TECHNICAL PROGRESS REPORT
for the Second Quarter of FY 1995
(January 1, 1995 - March 31, 1995)

UPGRADED COAL INTEREST GROUP

by

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ABSTRACT

The group met on January 10 and 11, in Nashville, TN. The status of various coal upgrading technologies was reviewed. Four new technology opportunities were given reviews, Coal/Waste pellets, Custom Coals advanced technology, CSRC sulfur removing bacteria and a Mag-Mill which is a magnetic separation done within the pulverizer.

Coal Waste pellets is a technology for making pellets of coal and fiber waste from recycling plants. The incentives are low cost and low sulfur and nitrogen. Lebowitz made a field trip to the pilot unit in Canton Ohio.

The Mag Mill takes advantage of the natural concentration of pyrite in the pulverizer recycle stream (due to its hardness). Special magnets are installed in the mill to remove pyrite from this stream.

Custom Coals reported on an advanced two step process for removal of organic sulfur from coal.

Consolidated Sulfur Reduction Co. reported on a two step microbial desulfurization process.

PROJECT OBJECTIVES

The objectives of the Upgraded Coal Interest Group (UCIG) are as follows:

- Review and update the status of various coal upgrading technologies and developments and critically assess the results.
- Perform engineering screening analyses on various coal upgrading approaches.
- Perform commercialization analyses that will promote the availability and use of upgraded coal products by quantifying the benefits of using them. Identify market opportunities for introduction of upgraded coals.
- Perform critical analyses on a variety of coals and technologies in areas important to users but not readily available. Perform critical experiments which will show the differences between technologies.
WHAT'S NEW IN UPGRADED COAL?

Prepared for the Upgraded Coal Interest Group
by
Fossil Fuel Sciences
HOW WILL THE RECENT FEDERAL ELECTION AFFECT UPGRADED COAL PROJECTS?

RACE TO KILL DEPARTMENT OF ENERGY

"There is a real competition to see who is more aggressive at protecting the taxpayers' money," said David Nemtzow, president of the Alliance to Save Energy.

Sen. Bob Dole, Republican majority leader in the Senate said that the Energy Department is a candidate for elimination. He said he didn't see "any useful purpose" in continuing the department and its activities "can be wrapped into something else."

"I think the federal government ought to be cutting agencies and, if possible, departments," said Deputy Energy Secretary Bill White, who is leading a massive reorganization effort at the department.

There probably isn't another part of government that would want waste clean up tasks, which will cost $12.5 billion during 1995. The nuclear weapons manufacturing and cleanup represent two-thirds of the department's $18 billion budget. The remainder is basic physics research, energy research programs, the Strategic Petroleum Reserve and government-owned electric power systems.

THE ADMINISTRATION:

President Clinton has included the following as part of his $24 Billion cut to finance the "Middle Class Tax Break":

- $1.2 B from Applied Science - including a Clean Coal Program
- $3 B in "Strategic Realignments" - rumored to include a National Lab and an Energy Technology Center
- $4.4 B "Savings" in waste clean-up
- $2 B for sale of the Naval Petroleum Reserve and sale of uranium obtained from former Soviet Union
- $12 B for sale of power administrations

The President announced that he had ordered Vice President Al Gore to expand the existing 'reinventing government'...

Mr Gore described the Energy Department as a "relic of the OPEC and Cold War period ..."
THE CONGRESS:

The former Energy and Commerce Committee has been broken up.

The new Commerce Committee, retained most of the jurisdiction over most energy and environment issues.

Robert Walker of Pennsylvania will chair the new Technology and Competitiveness Committee (Science Committee?) which will assume jurisdiction over some energy issues, primarily research and development that had been under Energy and Commerce.

Anticipated that the fight over energy-related R&D will come in the appropriations committees. "How much of the research will the new House leadership view as inappropriate government action that would best be done by private sector?"

Other committees important to the energy industry include Appropriations, which will be chaired by Rep. Bob Livingston of Louisiana, and Ways and Means, which will be taken over by pro-industry Rep. Bill Archer of Texas, who favors the tax incentives sought by independent producers.

