Pre-Drying the Lignite to GRE's Coal Creek Station

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May 2005

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Team Members

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LIGNITE ENERGY COUNCIL

EPRI

LEHIGH University

FALKIRK
THE FALKIRK MINING COMPANY

Coal Dryer Summary

- Coal drying benefits
- Project history
- Pilot plant arrangement
  - Testing parameters
  - Drying results
- Prototype & beyond

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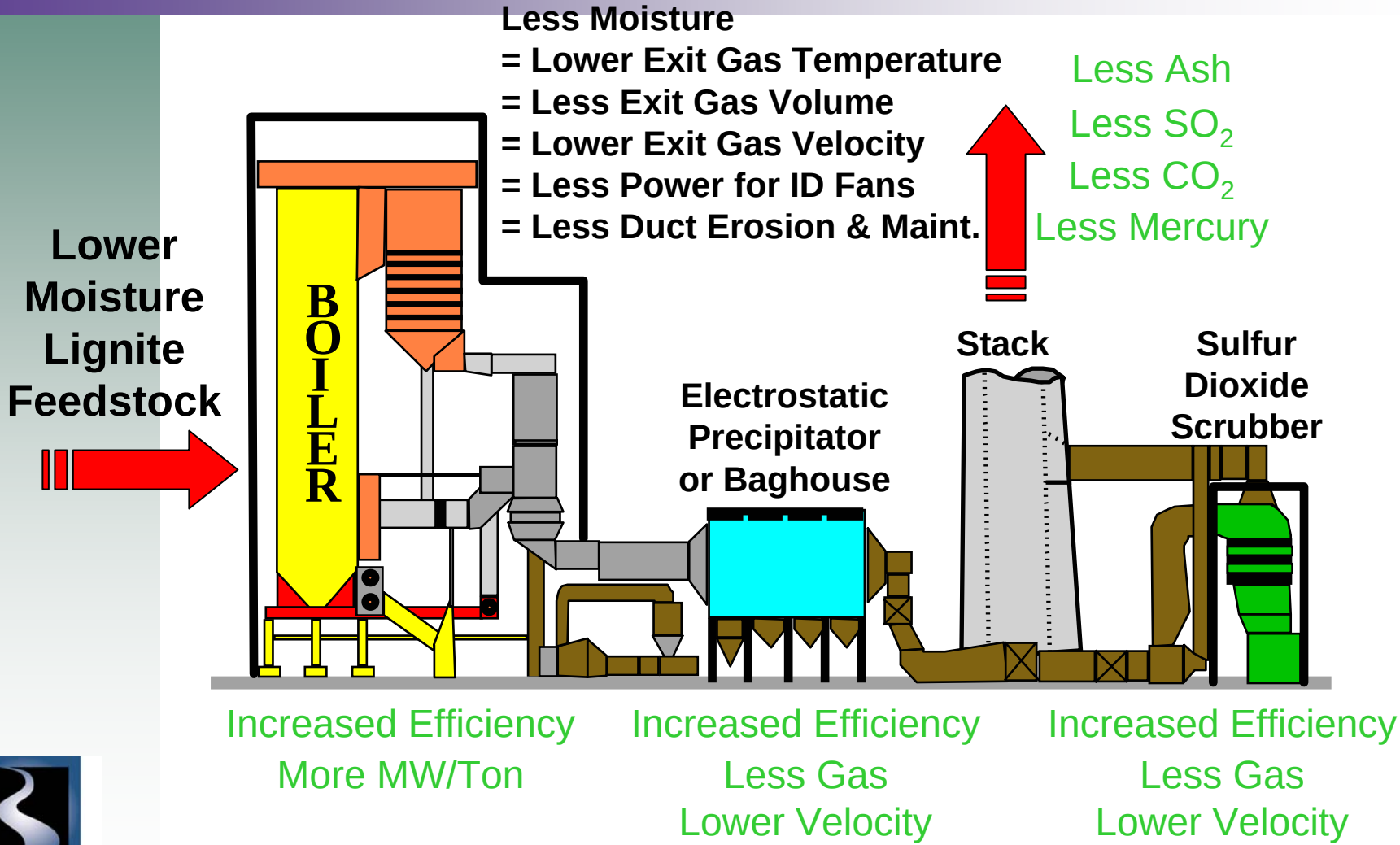
Coal Creek Station

