QUARTERLY PROGRESS REPORT

PREPARED FOR THE ALASKA ENERGY AUTHORITY
BY
CHENA POWER COMPANY

PROJECT TITLE: Chena Power Geothermal Power Plant

COVERING PERIOD: July 1st through September 30th, 2006

DATE OF REPORT: October 20th, 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 more than $300,000 of diesel fuel annually[1].

[1] Based on April 2006 fuel cost of $2.48 per gallon, and current rate of use. This number has been revised upward since 2003 by 200%, due to increasing fuel cost and increased power needs of site, primarily due to 60kW increased load for new 5000ft² greenhouse.

EXECUTIVE SUMMARY

During the past Quarter, the first 200kW power plant module was installed and has been operating continually with the exception of a period of 10 days in September when the plant was shut down to replace the production well pump. Specific project milestones met during this Quarter include:

1. Hot water pipeline installed – 3000ft of 8in insulated HDPE laid from production well to power plant in late July.
2. Cold water pipeline installed – 2400ft of 18in steel pipe and 300ft of 16in steel pipe from infiltration gallery to power plant
3. First power plant module delivered to site and installed, tested and commissioned by UTRC
4. Satellite dsl system installed at power plant for communications
5. Grand Opening & Ribbon Cutting Ceremony held in conjunction with the 1st Annual Chena Renewable Energy Fair.
6. Power plant operation – 1257 hours have been logged as of October 13th

This report will provide an update on each of these areas of focus, organized as Part 1-6.

As reported in July, the first 200kW power plant module was delivered July 8th. It began generating power on August 8th, 2006, after a delay to complete the onsite infrastructure and pipeline. A UTRC crew was on hand for 5 days in mid July, and again in early August to hook up and commission the system.

Since the unit began generating power on August 8th, it has logged 1257 hours, generating 213MW-hrs and displacing 15,235 gallons of diesel fuel. This has resulted in a savings of $37,784 in fuel costs, or $721/day of operation.

The second power plant module is scheduled to arrive on October 21, 2006, at which time 100% of onsite generation will be from geothermal energy.

The project budget is on track from the previous Quarter, with a total project budget of $2,462,145. Approximately $530,000 was spent by Chena Hot Springs and Chena Power on the project during this report period, as a combination of in-kind and cash contributions. A complete financial report to date will be submitted within the next few days to supplement this report.

PART 1: HOT WATER PIPELINE INSTALLED

Installation of 3000ft of 8in insulated HDPE was completed at the end of July. The line was laid in a shallow ditch along 90% of the route, and will eventually be buried. The pipeline follows an existing unimproved road along the south boundary of the Chena Hot Springs Resort Property.

Water is produced from Well#7 at 500gpm and 165ºF. 1.8ºF in temperature is lost in the pipeline. Between August 31st and September 3rd, an electrical short developed in the submersible pump wire due to high pressure and temperatures downhole which caused faulty splices to leak. Fortunately, the vfd protected the pump motor as designed and no damage is apparent. Unfortunately, the pump needs to be returned to the factory to replace the damaged wire (sealed to the pump housing). A spare motor was available onsite and installed as a replacement on September 3rd and the plant put back in operation[2].

Figure 1. Geothermal well pump tested prior to hookup to pipeline

[2] A second, planned shutdown also occurred during September 5-8th to improve injection system

PART 2: COLD WATER PIPELINE INSTALLED

Installation of the 2400ft 18in steel plus 300ft 16in steel cold water supply pipeline was completed August 6th, just prior to power plant startup. Due to delays in installation and complexity of welding, an outside contractor was hired to complete the work.

Chena Power designed the cold water pipeline to avoid the necessity of pumping the water by employing a low tech siphon to 'pull' water out of a shallow, large diameter well (called an infiltration gallery). The elevation difference of +31ft between the infiltration gallery and the power plant allows 1500gpm to flow through the condenser. The cold water gains 10ºF before being discharged to Monument Creek. Chena Power has obtained a permit to discharge this water from DEC. An automatic shutdown procedure is in place to avoid the potential for discharge into Monument Creek if a leak in the condenser is detected.

The cold water system as a whole was a challenge to design and construct, and still needs to be insulated and buried for winter operation. An air cooler is also being ordered and will operate using glycol as a cooling medium for the power plant unit.

Figure 2. Installation of Cold Water Pipeline

PART 3: FIRST POWER PLANT MODULE INSTALLED

The first power plant module was installed in July, with commissioning taking place the first week of August. During this time, the unit was connected to cold and hot water supply lines, 480VAC was run to the plant from the UPS, electronics were installed and tested, and programs updated. Three Chena Power/ Chena Hot Springs employees, Kregg Reber, Bernie Karl, and Gwen Holdmann, were trained on operation.

