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REVIEW OF U.S. DEPARTMENT OF ENERGY HEALTH AND
ENVIRONMENTAL RESEARCH AND DEVELOPMENT PROGRAM
SUPPORT TO SRC-II TECHNOLOGY DEVELOPMENT

Topical Report

By
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MASIER

July 1980

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Environmental Research and Technology, Inc.
Pittsburgh, Pennsylvania

and

Carnegie-Mellon University
Pittsburgh, Pennsylvania



U. S. DEPARTMENT OF ENERGY

FOSSIL ENERGY

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TOPICAL REPORT

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INTRODUCTION

This report documents activities of Carnegie-Mellon Institute of Research (CMIR) and its subcontractor, Environmental Research & Technology, Inc. (ERT) performed between July, 1978 and June 1980 for the Department of Energy (DOE) contract EX-765-01-2496 (formerly contract E(49-18)-2496). The preparation of this document was completed under contract DE-AC01-76ET10249.

This volume is one of seven topical reports completed for this contract extension. These reports were prepared in draft form for various project activities during the original contract. The material in these reports has not been updated to reflect recent developments.

Portions of this report have been previously released in the DOE document "Final Environmental Impact Statement - Solvent Refined Coal-II Demonstration Project" DOE/EIS-0069, January, 1981 (Appendix Y-2).

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INTRODUCTION

As an integral part of its synthetic fuels technology development program, the Department of Energy is committed to a major effort to insure the environmental compatibility of its developmental technologies. One key element of DOE's environmental mission is the construction of a comprehensive health and environmental data base that (1) identifies and scopes significant environmental issues; (2) provides a quantitative basis for analysis of identified environmental risks; (3) provides a quantitative basis for the determination of environmental management needs, options, and performance requirements; (4) provides a quantitative basis for the selection of control systems and the preparation of required environmental impact statements, construction and operating permits; and (5) provides broad substantive evidence of the environmental acceptability of synthetic fuel technology. Development of such a data base is distinctly an interdisciplinary activity requiring a wide range of skills from process and environmental engineering to biology, ecology, and chemistry. DOE has within its organization the requisite skills necessary for such an interdisciplinary activity and is effectively marshalling them in a joint project team approach.

The Assistant Secretary for Environment (ASEV) is responsible for assessing technology-related health and environmental issues. The Assistant Secretary for Fossil Energy (ASFE) in turn is leading the SRC Program's process and environmental engineering efforts by addressing environmental management issues in the context of the available data and EV's related analysis. The Assistant Secretaries are working together to formulate meaningful experimental testing designs needed for the comprehensive development of the health and environmental program data base.

The DOE has prepared in-depth programmatic outlines of its synthetic fuels environmental program plans annually since 1977.⁽¹⁾

(1) "Environmental Development Plan for Coal Liquefaction", prepared by the U.S. Department of Energy, October, 1979. DOE/EDP-0044.

These Environmental Development Plans (EDP's) describe data base issues as they arise at various stages of process development from bench-scale to demonstration- and commercial-scale operations. A series of Project Environmental Plans (PEP's) address site-specific technical programs. One such Project Environmental Plan has been prepared for the SRC-II Demonstration Program in Morgantown, West Virginia.⁽²⁾

This document outlines the technical framework of DOE's overall synthetic fuels health and environmental characterization program. Current project environmental activities directly associated with SRC-II technology development are summarized for the convenience of the Environmental Impact Statement reviewers. An extended, technically detailed statement of the SRC-II health and environmental program, activities, and plans was released in late 1980, as part of the final Environmental Impact Statement of the SRC-II Demonstration Project.

(2) "Project Environmental Plan for the SRC-II Demonstration Plant", prepared by the U.S. Department of Energy, April 2, 1979.

FRAMEWORK OF DOE HEALTH AND
ENVIRONMENTAL CHARACTERIZATION PROGRAM

In other, more mature, commercial industries with known environmental characteristics, substantial data bases have been developed on the health and environmental impacts of pollutants (e.g., SO₂, NO_x). On the basis of such data, EPA promulgated ambient environmental quality standards that are not to be exceeded. Through a combination of appropriate air and water quality modeling and available control technology analysis, source emission limitations are determined. At this early stage in synthetic fuels development, only limited environmental data bases exist. There are presently no formal regulations on commercially significant effluent species and resulting health and environmental impacts. Thus the basic pattern of data base development, used for many commercial/industrial source categories during the 1960's and 1970's, must now be applied to evolving synthetic fuels technologies.

Focus of DOE Health and Environmental
Characterization Efforts

In contrast to past cycles of data base development, which were carried out on large-scale commercial systems, DOE is aggressively seeking to maximize the development of data on smaller subcommercial-scale systems. By this means, needs for control are identified early in the development process and at the smallest feasible scale. Maximum and effective control can therefore be implemented before systems reach commercial scale. Health and environmental characterization begins selectively at process development unit scales (PDU < 100 lbs/hr) and increases steadily through pilot plants (typically 1-10 ton/hr) and demonstration plants (typically 100-300 tons/hr). In using this approach, commercial-scale systems will emerge with well-defined environmental control systems requiring only fine tuning.

