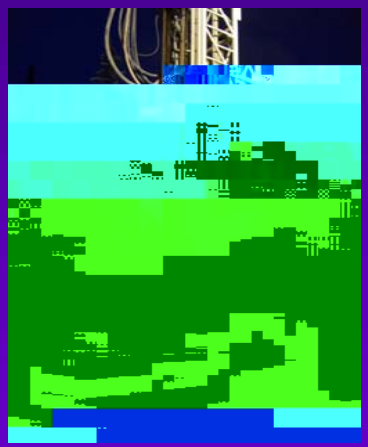
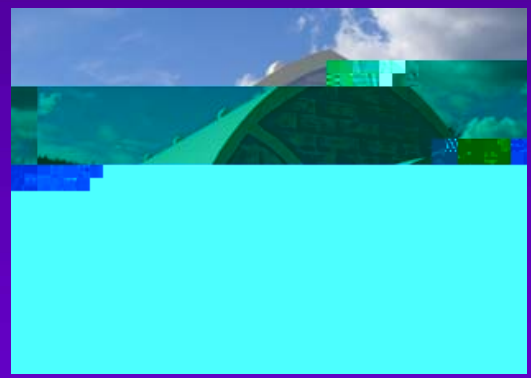
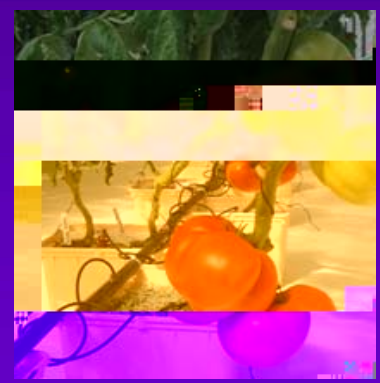
From Hot Water to Hydrogen

Bringing Geothermal Power to Alaska







Presented by: **Bernie Karl**

SMU Geothermal Conference June 12th, 2007

Chena Hot Springs

Chena Hot Springs

Chena Hot Springs VISION:

To become a self-sustaining community in terms of energy, food, heating and fuel to the greatest possible extent

Chena Hot Springs MISSION:

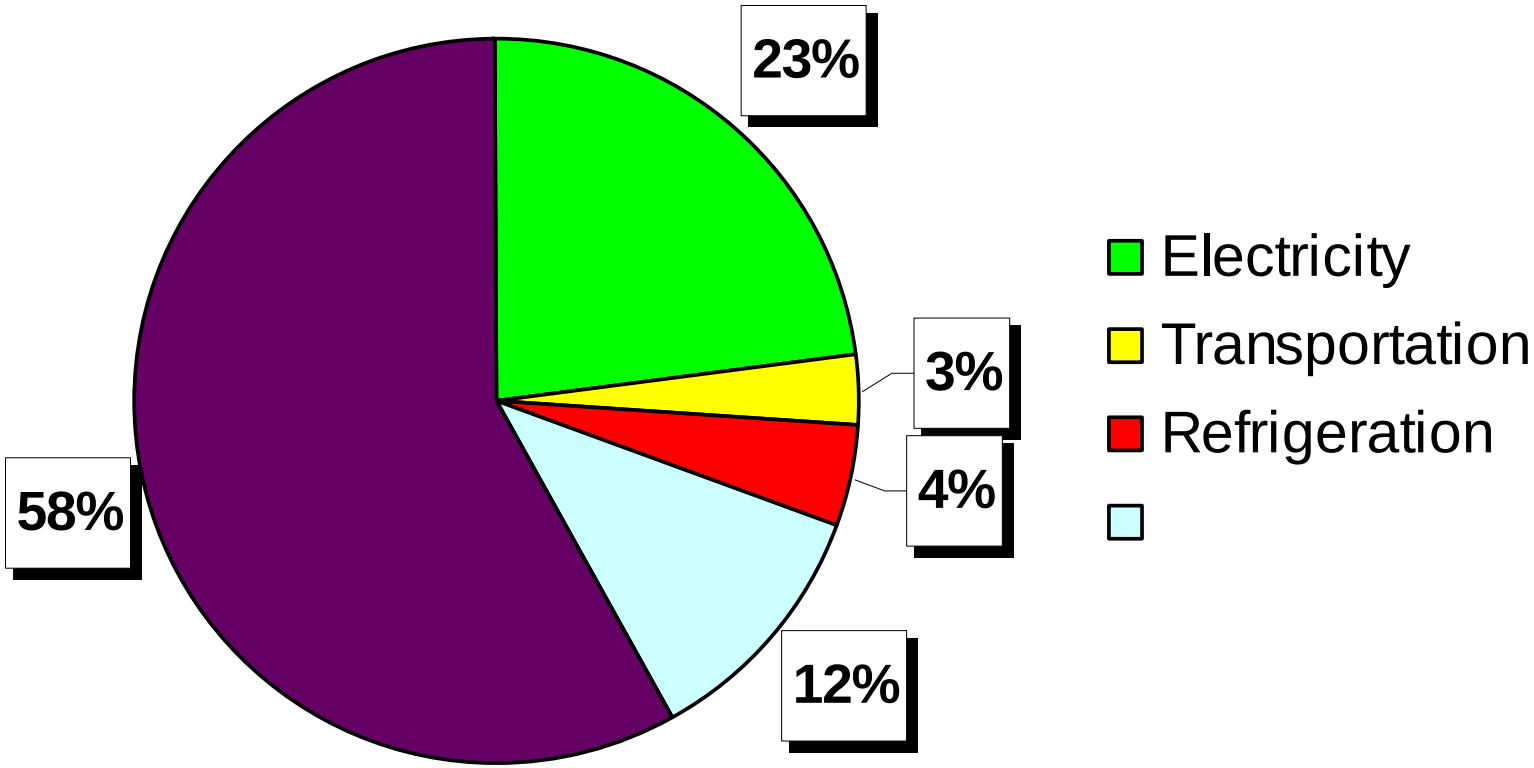
To encourage renewable energy and sustainable community development throughout Alaska

To make Alaska a leader in renewable energy development

Forming Partnerships with:

- *University of Alaska (Horticulture, Geophysical Institute, Mining, Geology)*
- *Southern Methodist University*
- *Department of Energy*
- *Alaska Energy Authority*
- *Denali Commission*
- *United Technologies Corporation*
- *Golden Valley Electric Association*
- *REAP (Renewable Energy Alaska Project)*

Energy Use at Chena Hot Springs (total 850 kW_{eq})



District Heating

District Heating

- First geothermal well drilled in March 1998
- All buildings on property are heated geothermally using ~300gpm of 165°F water
- Estimated yearly savings of $183,000 in heating fuel coats

Moose Lodge, 20,000ft² heated solely with geothermal district heating system

Greenhouse & Gardens

- First greenhouse established in 2004 as a joint project between Chena Hot Springs and UAF
- Producing crops for onsite use on a year-round basis

