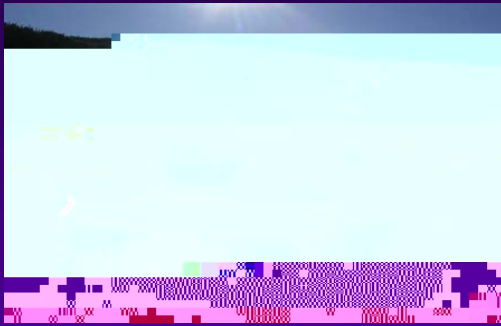
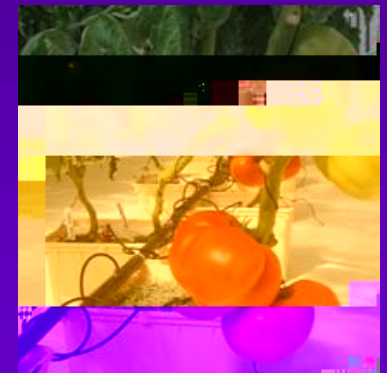
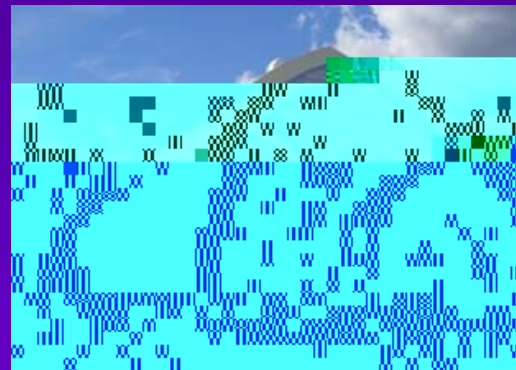
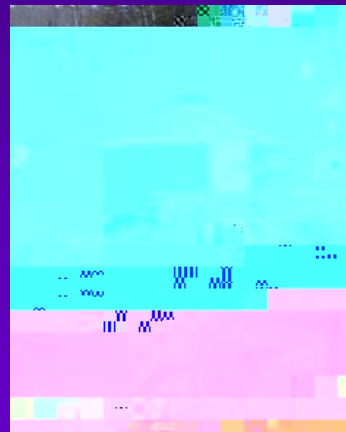
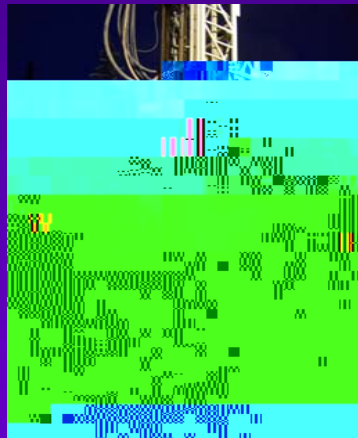


From Hot Water to Hydrogen

Bringing Geothermal Power to Alaska



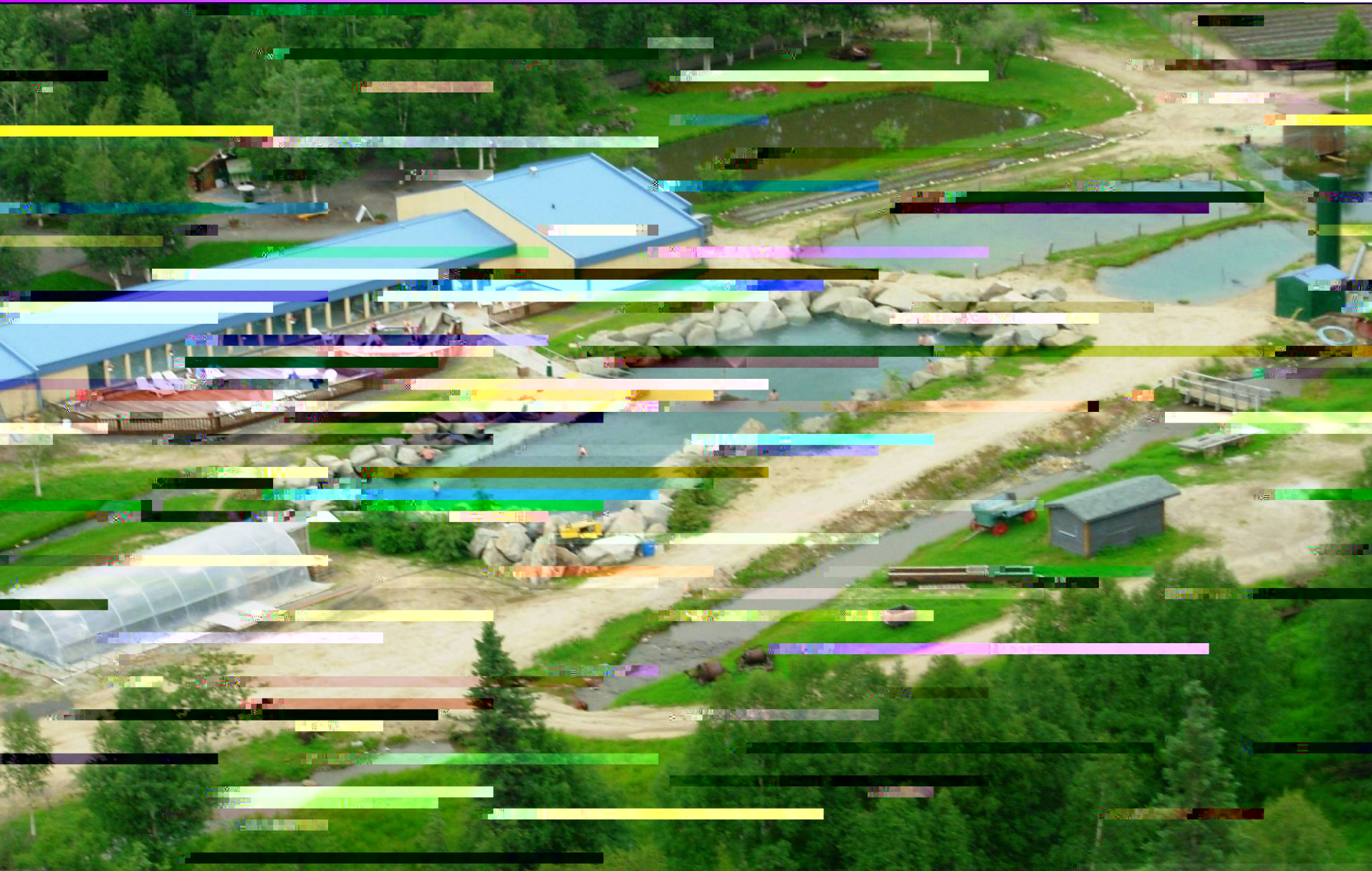
Alaska



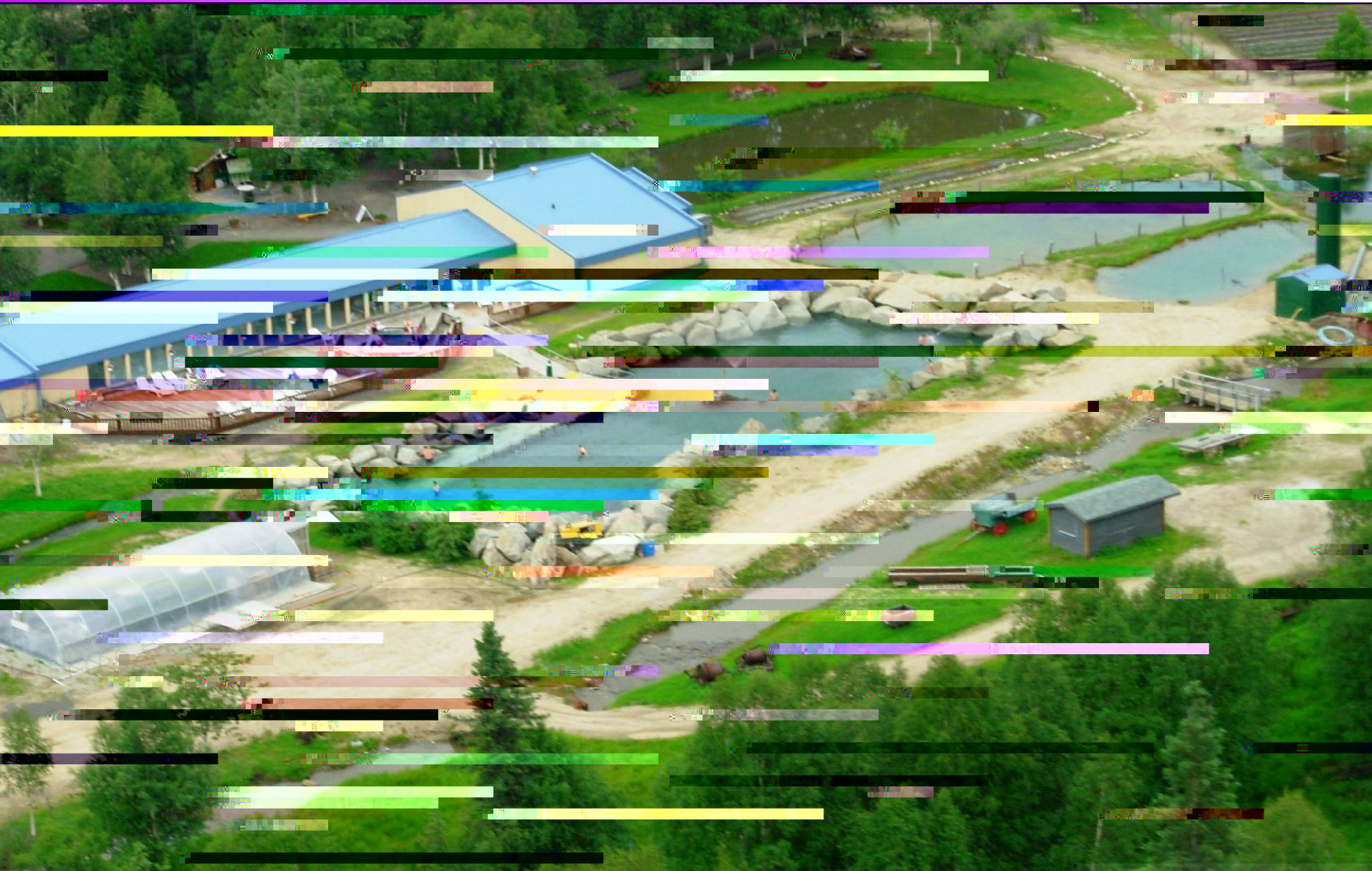
Presented by: Bernie Karl

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***

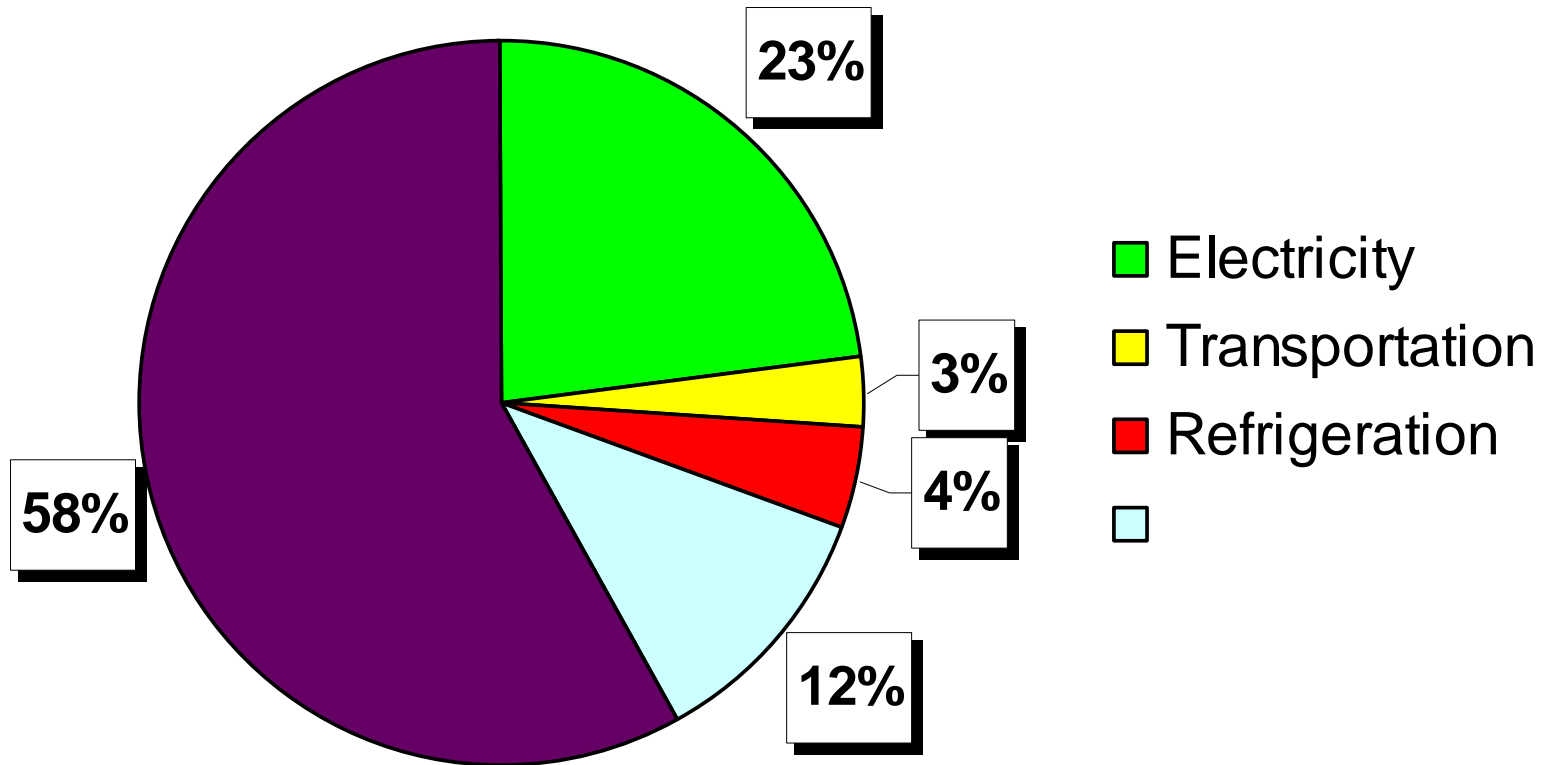


Forming Partnerships with:

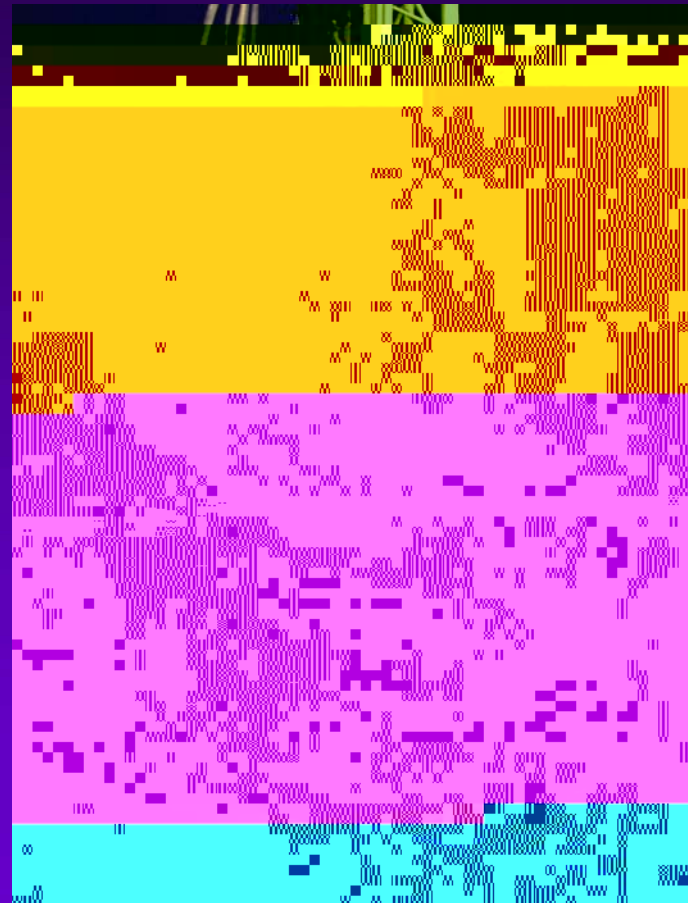
- *University of Alaska (Horticulture, Geophysical Institute, Mining, Geology)*
- *Southern Methodist University*
- *Department of Energy*
- *Alaska Energy Authority*
- *Denali Commission*
- *United Technologies Corporation*
- *Golden Valley Electric Association*
- *REAP (Renewable Energy Alaska Project)*



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



District Heating



District Heating



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



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

Greenhouse & Gardens



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



Greenhouse & Gardens



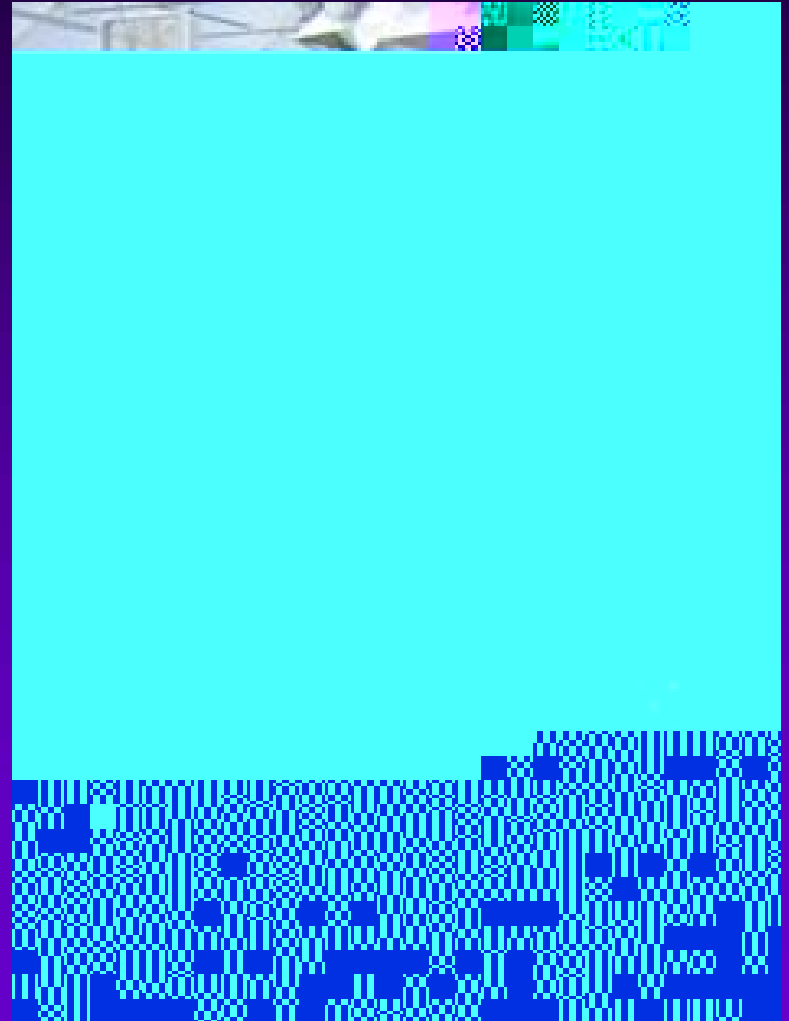
- Ø First greenhouse established in 2004 as a joint project between Chena Hot Springs and UAF
- Ø Producing crops for onsite use on a year-round basis
- Ø New 5000ft greenhouse recently completed for 2006 season
- Ø Heated from geothermal wells but could operate off any waste heat source

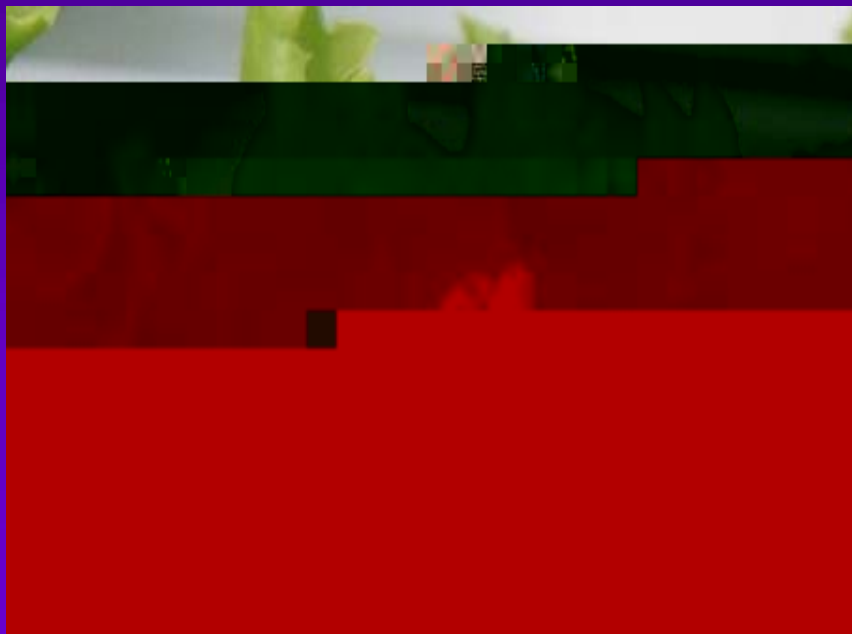
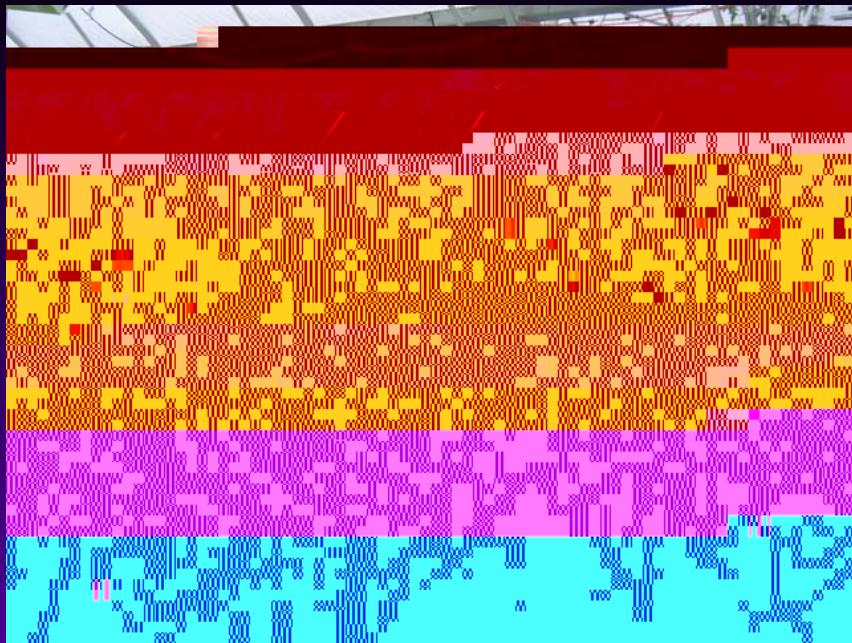


