



ENVIRONMENTAL REVIEW of SYNTHETIC FUELS

INDUSTRIAL
ENVIRONMENTAL
RESEARCH
LABORATORY

VOL. 1 NO. 1

JANUARY 1978

RESEARCH TRIANGLE PARK, NC 27711

INTRODUCTION

In response to the shift in the U.S. energy supply priorities from natural gas and oil to coal, the Environmental Protection Agency has initiated a comprehensive assessment program to evaluate the environmental impacts of synthetic fuel processes having a high potential for eventual commercial application. This overall assessment program is being directed by the Fuel Process Branch of EPA's Industrial Environmental Research Laboratory, Research Triangle Park (IERL-RTP).

The primary objectives of the EPA Synthetic Fuels Environmental Assessment/Control Technology Development Program are to define the environmental effects of synthetic fuel technologies with respect to their multimedia discharge streams and their health and environmental impacts and to define control technology needs for an environmentally sound synthetic fuel industry. The synthetic fuel technologies being studied in this program include low/medium-Btu gasification, high-Btu gasification, and liquefaction. To achieve the program's overall objectives, the EPA has defined six major task areas that are discussed in this review. The contractors involved in the overall program, their EPA Project Officers, and the start and completion dates of each contract are tabulated on page 6.

This publication is the first in a series of periodic reviews of recent activities in the production of synthetic fuel from coal. Included are activities of the EPA's contractors, summaries of major symposia, a calendar of upcoming meetings and a list of major publications. The second in this series is scheduled for distribution in early 1978. Comments or suggestions which will improve the content or format of these reviews are welcomed. Such comments should be directed to the EPA or Radian Corporation personnel named on page 6 of this review.

CURRENT PROCESS TECHNOLOGY BACKGROUND

General Topics

Support Services for Fuel Processes — Cameron is providing the EPA Fuel Process Branch (EPA/FPB) with systems analysis and program support primarily in the areas of coal processing, coal liquefaction, and coal gasification.

Review of Coal Conversion Processes — As part of their program to develop control technologies for the products and by-products from coal conversion processes, Catalytic, Inc. has reviewed coal gasification and liquefaction processes. From this review a listing was prepared of processes and products/by-products to be studied in greater detail.

Low/Medium-Btu Gasification

Data Base for Low/Medium-Btu Gasification Technology — Radian conducted an extensive information search to identify significant data relative to low/medium-Btu gasification technology, with emphasis on gasification, gas cleanup, pollution control, and environmental regulations. Test methods, including pertinent sampling and analytical techniques, were investigated. Information on coal reserves, energy policies, and related fossil fuel technologies was also collected. The data base, which now contains approximately 10,000 citations and over 3500 full-text documents, is maintained as an independent library at Radian.

Analysis of Low/Medium-Btu Technology — One of the most significant activities during the first half of Radian's low/medium-Btu gasification program involved a detailed engineering assessment of available process, environmental, and control technology data for low/medium-Btu gasification and end-use technology.

Early study activity was centered on gas purification and pollution control processes. As data for other processes became available, the scope of this assessment was broadened to include coal pretreatment, gasification, and end-use technologies. The results of the engineering assessment were published in a two-volume document, "Environmental Assessment Data Base for Low/Medium-Btu Gasification Technology" (EPA-600/7-77-125a and b, October 1977). This report contains descriptions of: a) the processes which can be used to produce low/medium-Btu gas from coal, b) the constraints imposed upon those processes by the intended end-uses of the product gas, c) the air, water, and solid waste streams generated by those processes, and d) the pollution control techniques which appear applicable to multimedia discharge streams from those processes. Throughout this report, attention is focused on those processes which appear to have the highest likelihood of near-term commercialization. The results of this report provided significant input in establishing priorities for subsequent activities in the low/medium-Btu gasification program.

In-Situ Study — In May 1977, Radian published "In-Situ Coal Gasification: Status of Technology and Environmental Impact" (EPA-600/7-77-045). This report contains discussions of the chemistry, technical problems, and environmental considerations of in-situ gasification technology. Activities at specific U.S. and foreign in-situ projects are summarized. Descriptions of the objectives, experimental approach, and results of each of these projects are presented.

High-Btu Gasification

High-Btu Overview Report — TRW is preparing a technology overview report as a first step in their high-Btu coal gasification environmental assessment program. Nine gasification systems have been selected for detailed

analysis, including HYGAS, BI-GAS, COGAS, Hydrane, Synthane, Texaco, CO₂-Acceptor, Self-Agglomerating Ash, and Lurgi. A modular approach is being used in the process evaluation and in defining information gaps. These modules are identified as the gasification module, the gas treatment module, the pollution control module, and the integrated facilities module. A data sheet format has been adopted for presentation of the modules in an effort to avoid lengthy general process descriptions. To date, data sheets for the gasification module have been prepared on six of the nine processes being considered.

Liquefaction

Summary of Liquefaction Technology Prepared — A major effort in Hittman's environmental assessment program is the compilation of a data base in which data on 14 liquefaction processes are summarized. The data base was used to establish process priorities and to identify information gaps in the preparation of the report, "Technology and Environmental Summary for Coal Liquefaction." This report is expected to be available in January 1978. A prioritization scheme for future study was developed using criteria such as stage of development, potential hazard for residual emissions, and energy efficiency. The four processes to be investigated more thoroughly are Solvent Refined Coal (SRC), H-Coal, Exxon Donor Solvent, and Synthoil.