The DOE is addressing types of emissions, transport phenomena, and impact issues for the full range of operations from coal refining to product end use (see Figure 1). Modes of system operation that result in emissions range to steady state, upset, and decommissioning. Species characterization is driven by three factors: (1) existing regulatory compliance issues (e.g., SO₂ and NO_x in the air, NH₃ and phenolics in process waters); (2) emerging regulatory issues (e.g., Toxic Substances and Control Act, Resource Conservation and Recovery Act and Occupational Safety and Health Act); and (3) health and environmental effects research for potential, presently undefined issues.

Operational Strategy for Health and Environmental Data Base Development

DOE's data base generation efforts are operationally broken down into four basic components: (1) screening studies, (2) long-term baseline studies, (3) parametric and sensitivity studies, and (4) monitoring studies. Study activities focus on environmentally significant materials generated as coal processing intermediates, industrial hygiene, environmental control system effluents, transport system discharges, waste disposal effluents, and product end use effluents (see Figure 2).

As previously noted, sources of testing materials that are analogous to commercial-scale materials include PDU-, pilot-, and demonstration-scale coal processing, environmental control, transport, disposal, and end use systems. Although materials are frequently available, it should be noted that interpretive engineering analysis must be performed to project commercial-scale characteristics from data obtained on subcommercial-scale systems. In certain cases, there are technical limitations to developing the data base in advance of commercial-scale operations. These limitations can be minimized with careful equipment design and judicious choice of subcommercial-scale studies.

Within each of the four basic components of data base generation, issues addressed range from methodology development to the systematic application of established, verified procedures. Significant

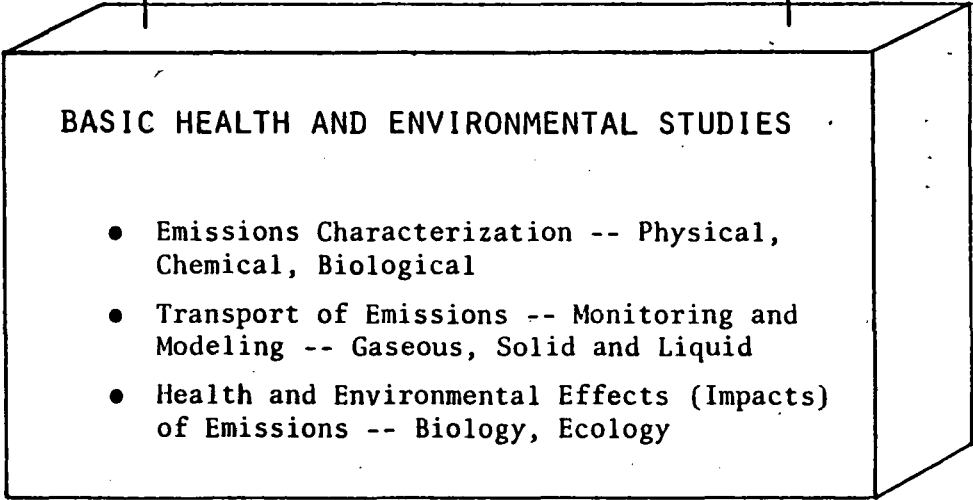
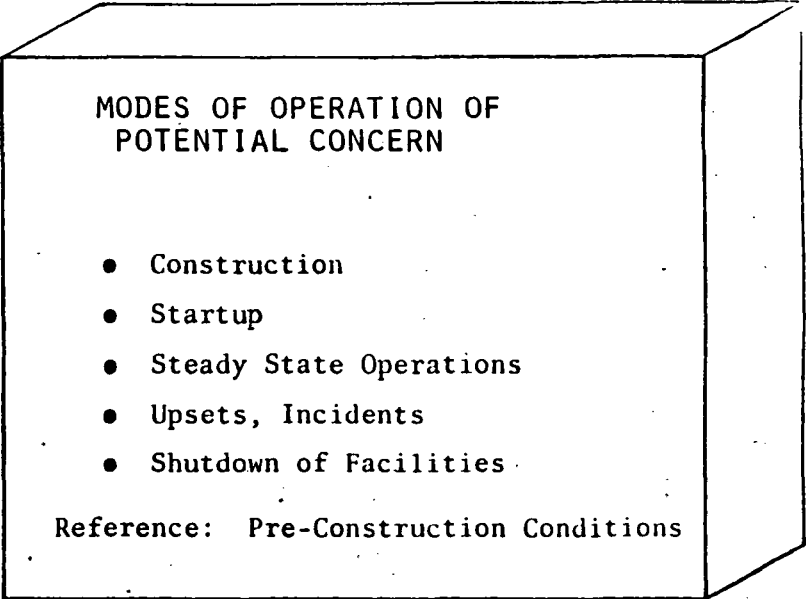
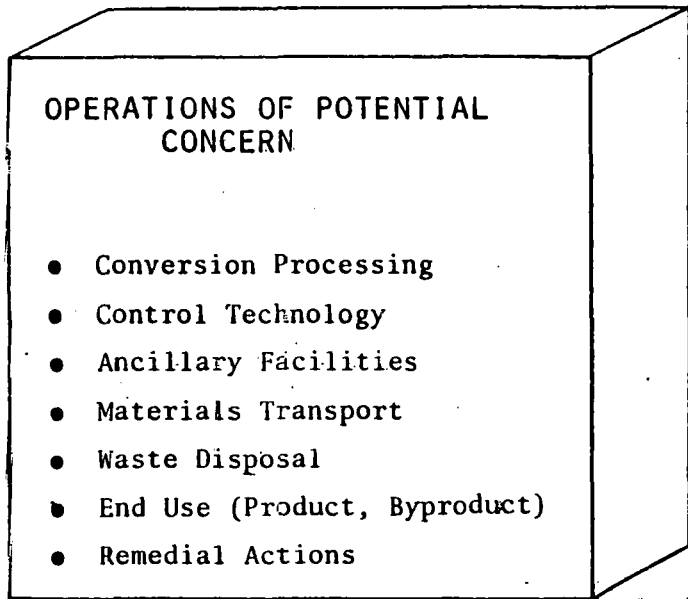