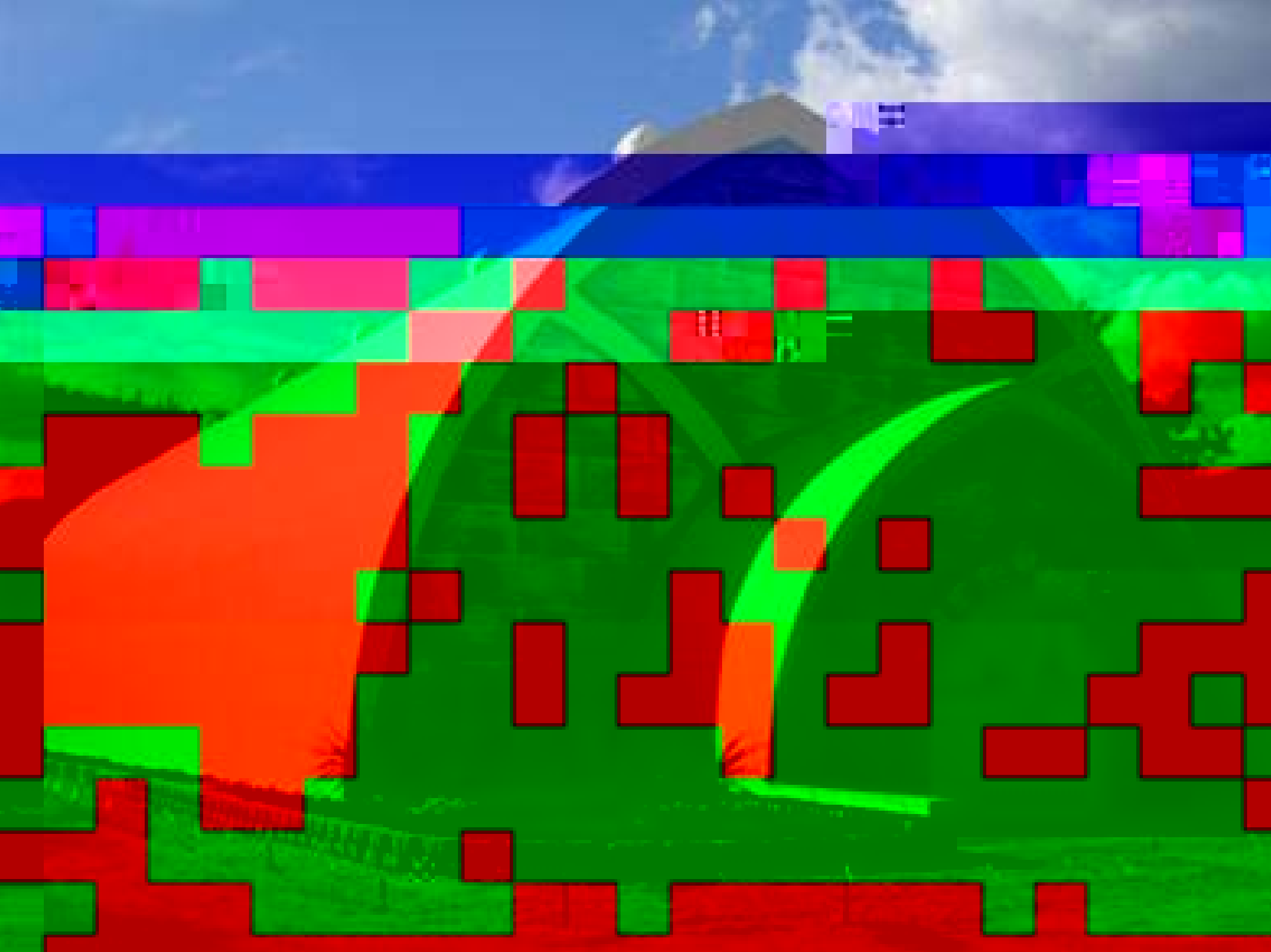
Greenhouse & Gardens



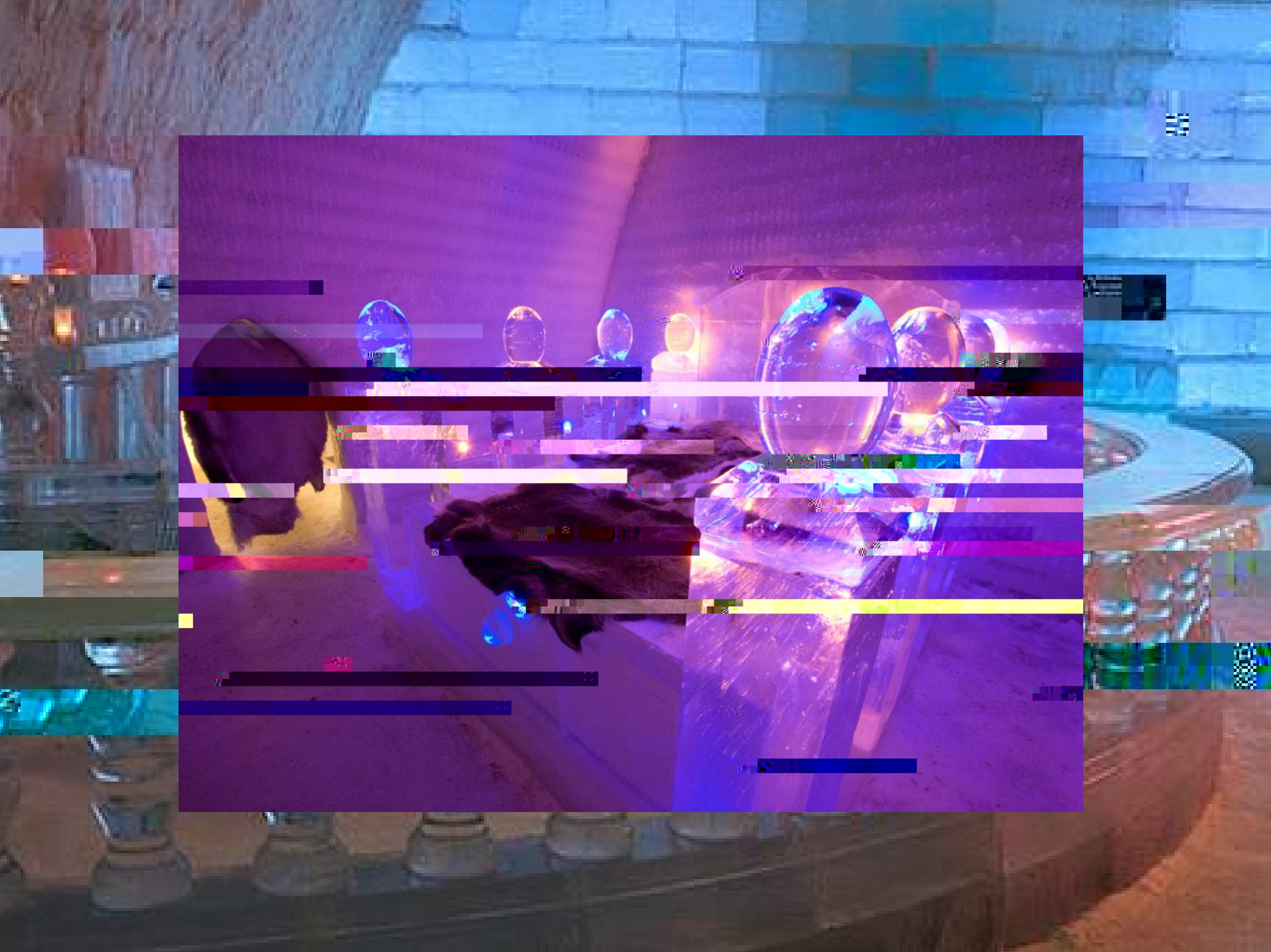
Geothermally Heated Greenhouse
#2 at Chena Hot Springs Resort





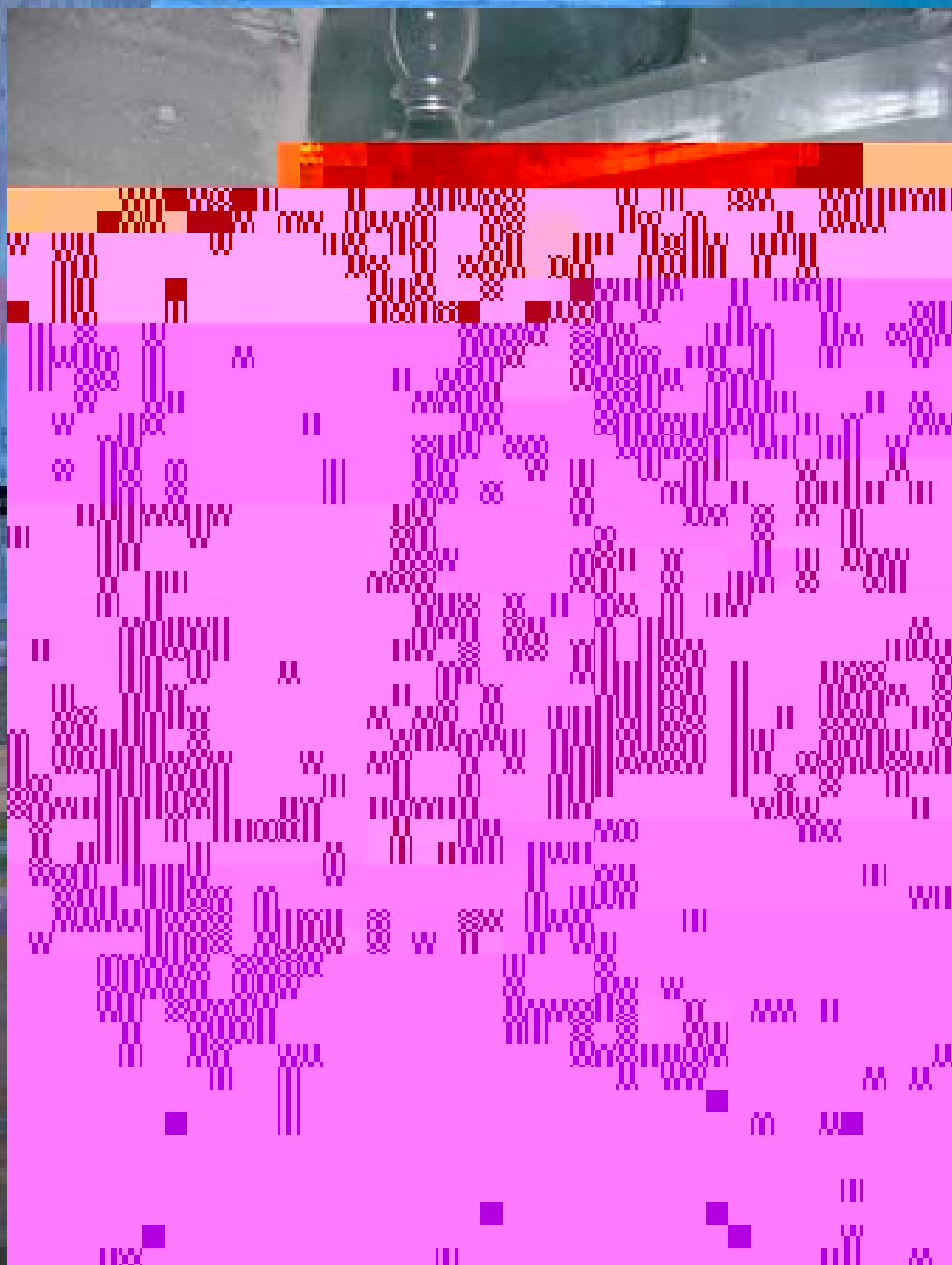










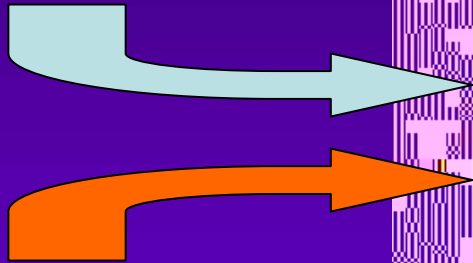




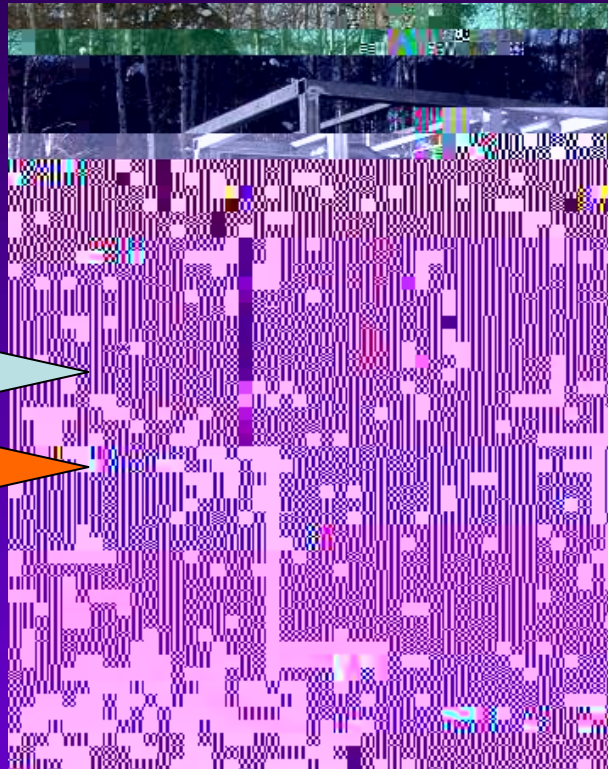
CHENA HOT SPRINGS ABSORPTION CHILLER



Monument Creek Provides Cooling Water (~40F)



Geothermal Wells Provide Hot Water (~165F)



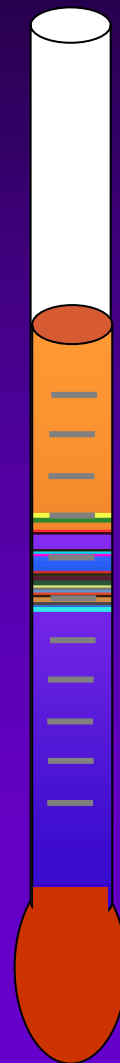
Approximately 15 tons of Refrigeration Required for Ice Museum (180,000 BTU per hour)





Conventional Wisdom for Absorption Chilling & Power Generation Cycles:

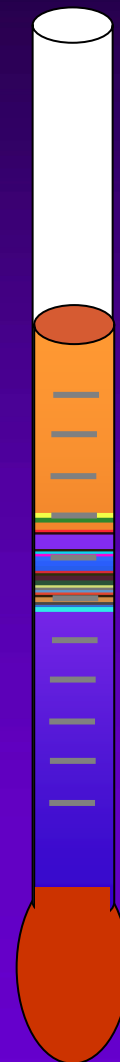
$$T \geq 230^{\circ}\text{F}$$





Conventional Wisdom for Absorption Chilling & Power Generation Cycles:

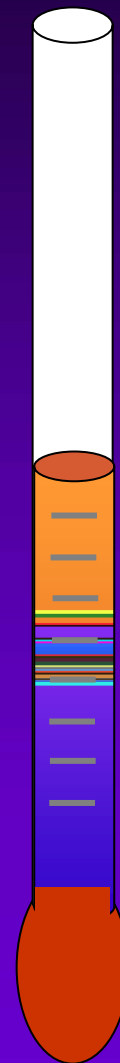
~~$T \geq 230^{\circ}\text{F}$~~





Conventional Wisdom for Absorption Chilling & Power Generation Cycles:

$$T \geq 165^{\circ}\text{F}$$



Chena Geothermal Power Plant



Pratt & Whitney
Aircraft Engines,
Gas Turbines &

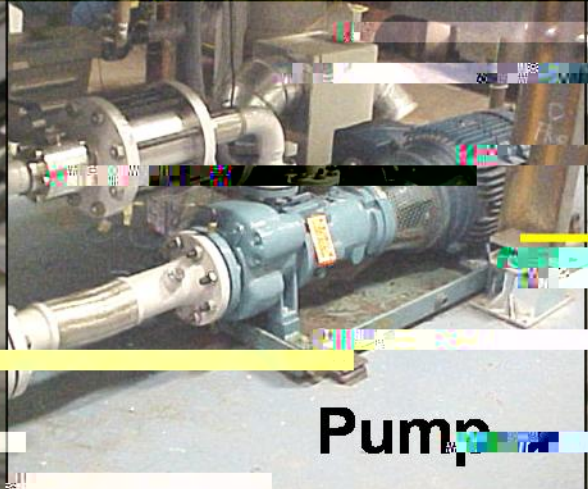
Carrier
Heating, Cooling
& Refrigeration



