

Raft River Geothermal Power Project

- GEOTHERMAL OVERVIEW
- RAFT RIVER PROJECT SITE
- PLANT & COOLING SYSTEMS
- WASTEWATER REUSE
- MONITORING RESULTS



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Geothermal Power Background

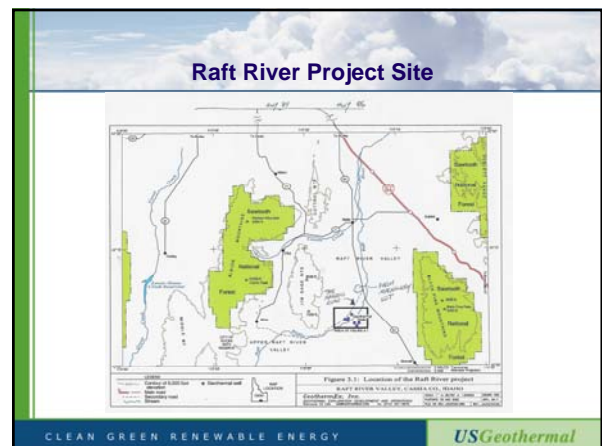
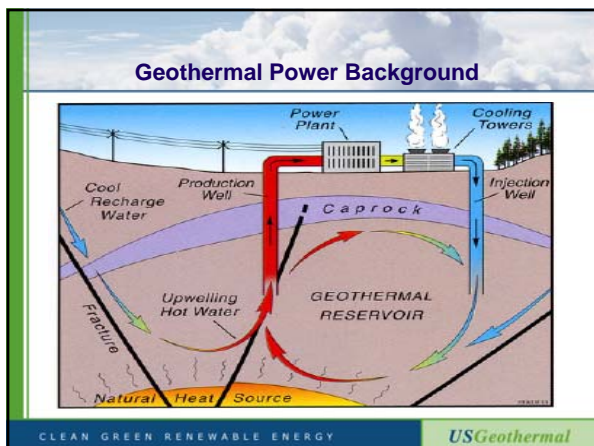
- Produced by utilizing heat that naturally exists within Earth's crust
 - National Renewable Energy Lab (NREL) estimates that heat within 10,000 meters of earth's surface is 50,000 times greater than energy that is available from petroleum and natural gas.
- Geological anomalies create "shallow" reservoirs of geothermal fluids (steam and water) that can be economically exploited
 - Typically reservoirs are 1,000 – 8,000 feet deep
- Geothermal fluids act as heat carriers that are piped to the surface and used to drive turbine generators
- Geothermal fluid is reinjected to sustain reservoir pressure
- Geothermal power is renewable without significant output deterioration over time

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Geothermal Power Background (cont.)

- Clean, safe, emission free
 - 100 MW eliminates 560,000 tons greenhouse gases annually
- Highest rate of green energy production (MWH to MW capacity)
- Generates "base load" power at 98% availability
- Renewable and Sustainable
 - No commodity consumption
 - All water is returned to the aquifer
 - Does not generate earthquakes
- Renewable energy incentives and credits

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Raft River Region & US Geothermal Project



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Raft River Project Site



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Pre-Project Site Conditions and Water Quality

- Beneficial use designation: cold water biota, salmonid spawning, and primary contact recreation.
- 303 (d) listed; 2004 TMDL limits established temperature, bacteria and sediment.
- Represents the last segment (2 miles) of functioning riparian system on Raft River.
- Perennial stream flows and an improving riparian system.
- 20 – 90 feet to groundwater, subject to significant annual drawdown.
- Geothermal springs and wells throughout valley.

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Typical Raft River Riparian Condition



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General Permit Considerations & Conditions

- Non-Contact Cooling Water is Not Wastewater
- Surface Water Quality Rules – Require Evaluation of Recharge
- Ground Water Quality Rule – Requires Assessment of Potential GW Impacts
- Primary Purpose of Permit is Ground Water Quality Protection
- Ground Water Quality
 - Lead and Fluoride exceed GW quality standards in domestic wells.
 - GW quality standards for TDS, Fe, Mn, Cl exceeded in most wells.
 - Average baseline TDS of all local cold water wells - 2214 mg/l.
 - Average baseline TDS in irrigation wells – 1237 mg/l.
 - 7 shallow & intermediate depth monitoring wells.
 - No increase in constituent load relative to ground water.

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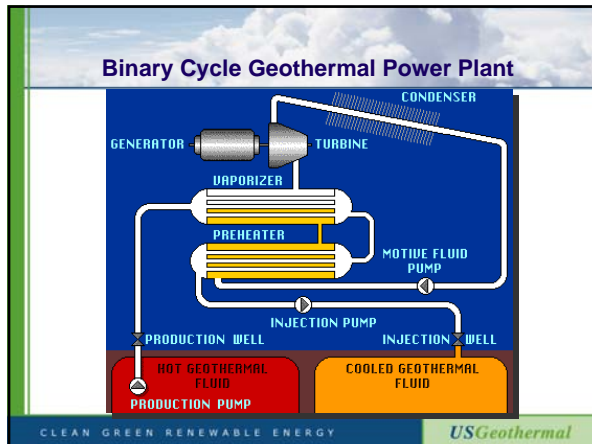
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Jim Sage Mtn. during Reservoir Testing