ENVIRONMENTAL DATA ACQUISITION

General Topics

Pollutants From a Laboratory Gasifier — RTI has initiated a parametric evaluation of pollutants from a laboratory gasifier. The program will consist of three phases: screening studies, parametric control evaluations, and reaction kinetics research. The screening studies will consider qualitatively and, for selected compounds, quantitatively the variety of chemical compounds produced during gasification reactions. RTI estimates up to 300 different compounds may be screened in the course of these tests.

In the second phase, parametric studies, the application of reactor operation to control of pollutants will be examined. Parameters to be considered for investigation include coal type, grind size, pretreatment methods, bed depth, temperature, pressure, steam flow rate, residence time, catalysts, and additives. Other parameters such as bed type (fixed, entrained, fluidized) and reactor type (batch, semi-batch, plug flow, mixed flow) will also be considered. Statistical methods will be used to minimize the number of tests required while still allowing all significant parameters to be investigated.

Work on Control Assay Development Initiated — Catalytic, Inc. has initiated work on Control Assay Development (CAD) for coal conversion processes. CAD is a program to complement environmental assessment activities. The objective is to perform quick screening treatments on streams suspected of containing pollutants requiring control. Analyses will be made before and after treatment to evaluate the effective-

ness of pollutant control. This program is expected to shorten the period of time between problem identification through Level 1 assessment and final recommendations for application of control technology.

Low/Medium-Btu Gasification

Test-Plan Manual — Radian has prepared material which provides guidelines for the development of environmental test programs. Major emphasis is placed on the strategy involved in developing process descriptions and selection of sampling and analytical techniques. This material is being incorporated into a comprehensive document, "Guidelines for Preparing Environmental Test Plans for Coal Gasification Facilities," which should be available in early 1978.

Test Sites Selected — Radian has arranged for conducting environmental tests at four low/medium-Btu gasification facilities: a) Holston Army Ammunition Plant, Kingsport, Tennessee; b) Kosovo Kombinat, Pristina, Yugoslavia; c) Glen-Gery Brick Co., York, Pennsylvania; and d) University of Minnesota, Duluth, Minnesota. Testing of the Holston plant was completed in early September 1977.

An environmental test plan for the Kosovo plant has been developed jointly by the Rudarski Institute (Belgrade, Yugoslavia), EPA, and Radian as part of a cooperative environmental research program. The Kosovo complex has been in operation since 1971, using Lurgi gasifiers to convert lignite from adjacent mines to fuel gas and fertilizer plant feedstocks. The test plan was completed in September 1977; sampling and analytical activities at the Kosovo facility started in November 1977. Radian is providing on-site technical assistance during the tests.

Preliminary test plans have been developed for the Glen-Gery (Wellman-Galusha gasifier) and University of Minnesota (Foster Wheeler/Stoic gasifier) sites. Testing at Glen-Gery is planned for early 1978; at the University of Minnesota, late 1978. Both programs will be conducted in cooperation with DOE's Gasifiers in Industry test program.

Report on Gasification Sample Analyses — During visits to several potential environmental testing sites, Radian obtained grab samples of selected liquid and solid discharge streams. EPA Level 1 analytical procedures plus some additional analyses were run on these samples. The results of this analytical work are being summarized in a report, "Analyses of Grab Samples from Fixed-Bed Coal Gasification Processes" (EPA 600/7-77-141). This report is scheduled for publication in December 1977.

High-Btu Gasification

Preparation for Testing — TRW, in planning its high-Btu gasification environmental assessment program, will place strong emphasis on environmental sampling and analysis at selected sites. A list of domestic and foreign installations suitable for testing is being prepared, and candidate facilities are being contacted to determine the best possibilities for field testing.

Liquefaction

Standards of Practice Manual (SPM) for Liquefaction — Hittman reports good progress on their SPM for liquefaction. The chapters dealing with state regulations and material balances have been completed. Investigation continues on definition of control devices applicable to liquefaction. The focus of future work will be on costs of control.

Material Balances for Liquefaction — As a part of their environmental assessment of coal liquefaction, Hittman is currently developing input/output information for the H-Coal, Synthoil, and Exxon Donor Solvent processes. Their work will be based primarily on existing information and material balances. Extensive material balances have already been done for the Solvent Refined Coal (SRC) process.

Test Plan for SRC Plant — Hittman Associates in cooperation with DOE has prepared a suggested sampling plan for the SRC plant in Ft. Lewis, Washington. This plan follows the phased sampling approach outlined by IERL-RTP for environmental assessment testing.

Results from SRC Burn — Hittman participated in a test burn of SRC in a commercial utility boiler at Plant Mitchell in Putney, Georgia, in June 1977. The primary purpose of the test was to determine if SRC could replace coal as a primary fuel in a pulverized coal-fired boiler. Flue gas samples were collected using Source Assessment Sampling System (SASS) trains. Air emission levels were evaluated using EPA-5 and ASME trains. Boiler efficiency tests were also conducted. Prior to the SRC burn, similar tests were performed while the plant was using its normal coal supply. From a combustion and power generation view, it was concluded that SRC can be used as a replacement for coal in conventional pulverized coal-fired boilers.