The Budget Committee will be chaired by Rep. John Kasich of Ohio.

Senate has put off change until a task force led by Sens. Pete Domenici of New Mexico and Connie Mack of Florida reports on March 1.

Domenici, who had been ranking Republican on both the Budget and Energy committees, will chair the former. Domenici already has sounded a note of caution about attempting wholesale budgetary changes.

"NOT ANOTHER PUBLIC WORKS COMMITTEE", SAYS NEW HOUSE SCIENCE PANEL CHAIRMAN

The old House Science, Space and Technology Committee will soon be known simply as the House Science Committee and will focus on science and technology of "real worth based on peer review," not science "used to confirm a political agenda or pork barrel politics." according to the new chairman Robert Walker, R-Pa."This will not be another public works committee."

The committee, has jurisdiction over all energy research, development and demonstration, and any projects related to the commercial application of energy technology.
Four Subcommittees:
- Space and aeronautics subcommittee.
- Basic research subcommittee. The panel will oversee the National Science Foundation; the Office of Science and Technology Policy; Office of Technology Assessment; and basic research issues.
- Technology subcommittee. The panel will oversee the Technology Admin.; the National Institute of Standards and Technology; Federal Aviation Admin. research, engineering and development; surface and water transportation research; all issues and policies that affect the competitiveness of private-sector technology development.
- Energy and environment subcommittee. It will handle all the Energy Dept.'s civilian research programs and all energy research, development and demonstration; all measures relating to the commercial application of energy technology; all the National laboratories; all Environmental Protection Agency research programs and all federal environmental research and development programs; National Oceanic and Atmospheric Admin. -- including marine research, oceanography and the National Weather Service.

"We need clean, efficient fuels for the future that will help get us out of an overburdening regulatory government."

"We live in revolutionary times, and can't continue the schizophrenic practice of the past" with the year-to-year giving and taking away of funding." - Favors multiyear authorizations for big-ticket projects to ensure their completion.

Believes in university-based research and moving government scientific centers to more university-associated models but opposes academic earmarks and wants to penalize those institutions that seek them.

Mr Armey, incoming house majority leader, suggested that the Departments of Energy and Education could be eliminated and the Commerce Department and the Environmental Protection Agency could be severely reduced.

CONCLUSIONS:

Federal Energy R&D faces the greatest challenge since 1952. Little support from the Administration; Congress has a new ideology of "the appropriate role for government". This difference between the parties is an historic one which has been manifested since the 20's.

Today's energy industries should consider the shut down of the syn-fuels program in 1980. It may be possible to extract "goodies" in return for gutting your favorite programs:
- Extension of Nonconventional Fuel tax credits
- Regulatory relief (e.g. Air Toxics) etc.
- These items are consistent with the currently favored ideology

The reduction in Committee's staff will make any "bottoms" up effort difficult - premium on access to the members.
LOW RANK COAL UPGRADING
CLEAN COAL DEMONSTRATIONS

ROSEBUD SYNCOAL PLANT (ENTECH PARTNERSHIP) - High Temperature Drying Process

Reduces moisture in the Rosebud coal from 25% down to 2%, and boosts heat content from 8,710 Btu/lb to 11,800 Btu.

Extensive Testing At Montana Power Corrette Plant
   - Improved boiler efficiency
   - Improved boiler cleanliness
   - Higher load

Continue to be limited by product stability. Able to transport product by applying a water based additive which stabilizes the product or ship untreated product in closed hopper cars. The additive works well but increases the moisture back to 10 - 15%. Hopper cars work fine but are slower to load and the coal is still unstable when unloaded.

Major marketing target includes industrials, cement and lime producers including Ashgrove Cement, Continental Lime and Empire Sand and Gravel.

Two commercial-scale projects using this technology are in the planning stage:
A lignite-upgrading plant at a Minnkota Power facility in North Dakota.
A plant located at a mine in the southern Powder River Basin, probably the Rocky Butte mine that Entech hopes to open in the late 1990s.

A major investment house report on Montana Power includes a discussion of the process development: The pilot plant is running at full capacity and the DOE has increased funding for what appears to be the only remaining viable solid synthetic coal process. To exploit the associated tax benefits, a commercial plant must be in service by 1997, which is still possible if adequate purchase commitments are obtained.