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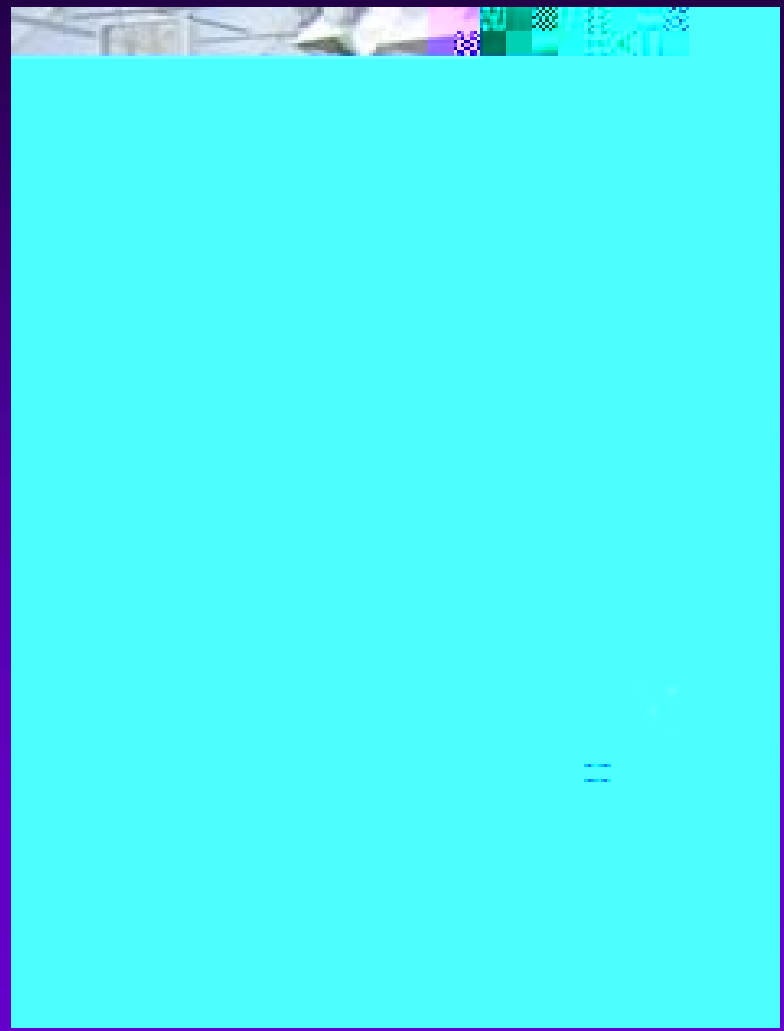
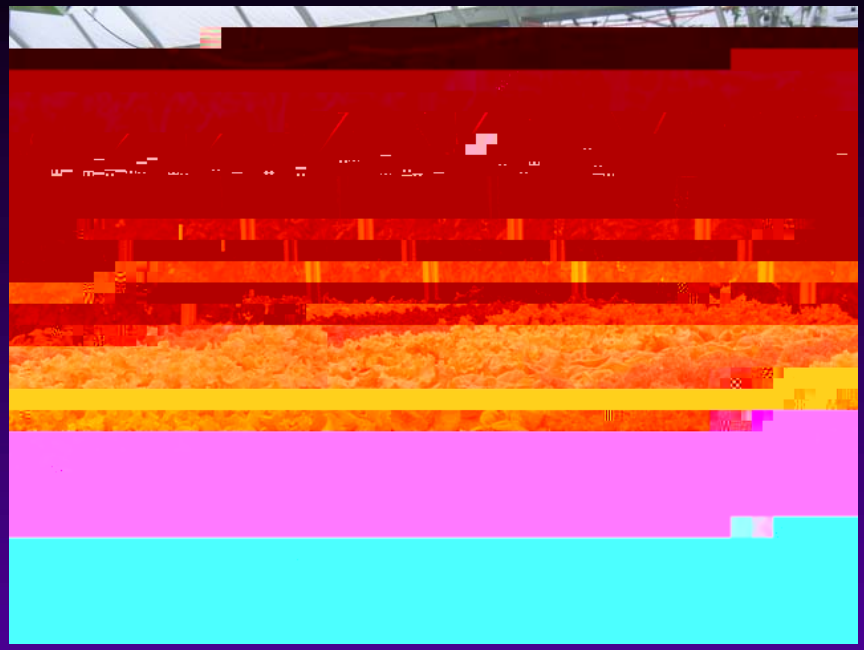
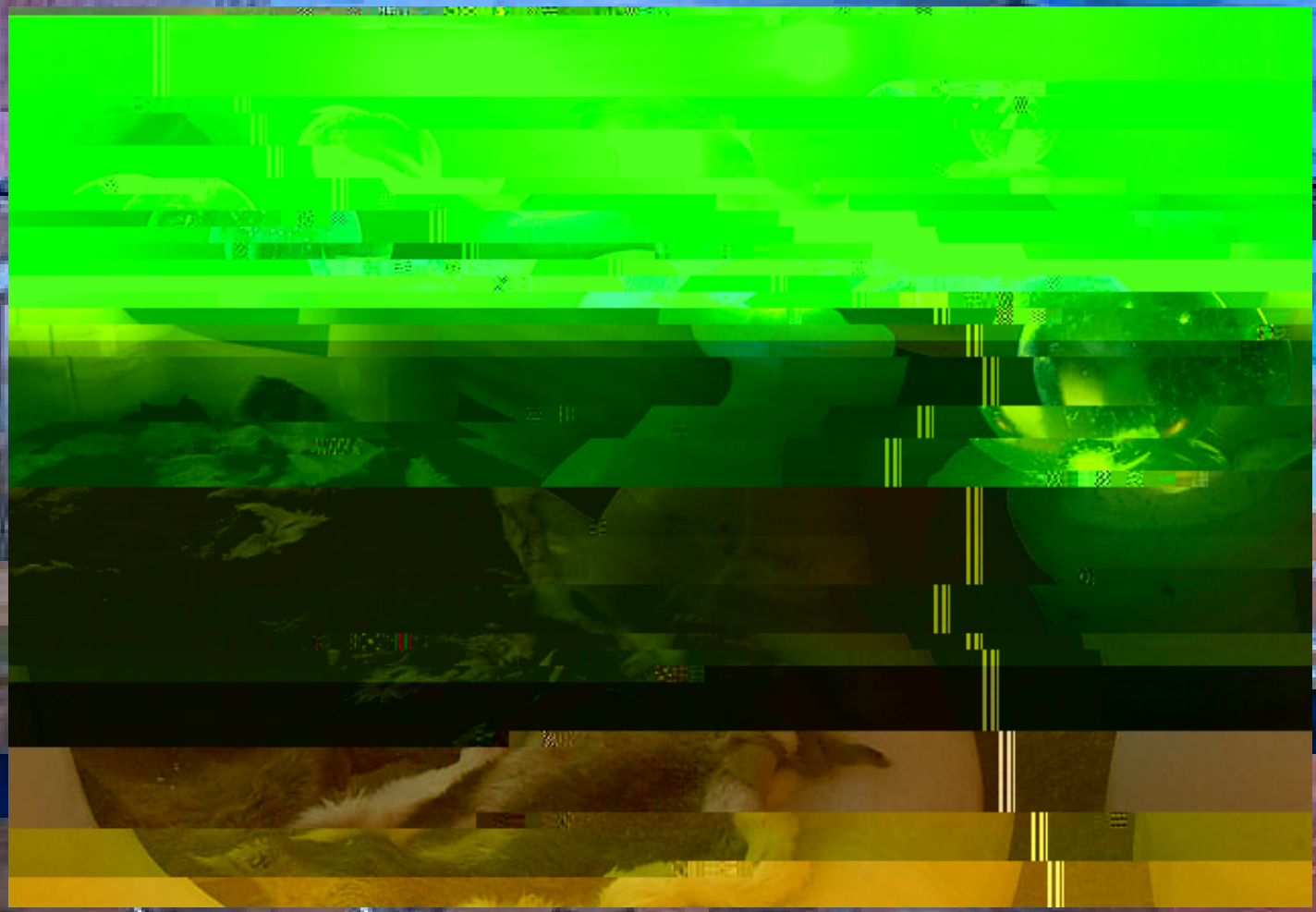
- First greenhouse established in 2004 as a joint project between Chena Hot Springs and UAF
- Producing crops for onsite use on a year-round basis
- New 5000ft greenhouse recently completed for 2006 season
- Heated from geothermal wells but could operate off any waste heat source