Lignite Fuel Enhancement
Incremental Moisture Reduction Project



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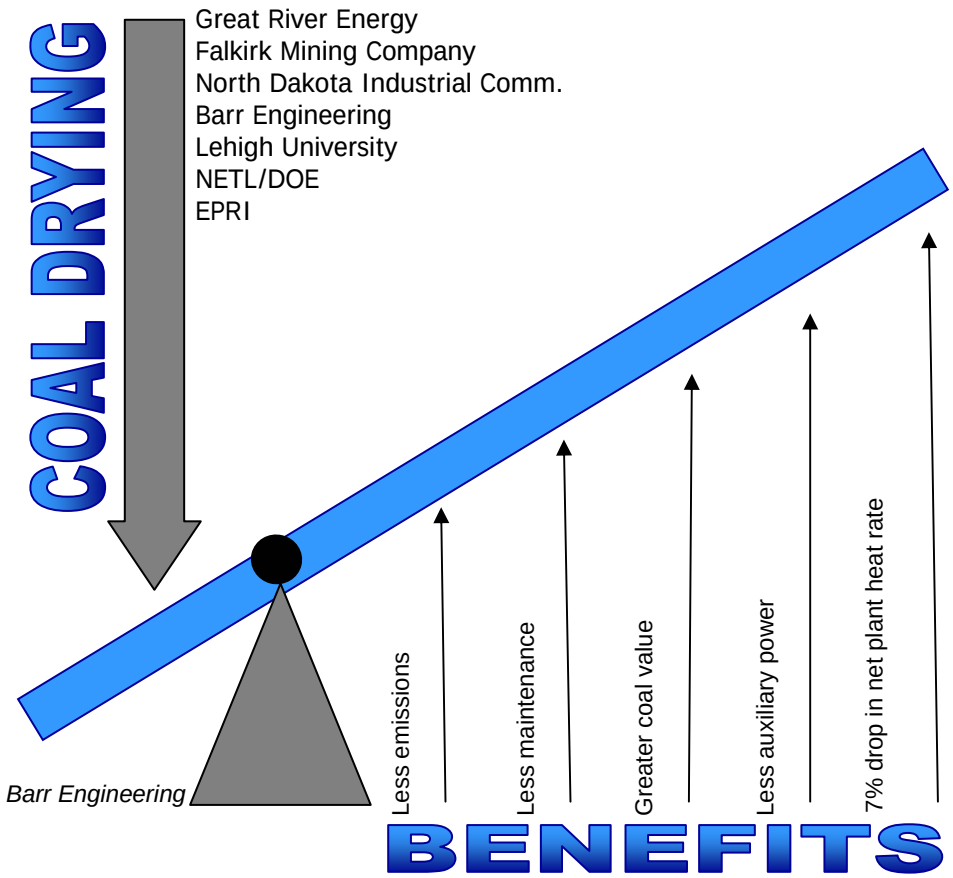

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Auxiliary Power Reduction

- Lower Fan FD, PA, ID Fan HP
- Lower Pulverizer HP
- Lower Cooling Tower HP
- Lower coal handling HP
- After adding the power for coal drying Aux power drops by about 17%
- This is a 1.2% improvement in NPHR

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Reduced Maintenance

- Coal conduit velocity drops by 30%
- Run 6 pulverizers instead of 8
- Flue Gas velocity drops, furnace and duct errosion drops.
- Coal handling wear drops due to lower coal flow.
- Improved Air Heater basket life.

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Reduced Plant emissions

- CO2, mercury, ash and sulfur will all be reduced by same percent as coal flow.
- In addition sulfur and mercury will be further reduced based on the increased ability to scrub.
- NOx is expected to drop due to the shift in combustion air from PA to FD.
- Precip. performance will improve due to lower velocities and temperatures.

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Change in Boiler Efficiency

- Base 100%-21%----------79%
- Target 100%-15.6%----------84.4%
- Change 1- 79%/84.4%----------6.4%

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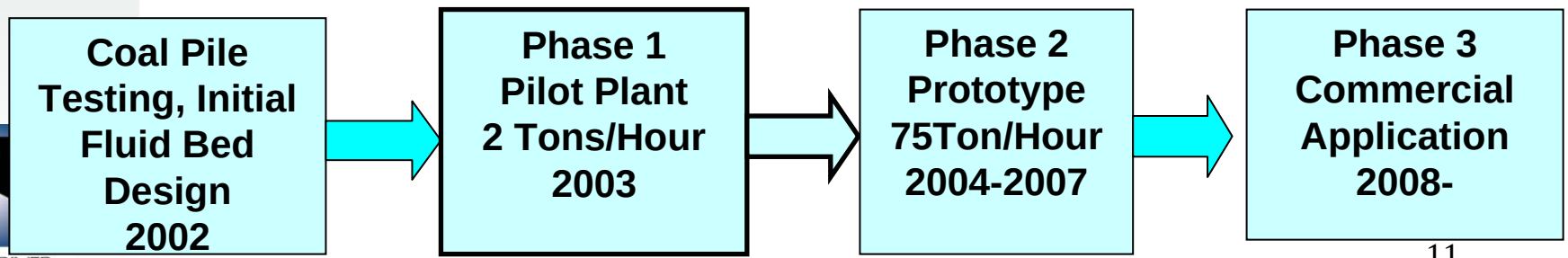
Lignite Drying: Goals and Schedule

