6
TG 8
Cooling Water Production Well
Geothermal Production Well
Geothermal Reinjection Well
Cooling Water Supply Line
Geothermal Fluid Supply Line
Geothermal Fluid Reinjection Line
Cooling Water Discharge Canal

PART 5: TESTING PROPOSED INJECTION WELLS AND PRODUCTION WELLS

Water Sampling
Additional water samples were collected from the production well sites for analysis for DOE and EPA permitting. Results are expected in early February.

Winter Drilling Project
During November and December, 2005, Chena Hot Springs deepened Well #2 from 256 to 820ft, and drilled 2 additional exploration holes[4]. The additional holes are part of an ongoing exploration project at the site[5], but will also contribute important information towards this project. Well #2 is slated to be used as a reinjection well, and a new hole drilled at the far western end of the field (TG#8) has yielded temperatures of 172.8°F at a depth of 600ft. This is 7°F higher than the existing production well, and this location may be chosen as the site of a future production well to supplement existing holes.

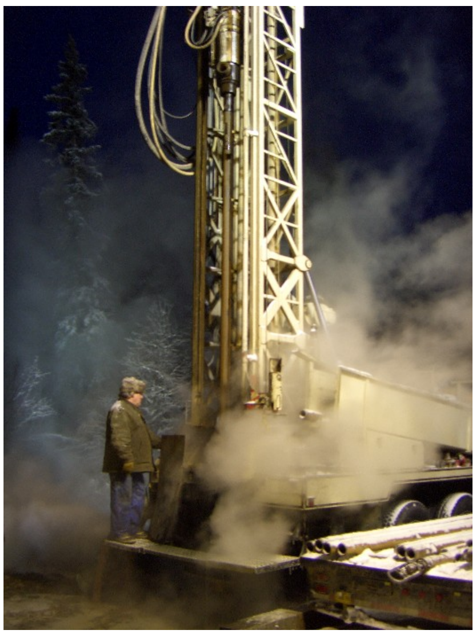


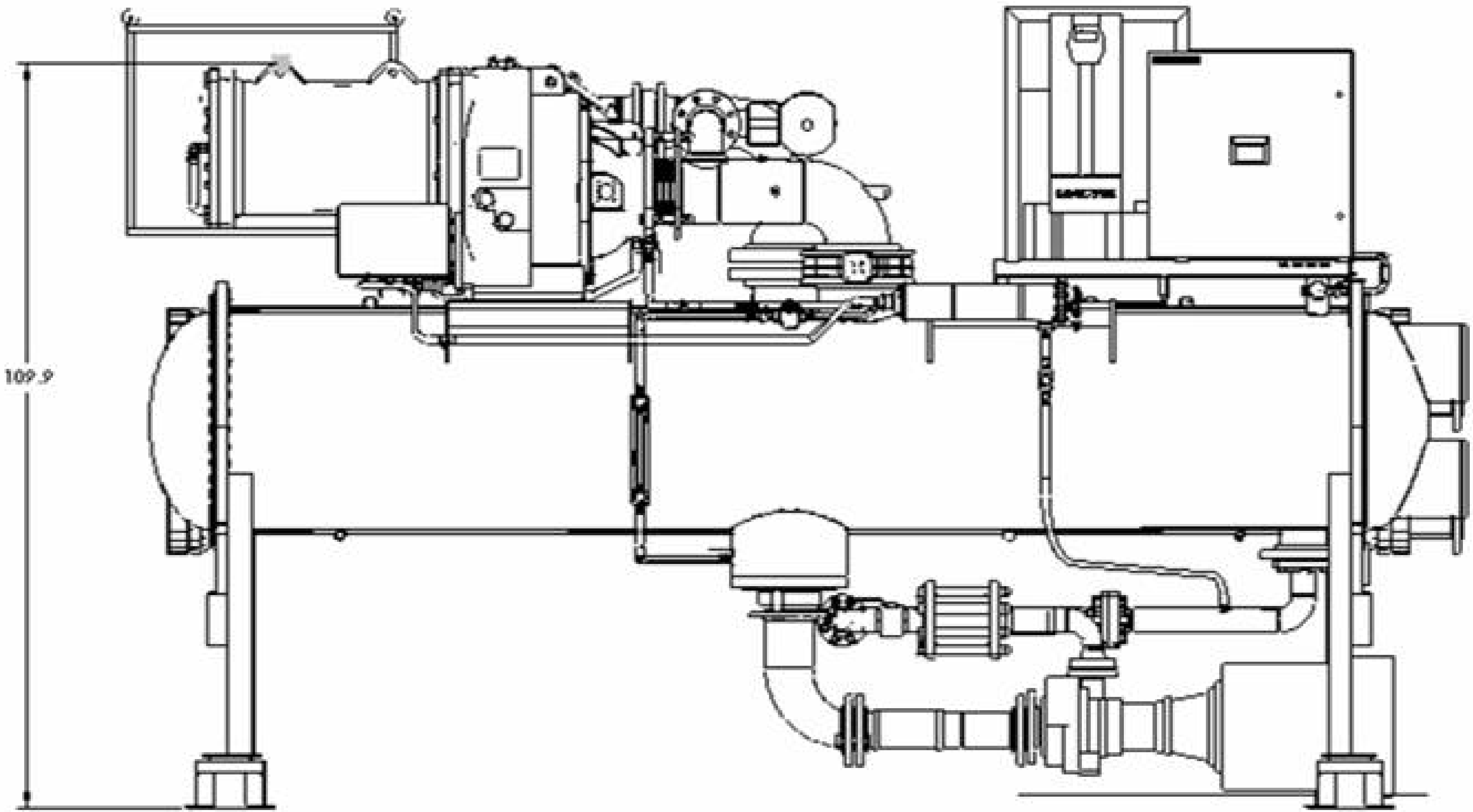
Figure 3. *Exploration Drilling Dec 14th, CHS*