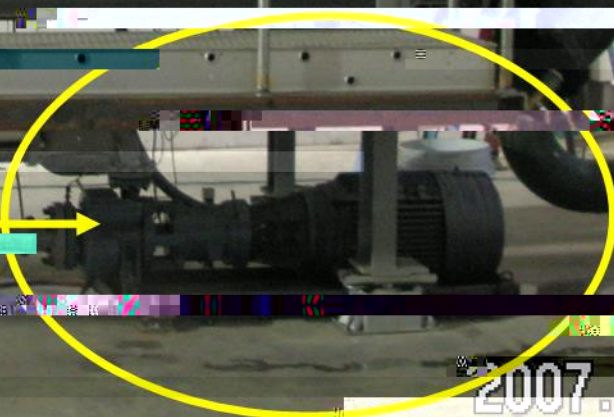
Chena Power Plant



Turbine and Generator

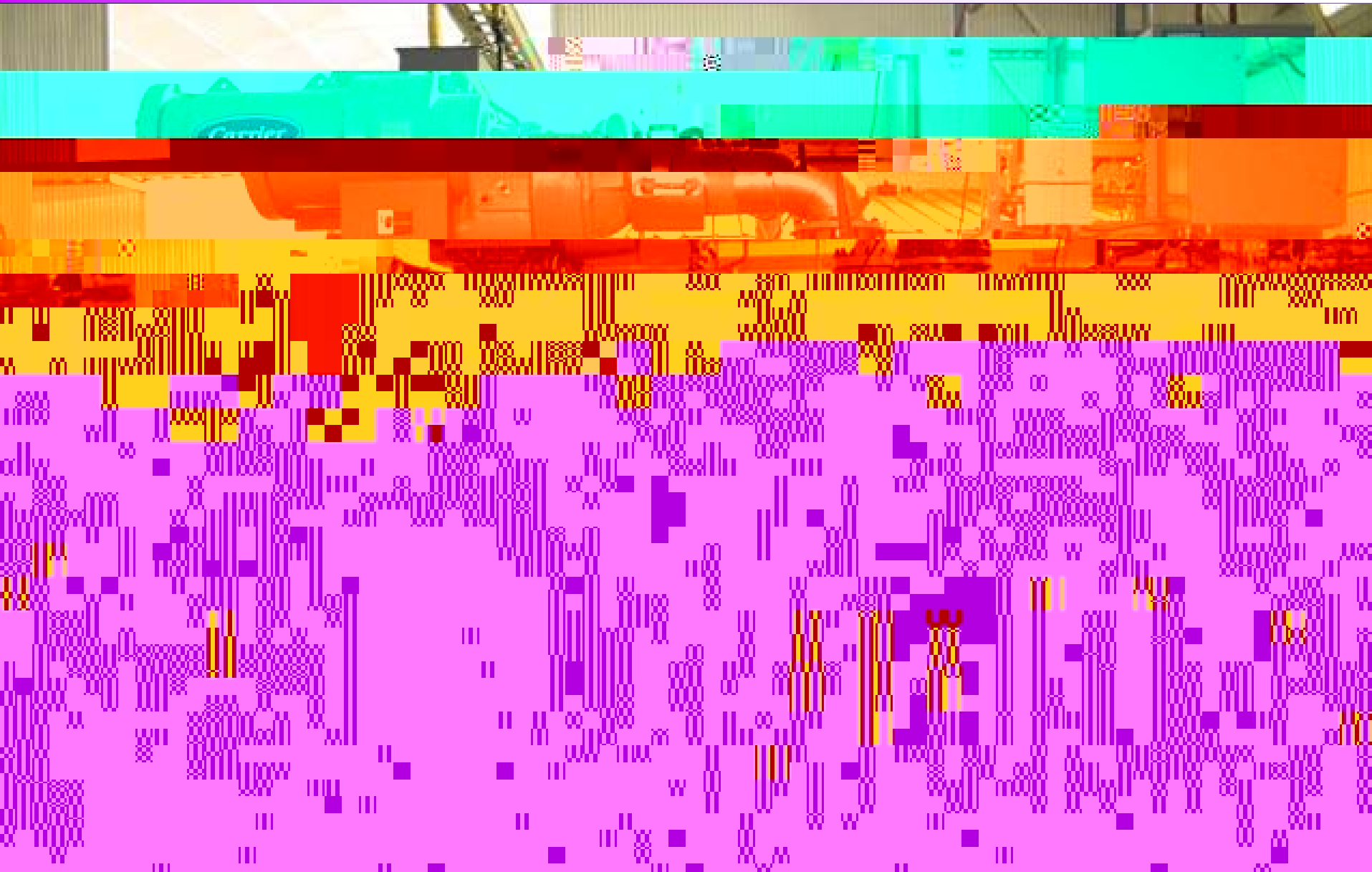


Pump

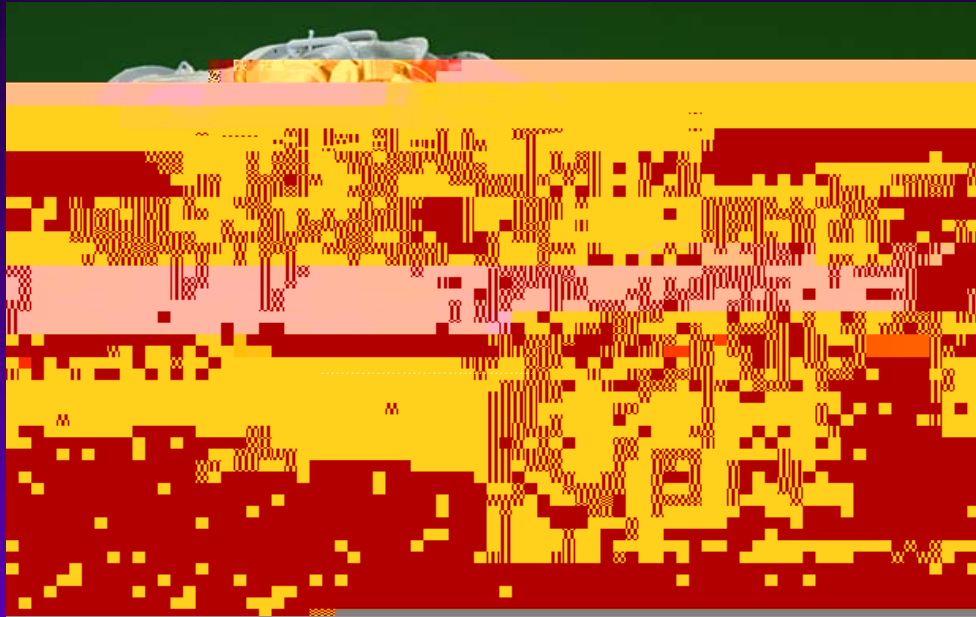


2007.07.18

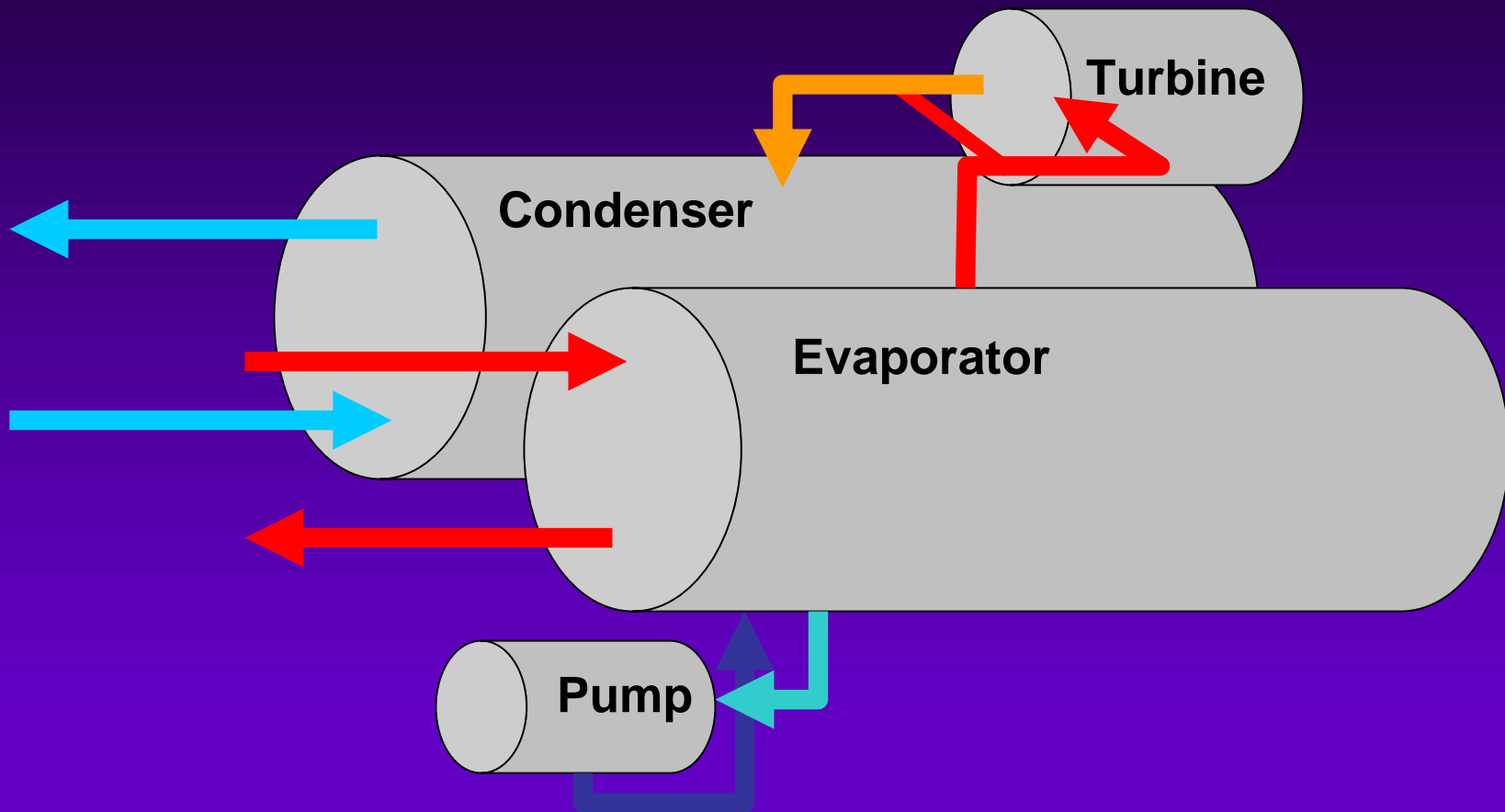
Chena Power Plant



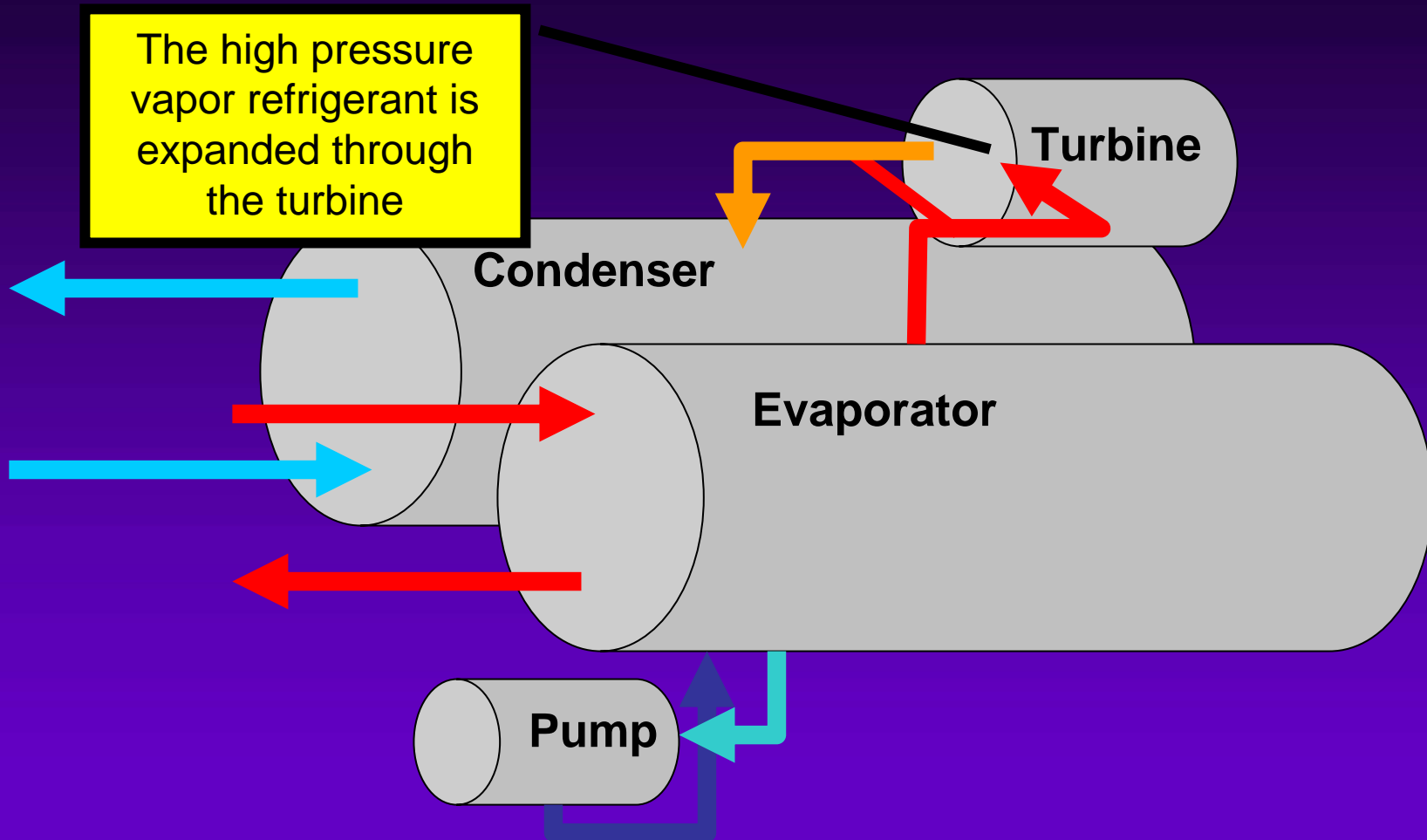
Carrier Chiller



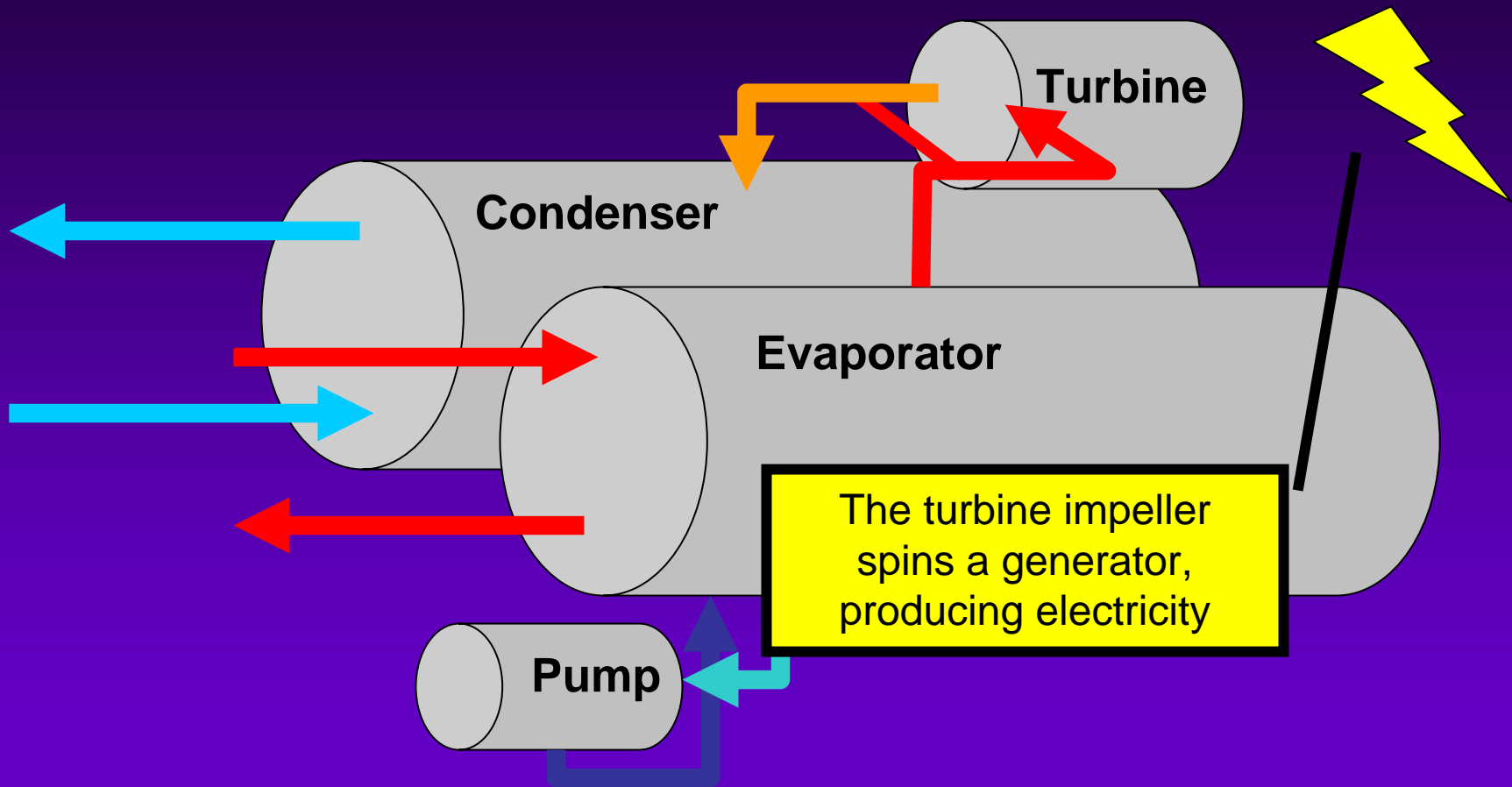
Chena Power Plant

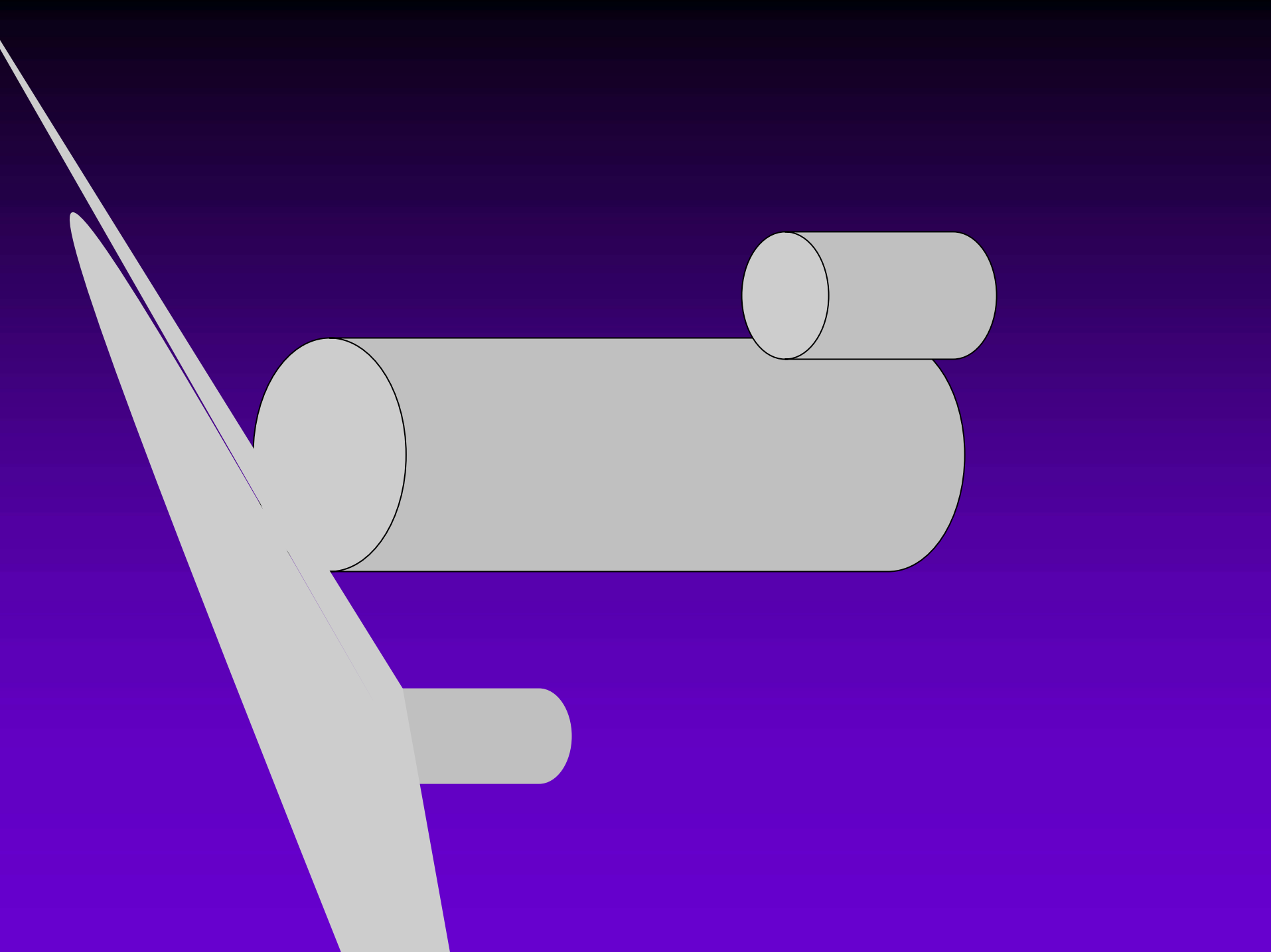


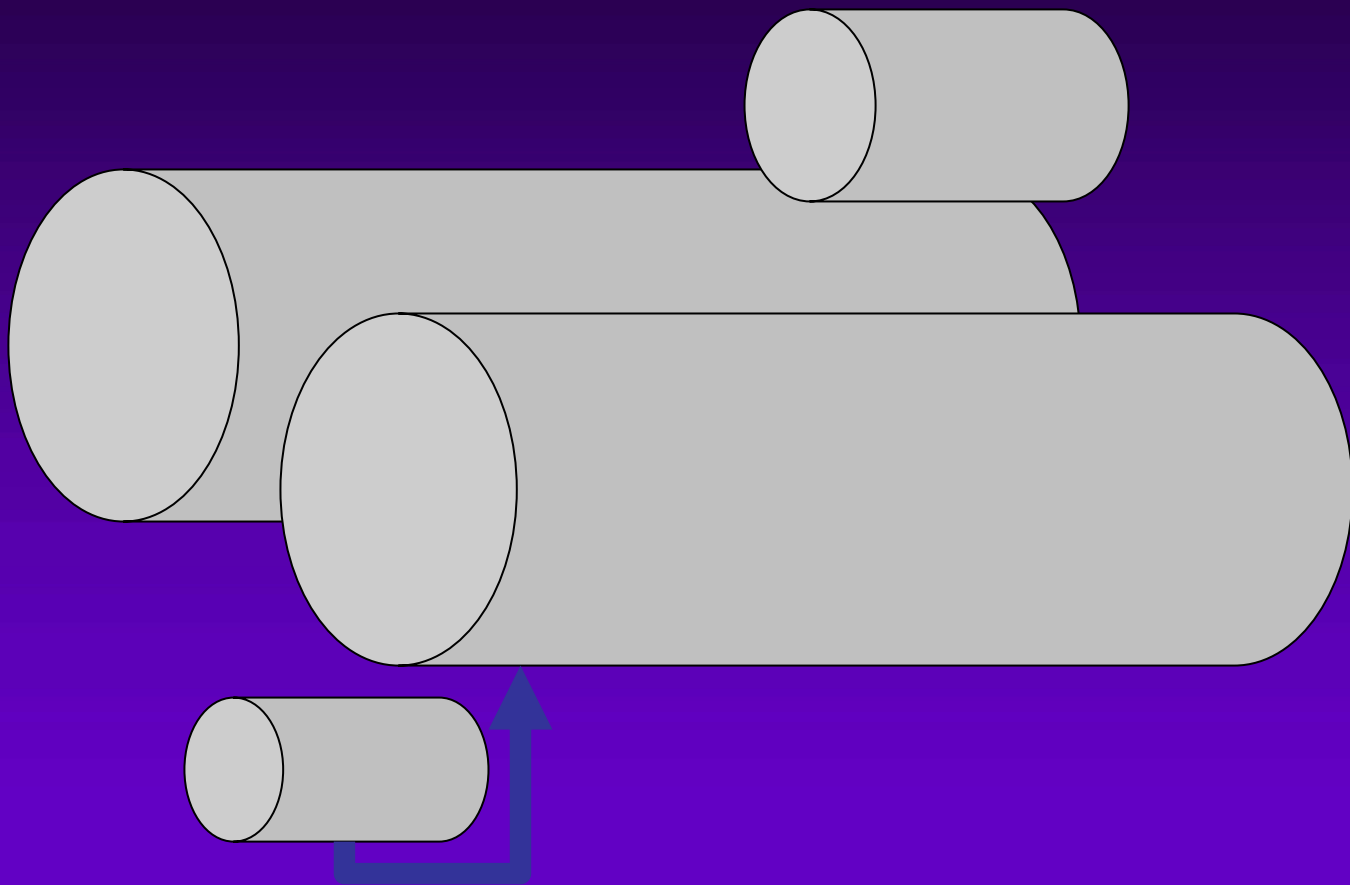
Chena Power Plant



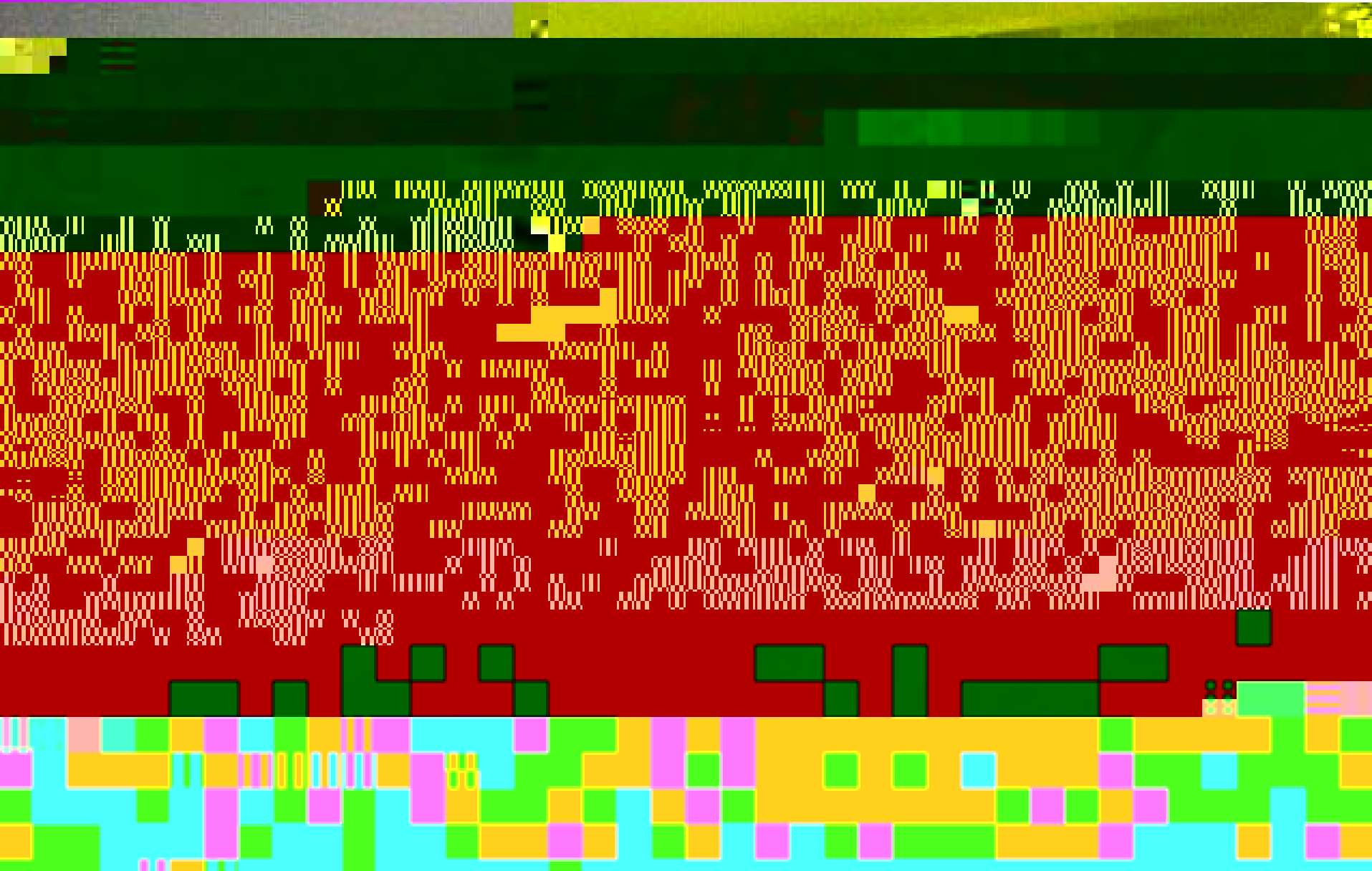
Chena Power Plant







Chena Power Plant



Chena Power Plant



Cold Water Supply



Cold Water Supply





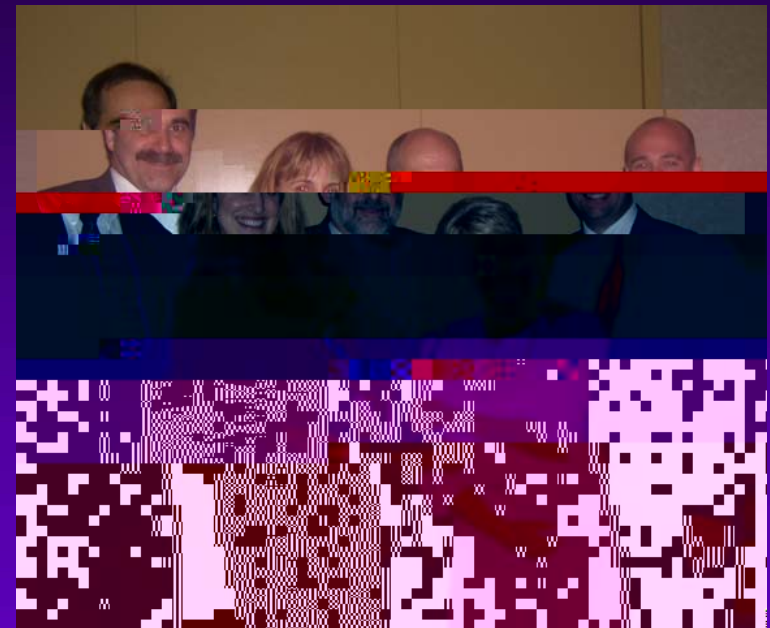
August 20th Official Opening – Chena Geothermal Power Plant