UTRC contributed all man-hours, travel, and housing expenses for their employees during installation.

Figure 3. Fred Cogswell (UTRC) trains Gwen Holdmann (Chena) on systems operation.

Figure 4. Part of installation team: From L to R, Gwen Holdmann (Chena), Bernie Karl (Chena), Bruce Biederman (UTRC), Tom Clarke (UTC Power), Fred Cogswell (UTRC), and Kregg Reber (Chena)

PART 4: COMMUNICATION SYSTEM INSTALLED

Chena Power installed a dedicated dsl satellite system to allow remote monitoring of the power plant from any location around the world. This is especially important because there is no phone line available at the power plant. The communication and data collection system is designed to accomplish several tasks:

1) Allow for alarms and alerts to be sent out in the case of potential problems with the unit. Because a constant grid is provided to the site via a UPS/battery bank, a power outage is not immediately apparent. The com system is designed to notify a monitoring system at UTRC, and send out automated calls to relevant individuals, including the front desk of Chena Hot Springs Resort, which is staffed 24 hours a day
2) Continual data logging of system components, including pressures and temperatures throughout the system, power output, flow rates for refrigerant and water, etc. This is automatically transmitted back to UTRC where it is analyzed.
3) Remote real-time system logon capability so UTRC operators can control and monitor the system in Hartford Connecticut as easily as if they were onsite.
4) Voice over IP will be installed to allow Chena and UTRC to consult and troubleshoot if necessary.

PART 5: GRAND OPENING

The official ribbon cutting ceremony for the power plant was held on August 20th, in conjunction with the First Annual Chena Renewable Energy Fair. 1400 people attended the Fair, with approximately 900 taking advantage of a free shuttle service from town provided by Chena Hot Springs Resort. 50 vendors and 35 workshops were held, attracting participants from around the country. Almost all Fair attendees toured the power plant during the event.

A number of individuals representing the Denali Commission, Alaska Energy Authority, Department of Energy, and United Technologies Corporation attended the celebration. Senator Ted Stevens and Governor Frank Murkowski were also in attendance and addressed the crowd.

Figure 5. Official ribbon cutting to open the Chena Geothermal Power Plant

PART 6: POWER PLANT OPERATION

Since the power plant has been in operation, 213MW-hrs have been logged. This represents 15,235 gallons of diesel fuel displaced as of October 13th, for a total savings of $37,784 in fuel.

The power plant was shut down briefly from August 31st through September 3rd to replace the well pump motor (see part 1). There was also a scheduled shutdown September 11-16th to work on the cold water system and add Well#2 as a second injection well. This was worked that had been planned but not completed prior to the August 20th opening.

Other than these two shutdowns, which were not ORC related, there have been a few minor problems encountered, primarily with the water supply and some communication problems. All have been resolved. The ORC has not experienced any failures, although adjustments have been made to the code to allow for less sensitivity to changes in hot water flow rate, and to fix a glitch in the manual operations mode for the system controls.

An operational log sheet is included with this report.

ONGOING WORK

The second ORC module is expected to arrive in late October. It will be installed and commissioned by mid-November. A static switch was purchased for the UPS system, which will be installed to allow the diesel generators to drop offline once the second unit is installed. At that point, the entire site will operate off 100% geothermal power.

The cold water pipeline will need to be insulated before winter. A supplemental air cooled system will also be installed in anticipation of lower water table during winter months. A plan is also being devised to hook the hot water to the cold water pipeline to allow the line to be heated and thawed if needed.

The production pump will need to be replaced to accommodate the increased volume required to operate two ORC units. The existing well pump will be reinstalled in the nearby TG7 to be used for backup.

The geothermal floor heating will be hooked up in the power plant building, and an addition will be built which will enclose valves and termination of cold water supply system.

Well #1 and Well #4 are both being considered as additional potential injection sites.

PUBLICATIONS & PUBLICITY

This project has garnered tremendous interest from around the world. This has resulted in numerous speaking opportunities for UTC and Chena personnel at a number of venues. These include:

- Renewable Alaska Energy Project Quarterly Meeting, August, Gwen Holdmann
- Alaska Geothermal Conference Aug 20th: Joost Brasz (Carrier), Gwen Holdmann (Chena)
- Alaska Power Association Annual Meeting, August 25, Gwen Holdmann
- GVEA Green Power Advisory Committee, August 29th, Kat Keith (Chena)
- Geothermal Resource Council Annual Meeting, August 30th, Fred Cogswell (UTRC)
- University of Alaska, September 20th, Bernie Karl

Additionally, this project has earned significant press, including:

- Front cover Fairbanks Daily News Miner (twice)
- Anchorage Paper
- Geothermal Historic Timeline Poster
- Article in Popular Mechanics
- Public Radio segment

The project is currently a finalist for the Power Engineering Project of the Year Award. Chena has also been named the recipient of a national Green Power Leadership Award which will be officially announced December 4th.