Greenhouse & Gardens

Geothermally Heated Greenhouse #2 at Chena Hot Springs Resort

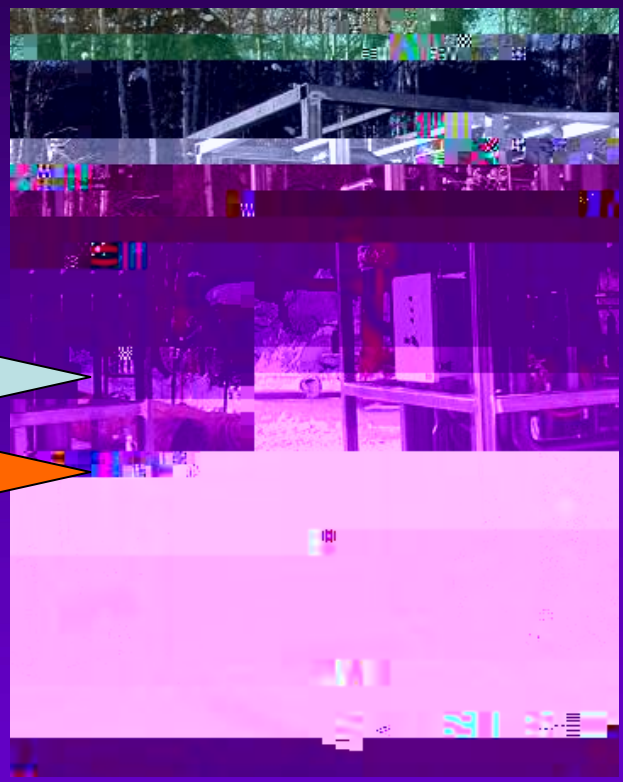






CHENA HOT SPRINGS ABSORPTION CHILLER

Monument Creek Provides Cooling Water (~40F)

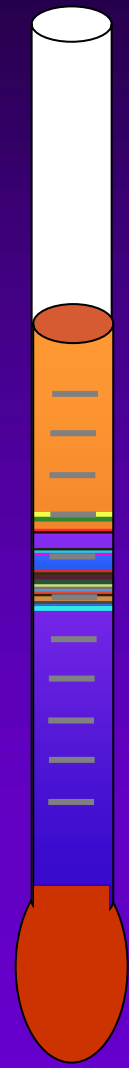


Geothermal Wells Provide Hot Water (~165F)

Approximately 15 tons of Refrigeration Required for Ice Museum (180,000 BTU per hour)

Conventional Wisdom for Absorption Chilling & Power Generation Cycles:

$T \geq 230^{o}F$



Conventional Wisdom for Absorption Chilling & Power Generation Cycles:

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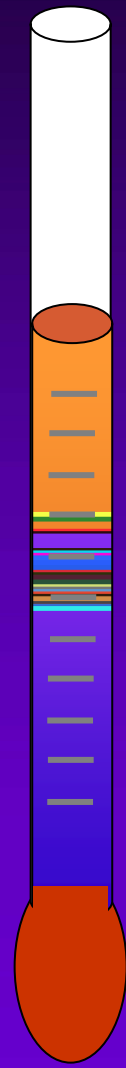

Conventional Wisdom for Absorption Chilling & Power Generation Cycles:

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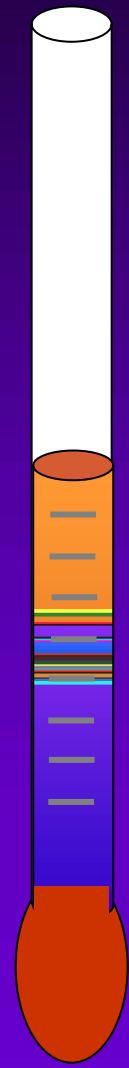