Analyses of grab samples from the SRC burn indicated no detectable levels of C₁-C₈ hydrocarbons. SO_x levels were comparable to those from low sulfur coal combustion. NO_x levels were higher; these were attributed to the high combustion temperature or to higher organic nitrogen in the fuel. Conclusions have not yet been drawn as to the capability of electrostatic precipitators or the necessity to reduce the particulate matter to a lower level.

CURRENT ENVIRONMENTAL BACKGROUND

General Topics

Environmental Standards — Pullman Kellogg has almost completed gathering federal, state, regional, and international environmental standards for coal conversion systems. The composition of effluents expected from processes using current or developing control technologies will be checked against environmental standards.

Hittman has also reviewed existing federal and state environmental standards to aid in their development of recommendations for future legislation specifically directed toward coal liquefaction. Current standards are not directly applicable to liquefaction. Among the general topics researched were effluent limitations, new source performance standards, and best available control technology standards (BACT). A survey was made of all existing air, water, and solid waste criteria affecting the sixteen states most likely to have liquefaction plants because of their coal reserves.

ENVIRONMENTAL OBJECTIVES DEVELOPMENT

General Topics

MEG's Development Status — RTI has developed Multimedia Environmental Goals (MEG's) for several hundred pollutants. This identifies many of the pollutants investigators need to be aware of and defines the concentration levels at which these pollutants might be of concern.

Two major phases of work have been pursued in the development of MEG. First, ambient pollution levels have been related to corresponding concentrations in humans, animals, and plants, and these concentrations have been related to toxic or other detrimental effects within the organism. Second, substances have been characterized by their chemical, physical, and other behavioral properties to provide a summary and data baseline that can be used by environmental assessment contractors.

A 2 volume publication of "Multimedia Environmental Goals for Environmental Assessment" (EPA-600/7-77-136a and 136b, November 1977) explains the formats and nomenclature used in the MEG charts and presents MEG charts for some 200 pollutants. Future plans include the development of MEG charts for over 400 additional components.

Liquefaction

Process Assessment Methodology for Environmental Assessment — The first step in Hittman's approach involves establishing processes to be given future study. Factors in this selection are their prospects for commercialization (e.g., stage of development, availability of components, potential market size) and their potential environmental impacts (i.e., known hazards and character of waste streams). The second step involves quantifying or weighing the importance of these criteria. Hittman has selected the Decision Alternative Rational Evaluation (DARE) system, a computer model designed to assist in decision analyses of this type.

CONTROL TECHNOLOGY ASSESSMENT

General Topics

Control Technology for Waste Utilization and Disposal — The first step taken by Pullman Kellogg in this program was general definition of all potential environmental problems associated with fuel conversion processes. Information on the composition and quantity of typical discharge streams from coal conversion processes was gathered. Most of this information was primarily concerned with process operation and included very little on effluent stream data.

Control Technology — Catalytic, Inc. is reviewing control technologies being considered for products and by-products from coal conversion processes. A technical literature file has been established and is being maintained and updated on a regular basis. The file is dedicated to pollutant control technologies for coal conversion processes. Other tasks have been initiated to review control technology and identify needs.

Coal Gasification

Acid Gas Removal Process Prioritization — HRI has prioritized a selected group of 16 acid gas removal processes to arrive at appropriate choices for the following typical end-uses: a) high pressure (7 MPa or 1000 psig) gasification for the manufacture of SNG, b) intermediate pressure (3 MPa or 400 psig) gasification for the manufacture of turbine fuel, c) low pressure gasification for the manufacture of low pressure fuel gas, and d) low pressure gasification and compression for the manufacture of synthesis gas. The prioritization narrowed the initial selections down to 6 processes for which more detailed engineering evaluations will be performed.

Overview of Control Technology — An overview of control technology for industrial gasifiers is being prepared by HRI. The overview is divided into four main sections:

- Coal gasification technology
- Gas cleanup systems
- Comparison of conventional industrial gas cleanup processes to modern technologies
- Control technology overview

Control Engineering Handbook — Cameron Engineers is compiling a "Multi-Media Environmental Control Engineering Handbook" (MECEH) which will include a detailed description of environmental control technologies applicable to coal conversion. This document will include information on commercially available pollution control equipment. The objectives of the handbook are to: a) categorize all commercially available control technologies into a systematic format, which can be easily accessed; b) provide technical data for each process, including process descriptions, ranges of application, efficiencies, and capital and operating costs; and c) provide a list of those who supply the specific equipment and/or license the technology.

Lurgi Document Result of Group Effort — Cameron edited and prepared individual sections of a first generation standards of practice manual for the Lurgi process titled "Evaluation of Background Data Relating to New Source Performance Standards for Lurgi Gasification" (EPA-600/7-77-057, June 1977). The report is the result of a task group effort to review the state-of-the-art for emission controls in first generation coal gasification plants. The objective of this effort was to provide to the EPA a compilation of technical background information for use in assessing the need and level of New Source Performance Standards for coal gasification plants. Organizations involved in this effort included Cameron Engineers, Inc., Catalytic, Inc., Hittman Associates, and Radian Corporation.