Project Awards and Recognition



**2006 Green Power Leadership
Award (EPA and DOE)**



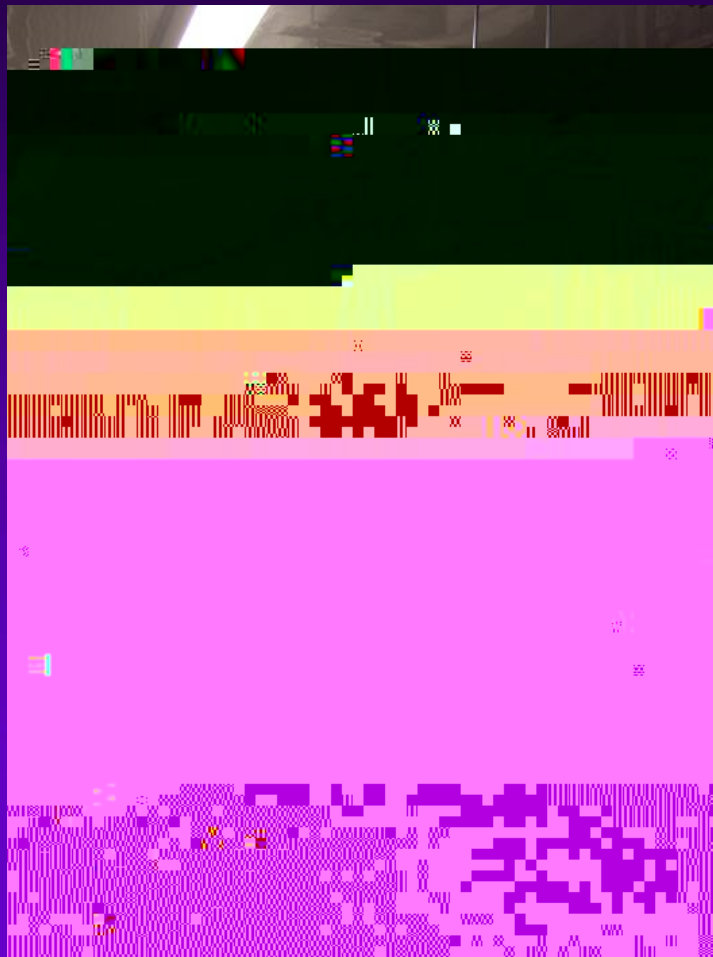
**Project of the Year
Renewable Energy Category
Power Engineering Magazine
PowerGen Conference 2006**



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)

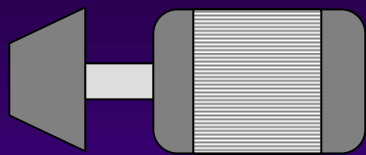


Batteries 3MW Total

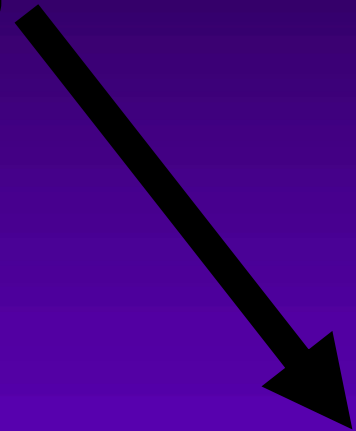
Battery and UPS System



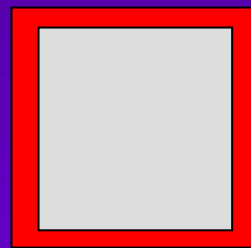
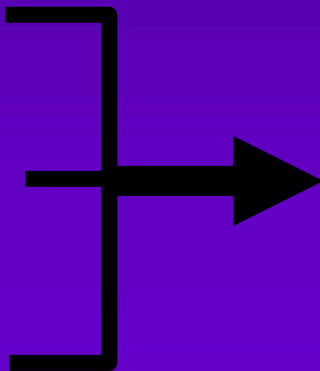
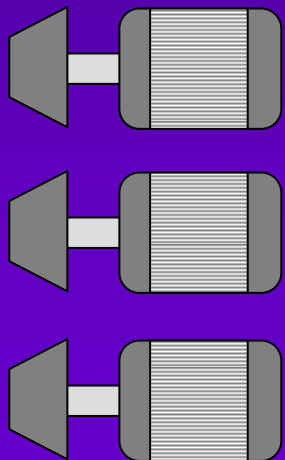
ORIGINAL CONFIGURATION



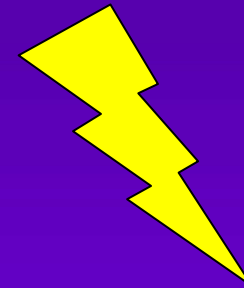
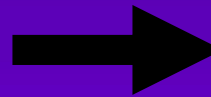
400kW Diesel Genset