- **Objectives**
  - Reduce the moisture content of lignite
  - Use waste heat from the power plant
  - Modify existing coal deliver systems
- **Goals**
  - Increase the competitive position of lignite-fired power plants
  - Reduce the environmental impact of lignite-fired power plants



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Drying Benefits Based on Test Burn

- Coal moisture decreased by **6.1 %**
- Coal HHV increased by **9.25%**
- Coal flow rate decreased by **10.8 %**
- Flue gas flow rate decreased by **4 %**
- Auxiliary load decreased by **3.8 %**
- Boiler efficiency increased by **2.65 %**
- Net unit heat rate improved by **2.75 %**
- Main steam temperature decreased by **4º F.**
- Reheat steam temperature remained constant

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PILOT and PROTOTYPE DRIERS

- **2T/h Pilot Test - NDIC $460k (Complete)**

- **Prototype to Full Scale - DOE /GRE $28M (Underway)**

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Pilot Coal Dryer Arrangement

Coal Creek Station

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NDIC Pilot Testing at Coal Creek Station

September to November 2003

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Testing Objectives

- Gain operating experience with lignite in a scalable fluid bed dryer.
- Confirm lab testing results in a scalable fluid bed dryer.
- Determine effect of air flow, bed coils, Bed depth and coal feed rate on dryer operation and cost effectiveness

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Test Variables and Ranges

Parameter	Minimum	Maximum
Air Flow	4200 scfm	6000 scfm
Air Temperature	140 F	200 F
Coil Temperature	140 F	200 F
Coal Flow	2000 #/hr	6000 #/hr
Bed Depth	15”	35”

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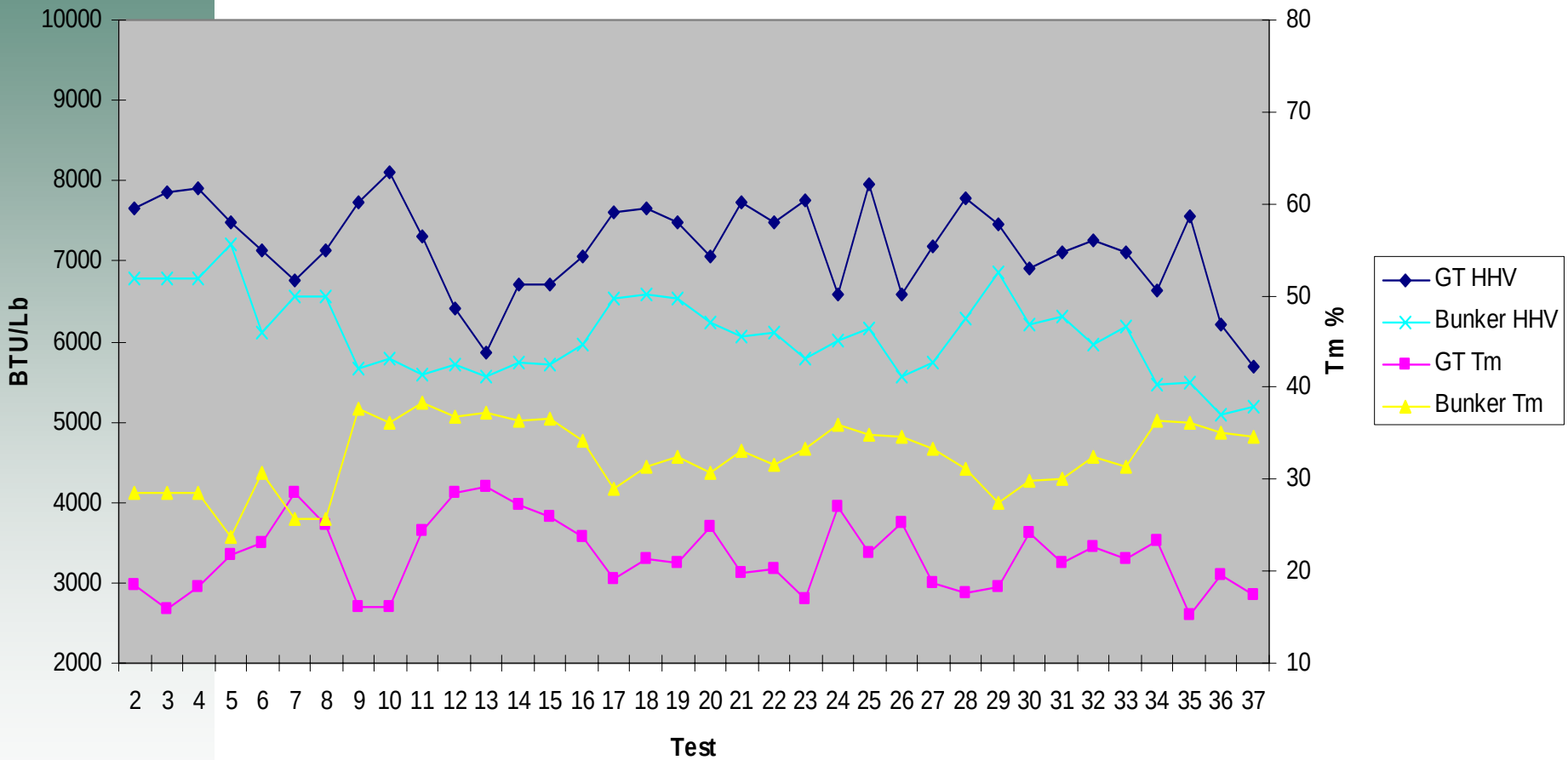
Coal Feed vs Coal Product Tm and HHV



