


Geothermal Energy Technology
Powering Projects in Alaska and China

Bernie Karl

CHENA POWER




Chena Hot Springs Resort

OUR VISION

To become a self-sustaining, self-reliant community that can produce the energy, food, and fuel to meet our needs

SUSTAINABLE LIVING

CHENA HOT SPRINGS RESORT
FAIRBANKS, ALASKA





CHENA HOT SPRINGS RESORT

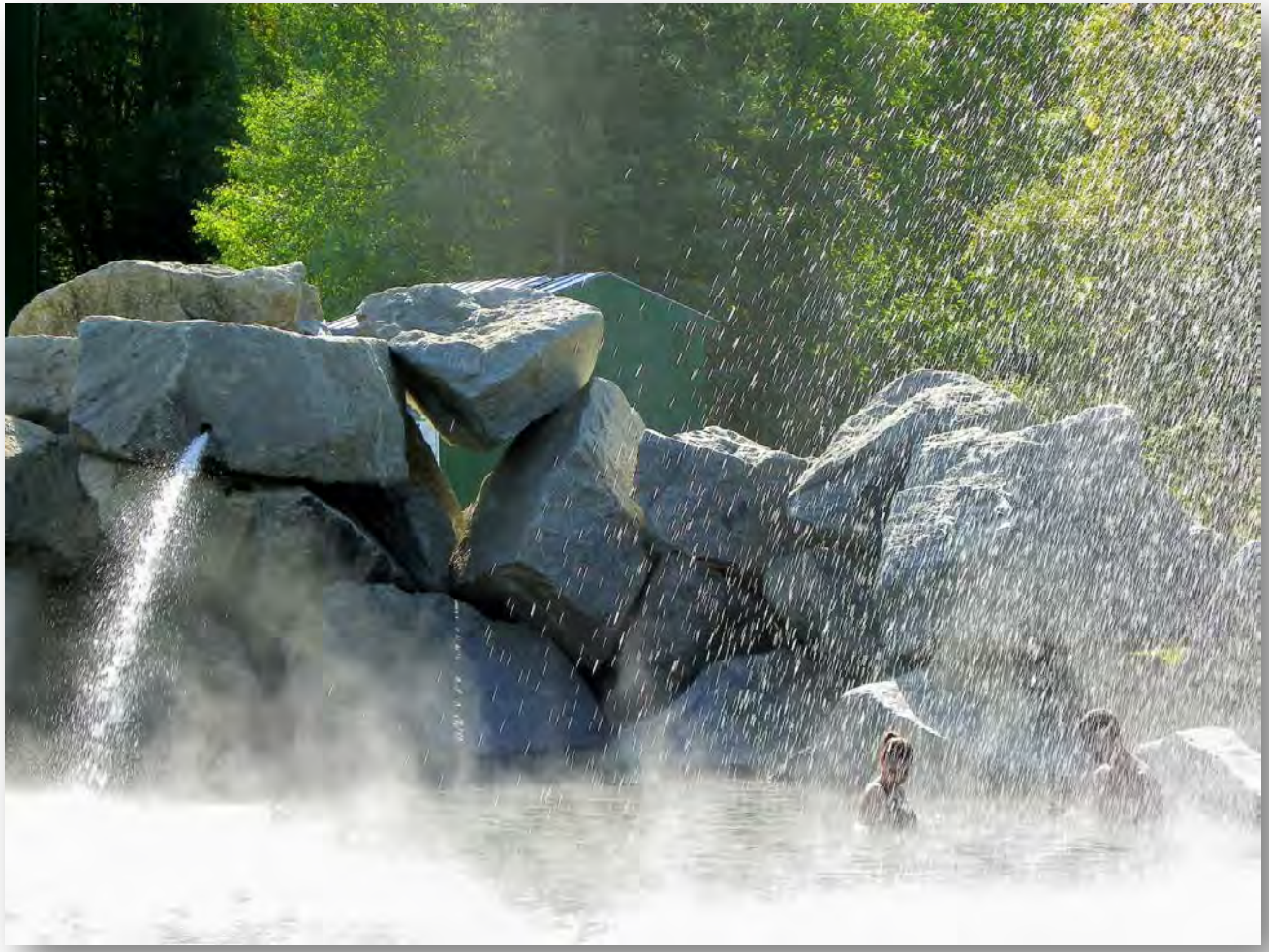




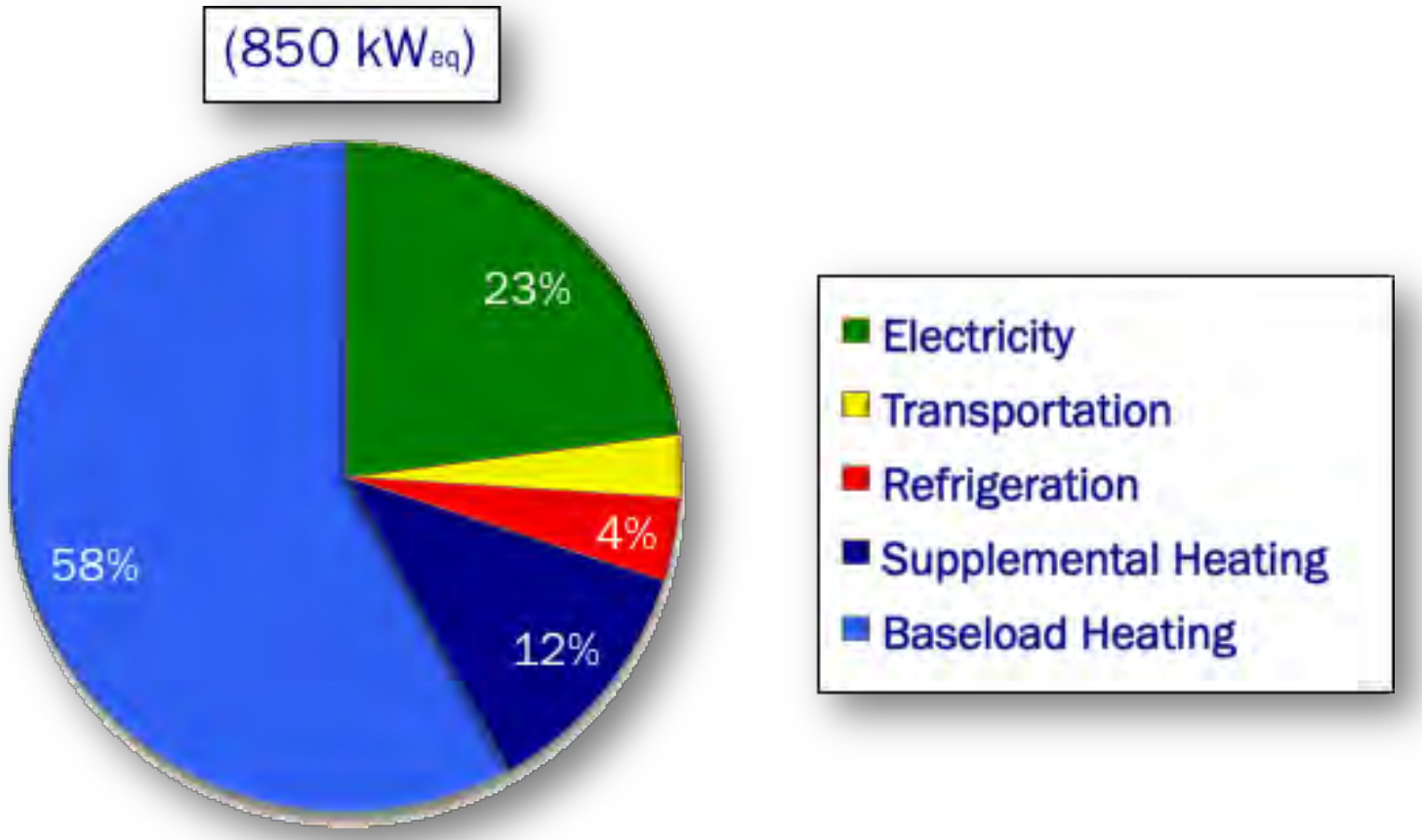

- Accommodations
- Activities
- Healing Waters
- World Class Dining
- Aurora Viewing
- Wildlife Viewing
- And many other adventures!