FIGURE 1. FOCUS OF A HEALTH AND ENVIRONMENTAL DATA BASE ON SRCII-RELATED MATERIALS

FOCUS OF CHARACTERIZATION STUDIES	MAJOR CHARACTERIZATION PROGRAM COMPONENTS
<ul style="list-style-type: none"> ● PROCESS INTERMEDIATES 	<p style="text-align: center;">COMPONENT 1: SCREENING STUDIES</p> <ul style="list-style-type: none"> ● Establishment, verification of engineering, chemistry, and biology methodologies for sample collection, preservation, and analysis. ● Initial evaluation of representative SRC-II material properties using a range of short term chemical and biological tests. ● Initial evaluation of the performance of environmental control systems and the fate of environmental species in transport spills, waste disposal, and product/byproduct end use.
<ul style="list-style-type: none"> ● INDUSTRIAL HYGIENE 	<p style="text-align: center;">COMPONENT 2: LONG TERM BASELINE STUDIES</p> <ul style="list-style-type: none"> ● Specification of most representative SRC-II materials for long-term health and environmental testing, based upon Component 1 results and best judgments on probable demonstration plant design. ● Specification and execution of unit operation tests for the production of significant quantities of priority testing materials at conditions considered most representative of demonstration-scale operations. ● Selection and performance of a range of long-term biomedical and ecological tests on specified set of SRC-II related materials.
<ul style="list-style-type: none"> ● ENVIRONMENTAL CONTROL SYSTEMS 	<p style="text-align: center;">COMPONENT 3: PARAMETRIC & SENSITIVITY STUDIES</p> <ul style="list-style-type: none"> ● Investigation of the effects of variations in selected processing conditions (e.g., reactor temp. and residence time, boiling range of product oil) on the health and environmental properties measured in Components 1 and 2 of program. ● Investigation of the effects of coal type on the properties of SRC-II-related materials. ● Correlation studies on short- and long-term biological and ecological assays in order to establish bounds on the interpretation of short-term bioassay results.
<ul style="list-style-type: none"> ● TRANSPORT SYSTEMS (PRODUCTS, WASTES) 	<p style="text-align: center;">COMPONENT 4: MONITORING STUDIES</p> <ul style="list-style-type: none"> ● Development of methodology for the monitoring of chemical, biological, and ecological materials transport. ● Development of methodology for the modeling of chemical, biological and ecological materials transport. ● Workspace and ambient (air, water, ground) monitoring of the transport of priority SRC-II-related materials. ● Monitoring of the impact of SRC-II-related emissions on biological and ecological systems.
<ul style="list-style-type: none"> ● WASTE DISPOSAL SYSTEMS 	
<ul style="list-style-type: none"> ● PRODUCTS 	
<ul style="list-style-type: none"> ● END USE SYSTEMS (PRODUCTS, BYPRODUCTS) 	

FIGURE 2. OPERATIONAL STRATEGY FOR THE DEVELOPMENT OF AN SRC-II HEALTH AND ENVIRONMENTAL DATA BASE

methodology development, modification, and refinement have been necessary at all levels of effort to accommodate the unique properties of coal-based systems.

Program development is necessarily iterative (see Figure 2). Early screening results on a small scale equipment suggest the need for further screening studies on a larger-scale systems. Results of screening studies set the priorities for more extensive and costly long-term baseline biological and ecological studies. Parametric studies establish the sensitivity of measured screening and baseline characteristics to changes in processing conditions and also provide a basis for correlating low- and high-tier biological and ecological test information. Monitoring system development is stimulated by findings in screening and baseline characterization efforts. Choice of monitoring systems is dependent upon screening and baseline biological and ecological test results and results of initial site analyses. As a result, the overall characterization program necessarily emerges in phases, each with a distribution of activities in the four component areas.