TECHNOLOGY AND/OR COMMERCIAL DEVELOPMENT

DOE and Poland Join in Fossil Energy Research — DOE and the Polish Ministry of Mining have agreed to perform eight fossil energy research projects. The projects will include pump testing; catalysts for hydrogenation processes; coal extraction and ash removal; carbonization of solid residues from coal liquefaction processes; effects of hydrogen donor solvent and extraction recycle solvent proportion on the results of the coal extraction process; non-catalytic coal liquefaction in the presence of hydrogen; coal combustion; and gasification for magnetohydrodynamics method of power generation. DOE will provide most of the funding for the 5-year, \$6.5 million research program.

Gasifier Installation — North Carolina State University has completed site preparation activities for installation of a gasifier. This gasifier will provide feed gas for NCSU's research into the environmental aspects of acid gas removal. In support of this effort, HRI has completed a study evaluating acid gas removal systems as applied to gases derived from coal. A recommendation for a coal pretreating process is also being developed by HRI for NCSU's test facility.

Combined Cycle, High Temperature Gas-Turbine Systems Development — General Electric and Curtiss-Wright have been selected by DOE and are negotiating contracts on continued development of combined cycle, high temperature gas-turbine systems to generate electricity using coal-derived fuels. The program is expected to cost between \$50 and \$100 million over a 6-year term. General Electric proposes using low-Btu gas from coal in a water-cooled turbine; Curtiss-Wright proposes using an air-cooled turbine.

The first phase of the program was started by General Electric, Curtiss-Wright, United Technologies, and Westinghouse Electric, who began development of the turbine systems several years ago at a cost of about \$9 million. Phase II will include test support and technology testing studies. Phase III will involve technology readiness and verification of the test program. When all three phases are complete, DOE expects to be ready for testing high temperature turbines on a commercial- or full-scale demonstration basis. Eventually, it is hoped that turbines can be used in electric power generation as baseload-rated machines.

In-Situ Gasification will be Tried in Canada — An in-situ gasification project is planned in Alberta, Canada. The process will involve drilling bore holes to the coal seam and then using controlled firing of the coal to produce gas. About 85% of a deposit can currently be removed using this technique.

Gasification Unit to be Built in Pennsylvania — A gasification plant will be built in Humboldt Industrial Park, near Hazelton, Pennsylvania. The Appalachian Regional Commission has approved a \$1.2 million grant for the plant. It will convert 0.5 kg/s (50 tpd) of anthracite coal into 0.33 m³/s (10⁶ cfd) of 160,000 J (150 Btu) gas.

Caterpillar Plans Gasification Plant — Caterpillar Tractor Co. plans to build a gasification plant in York, Pennsylvania, as a means of reducing their dependence on natural gas. The plant will gasify 1.6 kg/s (150 tpd) of bituminous coal. Sulfur removal will be achieved in a Peabody Holmes-Stretford unit, which will remove 0.041 kg/s (3.9 tpd) of sulfur from the raw product gas.

Phillips Petroleum, Davy Powergas Suggest Gasifier Venture — These two firms are discussing the prospect of building and operating coal gasification plants using the Winkler fluidized-bed process. They propose a joint venture using private funding to build a demonstration plant which could be operated either in conjunction with a commercial-scale plant or separately. The plant would be sized to process about 2 kg/s (8 tph) of coal at up to 1.5 MPa (15 atmospheres) operating pressure. With completion of contractual arrangements this year, plant operation in 1979 would be a target of the joint venture.

G.E. Study Indicates More Efficient Generation Systems Possible — NASA sponsored a 2-year study by General Electric which concludes that advanced generating systems will make possible cheaper, more efficient coal-fired plants during the next 6 years. Seven advanced systems were studied: two types of advanced steam-turbine cycles, two combined cycle gas turbines, a closed gas-turbine cycle, a metal vapor topping cycle, and open-cycle magnetohydrodynamics (MHD). All of the above were estimated to be more efficient than conventional coal-fired plants with scrubbers, with MHD the most efficient (48%). However, MHD processes currently have scale-up difficulties. The gas-turbine combined cycle and advanced steam-turbine cycle with an advanced low-Btu coal gasifier were selected as having the best possibilities.

Battelle to Operate Integrated System — Battelle's Columbus Laboratory is conducting an experimental project that gasifies coal to make medium-Btu synthesis gas that could be used as a feedstock for chemical plants. The Battelle technique is an outgrowth of a Union Carbide process for gasifying low-sulfur Western coal (U.S. Patent 3,171,369). Battelle's agglomerating burner gasification process is designed to demonstrate the feasibility of making a nitrogen-free gas that does not have to be treated to remove fine particles of coal. It could also use all types of coal feedstocks.

So far the Battelle group has run the burner and gasifier independently for varying times up to 130 hours. The next step is to operate the burner while continuously circulating the solids and feeding coal into the gasifier.

BCR Plans Tests for BI-GAS — The BI-GAS pilot plant (Bituminous Coal Research, Homer City, Pennsylvania) is designed to produce high-Btu gas using a two-stage entrained-bed slagging gasifier. The gasifier is designed to work at a maximum pressure of 10 MPa (1500 psig); however, to date test pressures have been limited to 5.3 MPa (750 psig). Plans for tests include increasing the pressure to the optimum level, first using Montana Rosebud coal, then using other coals. Environmental testing is expected to include ambient air sampling as well as multimedia effluent sampling. The life of various metals and refractory materials will also be tested in future runs both within the gasifier and in the coal conveying system.