Injectivity Testing
Potential Injection wells were tested to determine their injectivity index (important for calculating the amount of water which can be injected into the wells). Water was pumped into each well and downhole pressure measured to determine the amount of water each well can 'drink'. Logs were also run of each well to determine where the fracture zones were located and where the water was leaving the wellbore.

[4] Drilling was completed by Arctic Drilling based in Fairbanks, Alaska
[5] The joint DOE/ Chena Hot Springs GRED III Project

PROJECT BUDGET AND TIMELINE

During the period from October 1st – December 31st covered by this report, $176,081 was spent on this project, in components, labor, and in-kind donations from its sister companies, Chena Hot Springs Resort and K&K Recycling. The project budget and timeline which were included with the last Quarterly are still valid. No invoices have been submitted to AEA to date for this project, and none will be submitted with this report. Chena Power will begin submitting invoices with the next submitted Quarterly report.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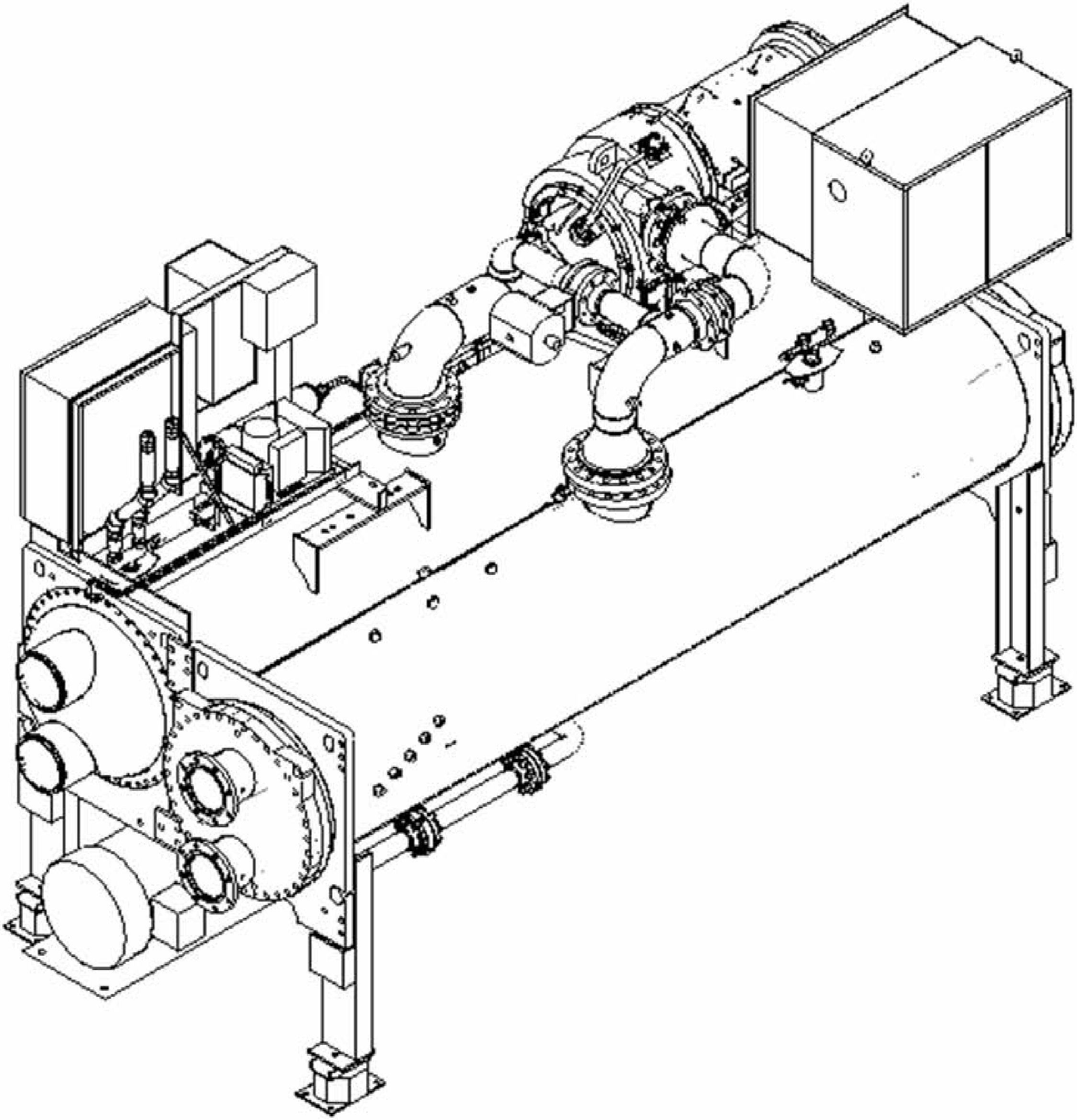