All made possible with renewable energy!

THE HEALING WATERS



ENERGY USE AT CHENA HOT SPRINGS



CHENA AURORA ICE MUSEUM

CHENA ABSORPTION CHILLER

Monument Creek
Provides Cooling Water
(~40F)

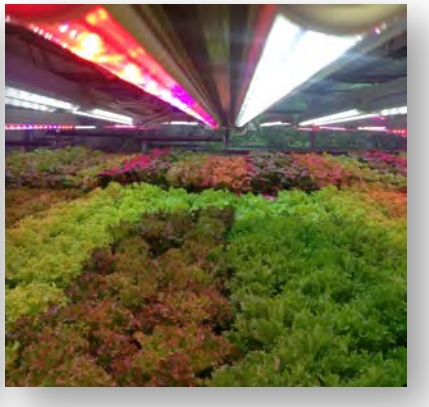
Geothermal Wells Provide
Hot Water (~165F)

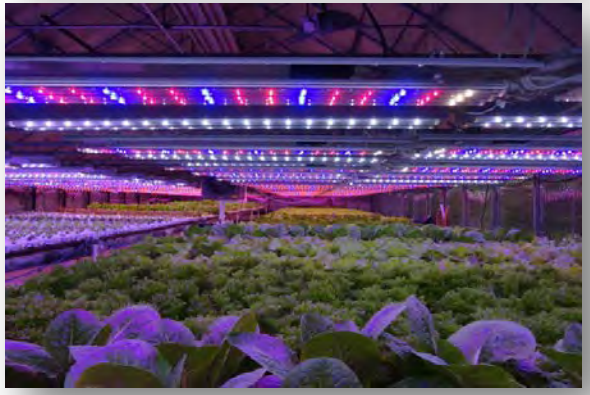
Approximately 15 tons of
Refrigeration Required for
Ice Museum (180,000 BTU/h)

DISTRICT HEATING

- First geothermal well drilled in November 1998
- All buildings on property are heated geothermally using ~300gpm of 165°F water
- Estimated yearly savings of $383,000 in heating fuel costs

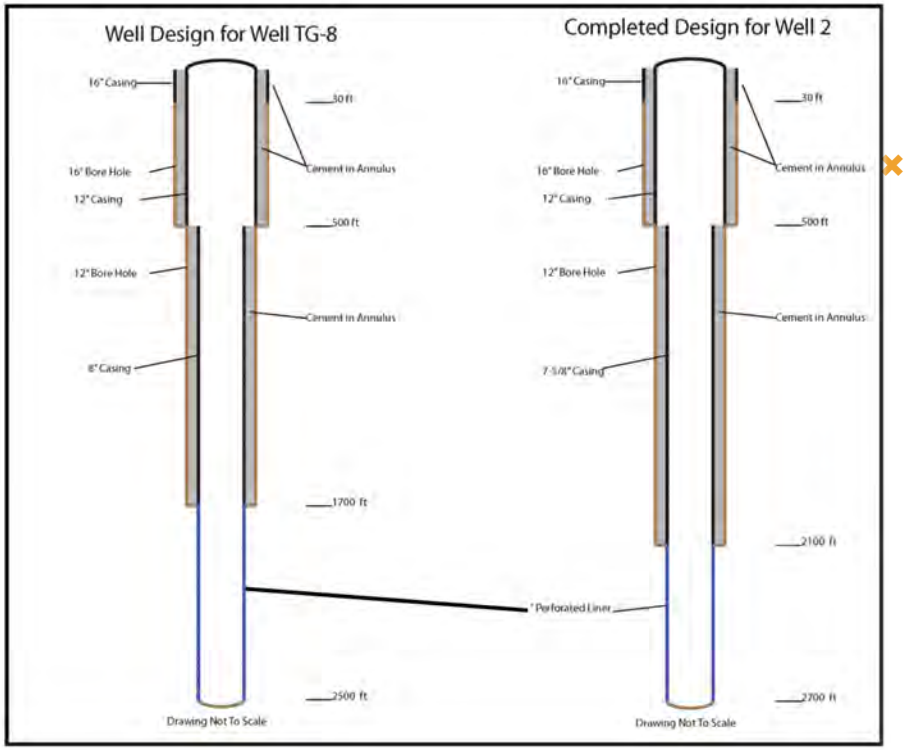
CHENA FRESH GREENHOUSE





The LED and hydroponic systems decrease winter energy costs and increase production. It is the largest of its kind in Alaska and the USA.