HYGAS Test Encouraging — A 92% carbon conversion of Illinois No. 6 caking bituminous coal is another milestone passed by the Institute of Gas Technology's HYGAS coal gasification process. A temperature of 1200°K (1700°F) in the steam-oxygen gasification stage of a multi-stage reactor was required for the conversion at 7 MPa (1000 psig) without slagging. The process has already proved successful on non-caking western lignite and subbituminous coal and on eastern caking bituminous coal.

SRC Gains Support Due to Test Run — The Solvent Refined Coal (SRC) process may receive private financing due to a successful test run at Plant Mitchell in Putney, Georgia. DOE and Southern Co. sponsored the 18-day test run in which some 2.7×10^6 kg (3,000 tons) of SRC were burned in a 22.5 megawatt boiler.

A private group may go ahead with a commercial plant in Western Kentucky with or without federal support. Rust Engineering, who built the Ft. Lewis plant that supplied the SRC for the Georgia test burn, is now designing a 21 kg/s (2,000 tpd) plant for the State of Kentucky for producing a "solid" SRC. Gulf Mineral Resources Co., who operates the Ft. Lewis pilot plant in Washington under contract to DOE, is also interested in the "advanced" technology of SRC. The company will soon try to conduct a test of a "liquid" (at room temperature) version of the SRC process.

Germany to Build a Liquefaction Plant — A coal liquefaction pilot plant will be built in Voelklingen, South Germany, by Saarbergwerke at the cost of \$13 million. Saarbergwerke, a 74% federally- and 26% Saarland state-owned conglomerate, says the plant will have a coal input of 6 metric tpd, most of it coming from nearby Saarland mines, and will produce naphtha and light heating oil. Based on current German coal prices, the process is uneconomical according to a government spokesman; but he adds that the plant comes from Germany's desire to end dependence on energy from costly and "politically unstable" foreign sources.

Industry Joins with DOE to Build Liquefaction Plant — Several companies have joined with DOE in financing a coal liquefaction demonstration plant. Exxon Research and Engineering, Electric Power Research Institute, Carter Oil Co., and Phillips Petroleum will join to provide 50% of the funds. DOE will supply funds for the remainder of the \$240 million program. Other private-sector participants may join the venture later.

The pilot plant will use the Exxon Donor Solvent (EDS) process and will be capable of processing 2.6 kg/s (250 tpd) of coal into liquid fuels. It will be located adjacent to Exxon's refinery at Baytown, Texas, with Exxon's Baytown Research & Development Division.

DOE Initiates End-Use Application Program — In 1976 the DOE published a program opportunity notice (PON-FE-4) entitled "Integration and Evaluation of Low-Btu Coal Gasification Technology in Operational Environments." The primary goal of that procurement action was to evaluate technically and economically commercial-size low-Btu gasification units supplying gas for various end uses. Currently six projects are in this program: Pike County, Kentucky (two Wellman-Galusha gasifiers); University of Minnesota at Duluth (Foster Wheeler/Stoic gasifier); General Refractories in Hitchens, Kentucky (two Woodall-Duckham gasifiers); Irvin Industries, Georgetown, Kentucky (two Wellman-Galusha gasifiers); and Glen-Gery Brick Company, York, Pennsylvania (Wellman-Galusha gasifier).

Other government agencies, such as the EPA and NIOSH, will work together with DOE for environmental assessments and study of the occupational health and safety impacts of these projects. It is hoped that the results of these efforts will provide realistic data that can be applied to commercial-size, low-Btu gas production units.