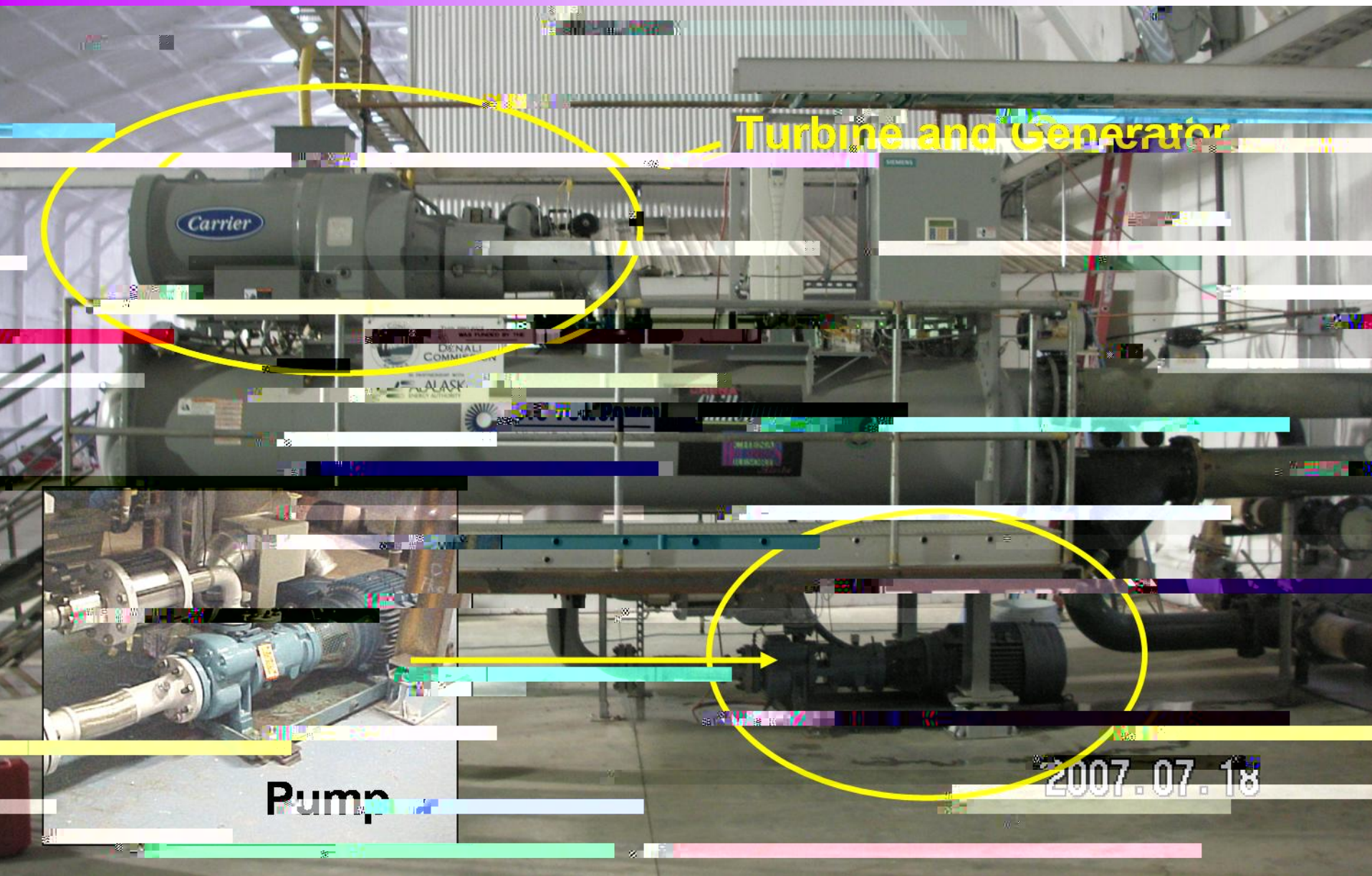
Chena Geothermal Power Plant

Pratt & Whitney
Aircraft Engines,
Gas Turbines &

Carrier

Heating, Cooling & Refrigeration

Chena Power Plant

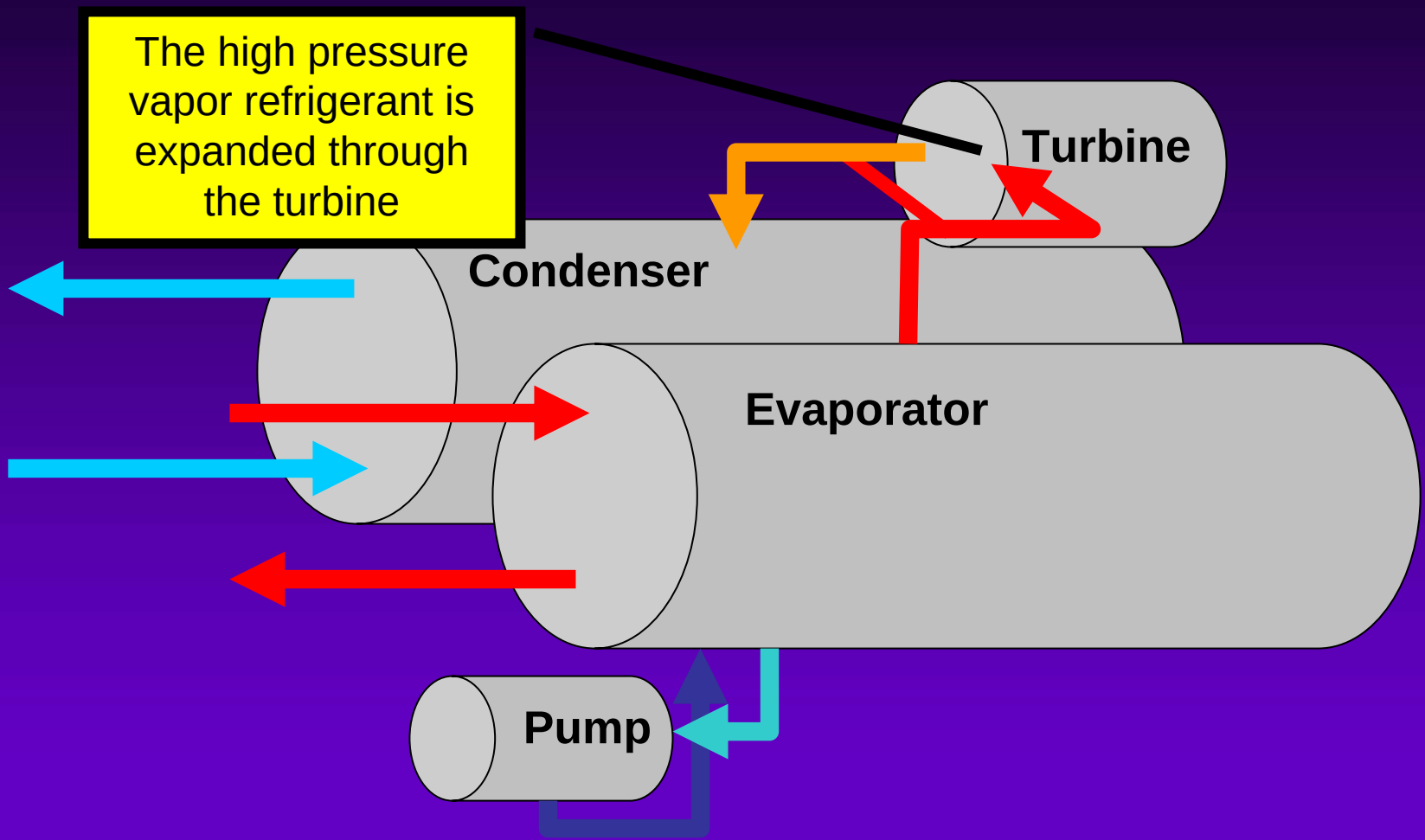


Chena Power Plant

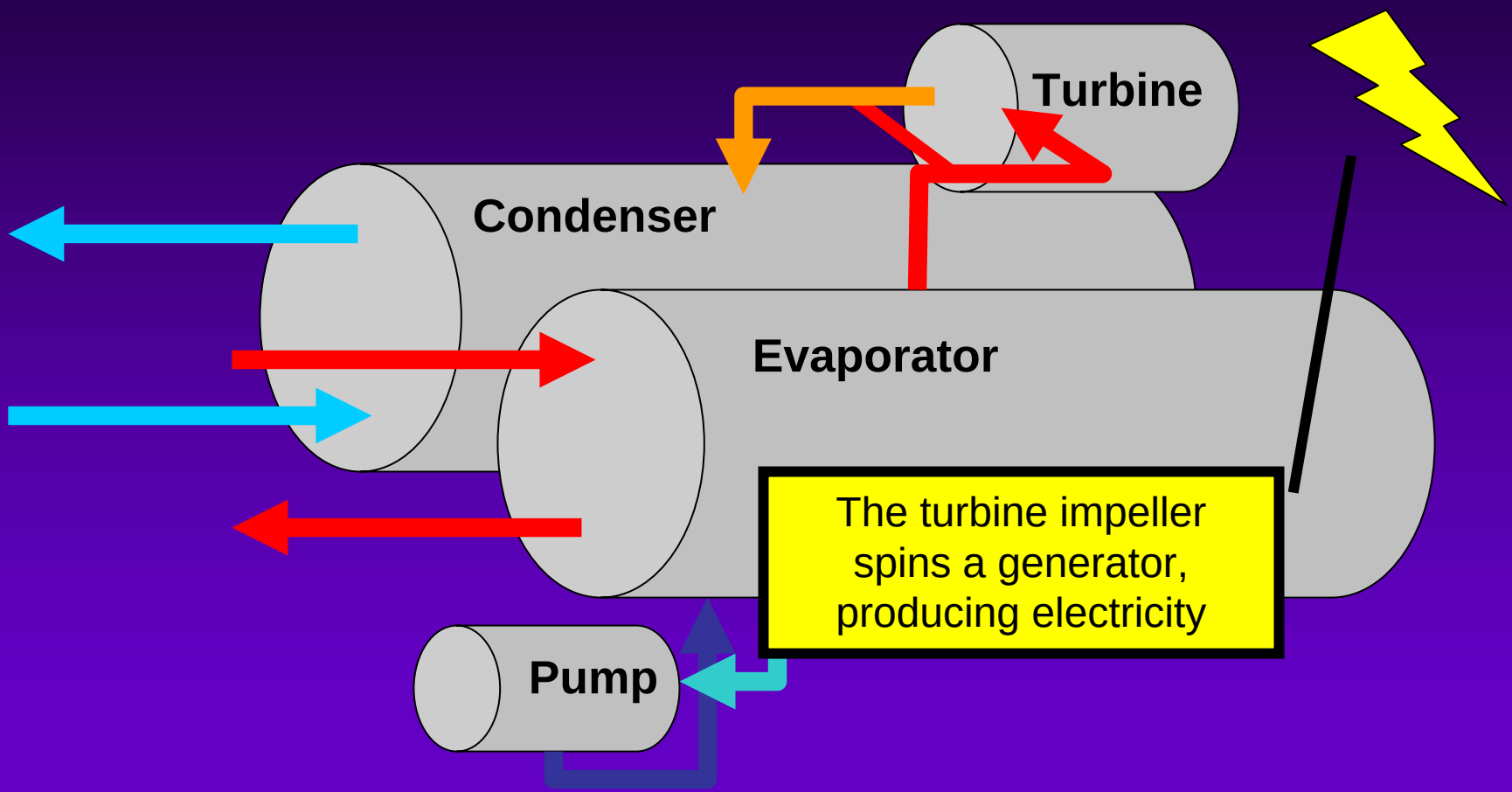
Carrier Chiller

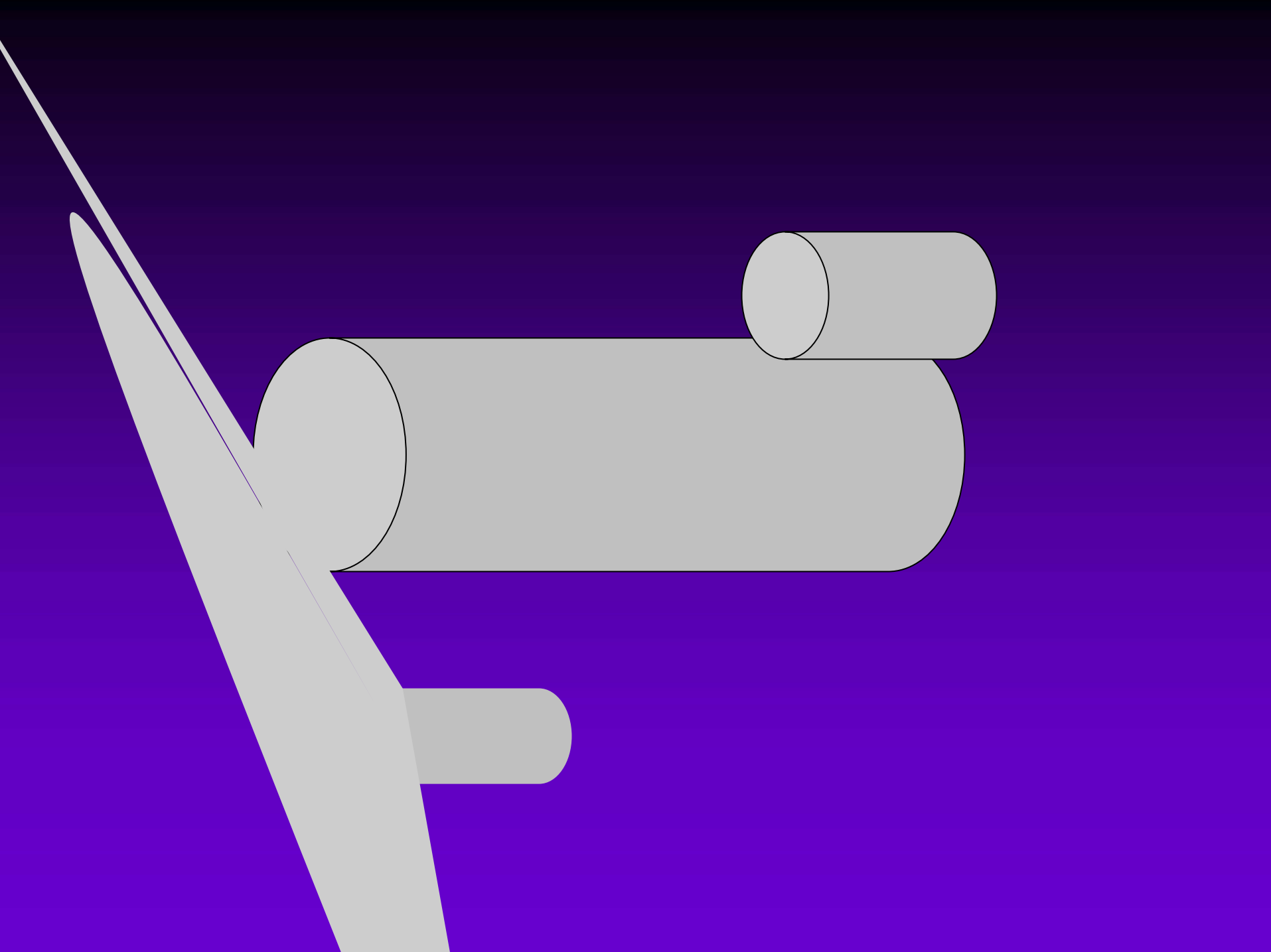