NEW GEOTHERMAL WELLS



- Deepening well TG-8 increased the geothermal capacity of the reservoir, and produces water at 174 ºF

The total project cost to drill the two wells will be an estimated $2,154,000.

NEW 2500’ PRODUCTION WELL
174ºF WATER DRILLED WITH A JEFCO 50K USING A WASSARA WATER HAMMER. 2000-2500 PSI COLD WATER.

NEW INJECTION WELL 2700’

DRILLING 2700’ INJECTION WELL

TESTING WELL

2000 PSI AIR BOOSTER

DRILLING WITH 2000 PSI AIR AND HIGH PRESSURE COLD WATER

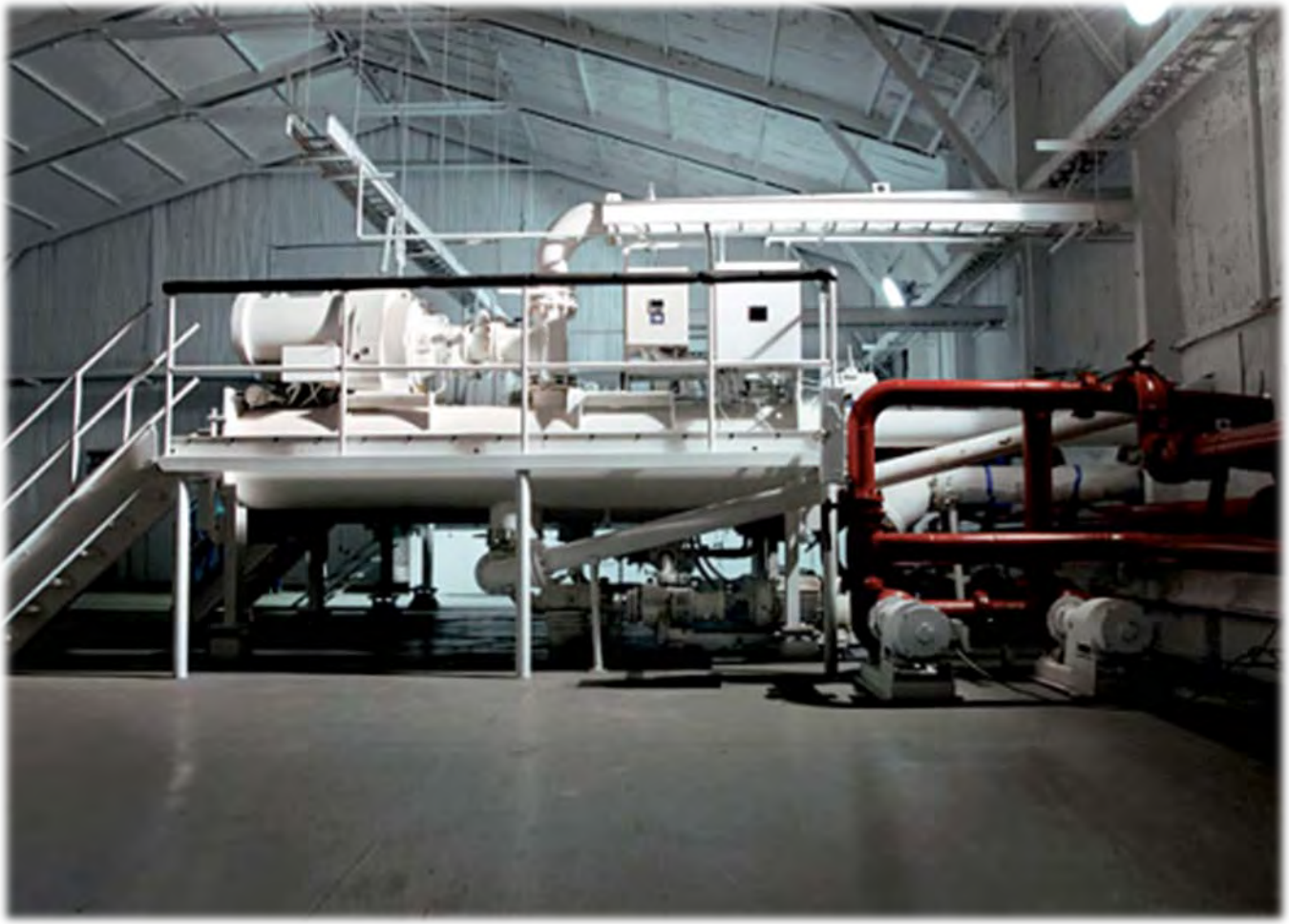
10,000 PSI MUD PUMPS WITH WATER FILTERS

2500 FT PRODUCTION WELL 174º F

Project support provided by

DOE, U.S. Department of Energy
United Technologies Corporation

CHENA POWER
GEOTHERMAL POWER PLANT



CHENA POWER
MOBILE ORC

CHENA POWER MOBILE ORC PROJECT GOALS

- To validate the production of low temperature resources
- To help realize the potential for geothermal production on oil & gas sites
  - Both producing and non-producing wells, in terms of fossil fuel
  - Show that lower cost geothermal projects are possible, as most geothermal costs are associated with drilling
  - Prove to oil & gas companies that our unit operates safely and efficiently
- Test and document the reliability of this new technology
- Gain a better understanding of operational costs associated with this equipment
- Help realize that a more distributed power generation network is attainable and an effective solution to energy problems

MOBILE ORC PROJECT TIMELINE

Construction Phase

July 1, 2008

Aurora Energy Validation of ORC using a waste heat stream for urban municipal energy generation in Fairbanks, AK