LOG 8-10-06 through 10-13-06					Average			Calculated		
Date		Stop/Start	Alarms	Comments	PumpKW	GenKW	Hours	PumpKW-h	GenKW-hr	Net-kW-hr
10-Aug		none	none		19.48	-173.00	24.00	514.23	4151.44	3637.21
11-Aug	a	none	none		19.46	-177.48	11.47	245.49	2035.37	1789.89
	b	1 and 1	none		16.79	-148.70	12.53	231.32	1862.90	1631.58
12-Aug		none	none		19.50	-177.03	24.00	514.84	4248.74	3733.90
13-Aug		none	none		19.56	-180.86	24.00	516.38	4340.67	3824.29
14-Aug		1 and 1	none		19.39	-179.15	24.00	511.79	4299.68	3787.89
15-Aug		none	none		19.57	-182.45	24.00	516.55	4378.76	3862.21
16-Aug		1 and 1	28		18.85	-177.08	24.00	497.56	4249.97	3752.41
17-Aug		none	none		19.88	-187.18	24.00	524.95	4492.25	3967.29
18-Aug	a	none	none		19.85	-191.68	11.47	250.50	2198.88	1948.38
	b	none	none	Clock was set back four hours on NetLink	19.82	-194.15	0.33	7.09	63.15	56.06
	c	1 and 1	none	Lowered EvapTsat, shut down and turned off cold water.	14.52	-140.77	16.31	260.61	2296.23	2035.62
19-Aug		none	none	variations in EvapTsat at end	20.08	-194.76	24.00	530.05	4673.58	4143.53
20-Aug		1 and 1	5	Many variations, Alarm caused by bearing sensor force released	16.44	-164.87	24.00	433.85	3956.40	3522.54
21-Aug		1 and 1	12	Very low operation looks unstable (cavitation?). "tripped off line due	18.95	-185.86	24.00	500.18	4460.18	3959.99
22-Aug		1 and 1	12		18.51	-182.43	24.00	488.59	4377.73	3889.13
23-Aug		none	none		20.36	-196.09	24.00	537.33	4705.66	4168.33
24-Aug		3 and 3	12	"we began experiencing problems at the injection well site, unit tripp	18.04	-177.85	24.00	476.30	4267.86	3791.56
25-Aug	a	none	none	one blip in pressure.	18.19	-183.47	7.69	153.79	1410.51	1256.73
	b	none	none	At 7:53:00 PM switched to 1 minute data	18.07	-179.69	16.29	323.78	2927.37	2603.59
26-Aug		none	none		18.11	-178.89	23.98	477.68	4290.35	3812.68
27-Aug		1 and 1	12	Pressure dropped way before trip.	18.06	-173.72	23.98	476.38	4166.40	3690.02
28-Aug		none	none	At 9:21:01 AM switched back to 10 s data	18.31	-178.36	24.00	483.39	4280.18	3796.79
29-Aug		none	none		18.40	-183.62	24.00	485.78	4406.24	3920.46
30-Aug		3 and 2	25,11,12	At 8:30 EDT unit had reached 500 hours. Appears to have shut dov	13.05	-128.81	24.00	344.60	3091.08	2746.48
31-Aug		none	none	Off all day.	0.00	-0.03	24.00	0.00	0.69	0.69
1-Sep	a	none	none	Off all day.	0.00	-0.02	7.69	0.00	0.17	0.17
	b	none	none	Off all day.	0.00	-0.02	15.15	0.00	0.32	0.32
2-Sep		none	none	Off all day.	0.00	-0.02	24.00	0.00	0.49	0.49
3-Sep		none	none	Off all day.	0.00	-0.02	24.00	0.00	0.54	0.54
4-Sep		1 and 2	11	Started at end, 6 hours on. No heat for first start attempt	4.84	-43.90	24.00	127.69	1053.52	925.84
5-Sep		none	none		20.87	-201.80	24.00	550.88	4842.19	4291.31
6-Sep		none	none		20.84	-199.25	24.00	550.24	4781.70	4231.45
7-Sep		none	none		20.85	-200.56	24.00	550.22	4812.48	4262.25
8-Sep	a	none	none		20.95	-208.43	8.85	203.99	1844.99	1640.99
	b	none	none		20.80	-195.78	15.14	346.38	2964.56	2618.18
9-Sep		3 and 3	25,11,12	Nuisance Low oil SH, Couldn't get Pr < 2.5, lost heat. (on for 15.83	13.17	-128.02	24.00	347.74	3071.81	2724.06
10-Sep		1 and 0	12	Lost heat. (On for 13.1 hours)	9.94	-102.33	24.00	262.45	2455.73	2193.28
11-Sep		none	none	Off all day.	0.00	-0.02	24.00	0.00	0.44	0.44
12-Sep		none	none	Off all day.	0.00	-0.02	24.00	0.00	0.50	0.50
13-Sep		none	none	Off all day.	0.00	-0.02	24.00	0.00	0.49	0.49