The marketing focus has switched from utilities to industrial customers, which tend to be less price-sensitive and have closed storage facilities enabling them to handle product directly from the new pilot plant. Although progress continues, we have been concerned that the pace will not allow a full-size plant to be operating by 1997 - a DOE requirement for receiving valuable section 29 (synthetic fuel) tax credits.

ROSEBUD OFFERS FREE COAL TESTS FOR SYNFUEL PLANT

Come one, come all and bring your raw coal with you -- at least 1,000 tons of it. The Rosebud Syncoal Partnership is offering to test low rank coal at its coal upgrading demonstration plant in Montana free of charge. Includes written report and bulk samples. No takers yet.
ENCOAL PROJECT - A coal pyrolysis process which makes both liquid and solid fuel products

Claim to have solved the stability problem

Shipping blends of solid product (PDF) and PRB coal

The first shipment of clean fuel from ENCOAL Corp.'s clean coal plant has been made to an Oklahoma power plant in October 1994. 60,000 tons of blends of the PDF and the parent western coal -- ranging from 15% to 30% clean coal -- to Western Farmers' Hugo plant in Oklahoma.

Have also sent 10,000 to 20,000 ton shipments of 40%, 70% and 90% PDF/coal blends to Muscatine Power in eastern Iowa.

The 90% case was not a blend as such but was PDF with the cars topped with coal for transportation.

Claim to have had no problems with shipping, handling, or combustion except that the ESP performance was not as good due to the low sulfur content of the product.

Plan 30,000 ton burn at Wisconsin Power and Light who demands pure PDF.

SGI (the technology licensor) is teaming with Mitsubishi Heavy Industries to push the LFC technology in China. The two are studying the economic and technical feasibility of siting an LFC clean coal refinery at Longkou Harbor in China's Shandong province.

Represents the largest pyrolysis plant where both the solid and liquid products were sold as premium fuels. Both fuels have seen extensive industrial use.

SGI has tested mildly caking coals (require pre-oxidation step) as well as sub-bituminous coal on a 50 lb/hr PDU. They are completing a 1 TPH PDU to produce samples and for process development.

BOTH ENCOAL AND SYNCOAL PROJECTS HAVE RECEIVED 2 YEAR EXTENSIONS OF OPERATION FROM DOE (50%).
KENNECOTT EYES DRYING PROCESS

Kennecott Energy is reported to be studying the feasibility of a drying process to boost the heating value of its sub-bituminous coals.

In the technology testing stage. Based on technology used by FMC Corp. coke plant in Kemmerer, Wyoming. Process was developed by Puron Corp. The FMC plant produces coke for their phosphorous plant.

Kennecott applied for EPA permit for an expansion of their facility near Gillette to produce up to 6 Million tons per year of upgraded coal.

Technology sounds like the front end of the FMC pyrolysis process which was piloted with US Steel in the early 1960s to make formed coke (500 ton per day plant built in Kemmerer in 1960). Multiple fluidized beds operating at progressively higher temperatures.
CUSTOM COALS AIMS FOR SPRING 1995 START-UP

With the bulk of major construction work done, Custom Coals Corp. plans to have its coal upgrading plant in Somerset County, Pa., complete by the end of February.

The clean coal plant would turn 2.9 million tons/yr of raw coal, mostly from area producers, into two types of clean coal: Carefree Coal, which meets Clean Air Act standards, and Self-Scrubbing Coal, which includes limestone to further reduce emissions.

CLEAN COAL TECHNOLOGY DEMONSTRATION PROJECT
Centerior Energy and the power department of the city of Richmond, Ind., will burn the Self-Scrubbing Coal, and Duquesne Light will burn the Carefree Coal.

COAL & SYNFUELS TECHNOLOGY (December 19, 1994) reported that Keystone-Conemaugh is looking at low sulfur coal and SO2 credits to meet Phase 2 emissions limits for Keystone. One possibility is clean coal upgraded at Custom Coals plant in Somerset County, Pa., which is due for full production in mid-1995 (C&ST 12/5). Key-Con official John Olansen said Key-Con likely will test the clean coal in 1996 for use at Keystone.