PROJECT TITLES, CONTRACTORS, AND EPA PROJECT OFFICERS IN FUEL PROCESS BRANCH ASSESSMENT PROGRAM

Project Title	Contractor	EPA Project Officer
Environmental Assessment of Low/Medium-Btu Gasification (March 1976-March 1979)	Radian Corporation 8500 Shoal Creek Blvd. Austin, Texas 78758 (512) 454-4797 (E.C. Cavanaugh/G.C. Page)	William J. Rhodes IERL-RTP Environmental Protection Agency Research Triangle Park, NC 27711 (919) 541-2851
Environmental Assessment of High-Btu Gasification (April 1977-April 1980)	TRW, Inc. 1 Space Park Redondo Beach, CA 90278 (213) 536-1116 (Chuck Murray)	William J. Rhodes IERL-RTP Environmental Protection Agency Research Triangle Park, NC 27711 (919) 541-2851
Environmental Assessment of Coal Liquefaction (August 1976-August 1979)	Hittman Associates 9190 Red Branch Road Columbia, MD 21043 (301) 730-7800 (Dwight Emerson)	William J. Rhodes IERL-RTP Environmental Protection Agency Research Triangle Park, NC 27711 (919) 541-2851
Control Technology For Products/By-Products (September 1976-September 1979)	Catalytic, Inc. 1500 Market Street Center Square West Philadelphia, PA 19102 (215) 864-8104 (A. B. Cherry)	Chester A. Vogel IERL-RTP Environmental Protection Agency Research Triangle Park, NC 27711 (919) 541-2134
Control Technology For Converter Output (January 1977-January 1980)	Hydrocarbon Research, Inc. P. O. Box 2391 334 Madison Avenue Morristown, NJ 07960 (201) 540-0180 (Harold Stotler)	Chester A. Vogel IERL-RTP Environmental Protection Agency Research Triangle Park, NC 27711 (919) 541-2134
Waste Stream Disposal and Utilization (April 1977-April 1980)	Pullman-Kellogg Research and Development Center 16200 Park Row Industrial Park Terrace Houston, Texas 77054 (713) 493-0291 (Louis Bostwick)	Chester A. Vogel IERL-RTP Environmental Protection Agency Research Triangle Park, NC 27711 (919) 541-2134
General Support (April 1976-December 1977)	Cameron Engineers, Inc. 1315 South Clarkson Street Denver, CO 80210 (303) 777-2525 (Ted Borer)	L. David Tamny IERL-RTP Environmental Protection Agency Research Triangle Park, NC 27711 (919) 541-2709
Acid Gas Cleaning Bench Scale Unit (October 1976-September 1981) (Grant)	North Carolina State Univ. Department of Chemical Engineering Raleigh, NC 27607 (919) 737-2324 (Dr. James Ferrell)	Thomas W. Petrie IERL-RTP Environmental Protection Agency Research Triangle Park, NC 27711 (919) 541-2708
Water Treating Bench Scale Unit (November 1976-October 1981) (Grant)	Univ. of North Carolina Department of Environmental Sciences and Engineering School of Public Health Chapel Hill, NC 27514 (919) 966-1052 (Dr. Philip Singer)	Thomas W. Petrie IERL-RTP Environmental Protection Agency Research Triangle Park, NC 27711 (919) 541-2708
Pollutant Identification From A Bench Scale Unit (November 1976-October 1981) (Grant)	Research Triangle Institute P. O. Box 12194 Research Triangle Park, North Carolina 27709 (919) 341-5836 (Dr. Forest Mixon)	Thomas W. Petrie IERL-RTP Environmental Protection Agency Research Triangle Park, NC 27711 (919) 541-2708

MEETING CALENDAR

Technology for Energy Conservation, January 23-27, 1978, Albuquerque, NM. Contact Energy Conservation Conference, c/o Information Transfer, Inc., Suite 202, 1160 Rockville Pike, Rockville, MD 20852.

Fifth Energy Technology Conference and Exposition, February 27-March 1, 1978, Washington, DC. Contact Richard F. Hill, ESCOE-Suite 405, 444 N. Capital St., Washington, DC 20001.

175th ACS National Meeting, March 12-17, 1978, Anaheim, CA. Contact A.T. Winstead, ACS, 1155 16th St., NW, Washington, DC 20014.

RECENT MAJOR MEETINGS

Fourth Annual International Conference of Coal Gasification, Liquefaction, and Conversion to Electricity

The Fourth Annual International Conference of Coal Gasification, Liquefaction, and Conversion to Electricity was held August 2-4 at the University of Pittsburgh School of Engineering.

It was generally agreed that currently the most likely application of coal gasification will be in industries that will require small gasifiers to provide gas for direct heat. Several companies presented papers stressing the commercial availability of low- and medium-Btu gasifiers. These included information on required capital investment, projected cost of the product gas, and how these compare to the projected cost of other fuel alternatives. However, as Russell Bardos stated in "Gasifiers in Industry," available economic and environmental data are limited. DOE, EPA, and NIOSH have initiated several joint ventures to provide these needed data to the public during a 3 to 4 year period.

The developing technology for gasification and liquefaction was also discussed. Gasification topics included energy efficiency, quality of product gas, types of coal used, and test planning. Technologies for using coal gas as a synthesis gas and for magnetohydrodynamic power generation are being developed. In the area of liquefaction a PERC/DOE paper stressed the dependability of the Synthoil process operation, and Gulf and Rust Engineering gave updates on their work with SRC.

Installation of four new FBC units in the U.S. was announced. Babcock and Wilcox, Ltd. is giving commercial guarantees on these units along with guaranteeing sulfur removal.

Environmental aspects of coal conversion technologies were discussed. Several types of flue gas desulfurization processes were presented. Government directed/operated work was outlined in detail in "Environmental Assessment and Regulation for Coal Conversion" presented by John Cleland of RTI. Work in coal cleaning was mentioned here and in other presentations.

Environmental Aspects of Fuel Conversion Technology, III

The Third Annual Symposium on Environmental Aspects of Fuel Conversion Technology was held September 13-16, 1977, at the Diplomat Hotel in Hollywood, Florida, under the sponsorship of USEPA-IERL-RTP. The first and second symposia in this series highlighted coal conversion processes and environmental assessment methodologies. This symposium placed more emphasis on environmental test methods and test results.

In the first session of the symposium, the Synthetic Fuels Program at IERL-RTP was described and methodologies for performing environmental assessments were presented. Other topics included multimedia environmental goals, non-site specific test plans, analytical methods, data acquisition by DOE, and occupational safety and health programs.