Chena Power Plant

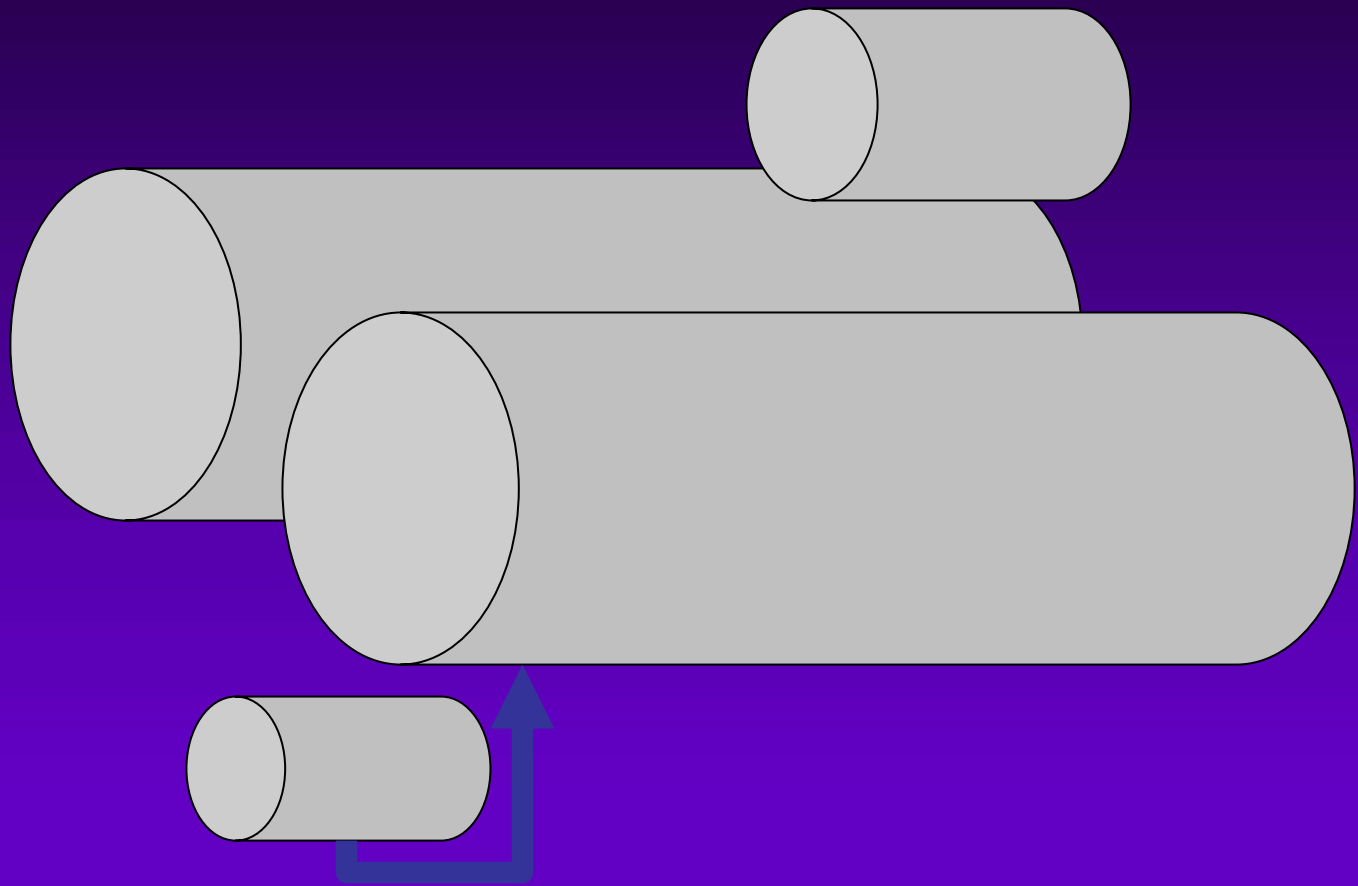
Chena Power Plant



Chena Power Plant







Chena Power Plant

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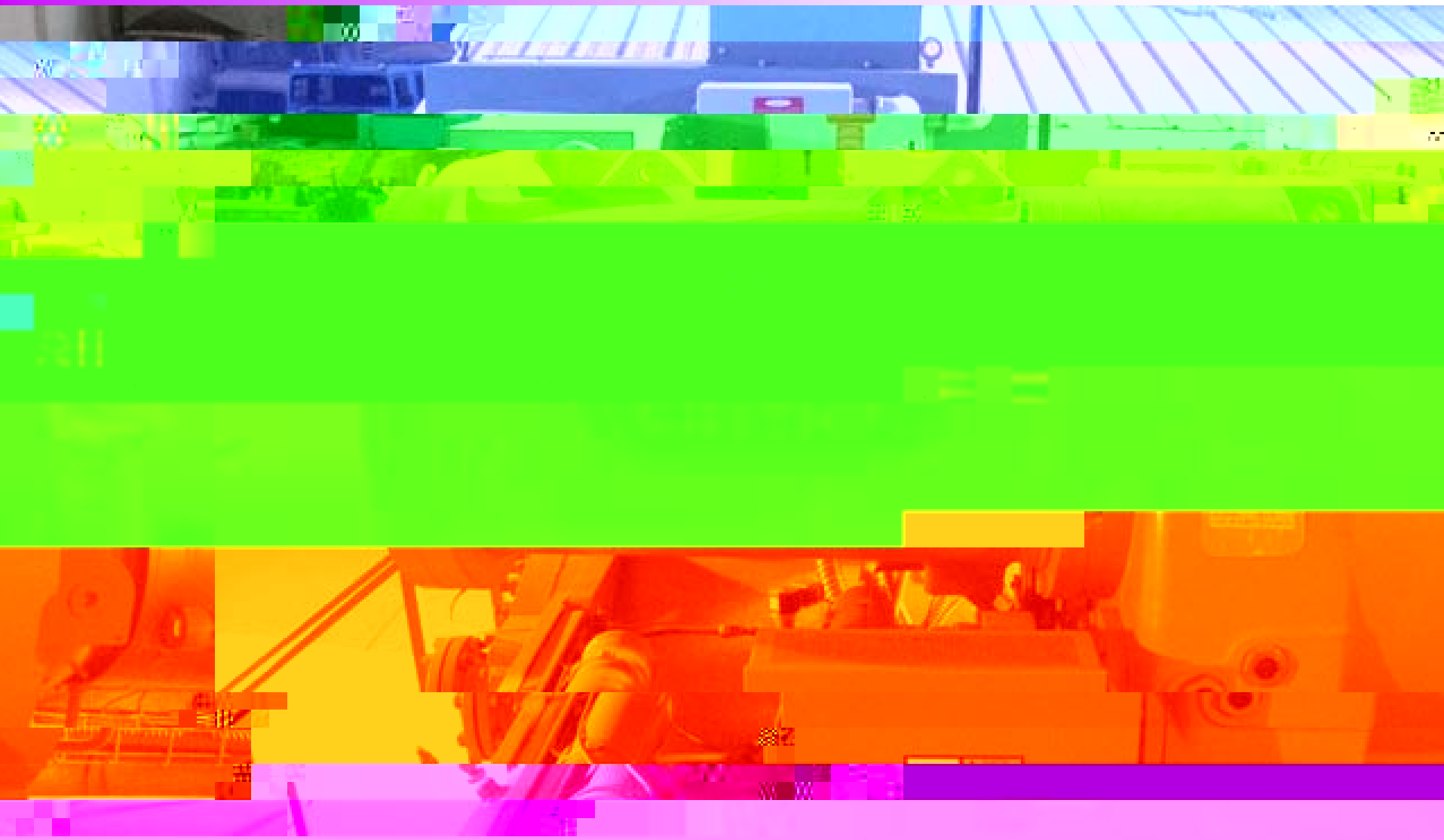
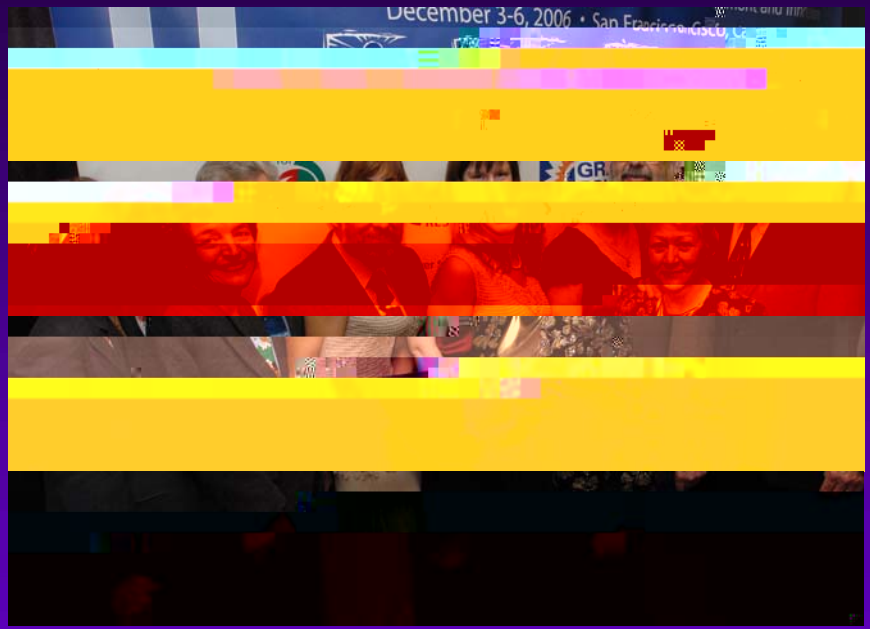


Cold Water Supply

Cold Water Supply

August 20th Official Opening – Chena Geothermal Power Plant