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Coal Feed and Product Properties

- Coal Feed
  - Tm 30 - 38.3%
  - HHV 5100- 6600 Btu/lb
- Coal Product GT
  - Tm 15.3 - 29%
  - HHV 5700 -8100 Btu/lb

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Summary

- Drying rate is affected most by the ability to add heat to the bed
- Moisture removal rates greater then 12% can be achieved in less than 18 minutes residence time in the bed
- Temperatures in the bed of up to 160˚F did not pose any problems
- Material that can’t be fluidized must be removed

NDIC Pilot Testing at Coal Creek Station

May to November 2004

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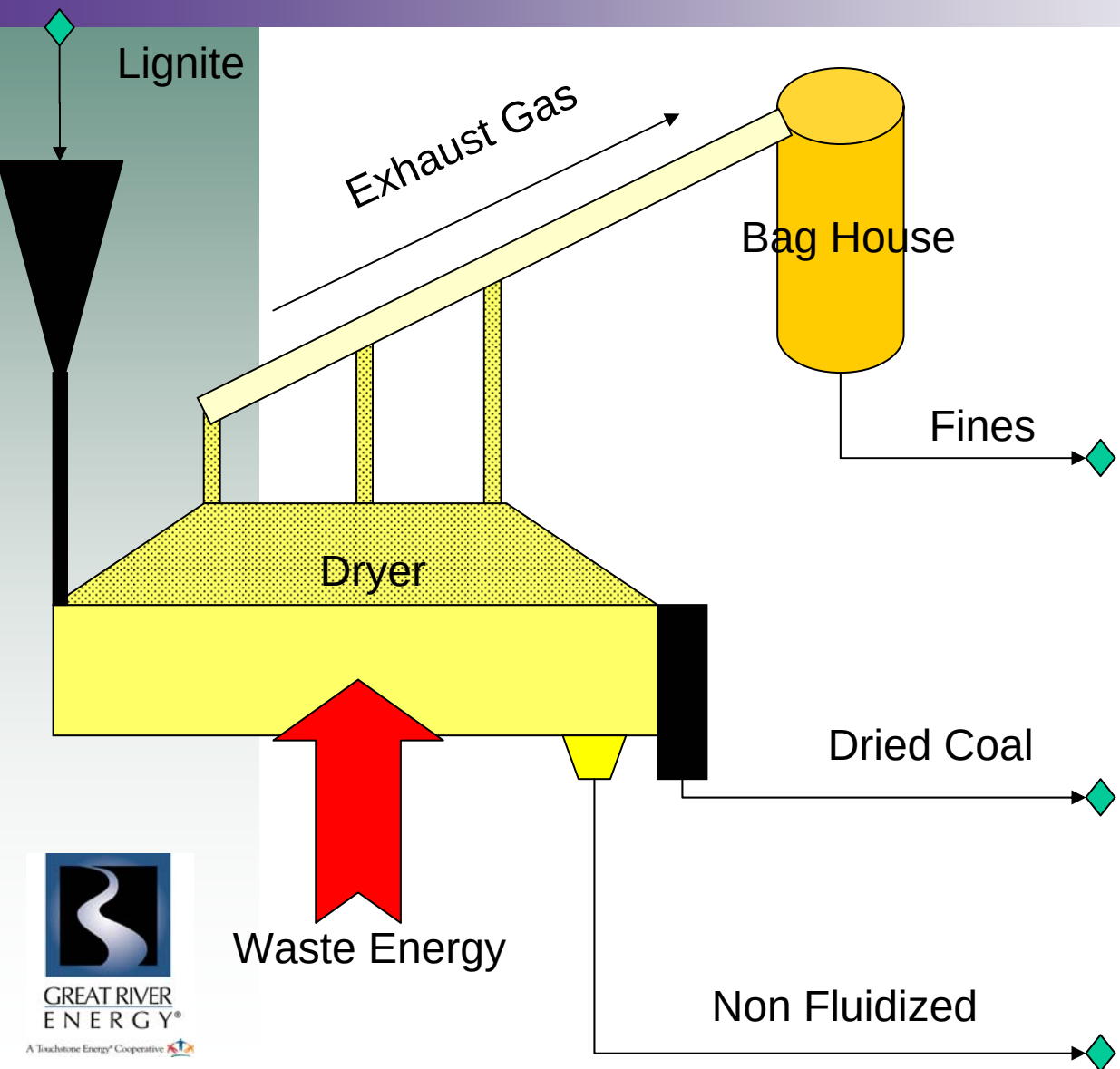
Dryer Product Streams:

Quality and Energy Enhancement



Treatment Options

- Magnetic Separation
- Screening
- Electrostatic
- Stratification

Treatment Objectives

- Energy Recovery
- Reduced Sulfur
- Reduce Ash
- Reduced Mercury
- Improved Performance

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Summary : Pilot 2004

- 80+ tests with Falkirk Lignite
- Tested four other low ranks
- Tested one PRB

- Elutriation <btu, >ash
- Undercut <btu, >S, >ash, >Hg

Plans to continue in the summer of ‘05

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Progressing from Pilot to Prototype

- DOE joins partnership under a collaborative funding agreement
- Contract with DOE was signed last July
- Prototype dryer construction to commence in May
- Prototype project as per the agreement with DOE does not include quality enhancement options

Project Objectives

- 1) Prove the commercial concept
- 2) Identify a CCS specific dryer
- 3) Explore additional beneficiation potential

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Milestone Activities

- Completed EIV: Feb 28th
- Complete Prototype Construction Jul ‘05
- Testing: Aug ’05 to Aug ‘06
- Project Milestone: Dec ‘05
- Period 2 begins Dec ‘05
- Period 3 begins Dec ‘06
- Project Complete Apr ‘08
- Unit 2 Only!

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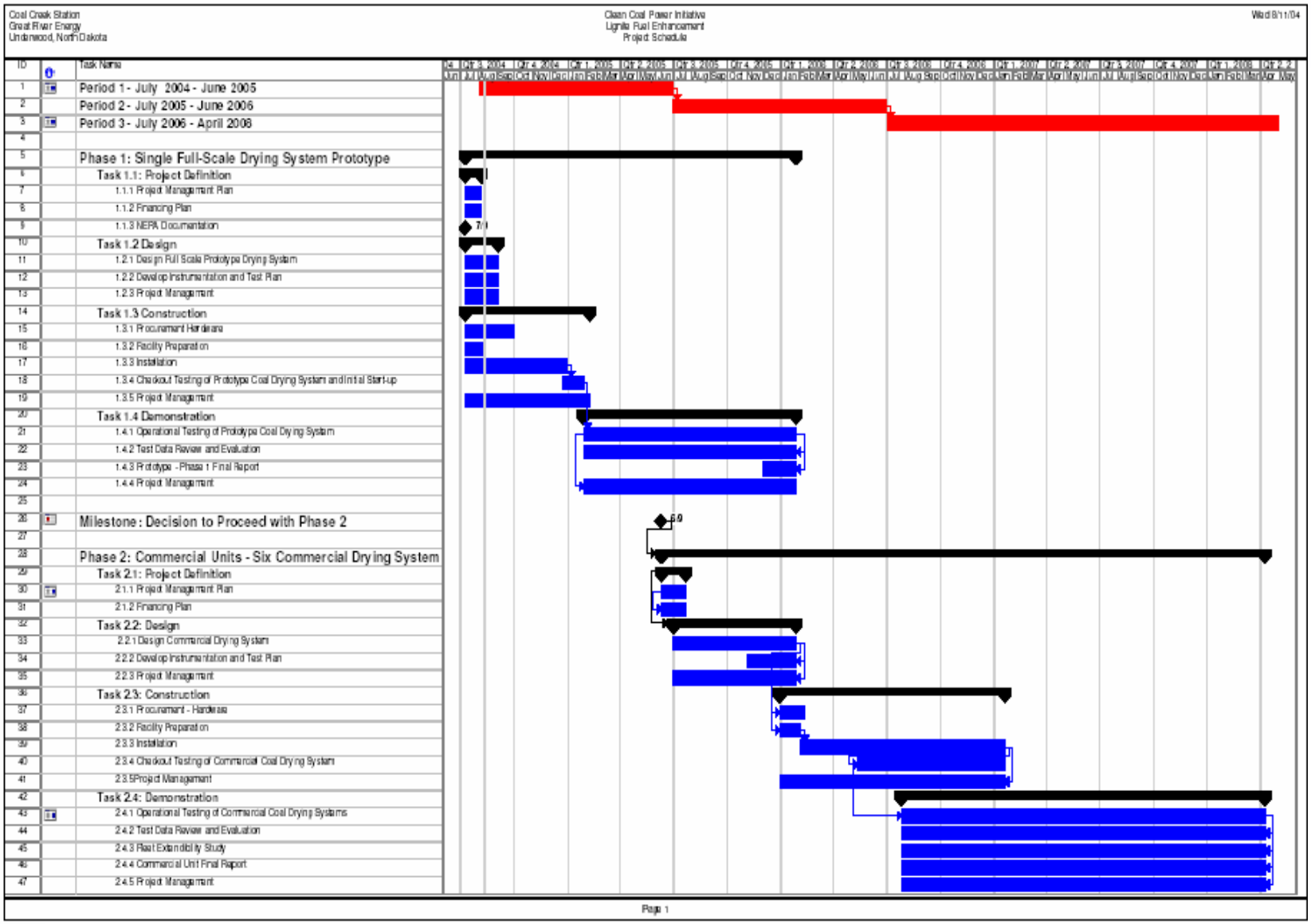
Project Schedule