In the second session, environmental assessments of low- and high-Btu coal gasification and coal liquefaction were considered. Topics included the Kosovo Test Program, fate of pollutants in industrial gasifiers, environmental testing of liquid fuels, parametric evaluations of pollutants, analytical techniques and analyses of coal tars, relationships between process variables and effluent production, cross media effects of gasification, low-Btu gas usage in combined cycles, and the fate of trace elements in Lurgi gasification.

In the third session, control technologies for coal conversion processes were addressed. Topics covered were converter output compositions, acid gas test facilities, Fischer/Tropsch process, coal residue leachates, phenolic water treatment, water use, refinery/coke oven water treatment technology, volatility of coal and its by-products, water treatment facilities, and gasification facilities testing.

RECENT MAJOR PAPERS AND PUBLICATIONS

Gasification Technology

Banchik, I.N., T.K. Subramaniam and J.H. Marten, "Pressure Reaction Cuts Gasification Costs," *Hydrocarbon Process.* 56(3), 121-25 (1977).

Bombaugh, Karl J., "A Non-Site Specific Test Plan," Presented at the Third Annual Symposium on the Environmental Aspects of Fuel Conversion Technology, Hollywood, FL, September 13-16, 1977.

Cavanaugh, E.C., et al., "Environmental Assessment Data Base for Low/Medium-Btu Gasification Technology, Volume I and II," EPA 600/7-77-125 a and b, EPA Contract No. 68-02-2147. Austin, TX, Radian Corp., November 1977.

Cleland, John G., "A Program for Parametric Evaluation of Pollutants from a Laboratory Gasifier," Presented at the Third Annual Symposium on the Environmental Aspects of Fuel Conversion Technology, Hollywood, FL, September 13-16, 1977.

Corbett, William E., "Low-Btu Gasification-Environmental Assessment," Presented at the Third Annual Symposium on the Environmental Aspects of Fuel Conversion Technology, Hollywood, FL, September 13-16, 1977.

Ellman, R.C., "Slagging Fixed-Bed Gasification," Presented at the Fourth International Conference on Coal Gasification, Liquefaction, and Conversion to Electricity, Pittsburgh, PA, August 2-4, 1977.

Ferrell, J.K., et al., "A Coal Gasification-Gas Cleaning Test Facility," Presented at the Third Annual Symposium on the Environmental Aspects of Fuel Conversion Technology, Hollywood, FL, September 13-16, 1977.

Fillo, J.P., et al., "Decomposition Characteristics of Phenol under Synthane Gasifier Conditions," PERC report for ERDA, Report No. PERC/RI/77/14. Pittsburgh, PA, PERC, March 1977.

Goodman, M., and E. Bailey, "Synthetic Medium-Btu Gas via Winkler Process," Presented at Fourth Annual International Conference on Coal Gasification, Liquefaction, and Conversion to Electricity, Pittsburgh, PA, August 2-4, 1977.

Haynes, W.P., et al., "Synthane Process Update, Mid 1977," Presented at the Fourth International Conference on Coal Gasification, Liquefaction, and Conversion to Electricity, Pittsburgh, PA, August 2-4, 1977.

Maddalone, R.F. and S.C. Quinlivan, "Technical Manual for Inorganic Sampling and Analysis," Report No. EPA-600/2-77-024, (NTIS NO. PB 266 842/AS), Redondo Beach, CA, TRW Systems Group, January 1977.

Murray, Charles F., and Masood Ghassemi, "High-Btu Gasification Environmental Assessment — Work Status and Plans," Presented at the Third Annual Symposium on the Environmental Aspects of Fuel Conversion Technology, Hollywood, FL, September 13-16, 1977.

Neben, E.W., and G.E. Pack, "Screening of SNG Alternatives," Presented at the Fourth International Conference on Coal Gasification, Liquefaction, and Conversion to Electricity, Pittsburgh, PA, August 2-4, 1977.

Page, Gordon C., "Fate of Pollutants in Industrial Gasifiers," Presented at the Third Annual Symposium on the Environmental Aspects of Fuel Conversion Technology, Hollywood, FL, September 13-16, 1977.

Patterson, R.C., "Low Btu Gasification of Coal: A C-E Status Report," Presented at the Fourth Annual International Conference on Coal Gasification, Liquefaction, and Conversion to Electricity, Pittsburgh, PA, August 2-4, 1977.

Phillips, Nancy P., and Charles A. Muela, "In-situ Coal Gasification: Status of Technology and Environmental Impact," Report No. EPA-600/7-77-045 (NTIS No. PB 268 576/AS), Austin, TX, Radian Corp., May 1977.

Robin, Allen M., "The Production of Synthesis Gas from H-Coal Liquefaction Residues," Presented at the 83rd National Meeting of AIChE, Houston, TX, March 20-24, 1977.

Sinor, J.E., ed., "Evaluation of Background Data Relating to New Source Performance Standards for Lurgi Gasification," Report No. EPA-600/7-77-057, (NTIS No. PB-269 557/AS), Denver, CO, Cameron Engineers, Inc., June 1977.

Stover, S.E., and F.D. Hoffert, "Selection of Acid Gas Treating Processes for Coal Converter Outputs," Presented at the Third Annual Symposium on the Environmental Aspects of Fuel Conversion Technology, Hollywood, FL, September 13-16, 1977.