Project Awards and Recognition



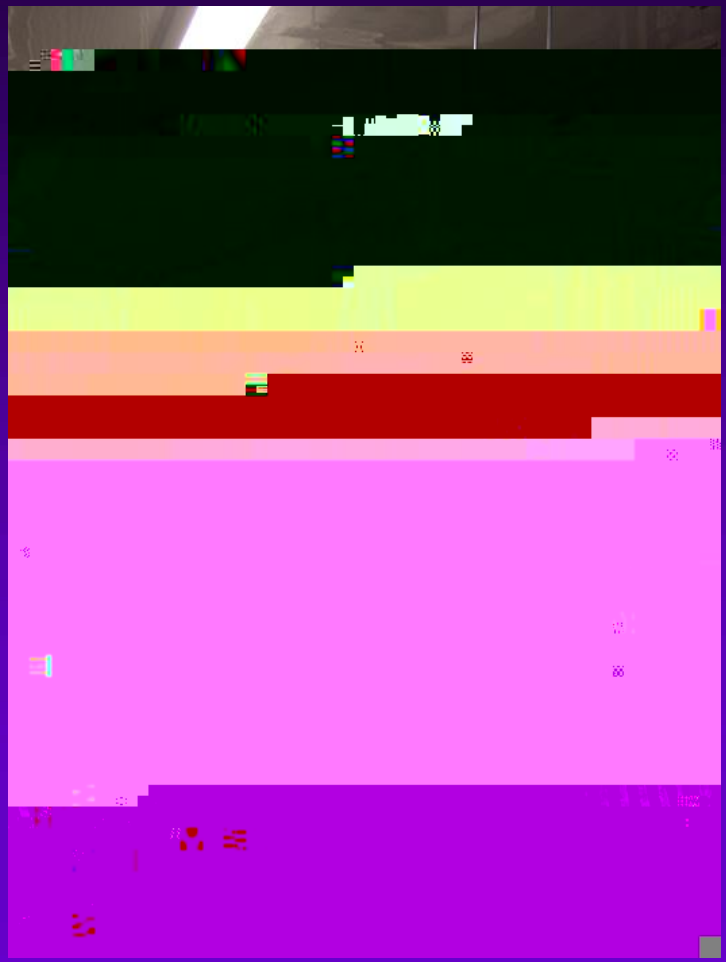
2006 Green Power Leadership Award (EPA and DOE)

Project of the Year
Renewable Energy Category
Power Engineering Magazine
PowerGen Conference 2006

Geothermal Energy is an ideal base load – doesn't depend on sun, wind, rainfall. 99% Availability is common.