14-Sep		none	none	Off all day.	0.00	-0.02	24.00	0.00	0.45	0.45
15-Sep	a	none	none	Off all day.	0.00	-0.02	8.85	0.00	0.19	0.19
15-Sep	b	none	none	Off all day.	0.00	-0.02	15.14	0.00	0.25	0.25
16-Sep		none	none	Off all day.	0.00	-0.02	24.00	0.00	0.48	0.48
17-Sep		0 and 1	none	Started first try. Ran for 6 hrs.	5.23	-47.72	24.00	138.12	1145.02	1006.90
18-Sep		none	none		21.32	-197.21	24.00	562.76	4732.47	4169.71
19-Sep		none	none		21.26	-199.38	24.00	561.18	4784.65	4223.47
20-Sep		none	none		21.22	-199.11	24.00	560.25	4778.19	4217.94
21-Sep		none	none		21.09	-196.21	24.00	556.76	4708.52	4151.76
22-Sep	a	none	none		21.25	-202.02	8.86	207.18	1790.26	1583.08
	b	none	none		21.06	-197.16	15.13	350.55	2983.43	2632.87
23-Sep		3 and 3	36/28,12	Shut down for work, tripped for loss of grid a little after restart. Trip	17.61	-164.39	24.00	464.73	3944.48	3479.75
24-Sep		none	none		21.14	-200.53	24.00	558.08	4812.38	4254.30
25-Sep		none	none		21.29	-207.23	24.00	561.98	4972.41	4410.43
26-Sep		none	none		21.42	-209.50	24.00	565.36	5027.67	4462.31
27-Sep		none	none		21.30	-207.00	24.00	562.32	4967.78	4405.46
28-Sep		none	none		21.23	-206.52	24.00	560.43	4956.11	4395.68
29-Sep	a	none	none		21.28	-208.32	8.87	207.48	1846.78	1639.29
	b	none	none		21.17	-206.86	15.13	352.28	3129.05	2776.77
30-Sep		none	none		21.30	-209.50	24.00	562.10	5027.14	4465.04
1-Oct		none	none		21.44	-214.59	24.00	565.90	5149.34	4583.44
2-Oct		8 and 8	25,11,31,11,	Code Download before alarm 13. Low oil superheat for 25 that start	15.05	-143.37	24.00	397.15	3440.45	3043.31
3-Oct		none	none	High side pressure became unstable, hot water pressure dropped.	21.63	-213.87	24.00	570.86	5132.00	4561.13
4-Oct		none	none		21.71	-212.94	24.00	573.05	5109.68	4536.63
5-Oct		none	none		21.81	-217.61	24.00	575.79	5221.70	4645.91
6-Oct	a	none	none		21.85	-217.37	8.87	213.19	1928.47	1715.28
	b	none	none		21.72	-214.08	15.12	361.25	3237.12	2875.87
7-Oct		none	none		21.79	-217.95	24.00	575.04	5229.78	4654.73
8-Oct		none	none		21.82	-217.38	24.00	575.89	5216.82	4640.93
9-Oct		1 and 0	??	At 10:20 lost communication with ORC, System goes to off.	21.74	-212.06	24.00	573.84	5088.99	4515.15
10-Oct		3 and 4	13,28,28	**Communication back at 3:12 am. NEED TO STUDY**	20.45	-194.73	24.00	539.73	4673.29	4133.56
11-Oct		none	none		21.63	-214.63	24.00	570.96	5150.76	4579.80
12-Oct		none	none		21.62	-214.84	24.00	570.64	5155.05	4584.41
13-Oct	a	none	none		21.76	-218.88	8.88	212.53	1943.36	1730.83

Total kWhr generated to date:	213297
Total Gallons Diesel Displaced:	15235
Savings @ $2.48/ gal fuel cost	$ 37,784