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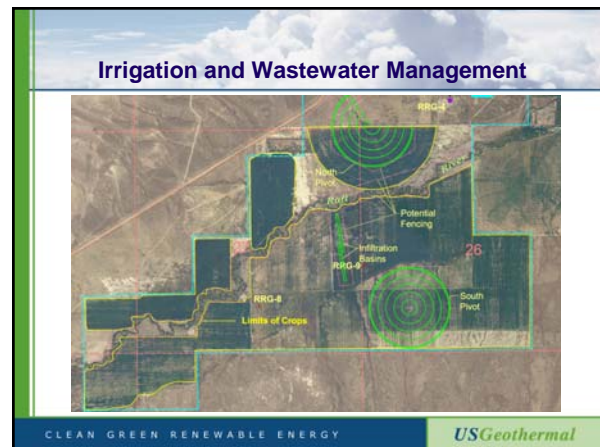
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Operational Parameters

- **Three Fluid Cycles**
 - **Geothermal – Closed System 100% Injection**
 - +/- 5000 gpm at 280° from wells RRG-1,2,4,7
 - +/- 5000 gpm injected at 133° at wells RRG-3,6,11
 - **Isopentane “Working” Fluid – 100% Recycled**
 - 183,000 lbs with approximate 1% loss annually
 - **Cooling Water – Reuse and Irrigation**
 - Average 500 gpm from three wells
 - 40% reuse and irrigation (app. 200 gpm)
 - 60% evaporative losses (app. 300 gpm)

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Cooling Water Reuse

- Utilized existing water rights for the property
- Soils are silt loam +/- 60 inches
- Agricultural water right converted to an industrial water right (IDWR)
- 60% percent reduction due to higher consumptive & year round use
- Pre-project Irrigation
 - 940 acres irrigated cropland
 - Average TDS concentration – +1250 mg/l
 - Average TDS load - 4.6 tons/acre/year
- Post Construction Reuse and Irrigation
 - 113 acres irrigated pasture and infiltration area (3 acres)
 - Average TDS concentration – 2483 mg/l
 - Average load – 9 tons/acre/year (2009 actual is 7.25 tons/acre)

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RO Unit and Cooling Tower Additives

• Cooling Tower Additives

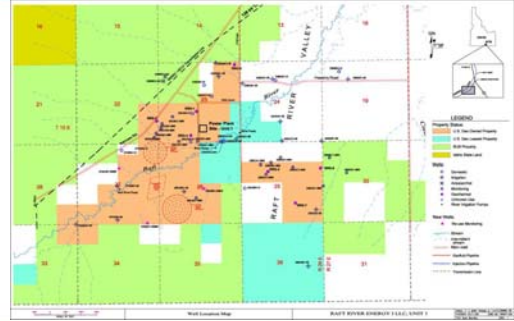
- 25 gal/month Bromine - bacteria control
- 106 gal/month Anti-scalent
- 285 gal/month Chlorine – bacteria control
- 275 gal/month Sulfuric Acid

• Reverse Osmosis System Additives

- 68 gal/month Anti-scalent
- 183 gal/month Sulfuric Acid
- 15 gal/month "Porson" – bacteria control

(Average Process Water – 500 gpm or 21.6 million gallons/month)

Raft River Project and Well Sites



Monitoring Network and Schedule

• Three Monitoring Components

- Non-Contact Cooling Water (1 site)
 - Continuous, Monthly, Quarterly
 - Composite and Grab samples
- TDS, EC, pH, As, Cl, Pb, F, N, P, Fe, & Mn
- Groundwater
 - 5 upgradient, 7 downgradient
 - First Year - Quarterly
 - Semi-Annual thereafter
 - TDS, EC, pH, As, Cl, Pb, F, N, P, Fe, Mn, D.O. &Temp.
- Soils
 - Annually (3 monitoring units)
 - SAR, pH, EC, Mn, Fe, Cl, P, Na



Center Pivot Operations April 15 – October 31



Infiltration Area Operations November 1 – April 14



Predicted & Monitored Cooling Water Quality



| Parameter | Predicted Cooling WQ | Monitoring Results |
|------------------|----------------------|--------------------|
| TDS | 2958 | 2483 |
| Chloride | 888 | 800 |
| Nitrogen | 1.55 | 1.5 |
| Fluoride | 4.8 | 2.54 |
| Arsenic | not predicted | <.05 |
| Iron | not predicted | .2 |
| Lead | not predicted | <.005 |
| Ortho- Phos as P | 3.3 | .5 |
| Manganese | not predicted | <.05 |
| Magnesium | 53.5 | 49 |
| Sodium | 543 | 375 |

Background & Monitored Groundwater Quality



| Parameter | Background Groundwater | Monitoring Results |
|-----------------|------------------------|--------------------|
| TDS | 2214 | 1555 |
| Chloride | 953 | 716 |
| Nitrogen | (.83 - 2.0) | 1.9 |
| Fluoride | 3.6 | 2.8 |
| Arsenic | <.05 | <.05 |
| Iron | 4.2 | 3.0 |
| Lead | <.005 | <.005 |
| Ortho-Phos as P | (.02) RR-5 | .23 |
| Manganese | .27 | <.05 |
| Sodium | 489 | Not tested |

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Background & Monitored Soil Conditions

| Parameter | Baseline Soil | Monitoring Results |
|-----------------------------|---------------|--------------------|
| SAR | .90 | .62 |
| Chloride | .03 | .52 |
| Nitrate | 8.42 | Not required |
| Calcium | .36 | Not required |
| Potassium | 21.10 | 421.98 |
| Iron | 5.33 | 4.26 |
| Magnesium | .32 | Not required |
| Plant available Phosphorous | 2.71 | 2.78 |
| Manganese | .32 | 48.78 |
| Sodium | 3.14 | 62.96 |



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Accomplishments to Date



- Filed and maintained a Runoff Water Management Plan
- Filed and maintained a Grazing Management Plan
- Completed 2 Annual Reporting Periods (2008, 2009)
- Increasing concentration of soil constituents
- No runoff to Raft River
- No impacts or discernable trends in groundwater
- Significant Improvements to Raft River riparian corridor

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