Cannot respond quickly to load fluctuations

Battery and UPS System

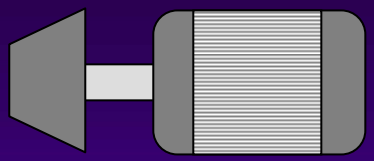


UPS System (MGE)

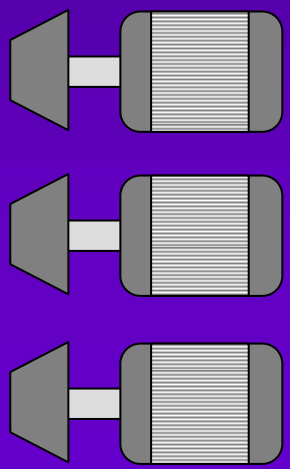
Batteries 3MW Total

Battery and UPS System

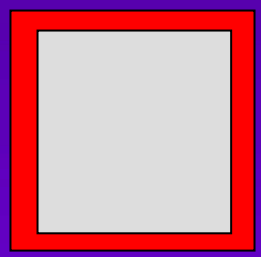
ORIGINAL CONFIGURATION



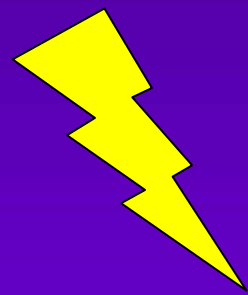
400kW Diesel Genset



200kW Cat 3306Diesel Gensets



Inverter/Batteries 480VDC/480AC

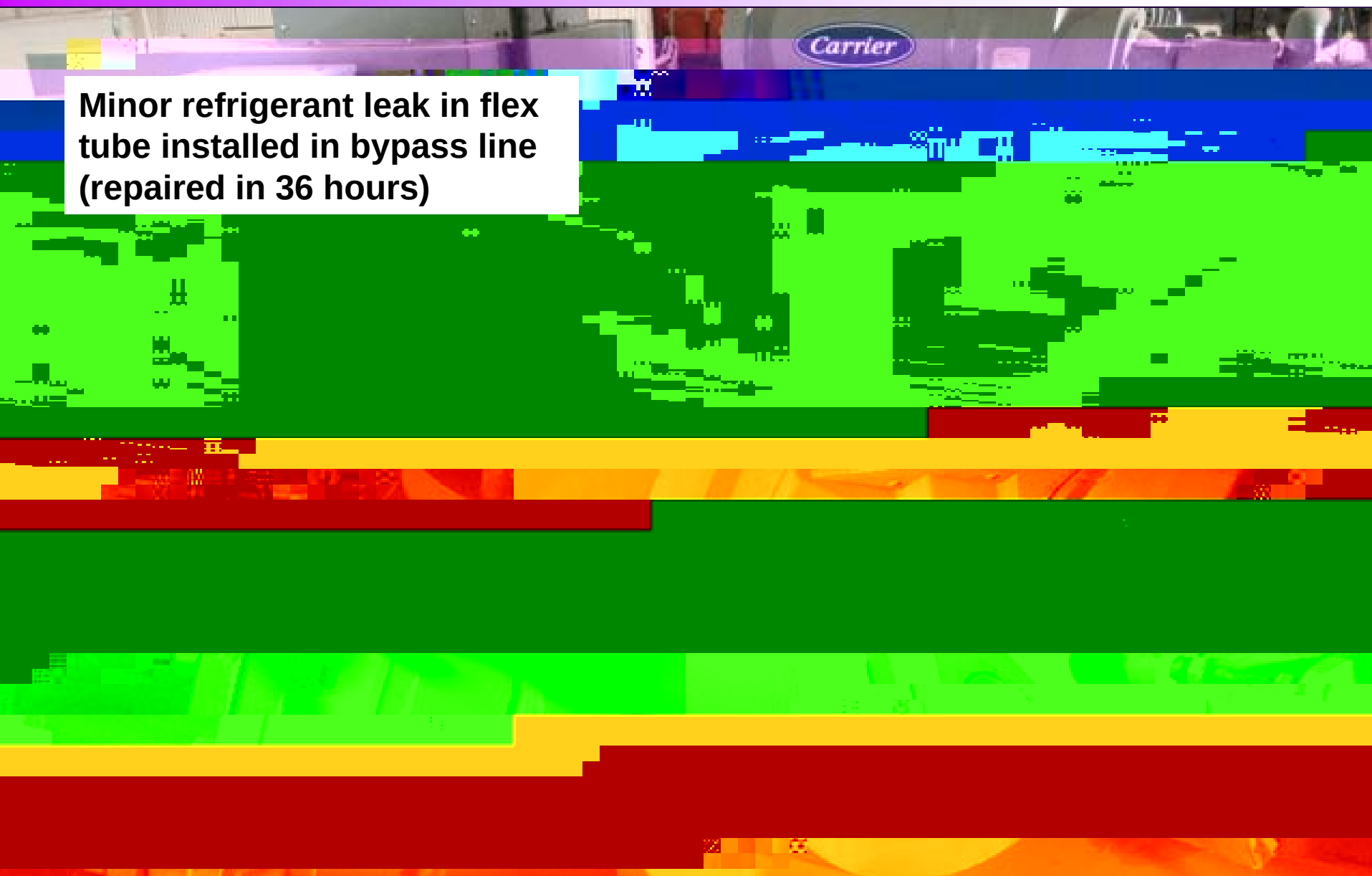


480VAC Output

Project Economics

- Offset $160,000 of diesel fuel in 4 months of operation in 2006
- Has created 3 new skilled positions
- Has increased electric use onsite by 40% in the last Quarter of 2006
- Has operated with 95% availability

Project Challenges



Minor refrigerant leak in flex tube installed in bypass line (repaired in 36 hours)

Project Challenges

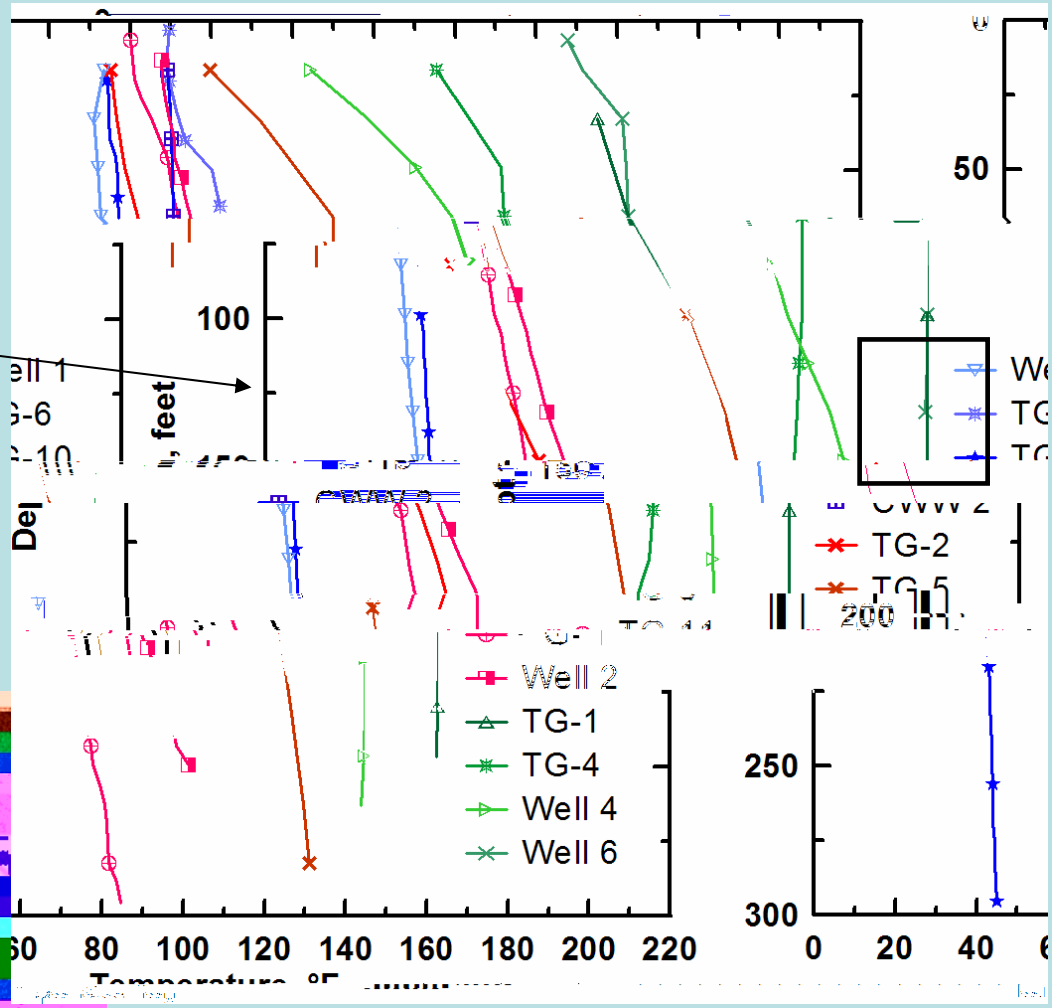
Some freezeup and low water table problems during winter months with water cooled system