200kW Cat
3306 Diesel Gensets



Inverter/Batteries
480VDC/480AC



480VAC
Output

Project Economics

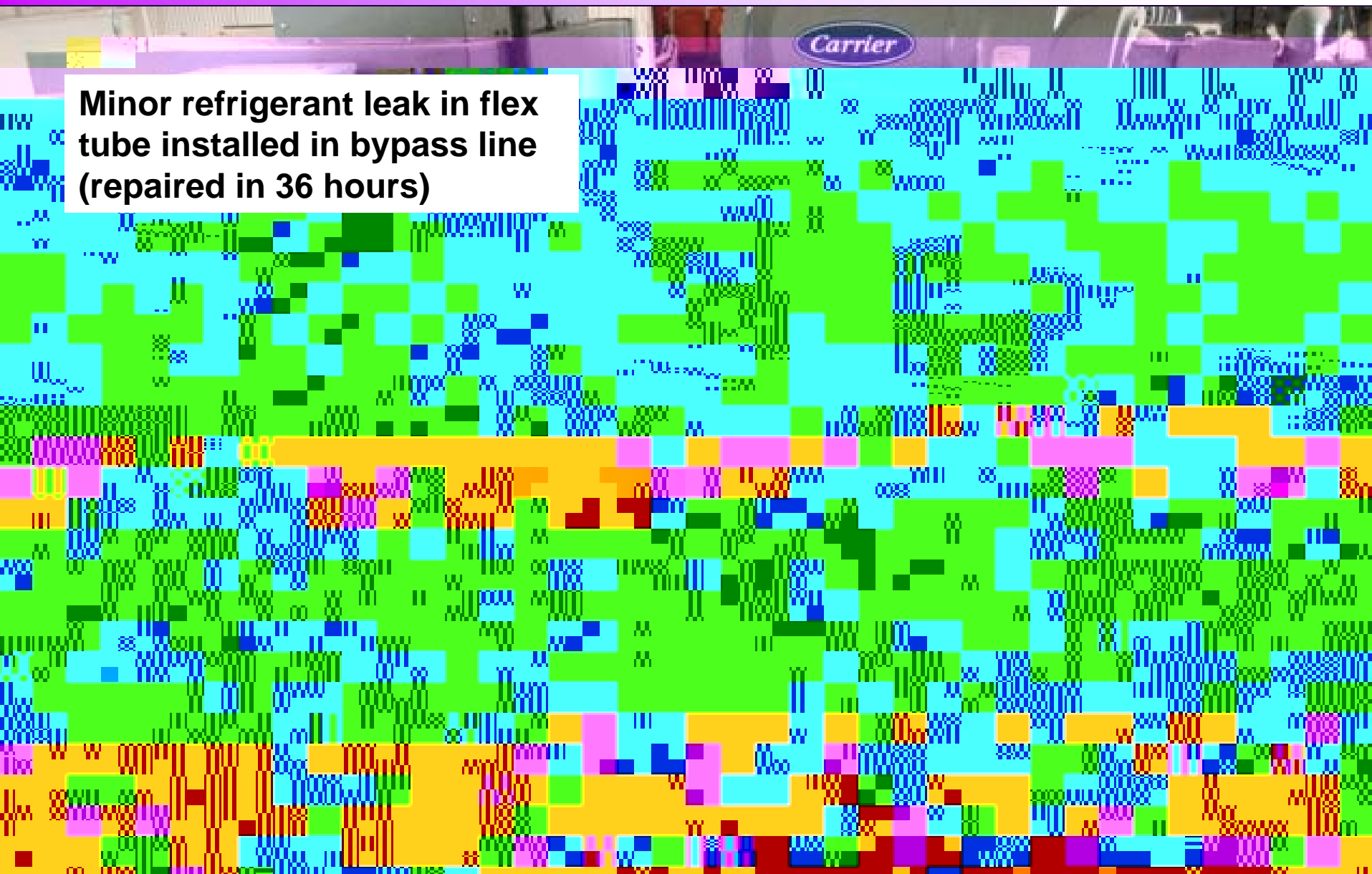


- Offset \$160,000 of diesel fuel in 4 months of operation in 2006
- Has created 3 new skilled positions
- Has increased electric use onsite by 40% in the last Quarter of 2006
- Has operated with 95% availability

Project Challenges



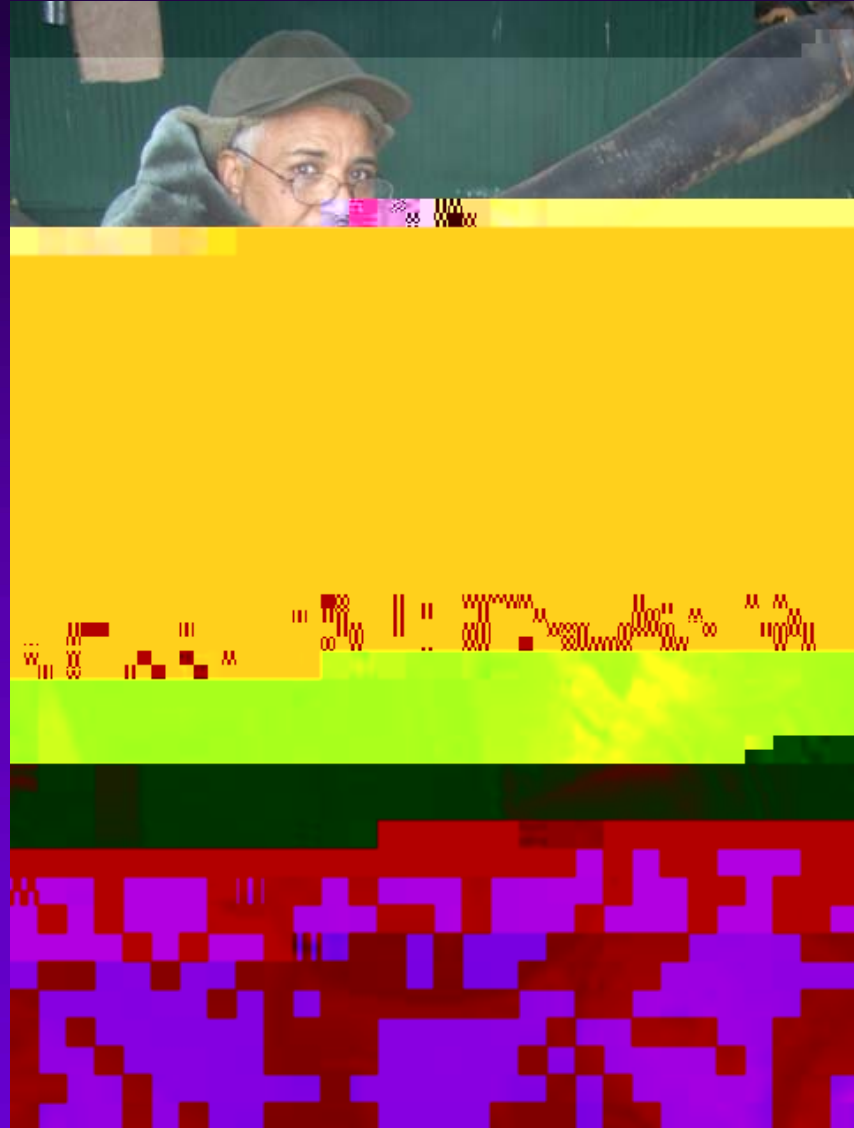
Minor refrigerant leak in flex tube installed in bypass line (repaired in 36 hours)