"Ruhrchemie to Build Coal-Based Syngas Plant," *European Chemical News*, page 30, April 15, 1977.

Liquefaction Technology

Emerson, Dwight B., "Liquefaction Environmental Assessment," Presented at the Third Annual Symposium on the Environmental Aspects of Fuel Conversion Technology, Hollywood, FL, September 13-16, 1977.

Koralek, C.S., and Bruce May, "Flue Gas Sampling During the Combustion of Solvent Refined Coal In a Utility Boiler," Presented at the Third Annual Symposium on the Environmental Aspects of Fuel Conversion Technology, Hollywood, FL, September 13-16, 1977.

Schiller, J.E., and D.R. Mathiason, "Separation Method for Coal-Derived Solids and Heavy Liquids," *Anal. Chem.* 49(8), 1225-1228 (1977).

Schmid, B.K., and D.M. Jackson, "Recycle SRC Processing for Liquid and Solid Fuels," Presented at the Fourth International Conference on Coal Gasification, Liquefaction, and Conversion to Electricity, Pittsburgh, PA, August 2-4, 1977.

Schultz, H., et al., "The Distribution of Some Trace Elements in the 1/2 Ton Per Day Synthoil Process Development Unit," Report No. PERC/RI-77/2. Pittsburgh, PA, PERC, February 1977.

Energy and Environmental Analysis, Inc., "Environmental Review — Solvent Refined Coal Pilot Plant, Fort Lewis, Washington," ERDA, 1977.

"Fluidization Theories and Applications," AIChE Symposium Series No. 161, Volume 73, 1977.

Other

Bostwick, Louis E., "Control Technology Development for Fuel Conversion System Wastes," Presented at the Third Annual Symposium on the Environmental Aspects of Fuel Conversion Technology, Hollywood, FL, September 13-16, 1977.

Cleland, J.G., "Environmental Assessment and Regulation for Coal Conversion," Presented at the Fourth International Conference on Coal Gasification, Liquefaction, and Conversion to Electricity, Pittsburgh, PA, August 2-4, 1977.

Considine, Douglas M., Editor-in-Chief, *Energy Technology Handbook*. New York, NY, McGraw-Hill, 1977.

ERDA, "Project Plan 1977-1979 National Coal Utilization Assessment," ERDA 77-19. Washington, DC, March 1977.

Fruchter, J.S., et al., "High Precision Trace Element and Organic Constituent Analysis of Oil Shale and Solvent Refined Coal Materials," *Amer. Chem. Soc., Div. Petrol. Chem., Prepr.* 22(2), 793-807 (1977).

Hundemann, Audrey S., "Pollution and Environmental Aspects of Fuel Conversion (A Bibliography with Abstracts)." NTIS/PS-77/0212. Springfield, VA, NTIS, April 1977.

Hylton, J.D., ed., "1977 Symposium on the Coal Dilemma: How and Where to Use It." Symposium sponsored by the Division of Industrial & Engineering Chemistry, American Chemical Society. Denver, CO, Cameron Engineers, Inc., 1977.

Kingsbury, Garrie, L., "Development of Multimedia Environmental Goals (MEG's) for Pollutants from Fuel Conversion Processes," Presented at the Third Annual Symposium on the Environmental Aspects of Fuel Conversion Technology, Hollywood, FL, September 13-16, 1977.

Ralph M. Parsons Co., "Oil/Gas Conceptual Design/Economics Analysis: Oil and SNG Production." Report No. ERDA-FE-1775-8, R & D Report No. 114, Interim Report No. 4. Pasadena, CA, March 1977.

Rhodes, W.J., and L.E. Bostwick, "Environmental Program for Solid Wastes from Synthetic Fuels from Coal Technologies," Presented at the American Institute of Chemical Engineers 70th Annual Meeting, New York, NY, November 17, 1977.

Sohrab, M. Hossain, John W. Mitchell, and Alfred B. Cherry, "Control Technology Development for Products/By-Products of Coal Conversion Systems," Presented at the Third Annual Symposium on the Environmental Aspects of Fuel Conversion Technology, Hollywood, FL, September 13-16, 1977.

Sparacino, C.M., R.A. Zweidinger and S. Willis, "Analytical Techniques and Analysis of Coal Tars, Waters and Gases," Presented at the Third Annual Symposium on the Environmental Aspects of Fuel Conversion Technology, Hollywood, FL, September 13-16, 1977.

Goldstein, D.J., and D. Yung, "Water Conservation and Pollution Control in Coal Conversion Processes." Report No. EPA-600/7-77-065, (NTIS No. PB 269 568/AS), Water Purification Associates, Cambridge, MA, June 1977.

Environmental Review of Synthetic Fuels is prepared by Radian Corporation under EPA Contract 68-02-2147. Each contractor listed in the introduction of this report contributed to this issue. The EPA/IERL-RTP Project Officer is William J. Rhodes, (919) 541-2851. The Radian Program Manager is Eugene C. Cavanaugh, (512) 454-4797. Comments on this issue, topics for inclusion in future issues, and requests for subscriptions should be communicated to them.

The views expressed in Environmental Review of Synthetic Fuels do not necessarily reflect the views and policies of the Environmental Protection Agency. Mention of trade names or commercial products does not constitute endorsement or recommendation for use by EPA.