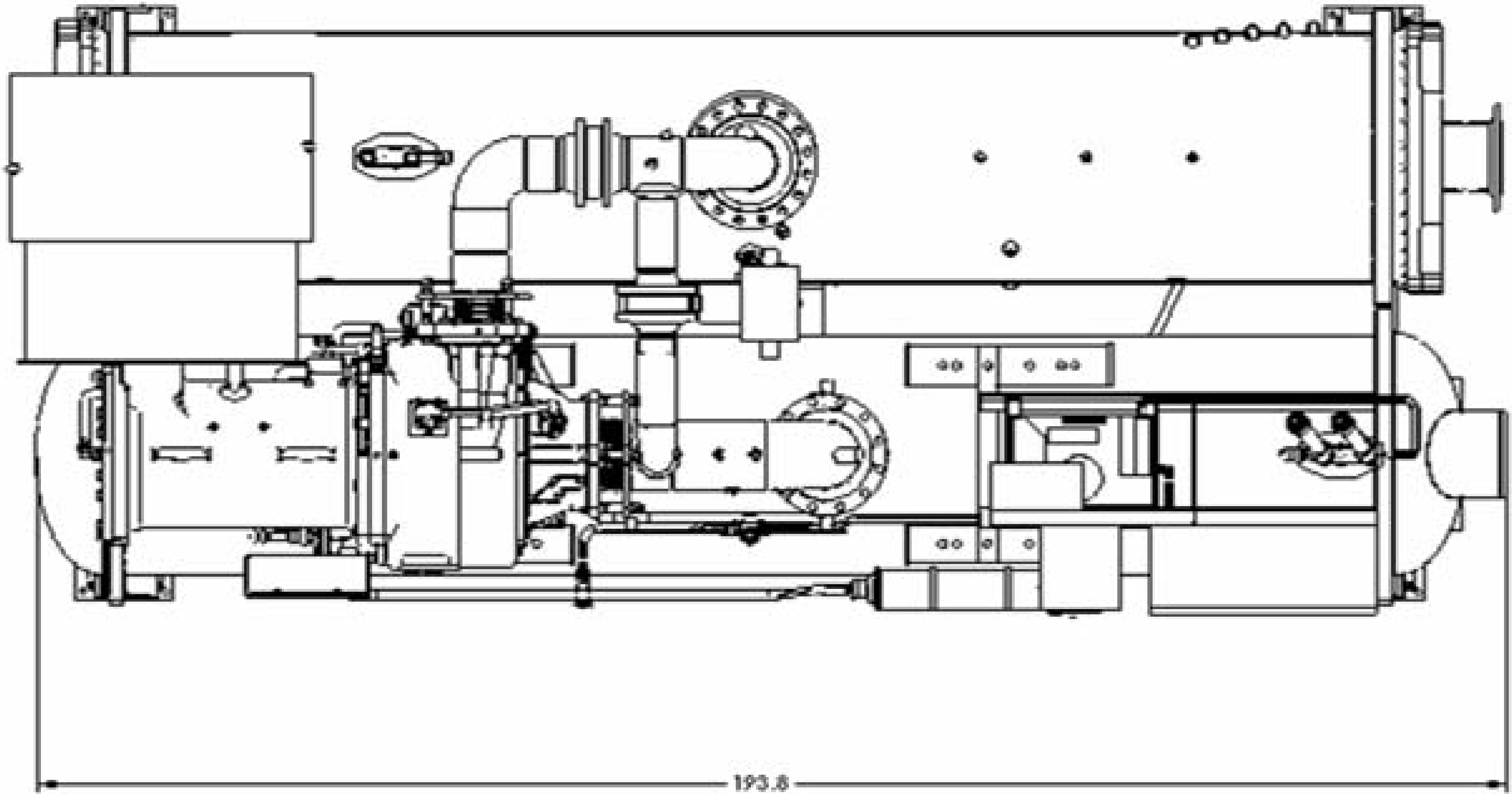

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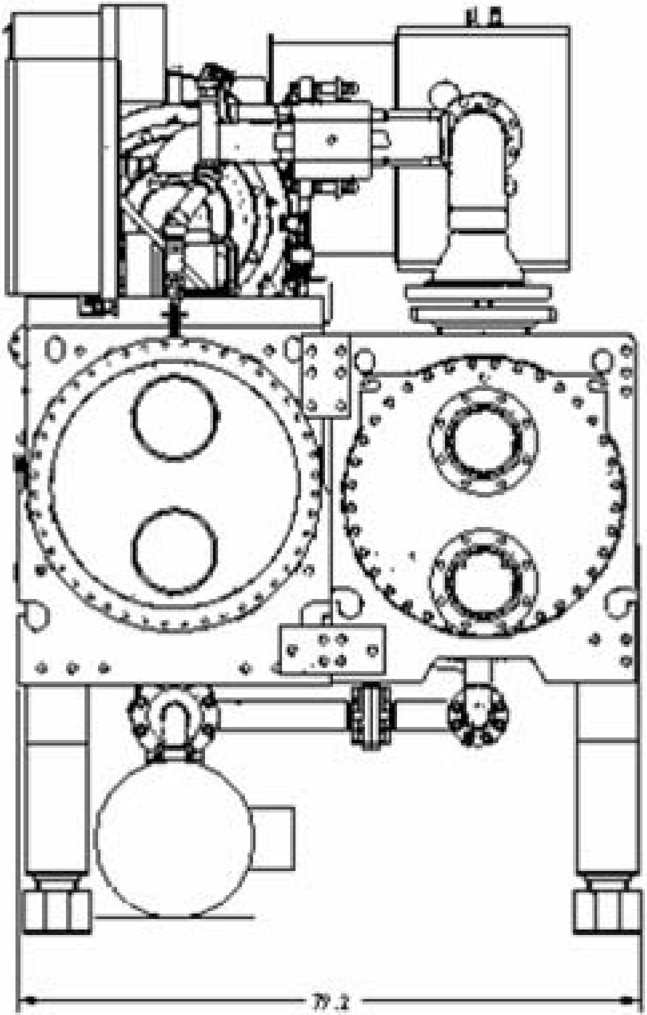
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