Characterization efforts on PDU- and pilot-scale equipment focus on screening and baseline studies of steady state and non-steady state production. At the demonstration scale, these activities are expanded to include extensive monitoring and the investigation of large-scale steady state and non-steady state effluent production and control characteristics.

SUMMARY OF SRC-II RELATED HEALTH
AND ENVIRONMENTAL CHARACTERIZATION ACTIVITIES

SRC-II related health and environmental characterization activities have been underway since the construction of the Fort Lewis pilot plant in 1972. These activities have been significantly intensified since 1977 in response to DOE's decision to extend development studies to demonstration-scale operations.

Major Participants in the
Characterization Program

The Assistant Secretaries for Environment (EV) and Fossil Energy (FE) have assigned to specific organizations the responsibility for health and environmental studies, and engineering efforts on SRC-II, respectively. Battelle's Pacific Northwest Laboratory is EV's lead laboratory for the chemical, biological, and ecological characterization and assessment of SRC-II technology. Pittsburg & Midway Coal Mining Co., a wholly owned subsidiary of Gulf Oil, is FE's prime contractor for the process and environmental engineering analysis of SRC-II control technology needs, options, and performance. Additional subcontractors, several of DOE's Energy Technology Centers, and DOE's National Laboratories are contributing significantly to the overall characterization program.

Resource Materials for
Characterization Studies

Major categories of materials of potential environmental significance in SRC-II technology include process intermediates, environmental control system materials, solid wastes byproducts, products, and related end use materials (see Table 1). Basic relationships between these materials, and materials which are potentially available for testing from predemonstration-scale equipment, are also indicated in Table 1. To date, SRC-II process sampling and characterization

TABLE 1

ENVIRONMENTALLY SIGNIFICANT SRC-II RELATED MATERIALS
AND POTENTIAL PRE-DEMONSTRATION PLANT SOURCES FOR TESTING

Environmentally Significant SRC-II Demonstration-Scale Materials	Potential Pre-Demonstration-Scale Analogs to Demonstration-Scale Materials	Potential Sources
<u>SRC-II PROCESS INTERMEDIATES</u>		
Coal	Coal ^(a)	SRC-II PP ^(d) , P99 ^(e)
Coal Slurry	Coal Slurry	SRC-II PP, P99
Recycle Slurry	Recycle Slurry	
Raw Naphtha	Raw Naphtha ^(b)	SRC-II PP, P99
Dissolver Effluent		
LP Cold Hydrocarbon	Middle Distillate Heavy Distillate 50°F Boiling Fractions	SRC-II PP, P99 SRC-II PP, P99 SRC-II PP, P99
LP Hot Hydrocarbon		
HP Cold Hydrocarbon		
Effluent Separator Quench		
Recycle Solvent		
Fractionator Recycle		
Lean/Rich Scrubber Oil		
Liquefaction Process Waters	Process Water	SRC-II PP, P99
• LP Sour Water		
• HP Sour Water		
• Slurry Prep Sour Water ^(c)		
Vacuum Flush Sour Water	Process Water	Texaco PP ^(f)
Fractionation Sour Water		
Light Ends Recovery Sour Water		
HDS Sour Water		
Methanation Sour Water		
Gasifier Sour Water		
Sulfur Recovery Sour Water		
<u>SRC-II-RELATED ENVIRONMENTAL CONTROL SYSTEM MATERIALS</u>		
Treated Process Waters	NH ₃ Recovery Effluent Tar Acid Recovery Effluent	Byproduct Recovery Pilot Units
• NH ₃ Recovery Effluent		
• Tar Acid Recovery Effluent	Biotreated Effluent	Benchscale Treatment Units
• Physical/Chemical Treatment Effluent		
• Biological Treatment Effluent		
• Evaporator Distillate		
Absorption Solutions	NH ₃ Recovery Solution Tar Acid Recovery Solutions Stratford Solution	Byproduct Recovery Pilot Units SRC-II PP ^(g)
• Oil Wash		
• Acid Gas Recovery		
• NH ₃ Recovery		
• Sulfur Recovery		

TABLE 1 (CON'T)

