FY95-XIX-61
LIGNITE RESOURCE CHARACTERIZATION AND EVALUATION FOR MITIGATION OF ASH DEPOSITION

CONTRACTOR: Energy and Environmental Research Center

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PARTICIPANTS

Sponsor	Cost Share
US DOE	$152,000
Montana-Dakota Utilities	57,000
Knife River Corporation	57,000
ND Industrial Commission	113,984
Total Project Cost	$379,984

Project Schedule - 2 Years
Contract Date - 5/31/95
Start Date - 7/1/95
Completion Date - 12/1/96

Project Deliverables
Semi-Annual Report - 12/31/95✓
Semi-Annual Report - 07/01/96✓
Final Report - 12/31/96✓

OBJECTIVE / STATEMENT OF WORK

The objective of this project is to relate coal quality to combustion characteristics. This site-specific project will evaluate coal quality at Knife River Corporation's Beulah Mine and power plant operation at the Coyote Station. The goal is to determine coal quality indicators that can be used in developing mining plans and blending options to maximize boiler operating efficiency.

STATUS

Detailed analyses were performed on 21 samples taken from seven cores and one in-pit source representing the Schoolhouse Bed seam (Seam 1), Upper Beulah-Zap (Seam 2), and Lower Beulah-Zap (Seam 3). Analyses included standard American Society for Testing and Material (ASTM) methods (proximate, ultimate, and elemental ash), computer controlled scanning electron microscopy (CCSEM) and chemical fractionation.

The predominant mineral forms are pyrite, quartz, and mixed clays. Significant portions of these minerals exist as very fine particles. The samples also contained high percentages of organically bound calcium, magnesium, sodium, and sulfur. The extractable sodium corresponded to 70%-90% of the total sodium present.

Correlations were found between fouling and slagging and ASTM analysis data. High-temperature fouling (HTF) correlated with $\%Na_20$/% total ash; low-temperature fouling (LTF) inversely correlated to % Al_20_3; and slagging correlated with total ash. Advanced indices predict that boiler slagging and fouling is less severe with Seam 1 than Seam 2 or Seam 3. Two mine areas were mapped using ash deposition severity contours to potentially aid in mine planning.

The February and June 1995 fouling-related outages at Coyote Station correlated to the use of coal from areas of the mine with high HTF indices. In both cases, coal from areas with a high HTF index began to be used 2 weeks prior to the fouling-related occurrence at the Coyote Station. Boiler field tests revealed temperature "windows" where fouling occurs more readily in the convective pass.

A software program was developed to predict coal quality impacts on ash deposition. Two computer modules were developed; one for the Beulah Mine, and one for the Coyote Station. The modules predict ash deposition for designated blends of coal from various parts of the mines.

Recommendations to improve boiler operation include the following:

- Augment the current stockpiling practice to facilitate selective coal use or blending. Current stockpiling is done to expedite unloading. An augmented scenario could involve three stockpiles; one for average fouling, one for very high fouling, and one for very low fouling. Blending or selective use could be done to optimize boiler performance.
- The HTF, LTF, and slagging indices should be incorporated into the specification of quality.
- Excess air should be maintained at a minimum of 3.0% O_2 for all operating conditions.
- An upper limit for furnace exit gas temperature (FEGT) of 2000^o to 2100^0 F should be set.
- A mining and blending program based on standard ASTM analysis, HTF, LTF and slagging indices should be developed.
- An in-line coal sampler should be installed so as-fired coal analysis can be more closely related to boiler operations using a predictive model that was developed.