

**LMFS-3 (RFP-92-1)**  
**LIGNITE UPGRADING FEASIBILITY STUDY**

**CONTRACTOR:** Bechtel Corporation

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**CONTRACT AMOUNT:** \$100,000

**Project Schedule – 1 year**

Contract Date – 8/27/92  
Start Date – 8/27/92  
Completed – 6/10/93

**Project Deliverables**

Status Report – 9/30/92 ✓  
Status Report – 11/30/92 ✓  
Draft Final Report – 1/21/93 ✓  
Final Report – 6/10/93 ✓

**OBJECTIVE / STATEMENT OF WORK**

The objective of this study was to evaluate current and emerging national and international lignite upgrading technologies and determine which could be used with North Dakota lignite. Specification goals for an upgraded lignite are: 10,800 Btu/lb., less than 1.2 lb. of SO<sub>2</sub>/MMBtu, resistant to moisture reabsorption spontaneous combustion, and a Na<sub>2</sub>O content of less than 2 percent in the ash.

This study was an independent technical and economic evaluation of upgrading processes. Work included: listing the most promising processes, indicating whether they can meet the specification goals, noting any improvements, assessing probability of success in five years, a preliminary estimate of relative costs, and an estimate of reductions in production costs.

In addition, samples of North Dakota lignite were analyzed and subjected to a sink-float study to create a reference for upgraded lignite. The study produced specific recommendations for testing North Dakota lignite.

**STATUS**

To meet the product specifications, upgrading processes were evaluated for their adequacy of sulfur reduction, sodium reduction, moisture reduction, and product stability, size and density.

The study evaluated physical, chemical, and biological processes for sulfur reduction. Hydrothermal drying and ion exchange processes were assessed for sodium reduction. Thermal drying, mild pyrolysis, and hydrothermal drying processes were evaluated for moisture reduction. Pelletizing, briquetting, and extrusion were evaluated as processes to yield a stable, lumpy, low-dust and high-density product. Eleven raw lignite samples were analyzed to create a study base and to define the upgrading needs of specific lignites.

Physical cleaning could be used for selected lignites to reduce sulfur content. Thermal drying could be used to remove moisture. Hydrothermal drying or mild pyrolysis could be used to treat high sodium, high sulfur lignites. Briquetting could be used to produce a stable, lumpy, dense product. A combination of these processes could be used with selected lignites to meet the upgraded lignite product specifications. Upgrading process costs and development status follows:

Upgrading Process	<u>Total Cost Processing + Raw Lignite</u> Raw Lignite Low – High \$6.00/ton - \$7.50/ton	Development Status
Physical Cleaning	\$0.50 - \$0.73/MMBtu	Commercial
Thermal Drying	\$1.03 - \$1.29/MMBtu	Commercial
Hydrothermal Drying (briquetting + physical cleaning)	\$1.50 - \$1.83/MMBtu	Under development
Hydrothermal Drying (briquetting without physical cleaning)	\$1.42 - \$1.72/MMBtu	Under development
Hydrothermal Drying (without briquetting)	\$1.16 - \$1.53/MMBtu	Under development
Mild Pyrolysis	\$1.09 - \$1.38/MMBtu	Under development

It was recommended that a program be developed to improve the confidence in scaling operations of the drying technologies. Hydrothermal drying processes especially need a better definition of unit operation to refine conditions and costs. Coarse and fine coal hydrothermal processes should be studied. Thermal drying and mild pyrolysis processes were considered to be near commercial.