Environmentally Significant SRC-II Demonstration-Scale Materials	Potential Pre-Demonstration-Scale Analogs to Demonstration-Scale Materials		
	Materials	Potential Sources	
<u>SRC-II-RELATED SOLID WASTES</u>			
Brine Concentrates	} →	Process Water-Derived Incinerator Solids Gasifier Slag	Evaporator/Incinerator PDU's Texaco PP
Chemical Treatment Sludges			
Incinerator Solids			
Gasifier Slag			
Used Catalysts	● →		
<u>SRC-II-RELATED BYPRODUCT MATERIALS</u>			
Sulfur (Claus)	→	Stretford Sulfur ^(g)	SRC-II PP Byproduct Recovery Pilot Units
Tar Acids	→	Tar Acids	
Anhydrous Ammonia	→	Anhydrous Ammonia	
<u>SRC-II-RELATED PRODUCT MATERIALS</u>			
Synthetic Natural Gas	● →		Upgrading PDU's SRC-II PP, P99 SRC-II PP, P99 SRC-II PP, P99
Liquid Propane	● →		
Liquid Mixed Butanes	● →		
Naphtha	→	Hydrotreated Naphtha	
Light Fuel Oil	→	Middle Distillate	
Heavy Fuel Oil	→	Heavy Distillate	
Full Boiling Range Fuel Oil	→	Middle/Heavy Distillate Blend	
<u>SRC-II-RELATED END USE MATERIALS</u>			
Combustion Particulates	→	Particulates	Boiler, Combustor and Turbine PDU's Hydrotreating PDU's Refinery Upgrading PDU's
Combustion Offgases	→	Offgases	
Hydrotreated Fuel Products	→	Upgraded Fuel Oils	
Refined Fuel Products	→	Refined Fuel Oils	

Footnotes:

- (a) → : Analogous demonstration-scale material available from pre-demonstration process unit.
- (b) } → : Groups of demonstration-scale materials that have pre-demonstration process unit analog(s).
- (c) ● → : Demonstration-scale materials that do not have pre-demonstration process unit analogs.
- (d) SRC-II PP: 30 ton per day SRC-II pilot plant at Fort Lewis, WA.
- (e) P99: 1 ton per day SRC-II PDU at Hamarville, PA.
- (f) Texaco PF: 12 ton per day Texaco pilot plant gasifier at Montebello, CA.
- (g) Stretford is an alternate sulfur recovery system for the demonstration plant.

efforts have focused primarily on materials produced during Fort Lewis pilot plant operations. Selected studies have been performed on Texaco gasifier pilot plant materials, and screening studies have been initiated on selected bench- and PDU-scale environmental control system alternatives.

A systematic evaluation is currently underway to determine (1) what additional predemonstration-scale equipment is capable of generating commercially relevant materials for testing; (2) what subset of these systems must, or should, be operated for characterization purposes prior to SRC-II demonstration plant operation; (3) what set of materials from these operations should be collected for characterization; and (4) what are the range and limits of reasonable interpretations of data generated from collected materials? Relevant materials, carefully selected on the basis of this evaluation will be characterized in the remaining period preceding startup of the SRC-II demonstration plant.

Major Current SRC-II Characterization Activities

Consistent with the joint nature of its program, DOE's initial round of characterization activities has focused on a delineation of current regulatory compliance issues and screening for areas of potential health and environmental concern. FE and its contractors have taken the lead in identifying and scoping EPA and OSHA compliance issues necessary to keep the demonstration program on schedule. EV and its contractors have led the effort to scope currently unregulated areas that could pose future health or environmental problems. Since the results of health and environmental screening studies pinpoint areas of further FE control technology evaluation, these tasks are interactive and necessarily iterative.

Principal areas of current FE activity include (1) comprehensive process and site specific studies required for compliance with the National Environmental Policy Act and various state and federal environmental permits; (2) extensive industrial hygiene research, development, and monitoring at the Fort Lewis pilot plant; (3) formulation of a large-scale, multiyear compliance toxicology

testing program for the analysis of key SRC-II materials; and (4) analysis of potential environmental incidents and the development and evaluation of remedial action scenarios. Specific projects associated with these activities are summarized by program component (i.e., Screening, Long-term, Parametric, Monitoring) in Tables 2 through 5. FE is currently reviewing available project results and will use this information as one basis for the specification of the next round of project studies.

Principal areas of current EV activity include (1) extensive methodology development for sophisticated chemical, biological, and ecological analyses of SRC-II related materials; (2) screening characterization of the chemical, biological, and ecological properties of a range of generically relevant SRC-II materials; (3) design and initiation of a series of long-term baseline studies of acute and chronic biological and ecological properties of key SRC-II materials; and (4) formulation of a detailed plan for the completion of a comprehensive health and environmental data base adequate for identification and assessment of environmental risks associated with the commercialization of SRC-II technology. Specific projects associated with DOE's program activities are also summarized by program component in Tables 2 through 5. As with FE, EV routinely reviews results of current projects as a partial basis for the addition of new projects. This will be particularly true in the area of health and environmental monitoring.

Both OSHA (through NIOSH) and EPA (through IERL) have strong interests in the analyses of DOE environmental program data and in the generation of independent characterization data. DOE is committed to active communication, cooperation and support of OSHA/EPA and their needs. Tables 2 through 5 also list several EPA- and OSHA-sponsored data base projects to which DOE and its contractors are contributing technical and analytical support. As in the past, each new stage of DOE's continuing commitments for SRC-II data base development will receive the full review of both the EPA and OSHA. This will insure the quality and adequacy of the information base for both DOE's and EPA/OSHA purposes.