COAL OUTLOOK (December 12, 1994) reports that Commonwealth Edison hopes to have all of the 500,000 tons of Utah coal which it has ordered to the stockpile at its Kincaid power plant. This coal is expected to last through May of next year. Sometime in the first quarter of 1995 Com Ed hopes to decide what coal will be ordered for the rest of 1995 and perhaps beyond, said Com Ed official Art Massa.

The utility is considering the option of taking upgraded and cleaned coal from the mine next to Kincaid, which had been supplying the plant for over 30 years: Peabody Coal’s Mine No. 10. But the company that wants to buy the mine from Peabody and build a coal upgrading plant there still hasn’t come to the utility with the results of a test upgrade of that coal, said Massa.

No final negotiations can take place until those test results are available.

COAL & SYNFUELS TECHNOLOGY (December 5, 1994) reports that Consolidated Sulfur Reduction Corp. says it has developed a process that uses bacteria to reduce sulfur levels in coal from 4% to 1%. Based on Technology developed at Dow Chemical, the process reported to remove both organic and inorganic sulfur.

CSRC has reportedly figured out how to avoid poisoning of the bacteria with process off-gasses and how to halt the reaction before the coal itself is attacked.
Uses -1mm coal (-16 Mesh). The bacterial mass produces a binder for reconstituting the coal.

COAL WEEK (October 17, 1994) reported an announcement that DOE to provide $250,000 for low sulfur coal development project with a partnership of Virginia Polytechnic Institute (VPI) and five major coal companies. The program is designed to assist the U.S. coal industry to improve its efficiency in producing low sulfur coals. $63,000 will be put up by the partners.

The Appalachian Clean Coal Technology Consortium (ACCTC) will include VPI, University of Kentucky and West Virginia University, and five affiliate coal companies including A.T. Massey, Arch Mineral, Amvest Mineral, Consol and Pittston.

The work plan includes 1) development of new, advanced coal cleaning technologies; 2) improvement of the efficiency of existing coal cleaning technologies; 3) information exchange and 4) training of personnel for industry.

COAL WASTE PELLETS
Alternate Fuel Inc. Process

COAL + WASTE FIBER + WEATHERPROOFING AGENT PELLETS

Lebowitz made a field trip to AFI Pilot Plant and R.C. Miller Stark Recycling Center

The recycling center takes 1000 tons per day of residential (50%), industrial (30%) and commercial (20%) garbage, "Dirty Murph". The waste is separated into paper products, iron, aluminum, various plastics, electric motors, by magnetic separators, and (believe it or not) hand sorting. The operation is characterized by a penchant for quality control - producing high quality waste products which draw a premium price on the recycle markets. The fiber product which is left for landfill, known as fluff, is the fiber for the AFI process.

The fluff is sulfur free and low in ash and chlorine (particularly important), and looks like lint. The AFI process compacts it and blends it with coal to make a hard pellets. Fluff ordinarily is land filled and brings a tipping fee subsidy with it.

AFI has a 25,000 tpy pilot plant in operation and a 300,000 tpy plant on the drawing board.

Good opportunity for a utility to "get involved" with using a very "safe" MSW.

KEY IS A RELIABLE SOURCE OF CLEAN FLUFF THAT WILL NOT BE CLASSIFIED AS MSW.

With the above caveat, this looks like a great opportunity!
EXPORTech and Joint Venture partner Bradley Pulverizer Company are developing a high efficiency magnetic separator to effect fine coal cleaning within the pulverizer itself. The principle of the device is to selectively remove the hardest minerals from the internal circulation of the mill (rich in pyrite) and to remove the pyrite with advanced magnetic technology. Potential benefits include:

- Substantial pyrite removal with very high BTU recovery
- Improved pulverizer maintenance
- Increased throughput
IOWA STATE ORGANIC SULFUR REMOVAL

- Aqueous System - Atmospheric pressure process
- Oxidation - Extraction Process using air and an acid solution with a dissolved salt (the solution is a readily available waste product).
- 20 - 40% organic sulfur removal and nearly complete pyritic sulfur removal

Before the last meeting, Bechtel had worked up an analysis based on data which were supplied from the project. Several questions arose from the Bechtel review:

- Change in oxidation state of the dissolved salt - Is the salt a reagent? Is the oxidation state changed? Can the product form of the salt be regenerated or removed?
- Is chlorine picked up on the coal? Can it be removed?