Planning for future deployments to Oil & Gas sites for co-production

~92% complete

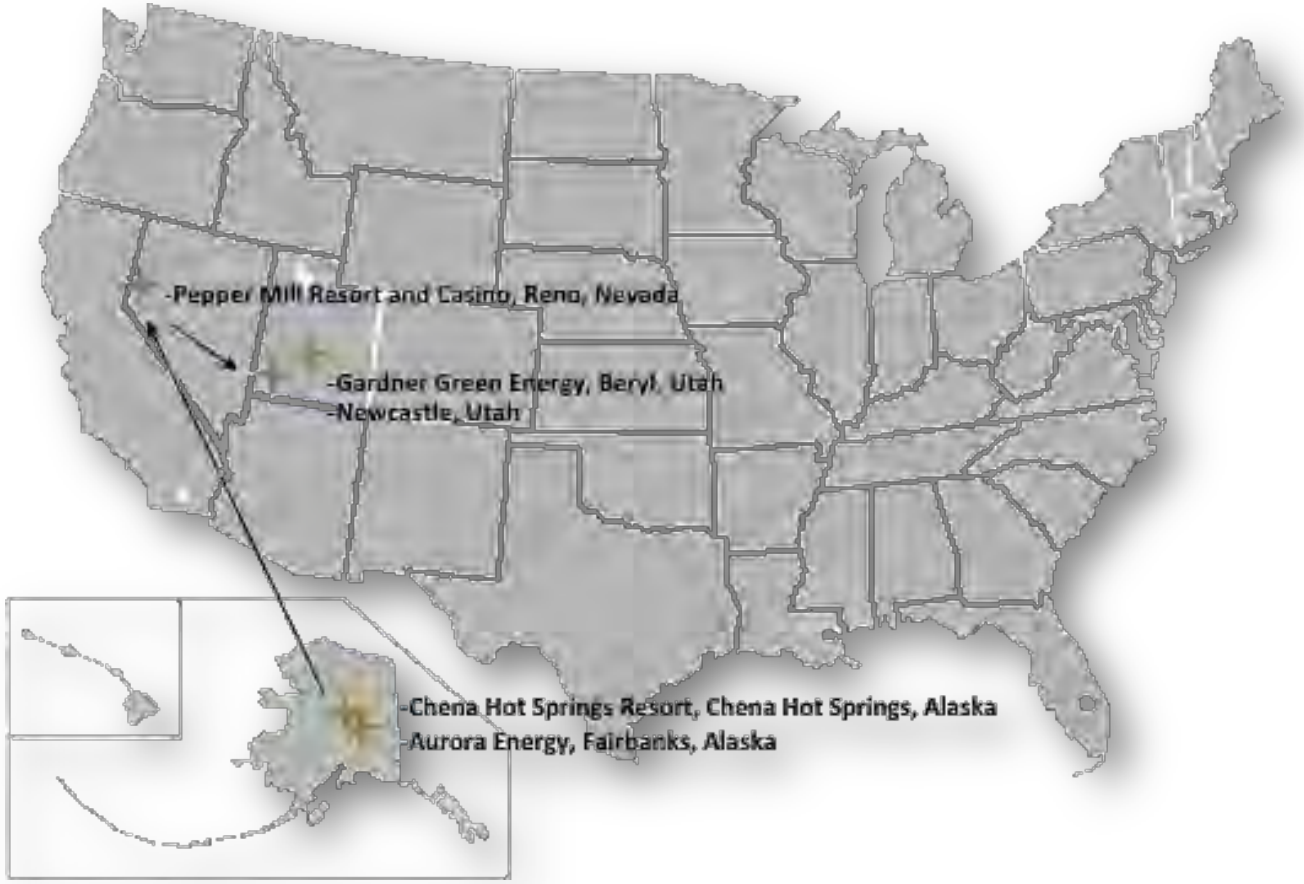
Final Report to DOE

May 16, 2014

Unit was producing power from Chena Hot Springs geothermal resource at the Renewable Energy Fair and U.S. Senate Energy and Natural Resources Sub-Committee Field Hearing

Display and Confirmation of the unit's mobility and its effectiveness for power generation for urban applications.