TABLE 2

SUMMARY OF CURRENT COMPONENT 1 ACTIVITIES:
SCREENING STUDIES ON SRC-II RELATED MATERIALS

Organization/Program	Material	Source (a)	Summary of Studies			Status	
			Chemistry (b)	Health & Safety (c)	Abiotic Environment		Biotic Environment (d)
<u>STUDIES ON SRC-II PROCESS INTERMEDIATES</u>							
<u>Battelle Northwest Labs</u>							
● Extensive methodology development and generic materials characterization.	Naphtha, middle and heavy distillates.	SRC-II Pilot Plant; 1Q/78	Chemical fractionation and analysis of active compound classes.	Lower-tier biomedical testing; acute, sub-chronic and chronic toxicity testing; rodent skin painting.	--	--	Essentially completed, 1978-1980
● Effect of boiling point on chemical and biological properties of SRC-II materials.	50°F boiling fractions of 400-975°F distillate.	SRC-II PDU; 2Q/80	Chemical fractionation and analysis of active compound classes.	Lower tier biomedical testing.	--	--	To be initiated 3Q/80
● Methodology development and initial characterization.	Vacuum bottoms, recycle and coal slurries.	SRC-II Pilot Plant; 2Q/80	Chemical fractionation and analysis of active compound classes.	Full range biomedical testing methods development.	--	--	To be initiated 3Q/80
● Chemical analysis of SRC-II process waters.	Process and makeup water.	SRC-II Pilot Plant; 2Q/80	Chemical fractionation and analysis; trace metals analysis.	--	--	--	To be initiated 3Q/80
<u>DuPont</u>							
● Biomedical screening of SRC-II, syn crude and petroleum materials.	Naphtha, vacuum bottoms, recycle slurry.	SRC-II Pilot Plant; 4Q/78	--	Ames testing and mouse skin painting.	--	--	Completed, 4Q/78 - 1Q/80
<u>Pittsburgh Energy Technology Center</u>							
● Effects of temperature, light and gaseous environment on the stability of coal liquids.	Naphtha, middle and heavy distillates.	SRC-II Pilot Plant; 3Q/79, 1Q/80	Physical property measurement (viscosity, density), chemical fractionation and organics analysis.	--	--	--	Ongoing since 1978
● Structural changes during coal liquefaction.	Coal, naphtha, middle and heavy distillates recycle slurry, process water and wastewater treatment influent.	SRC-II Pilot Plant; 3Q/79, 1Q/80	Chemical fractionation and organics analysis.	--	--	--	Ongoing since 1979

TABLE 2 (CON'T)

Organization/Program	Material	Source (a)	Summary of Studies				Status
			Chemistry (b)	Health & Safety (c)	Abiotic Environment	Biotic Environment (d)	
• Analytical characterization of coal liquids.	Coal, naphtha, middle and heavy distillates, recycle slurry.	SRC-II Pilot Plant; 3Q/79, 1Q/80	Chemical analysis screening for specific hazardous compounds.	--	--	--	Ongoing since 1979
• RCMA testing of coal conversion solid wastes.	Vacuum bottoms.	SRC-II Pilot Plant; 2Q/80	ASTM and EPA leach testing, organics analysis of leachates.	--	--	--	To be conducted 2-3Q/80
<u>Environmental Research and Technology, Inc.</u>							
• Characterization of SRC-II process waters for organic and inorganic contaminants.	Process waters.	SRC-II Pilot Plant; 2Q/80; SRC-II PDU; 2Q/80	Standard wet chemical analysis for organic and inorganic contaminants.	--	--	--	Ongoing, 2Q/80
<u>Washington State Univ.</u>							
• Characterization of trace elements and their fate in materials from the SRC-II process.	Coal, distillates, coal and recycle slurries, process waters, gaseous streams, Stretford sulfur.	SRC-II Pilot Plant; 1979-1980	Identification and quantification of trace metals, balancing across the SRC-II process.	--	--	--	Ongoing, 1978 thru 1Q/81
<u>Hittman Associates (e)</u>							
• Initial screening characterization of SRC-II process and materials to identify streams of potential environmental concern.	Coal, distillates, recycle and coal slurries, process waters, gaseous streams, Stretford sulfur.	SRC-II Pilot Plant; 1Q/78, 1Q/79	Chemical fractionation and analysis for organics; trace metals analysis; wet chemical analysis of process waters.	Lower-tier biomedical testing.	Soil and plant response to SRC-II materials.	Algae growth and animal toxic response to SRC-II materials.	Completed, 1978-1979
<u>Oak Ridge National Labs</u>							
• Effect of waste treatment on the toxic properties of coal conversion effluent water.	Treated process water.	SRC-II Pilot Plant; date unspecified	--	--	--	Aquatic cellular organisms monitored for population and O ₂ uptake in diluted effluent.	Completed, 1978
<u>STUDIES ON INDUSTRIAL HYGIENE</u>							
<u>Enviro-Control (e)</u>							
• Industrial hygiene compliance survey of Fort Lewis SRC-II pilot plant.	--	SRC-II Pilot Plant; 1Q/79	--	--	Monitoring of pilot plant workplace environment for trace organics, trace metals, particulates and physical agents.	--	Completed, 1979