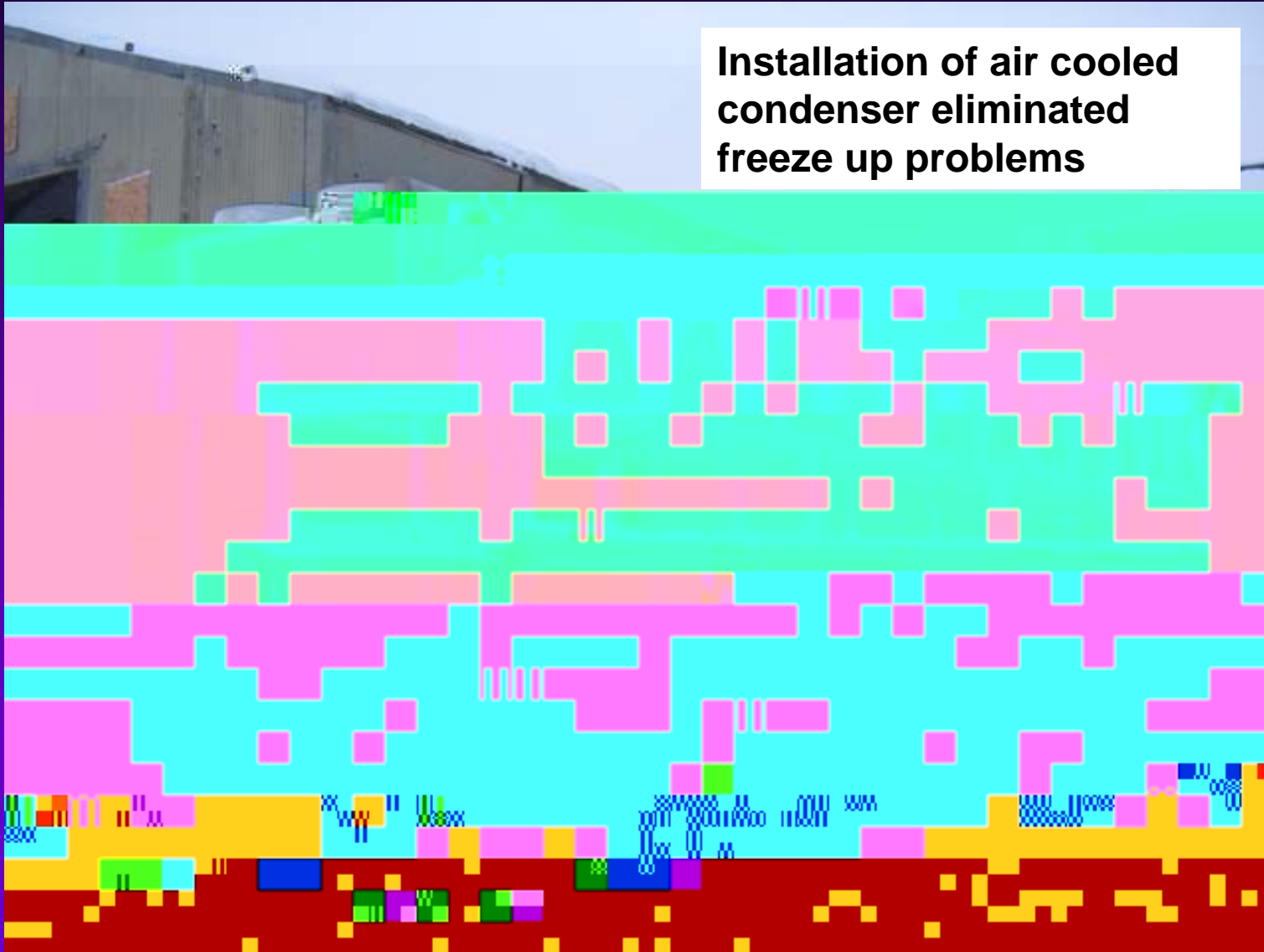
Project Challenges



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



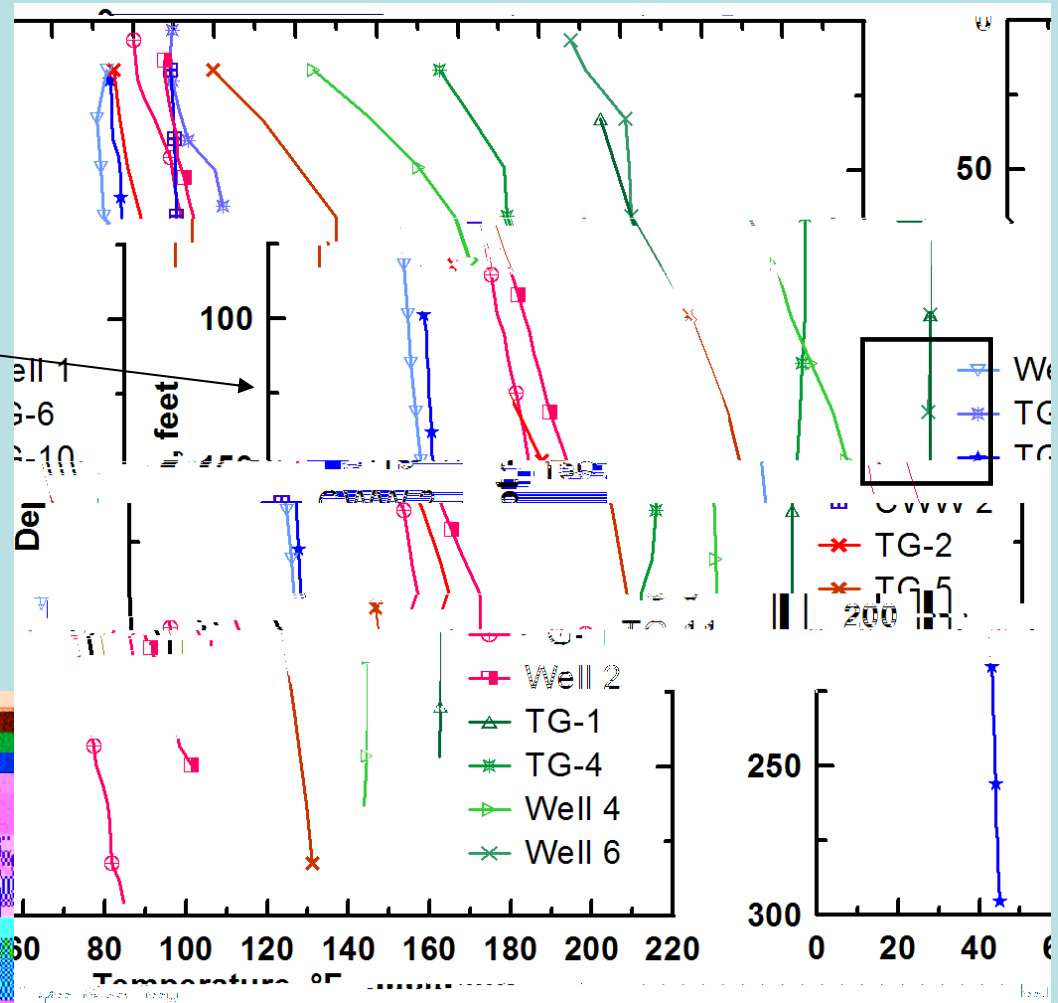
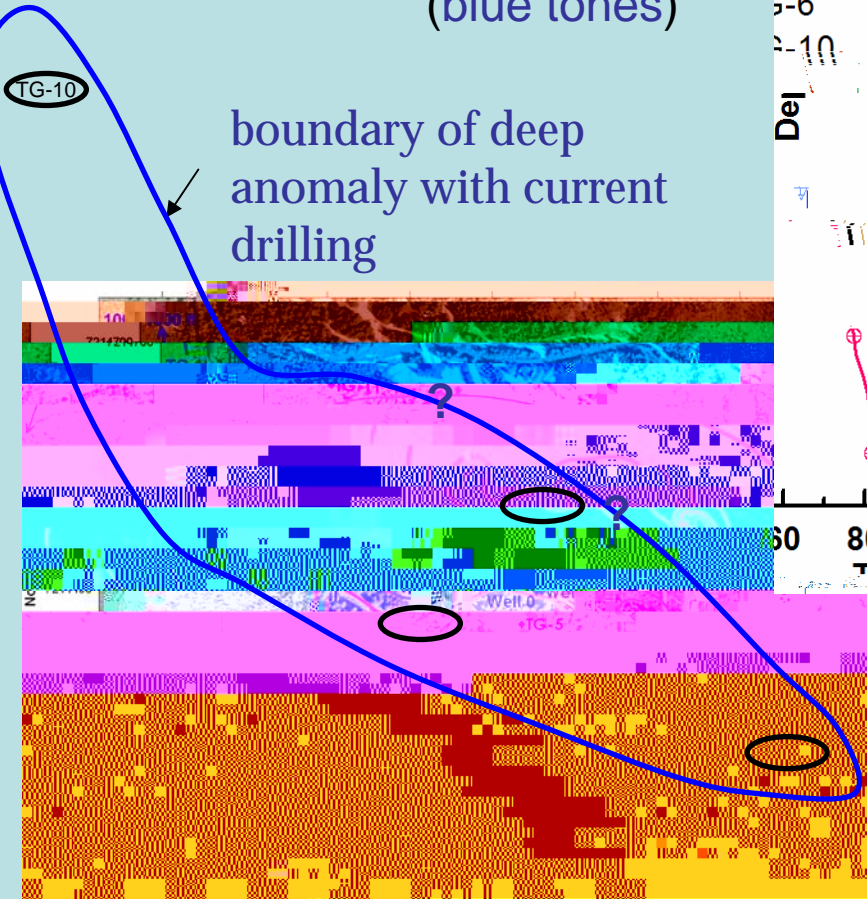
Project Challenges



Shallow Data

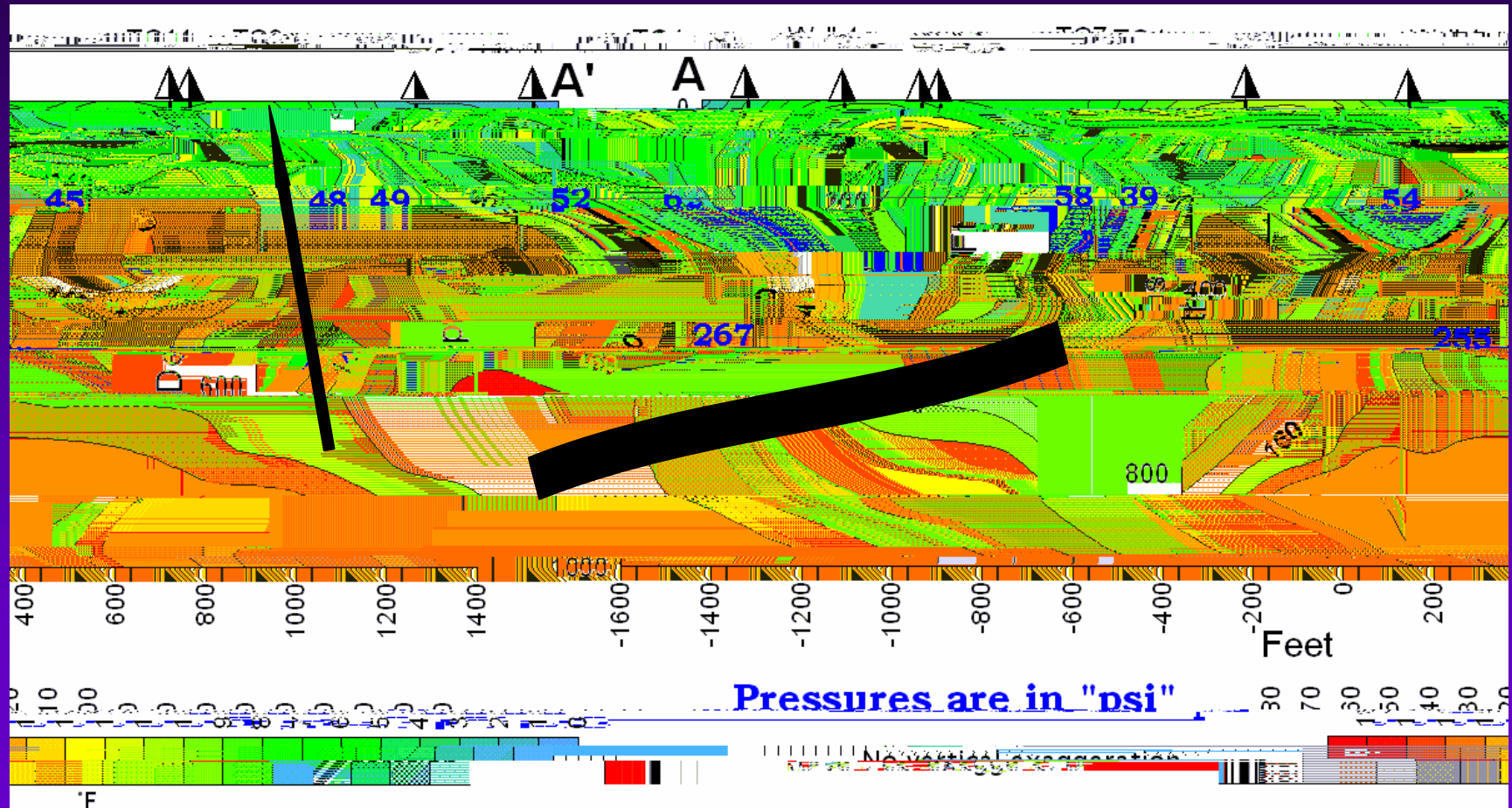
“Remote” wells (blue tones)

boundary of deep anomaly with current drilling



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

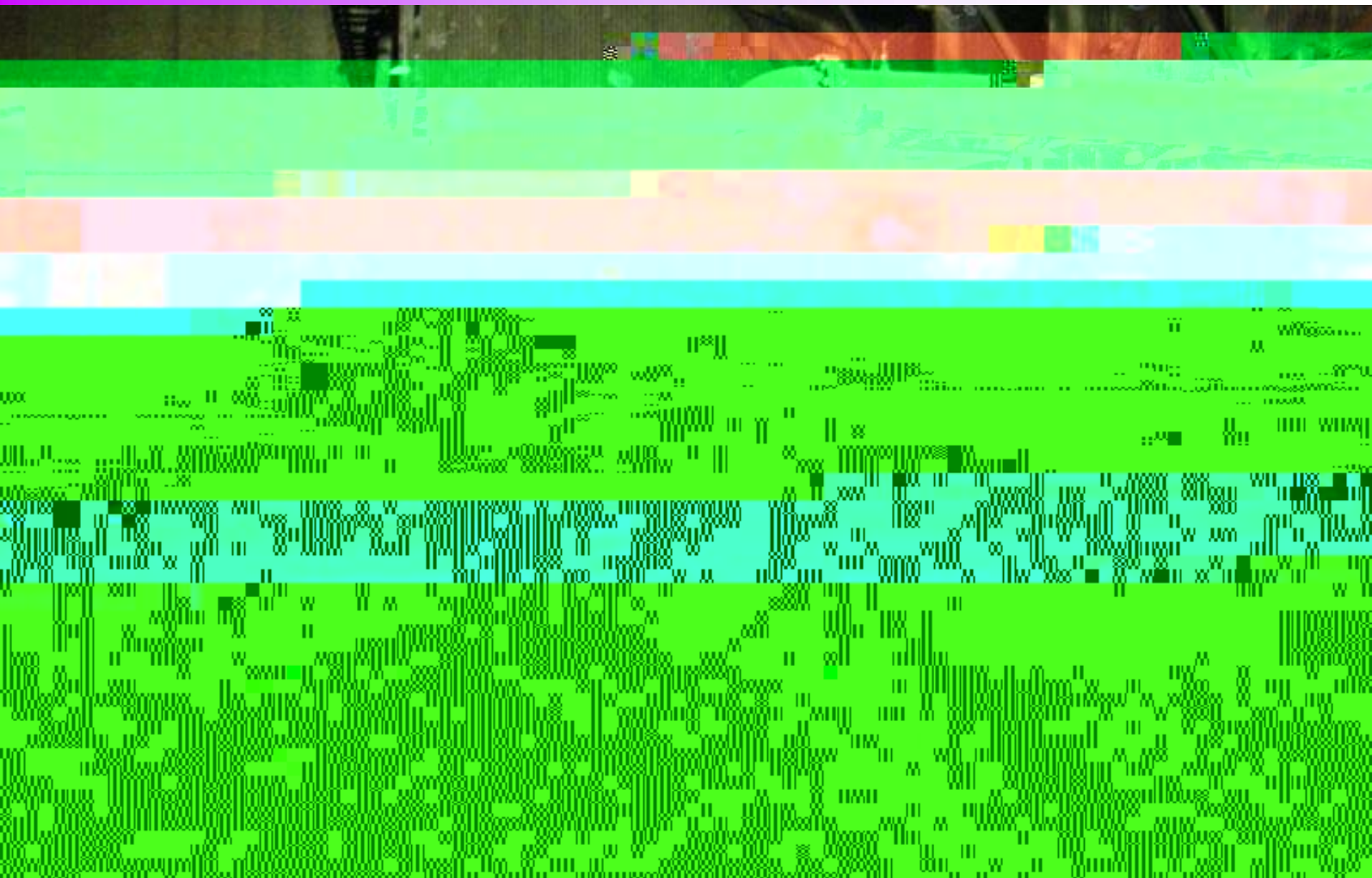
Project Challenges



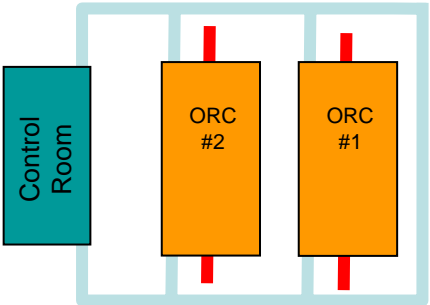
Chena Geothermal Power Plant



Chena Geothermal Power Plant



Chena Power Plant - Current



Ov



150ft

Chena Power Plant - Future



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