MAP OF THE MOBILE ORC'S PROGRESS



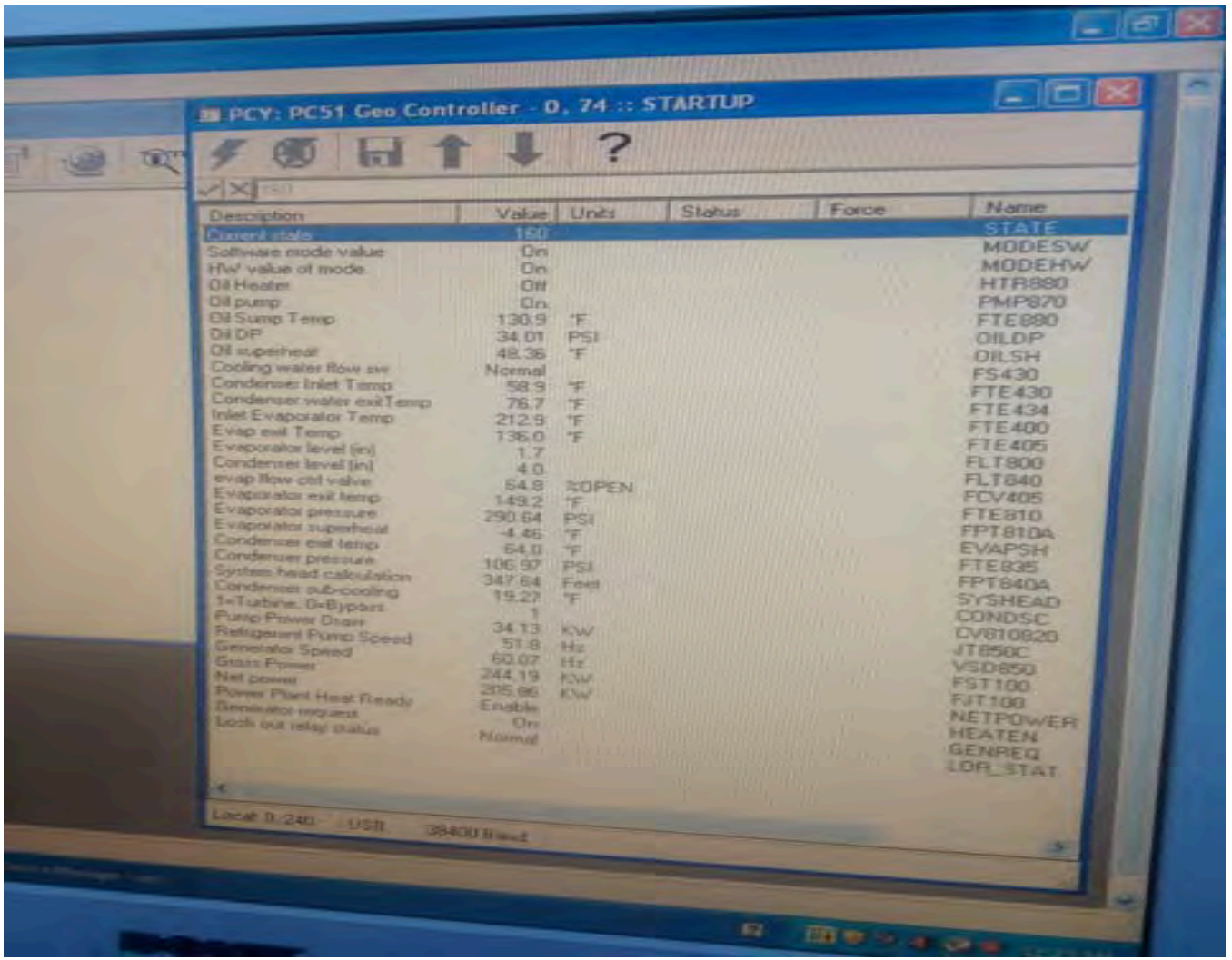
MOBILE ON LOCATION IN UTAH

Christenson Farm and Castle Valley Greenhouse in Newcastle, Utah

MOBILE ON LOCATION IN UTAH

The Mobile ORC is currently in Newcastle, Utah set to power a large scale greenhouse.


BENSHAW
Watts = 238k
VA = 274k
STOP
ALARM
RUN
stop
reset
menu
enter


PCY: PC51 Geo Controller - 0, 74 :: STARTUP
Description
Value
Units
Status
Force
Name
Current state
160
STATE
Software mode value
On
MODESW
Hw value of mode
On
MODEHW
Oil Heater
Off
HTR880
Oil pump
On
PMP870
Oil Sump Temp
130.9
°F
FTE880
Oil DP
34.01
PSI
OILDP
Oil superheat
48.36
°F
OILSH
Cooling water flow sw
Normal
FS430
Condenser Inlet Temp
58.9
°F
FTE430
Condenser water exit Temp
76.7
°F
FTE434
Inlet Evaporator Temp
212.9
°F
FTE400
Evap exit Temp
136.0
°F
FTE405
Evaporator level [in]
1.7
FLT800
Condenser level [in]
4.0
FLT840
evap flow ctrl valve
64.8
%OPEN
FCV405
Evaporator exit temp
149.2
°F
FTE810
Evaporator pressure
290.64
PSI
FPT810A
Evaporator superheat
-4.46
°F
EVAPSH
Condenser exit temp
64.0
°F
FTE835
Condenser pressure
106.97
PSI
FPT840A
System head calculation
347.64
Feet
SYSHEAD
Condenser sub-cooling
19.27
°F
CONDSC
1=Turbine, 0=Bypass
1
DV810820
Pump Power Draw
34.13
KW
JT850C
Refrigerant Pump Speed
51.8
Hz
VSD850
Generator Speed
60.07
Hz
FST100
Gross Power
244.19
KW
FJT100
Net power
205.86
KW
NETPOWER
Power Plant Heat Ready
Enable
HEATEN
Generator request
On
GENREQ
Lock out relay status
Normal
LOR_STAT
Local 0.240 : USB 38400 Baud

CHENA POWER ORC GENERATOR

Front view of heavy duty electronics cabinets.

Generator Assembly

REVOLUTIONARY TURBINES

View of turbine assembly.

BIOMASS FUEL SOURCE: PELLETS

Fuel pellets created on site with recycled paper and cardboard through K&K Recycling program.