TABLE 2 (CON'T)

Organization/Program	Material	Source (a)	Summary of Studies				Status
			Chemistry (b)	Health & Safety (c)	Abiotic Environment	Biotic Environment (d)	
<u>Flow Resources Corp.</u>							
• Literature search of coal conversion occupational related issues and review of available data.	--	--	--	--		Evaluation of health-related issues and programs to identify potential hazards in coal conversion processes.	Completed, 1977
<u>STUDIES ON ENVIRONMENTAL CONTROL SYSTEMS</u>							
<u>Chem Pro, Inc.</u>							
• Performance evaluation of Chem Pro process for removal of phenols from water.	Process water	SRC-II PDU; 3Q/79	Identification of Total Organic Carbon and phenols in raw and treated process waters.	--	--	--	Continuing, 1980
<u>STUDIES ON SOLID WASTE AND DISPOSAL</u>							
<u>Oak Ridge National Labs.</u>							
• MCHA testing of slag from gasification of SRC-II vacuum bottoms.	Gasifier slag	Texaco Pilot Plant Gasifier; 3Q/78	ASTM/EPA leach testing, and trace metal leachate characterization. Cl ₂ , Cl ₂ slag extraction for organics analysis.	--		Lysimeter testing of slag to determine trace metal mobility and fate.	Essentially completed, 4Q/78-1Q/80
• Field lysimeter testing of a Pittsburgh #8 coal.	Pittsburgh #8 coal.	--	Water leaching to identify leachate characteristics, including trace metals.	--	--	--	Essentially completed, 1978-1980
<u>Gulf Research and Development Co.</u>							
• Identification of residual organics in slag from gasification of SRC-II vacuum bottoms.	Gasifier slag	Texaco pilot plant gasifier, 3Q/78	Benzene extraction of slag to determine benzene solubles and PNA's.	--	--	--	Completed, 1979

TABLE 2 (CON'T)

Organization/Program	Material	Source (a)	Summary of Studies			Status
			Chemistry (b)	Health & Safety (c)	Abiotic Environment	
STUDIES ON SRC-II PRODUCT MATERIALS						
<u>DuPont</u>						
• Biomedical screening of SRC-II, syn crude and petroleum materials	Fuel oil blend of 2.9/1 middle to heavy distillate	SRC-II Pilot Plant; 4Q/78	--	Ames testing and mouse skin painting	--	Completed, 4Q/78-1Q/80
<u>Hartsville Energy Technology Center</u>						
• Effect of hydro-treatment on the biochemical properties of SRC-II liquids.	Fuel oil blend of 3/1 middle to heavy distillates.	SRC-II Pilot Plant; 4Q/77	--	Ames testing.	--	Completed, during 1979
<u>Battelle Northwest Labs</u>						
• Effect of hydro-treatment on the chemical and biological properties of SRC-II liquids.	Fuel oil blend of 2.9/1 middle to heavy distillates.	SRC-II Pilot Plant; 1Q/79	Chemical fractionation and analysis of active compound classes. Distillation of blend into 10°C boiling fractions.	Ames testing of whole, fractionated and distilled materials.	--	Completed, during 1979
	Hydrotreated fuel oil, two severities.	UOP hydro-treater				
• Ecological screening of the effects of SRC-II products.	Fuel oil blend of 2.9/1 middle to heavy distillates.	SRC-II Pilot Plant; 1979	Chemical and physical characterization.	--	--	Acute and chronic toxicity testing of dissolved organics on aquatic organisms.
<u>Oak Ridge National Labs</u>						
• Screening of chemical, biomedical and environmental characteristics of an SRC-II product fuel oil.	SRC-II Fuel oil blend, generic.	SRC-II Pilot Plant; data unspecified	Chemical fractionation and analysis, PNA identification.	Lower tier biomedical testing; acute toxicity testing, mouse skin painting studies.	--	Acute toxic characterization in fresh water and marine ecosystems.
<u>Pittsburgh Energy Technology Center</u>						
• Performance of coal-derived liquids in a 20 HP fired tube boiler.	Middle and heavy distillates; fuel oil blend, 3/1 middle to heavy distillate.	SRC-II Pilot Plant; 3Q/79	Chemical and elemental analysis.	--	Monitoring of boiler emissions for SO ₂ , NO _x , particulates, VOM, CO; gaseous and particulate-borne PNA's.	Ongoing, 1980

TABLE 2 (CON'T)

