Scoping Study:

Potential for Fine Coal Recovery from Indiana's Coal Settling Ponds

Interim Report
to the
CCTR Advisory Panel

Purdue-Calumet, Hammond, IN

December 6, 2006

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Interim Report Summary

In August, 2006, R.E. Mourdock & Associates, LLC was contracted by the Center for Coal Technology Research to perform a Scoping Study entitled "Potential for Fine Coal Recovery from Indiana's Coal Settling Ponds." The project was and is envisioned to be an important first step in determining what resource potential exists and what technological, environmental, governmental actions may be required to benefit from the carbon that remains in abandoned and active coal slurry ponds.

The Scope of Work as detailed in the contract consists of seventeen (17) tasks to be completed during the course of the project. The tasks are multi-disciplinary and thus the project team was assembled to include expertise in the areas of resource determination, market potential, coal beneficiation, mining, environmental and legal issues. Thus the project team consists of:

- **R.E. Mourdock & Associates, LLC** as principal investigator and coordinator
- **Indiana Geological Survey** for resource site identification / quantification
- **Purdue Water Institute** for cost/benefit analysis and beneficiation
- **Hull & Associates, Inc.,** for environmental assessment and impact
- **Charles B. Lee**, for existing market identification
- **James R. Holden, Esq**., for review of legal issues re: extraction, costs, right of entry, etc.

A fundamental goal of this Scoping Study is to identify a site or several sites that may be suitable for near-term development. In the event that target sites can be identified, the research team will make recommendations for a development strategy that would serve as a model for other sites across Indiana and throughout the Midwest. Minimal field work has been budgeted as a part of this Scoping Study but the tools and methods suggested in the final report will, it is believed, provide optimal means to allow for the extraction of the highest possible quality of coal fines from settling ponds.

The many tasks required as part of this Scoping Study have caused the several team members to work independently as background and baseline data are being assembled. Thus this interim report is divided by functions of the several researchers. As we move forward toward the completion of the final report the team members will be meeting to coordinate their findings to develop the working model.

Indiana Geological Survey: Resource Site Identification / Quantification

The purpose of the IGS work is to provide preliminary estimates of the total area and volume of coal slurry deposits in Indiana and to provide recommendations for future sampling and analysis. Toward this end, Dr. Denver Harper has completed numerous tasks that have helped define potential fine coal resources and organized data useful for future researchers.

Methods:

- Compile information on coal-preparation plants in Indiana
- Use historical and aerial photos to map the locations of preparation plants
- Use historical aerial photos to identify and map the slurry cells associated with the prep plants
- Compile data that can be used to estimate the volume of material present
- Evaluate the current "reclamation" status of the slurry ponds
- Make recommendations to REMA/CCTR regarding future drilling and sampling

Tasks that have thus far been completed as a result of the methods employed by Dr. Harper include the compilation of a map entitled "Distribution and Characterization of Coal Slurry Deposits." This map of all of the coal bearing counties in Indiana is a pronounced step forward from the prior publication of the Indiana Geological Survey, the work of Eggert, MM28, 1979. The map indicates the type of coal slurry deposit believed present (final cut, ground, spoil placement, impoundment). Pre and post 1978 sites are also noted.

Coal Age Magazine, a long standing publication of the industry provided fifty-six (56) articles during the period of 1926 - 1969 that helped to identify sites and provided information relative to the nature of the coal that may be present.

A comprehensive suite of Excel spreadsheets have been compiled to serve as a comprehensive bibliography to all known coal slurry deposit sites in Indiana. (attached). Partial data included on a mine by mine basis includes:

IGS Identification number
Mine Name / Company
Annual Capacity
Estimated overburden
Coal seam(s) mined
Data source (photos, maps, etc.)
Start Date
End Date
Date of referenced information

The most relevant information regarding the assembled data is that the historical review by Harper indicates on a mine by mine basis the location of the coal slurry pond at given

points of time. Historical aerial photos have been used to interpolate the development of ponds over the course of the mine life to allow a more accurate determination of volume and "recoverability" than was previously possible. The determination of the type of setting that was the scene of the deposit (e.g., final cut pit versus flooding an area of unreclaimed mine spoil) has enormous implications to the accuracy of forecasting the volume of material present. Equally important, the knowledge as to the type of site utilized will also ultimately help determine what method of recovery is most suitable for the deposit.