THERMAL OIL HEATER

Pellet intake on the Thermal Oil Heater.

- From the pelletizer, the pellets are transported directly to the thermal oil heater.
- Once there, they are moved directly into the heater via another conveyor system where they are burned to heat the thermal oil circulating through the heater to the generator.
- Utilizing separate contained loop systems, this oil is used to vaporize a refrigerant that is used as a working fluid for the generator.

CHENA POWER

ENGINEERING THE FUTURE

Chena Power / Kaishan Compressors

KAISHAN COMPRESSOR CO, LTD, AND ITS PRODUCTS

Yan Tang **PhD, MSc, PEng**
General Manager of Kaishan Compressor
President of Kerry North America Development Center
kaishanus1@gmail.com
2012.11.16

Designed in USA, Made in China

- What most companies are doing
- Kerry North America Development Center + Kaishan Compressor Co., Ltd

Kaishan Compressor Co., Ltd

- Zhejiang Quzhou Site (Headquarter):
  - 3 Hours by Train , 4 Hours by Driving to Shanghai
  - Foundry, Pressure Vessel, Heat Exchanger and Sheet Metal Plants
  - ORC Screw Expander Power Station
  - Small Screw Compressors
  - Reciprocating Compressors
  - Screw and Reciprocating Air Compressor Units
  - Centrifugal Compressors

Kaishan Compressor Co., Ltd

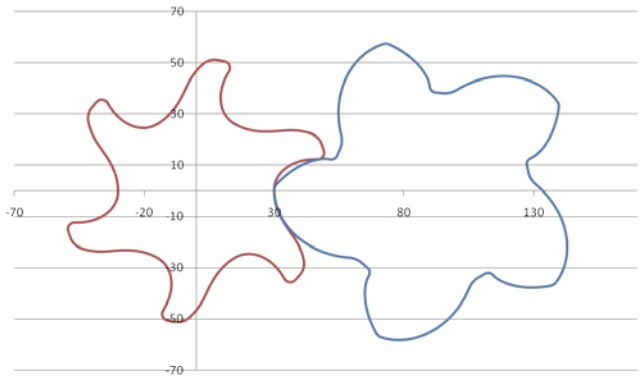
- Basic Numbers:
  - Current Employees: 3000
  - 2009 – 2011 Sales

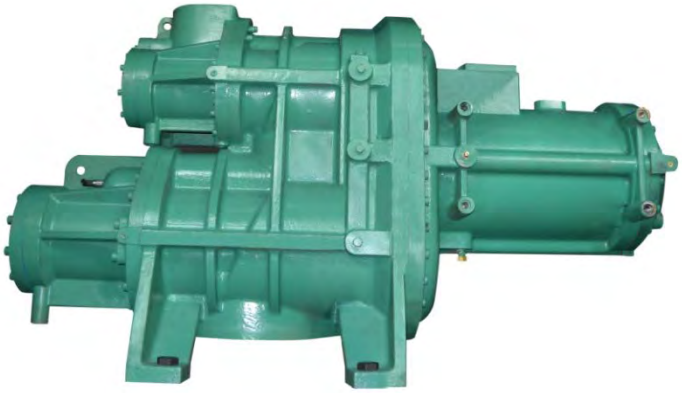
Year	Sales in US Dollars	Screw Compressor Units
2009	115.9M	15,000
2010	242.4M	25,000
2011	396.8M	32,000

  - 150,000 Reciprocating Air Compressors Annually
  - The 3rd Largest Screw Compressor Manufacturer by Volume in the World, the Largest in China
  - Kaishan Compressor is a Public Company, and IPO was completed on August 19th, 2011

Main Products

- **Refrigeration Screw Compressors and Screw Expanders**





New at Chena Hot Springs Resort
300 KW screw expander with a synchronous generator

New at Chena Hot Springs Resort
300 KW screw expander with a synchronous generator

THANK YOU

United Technologies Research Center

United State of America
Department of Energy

ALASKA ENERGY AUTHORITY

Pratt & Whitney Power

Fairbanks North Star Borough

K & K Recycling

CHENA POWER

PROJECT RESULTS: THE FUTURE

POWER, HEAT, FOOD

CHENA POWER