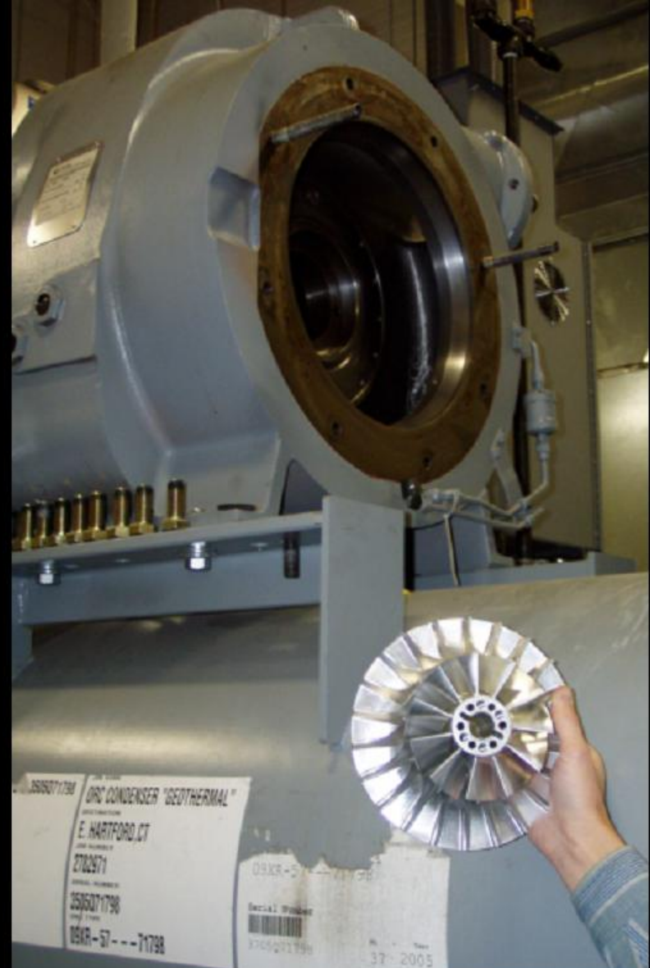
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50	°F AT	185	PSI	XX	°F AT	XX	PSI
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