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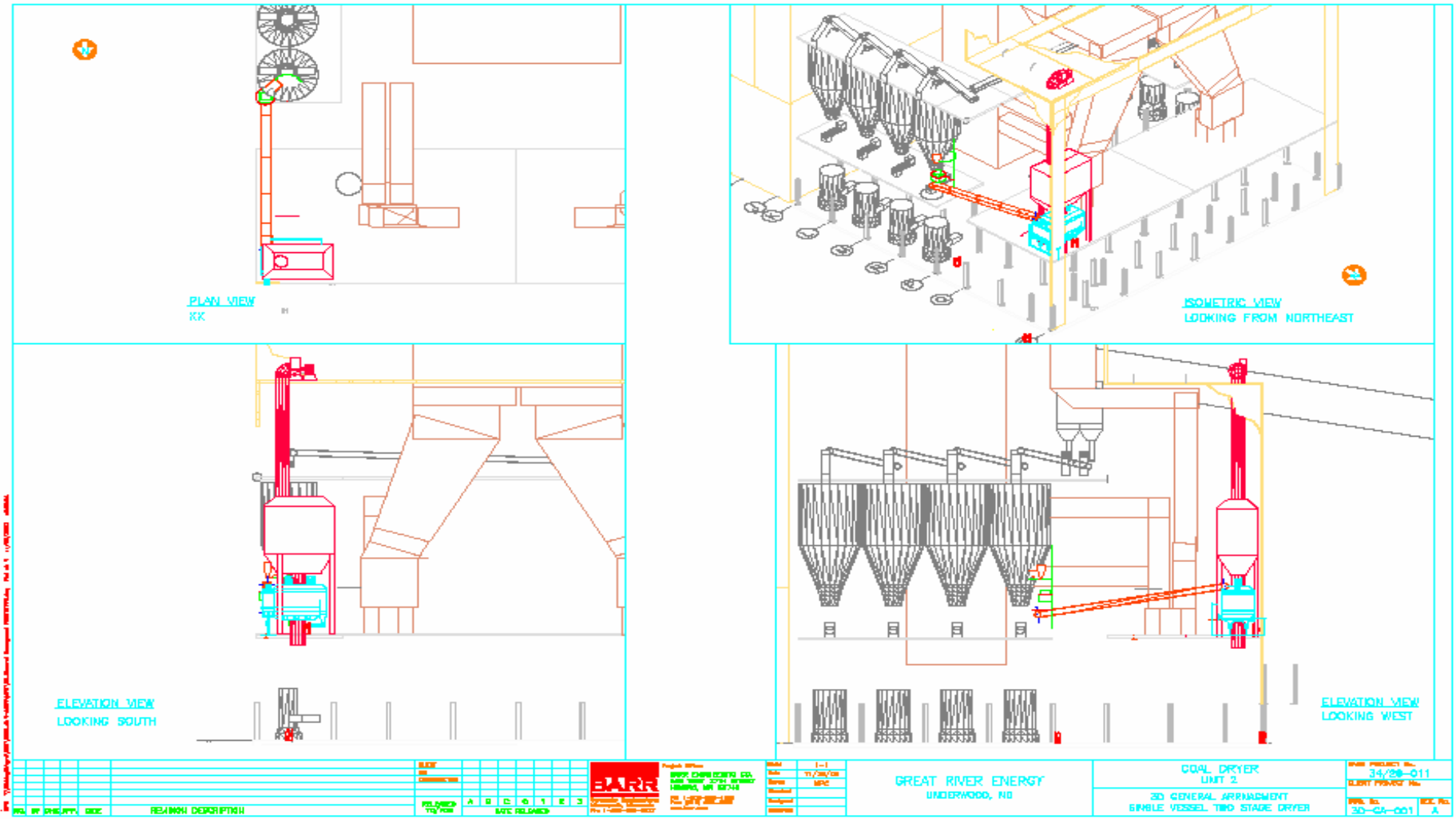
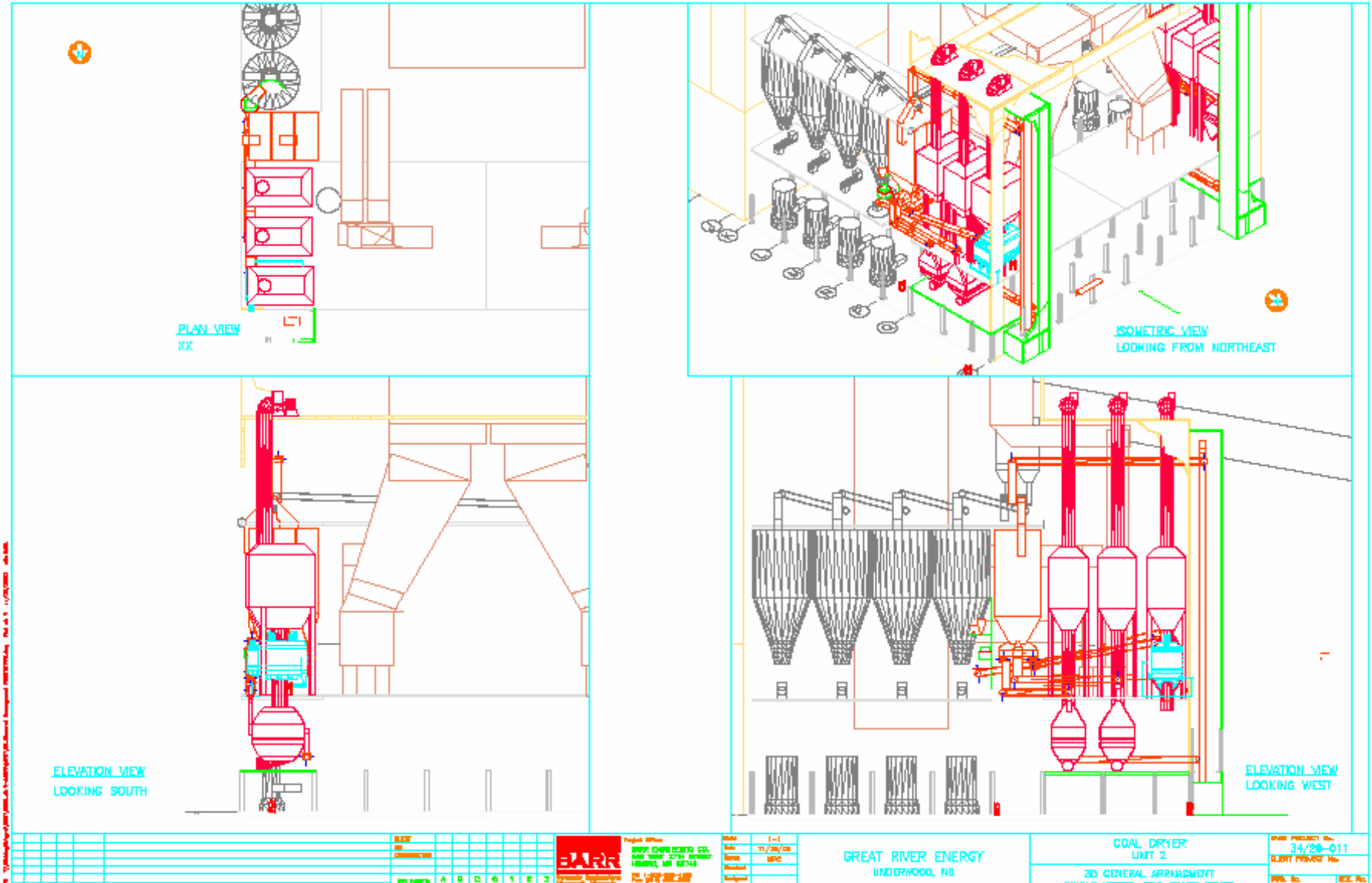
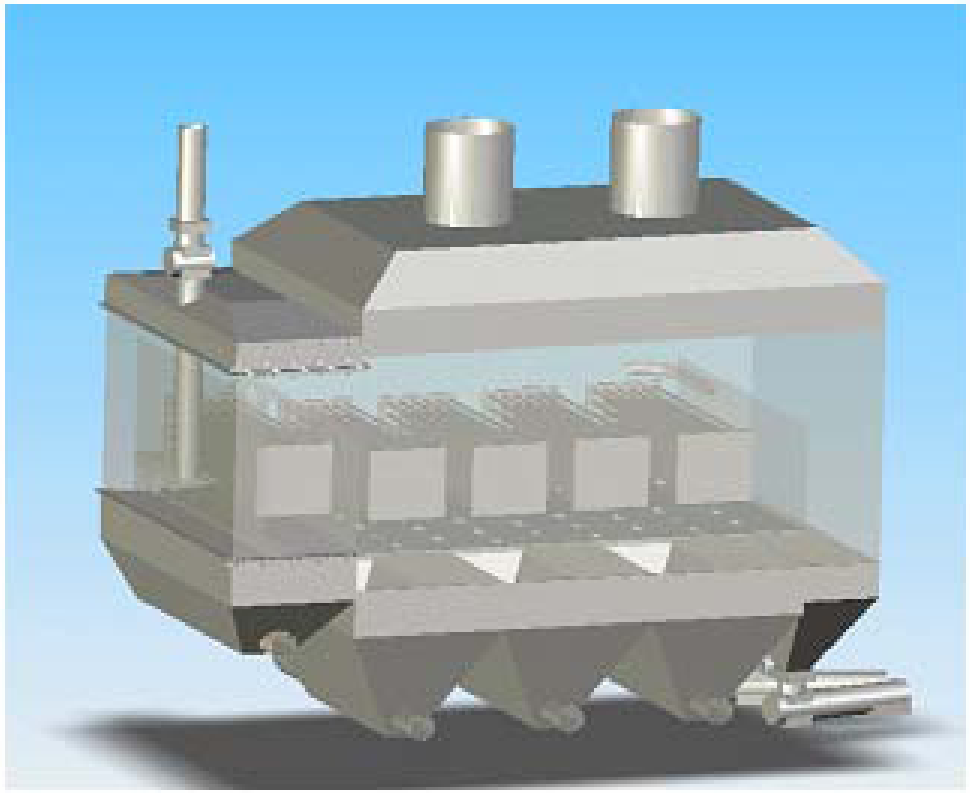
Lay Out Drawing for Prototype Dryer



Layout for Commercial Dryer



3D Dryer Model



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Dryer area looking South

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Dryer Area looking North

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Possible challenges

- 2T/hr to 75T/hr scale-up
- O&M issues
- Erosion/corrosion
- Materials life
- Concentrated reject stream
- Reheat temperature

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Prototype to Commercial

- One year proving time for prototype operation
- Five Additional dryers to complete drying of Unit 2 by April 2008
- Project to dry for second unit outside the financial scope of CCPI but, Repayment agreement

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Conclusion

- Economic, Efficiency, & Environmental Benefit
- Integrate systems for the best economic advantage
- Waste to Work
- Professional Team working on the design
- Lignite/PRB/Global Potential
- Prior research shows we take the next step!

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