To date important progress has been made in the identification of large areas where recoverable quantities of coal slurry may be located. The I.G.S. has identified the following.

Type placement locale	Abbreviation	Number of Sites	Identified Acres of Site
Final Cut Pits	FCP	69	751
"On ground" placement	GND	74	1144
Placement in/on Spoil Banks	SPL	62	858
Water flooded impoundments	IMP	95	1011
Non Slurry sites	NS	68	697
Totals		368	4461

Eleven sites have been located with coal slurry deposits in excess of 100 acres:

Mine Name & IGS Code		Identified Acres
Lynnville	K1	387
Minnehaha	D3	153
Hawthorn	E4	145
Ayrshire	K5	123
Friar Tuck	D4	123
Universal	A2	120
Chinook	C2	112
Latta	E1	112
Old Ben #2	J1	110
Old Ben #1 (aka "Enos")	J5	108
Old Chinook	C1	104
	Total Acres	1597

Charles B. Lee: Research into potential coal markets

To date, a research summary has been completed which details the existing conventional coal markets that could, with little or no technical modification, utilize as fuel coal fines recovered from Indiana's settling ponds. It should be understood that the boiler specifications of each unit will strictly dictate the "match" between the chemistry of a potential fine coal resource and that plant's capability of using the coal. The final report will include a summary of coal requirements on a per plant basis.

There are some fourteen (14) investor – owned cooperative and/or Municipal coal burning electric power generating companies in the state with twenty-four (24) plants currently permitted and operating.

There are thirty-two (32) industrial and institutional coal-burning electric generating plants in Indiana.

Another approach considered would be the recovery of fines solely for the purpose of blending the product with "freshly mined" coal from other operations. As of this date, some 33 producing coal mines are actively mining and selling product and, in the event that total delivered cost of fines to those mine operations could offset their current production, such mines could prove a likely market. The final report will detail the potential volume of coal fines that could be captured by this market segment.

Non-traditional markets exist and are developing in Indiana. Currently, the Wabash River Coal Gasification Plant is operating on a feedstock of petroleum coke but it may have application for fine coal utilization. The recently announced coal gasification project near Edwardsport also is a potential new market. Additional data will be included in the final report that may define the potential for coal fines as feedstock for coal gasification within the state.

The final market segment is "new technology utilization", or "what products might be developed from recovered coal fines that don't currently exist?" Mr. Lee, together with P.W.I and the I.G.S. will jointly research this topic for the final report.

Expected recovered product quality:

Research was performed based on product historically recovered and sold without further beneficiation. It is expected that the following would represent an "average" Indiana coal fines product:

Ash	14% - 30%
Moisture	18% - 28%
Sulfur	.5% - 7%
BTU/lb.	8,000 – 9,000

Purdue Water Institute: Cost/benefit analysis and product beneficiation

Through a team of graduate students, P.W.I. has assembled and researched more than 90 technical papers to date on potential methods of fine coal beneficiation. Papers under review detail potential methods including the use of polymers, centrifuges and filter presses to separate fines from non-coal impurities and to dewater the hydrophilic materials.

Hull & Associates, Inc.: Environmental Assessment and Impact

Hull & Associates' expertise will ultimately serve to define, on a site-specific basis, how the potential recovery of coal fines will impact a watershed, wetlands and the specific immediate environmental area near a recovery operation. Though the site-specific phase of their work has not yet begun, they have compiled a compendium of resources as to water quality and hydrologic effects of such operations. This compendium will be included in the final report and was compiled after a review of data sources from Indiana, Ohio, Pennsylvania, West Virginia and Illinois. To date, the compendium includes 58 articles from the various states that have direct applicability to the Scoping Study.

If appropriate at the time of the site-specific analysis, Hull will also make recommendations as to the use of "best available technology" to minimize disturbance to surrounding areas as a result of the recovery of coal fines.

James R. Holden, Esq.: Legal Issues

Mr. Holden's expertise will be applied to specific tracts under investigation. At this time, no specific recommendation has been made as to a site for this study so his investigations will be performed and included for the final report.