FINAL TECHNICAL REPORT
September 1, 2004, through August 31, 2005

Project Title: **POSSIBLE APPLICATION OF A NEW DRY COAL SEPARATOR IN AN ILLIONOIS COAL PLANT**

ICCI Project Number: 04-1/2.1B-3
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ABSTRACT

With plans to develop a new surface mine to extract coal needing only marginal cleaning from three different seams, S Coal Company decided to give dry separation technology serious consideration. Their proposed work would provide valuable information to Illinois coal operators interested in producing at minimal cost a quality product that is low in inert material. In contrast with most cleaning technologies used in the State of Illinois, dry separation achieves satisfactory cleaning of run-of-mine product without increasing the moisture concentration of the final product. This is desirable because product value decreases with increasing moisture content. The dry separation option chosen was a technology known as FGX, developed and commercialized in China during the past decade. FGX technology achieves density-based separation under the action of multiple forces including gravity and buoyancy. Gravity is brought into play through the use of a sloping separating deck. Buoyancy is achieved with the input of a fluidizing air stream combined with the vibratory motion of the screened separating deck.

Mining at S Coal Company's new pit near Elkville, IL commenced in the fall of 2004. Wet weather and abnormal geological conditions hampered development and delayed access to all three seams to be tested. In the meantime, Eriez Magnetics, owner of the FGX license in the US, elected to obligate their test unit at several mines in the Western US. Consequently, the proposed project never got off the ground within the one-year timeframe allotted for its completion. In lieu of this fact, researchers at the University of Kentucky and Virginia Polytechnic University have been contacted to request that testing of Illinois coal seams be included in ongoing work being done under a grant from the US Department of Energy (DOE) to collect data relative to FGX performance on various coal seams across the country.

EXECUTIVE SUMMARY

Illinois has extensive coal reserves in multiple seams underlying most of the lower two-thirds of the State. Due to the depositional nature of the reserves, quality varies from place to place throughout the State, but in large measure, two of the coal seams are continuous. These two seams, No. 5 and No. 6, are mined extensively and considerable data exists on various characteristics of these seams. However, most of this data is relative to wet coal cleaning processes widely used in the State of Illinois. A few attempts have been made to utilize dry cleaning techniques but little data is available on these efforts.

The need for an effective dry separation process arises from the competition being faced by the Illinois coal industry. As Illinois coal producers have struggled to compete with Western bituminous coal, two primary issues have emerged. One is coal quality with pollutants such as sulfur content becoming a key constraint on the ability to market Illinois coal. In contrast, Illinois' advantage has been a higher grade coal with greater heating value. However, nearly all of Illinois' coal requires cleaning to be marketable and the best available technologies for cleaning require putting the coal in slurry. Even after drying, a portion of the cleaning slurry remains increasing the moisture content of the final product and thereby reducing its value. The other issue is cost and once again, cleaning proves to be a detriment by adding to the cost of producing a salable product.

Dry separation technology offers the ability to reject ash and sulfur without increasing moisture content. It is a single stream process that involves minimal processing costs. The technology chosen for evaluation in this project is known as FGX, a new technology developed and commercialized in China. Within the last five years, nearly 200 FGX units have been placed into production in that country. The technical data on cleaning efficiency coming out of China is impressive but little or no data is available relative to US coals. The proposal was to evaluate coal cleaning performance of the FGX system on the three primary production seams in the State of Illinois, all being mined at S Coal Company's Elkville operation.

The FGX separator consists of a perforated separating deck, air chambers, and a vibrating mechanism. The separating deck, with riffles on its surface, is suspended in an inclined position both in the longitudinal and transverse directions. The angle of inclination is a process parameter that can be adjusted as desired. Gravity operates on the feed material due to the incline and the openings in the deck. Airflow supplied from a blower fluidizes the feed material on the deck and the vibratory mechanism provides a turning motion as the particles move toward the refuse end. Particle stratification takes place as a result of the motion supplied by the vibratory mechanism and the fluidizing forces of the airflow. Under the action of the vibratory force alone, coarse particles with lower density move to the upper layers of the bed of material. Under the action of the upward airflow alone, finer particles are blown to the upper layer irrespective of the particle density. Thus, with a suitable combination of vibration and airflow, solid stratification can be achieved. As a result, a bed of high-density refuse and pyritic particles forms on the bottom-most layer closest to the deck surface and is removed through the perforated openings into the refuse

chute. The buoyancy effect produced by the interaction of heavier particles can effectively control the misplacement of low density coal particles into the refuse bed, ensuring purity of the refuse being discharged from the system.

The value of this project also results from the fact that a majority of Illinois coal is produced from underground mines. In an effort to maintain an acceptable working height for men and equipment to operate in, some amount of out-of-seam material is invariably mined. Thus, the run-of-mine product can contain between 15% and 40% non-coal material requiring a cleaning process. However, the presence of this material often renders the cleaning process less effective. Recent research indicates that deshaling (removing the out-of-seam material) near the point of production significantly improves mine economics by avoiding the costs associated with handling this non-coal material and by improving the efficiencies of the cleaning operation. Towards this end, FGX technology is of particular interest to Illinois coal producers.

Unfortunately, circumstances at S Coal Company's new pit near Elkville, IL delayed or prevented any progress from ever taking place on this project. Mining of the new pit commenced in the fall of 2004 but wet winter weather followed by the encountering of abnormal geological conditions hampered access to the three coal seams to be tested. In the meantime, Eriez Magnetics, owner of the FGX license in the US, elected to obligate their test unit at several mines in the Western US. Consequently, the proposed project never got off the ground within the one-year timeframe allotted for its completion. As a result, the project was terminated without any of the proposed work being completed and without any of the research funds being spent.

It should be noted that because of continued interest in the data that was to be obtained from this project, researchers at the University of Kentucky and Virginia Polytechnic University were contacted regarding integration of Illinois coal seams into an ongoing project being conducted with funds from the US Department of Energy (DOE). The principal investigators on this project have an operating agreement with Eriez Magnetics to test various coals in the FGX test unit. It is hoped that Illinois coal seams will be included in this DOE project so that the desired data relative to FGX performance on Illinois coals can still be obtained.