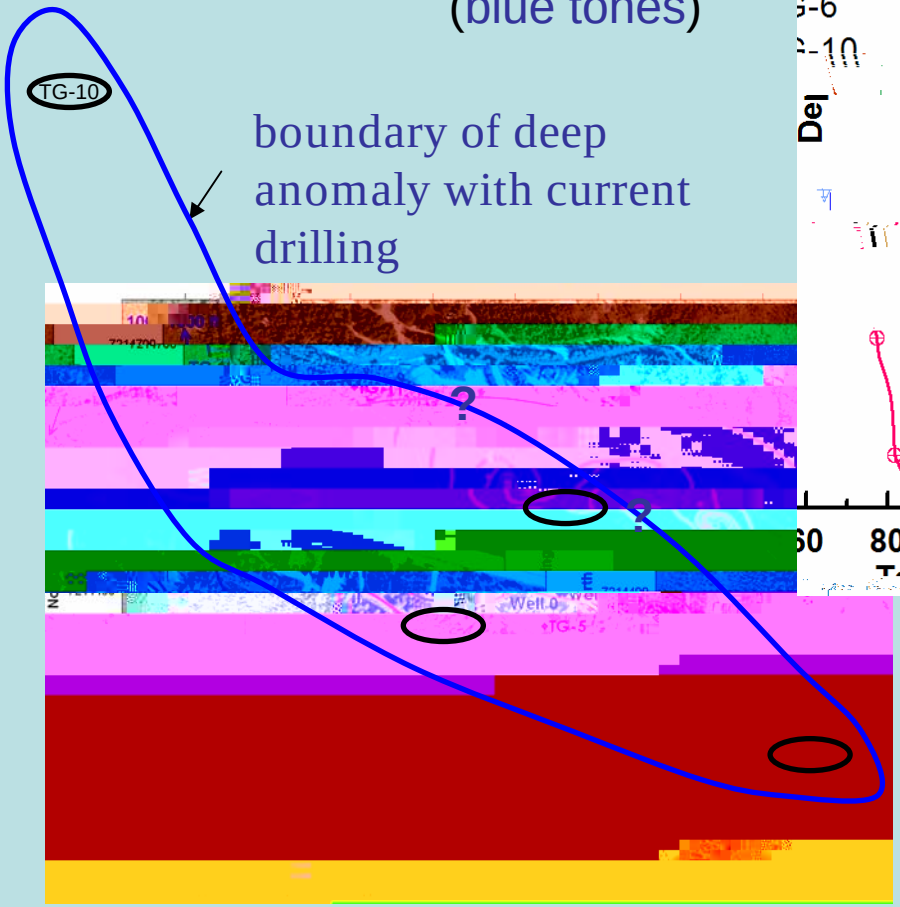
Project Challenges

Installation of air cooled condenser eliminated freeze up problems

Shallow Data

"Remote" wells (blue tones)

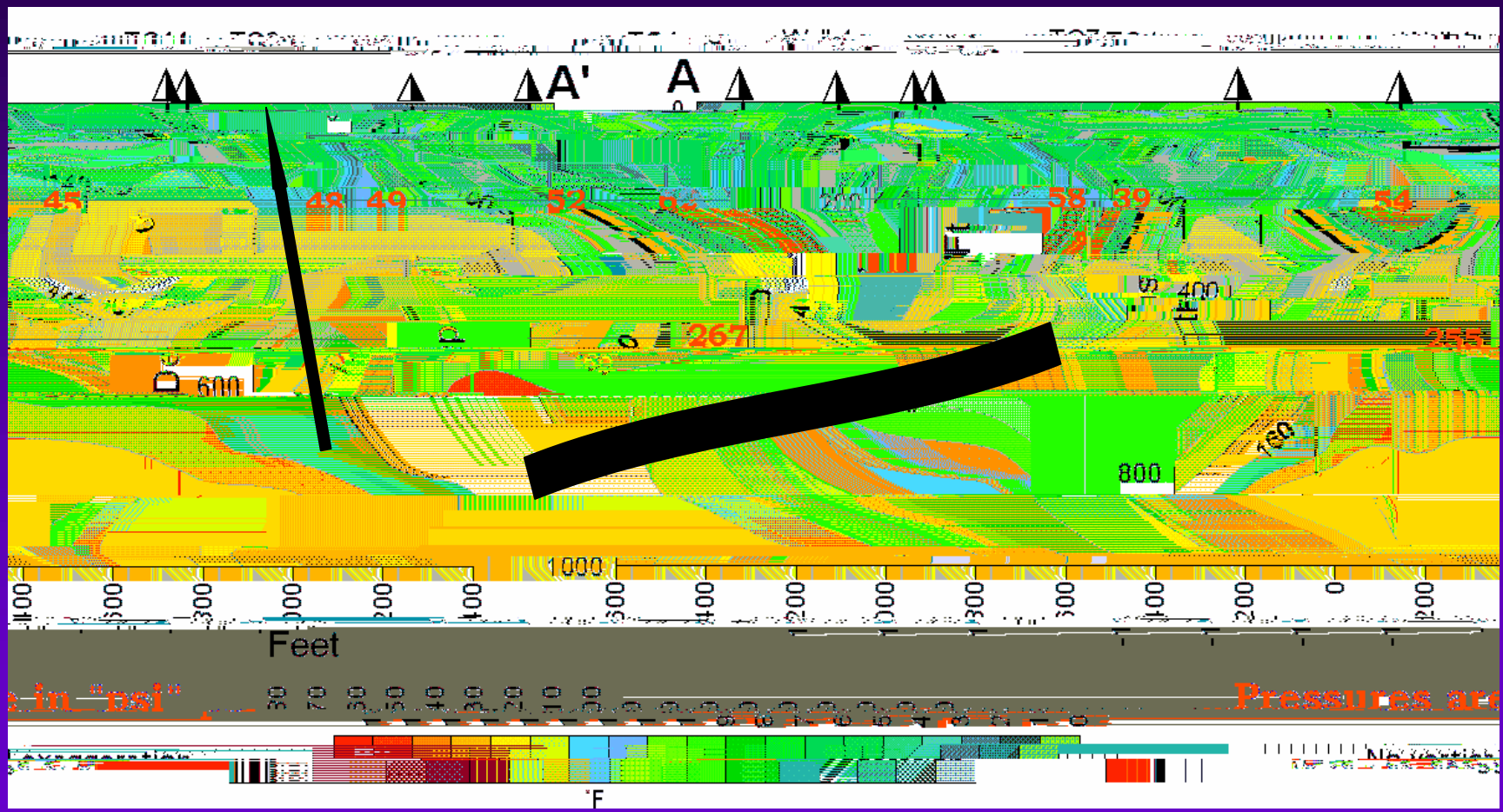




boundary of deep anomaly with current drilling

Lowest temperature gradients are 2-3 times the regional background.

Project Challenges



Chena Geothermal Power Plant

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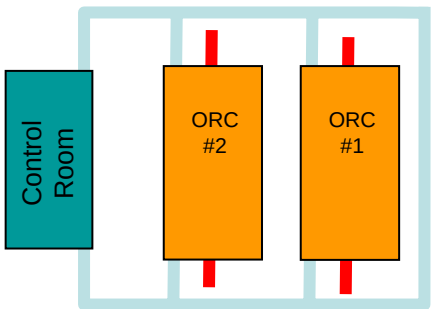
Chena Power Plant - Current



Ov

150ft

Chena Power Plant - Future


“There’s a better way to do it… find it”