As a result additional work was done by Prof. Chriswell. This work was analyzed in detail and a new process design has been prepared for the slurry study. A confidential report will be included in that study, and has been resubmitted to Bechtel for cost estimation.

Principal Findings:

- The salt is not a significant net reactant and appears to be a catalyst (may react and internally regenerate). The main oxidant is air. The proof of this is a series of runs without the salt present (air and acid only). The sulfur removal was slower but ultimately only about 25% less than with the salt.
- The coal has not increased in chlorine after neutralization. Chlorine is included in the coal before neutralization.
- About 35% reduction in nitrogen content of the coal also observed!
REMOVAL OF TRACE METALS BY ADVANCED COAL CLEANING

VIRGINIA POLYTECHNIC INSTITUTE

Illinois 6 Coal
Pittsburgh No. 8 Coal

One Stage
Two Stage
Complexing Agent
Figure 7. Combined trace element removals after Microcel, MGS and EDTA treatment processes for the Illinois No. 6 seam coal.
Figure 6. Combined trace element removals after Microcel, MGS and EDTA treatment processes for the Pittsburgh No. 8 seam coal.
SLURRY PROJECT ASSESSMENT
SLURRY PROJECT DEVELOPMENT

- REQUESTS FROM MEMBERS TO INVESTIGATE OPPORTUNITIES FOR PROJECTS
- REQUESTS FROM MEMBERS FOR INFORMATION ON METHODOLOGY

STEPS IN DEVELOPING A PROJECT: (OFFER CAFETERIA STYLE TO MEMBERS)

1. **IDENTIFICATION OF POWER PLANTS** where there is interest in consideration or where slurry utilization is feasible - This is primarily a matter for the utility and the power plant assessment consultant (see step 5 below) to determine which plants are included in the study and what are the utilities expectations based on feasibility of conversion to slurry and potential for NOx reduction.

2. **SURVEY OF POTENTIAL SLURRY RESOURCES** - Identify the potential resources (cleaning plants and ponds) in reasonable proximity to the power plants. Preliminary evaluation of the sources in terms of quality and quantity of coal, potential for upgrading, transportation and handling costs, environmental factors, and business intelligence factors. Prepare a short list of the most promising opportunities and a preliminary cost evaluation. (CQ)

3. **BUSINESS EVALUATION** - Obtain a more detailed business evaluation of the most desirable resources to see whether they are available, at what price, and to turn up any hidden problems, e.g., environmental obligations. Environmental and business due diligence. (MATS)

4. **RESOURCE CHARACTERIZATION** - Sample the pond or plant output and conduct recovery and upgrading tests. Estimate the quantity of the resource. Estimate recovery cost and delivered cost to each feasible power plant. (Multiple)

5. **POWER PLANT ASSESSMENTS** - Provide preliminary guidance during the selection of feasible plants in step 1, above, and identification of plants which have unusual problems or desirable features which would result in substantial difference from average cost. Conduct preliminary designs and cost estimates for sites which pair up with a good resource. (EER)

6. **COORDINATION AND DOCUMENTATION** - Coordinate the subcontractors - Prepare final documentation for the owner to base his decision and document due diligence. (FFS - Other)
COMMON ELEMENTS

1. SLURRY TRANSPORTATION AND HANDLING ALTERNATIVES AND COSTS
2. DUE DILIGENCE REQUIREMENTS FOR ESTABLISHING RESOURCE OWNERSHIP
3. LICENSING AND PERMITTING REQUIREMENTS GUIDELINES
4. ENVIRONMENTAL RELATED RISK ASSESSMENT GUIDELINES
5. STANDARDS FOR RESOURCE ASSESSMENT GUIDELINES