Organization/Program	Material	Source (a)	Summary of Studies				Status
			Chemistry (b)	Health & Safety (c)	Abiotic Environment	Biotic Environment (d)	
• Structural changes during coal liquefaction.	Fuel oil blend, generic.	SRC-II Pilot Plant; 3Q/79	Chemical fractionation and organic analysis.	--	--	--	Ongoing since 1979
• Analytical characterization of coal liquids.	Fuel oil blend, generic.	SRC-II Pilot Plant; 3Q/79	Chemical analysis, screening for specific hazardous compounds.	--	--	--	Ongoing since 1979

Footnotes:**(a) Facilities include:**

- SRC II Pilot Plant - 30 tons per day capacity located at Fort Lewis, Washington.
- SRC II PDU - 1 ton per day capacity located at Harnarville, Pennsylvania
- Texaco Pilot Plant Gasifier - 12 tons per day capacity located at Montebello, California.

(b) Chemical fractionation performed using acid/base/neutral extraction, column partition chromatography, Thin Layer Chromatography or High Performance Liquid Chromatography. Detailed chemical analysis can include High Resolution Mass Spectroscopy, combined Gas Chromatography/Mass Spectroscopy, Nuclear Magnetic Resonance, Ultraviolet or Infra-red Spectroscopy.**(c) Lower-tier tests can include, but are not limited to, Ames Salmonella, mammalian cell mutagenesis and transformation, prophage induction, recombination, acute oral and dermal toxicity and teratogenicity. Long-term tests can include carcinogenicity, inhalation toxicology, developmental toxicity and neuro-behavior.****(d) Aquatic organisms used in tests typically include species representing primary producers (e.g., algae), sediment dwelling organisms (e.g., insect larvae) and fish species.****(e) Interagency programs: Hittman Associates funded through U.S. EPA, Enviro-Control funded through NIOSH.**

TABLE 3

SUMMARY OF CURRENT COMPONENT 2 ACTIVITIES: LONG-TERM BASELINE STUDIES ON
SRC-II RELATED MATERIALS

Organization/Program	Material	Source ^(a)	Summary of Studies				Status
			Chemistry ^(b)	Health & Safety ^(c)	Abiotic Environment	Biotic Environment ^(d)	
<u>STUDIES ON PROCESS INTERMEDIATES</u>							
<u>Battelle Northwest Labs</u>							
• Baseline chemical, biomedical and environmental characterization of SRC-II materials.	Naphtha, middle and heavy distillate, recycle and coal slurry, vacuum bottoms, process water.	SRC-II Pilot Plant; 2Q/80	Chemical fractionation and active compound class analysis, trace metal and inorganics analysis.	Full range biomedical testing.	Acute and chronic testing with aquatic organisms and terrestrial systems. Determination of environmental fate, transfer, and bioaccumulation.		To begin by 3Q/80
<u>Gulf Mineral Resources Co.</u>							
• Compliance toxicology testing of SRC-II materials.	Recycle and coal slurry, vacuum bottoms.	SRC-II Pilot Plant; 2Q/80	--	Acute, oral and dermal toxicity; inhalation toxicology, animal skin painting, carcinogenesis, DNA repair.	--	--	To begin by 3Q/80
<u>Hydroscience, Inc.</u>							
• Chemical characterization of process waters from Texaco gasification of SRC-II vacuum bottoms.	Process waters: • quench blow-down, • clarifier overflow, • lockhopper overflow, and • scrubber blow-down.	Texaco Pilot Plant; 1Q/80	Characterization of inorganics, trace metals, dissolved gases and priority pollutants.	--	--	--	Ongoing thru 2Q/80
<u>Hittman Associates (e)</u>							
• EPA Level II assessment of the SRC-II process to quantify potential environmental effects.	Coal, naphtha, middle and heavy distillates, coal and recycle slurry, vacuum bottoms, process and treated waters, Stretford sulfur, gas treatment blowdown solutions, wastewater treatment sludges and gas vents.	SRC-II Pilot Plant; 1-2Q/80	Chemical fractionation and analysis for organics, inorganic and trace metals analysis, volatile organic matter analysis.	Ames mutagenesis, mammalian cell testing, acute/chronic toxicity.	Terrestrial soil respiration.	Aquatic acute static bioassay.	Ongoing, 1980

TABLE 3 (CON'T)

Organization/Program	Material	Source ^(a)	Summary of Studies			Status
			Chemistry ^(b)	Health & Safety ^(c)	Abiotic Environment	
<u>STUDIES ON SOLID WASTE AND DISPOSAL</u>						
<u>Battelle Northwest Labs</u>						
• Baseline environmental testing of slag produced by Texaco gasification of SRC-II vacuum bottoms.	Gasifier slag.	Texaco Pilot Plant; 1Q/80	Chemical analysis for trace metals/contaminant; aqueous and organic leaching.	Oral and dermal toxicity, teratogenicity, inhalation and developmental toxicity, neurobehavior; leachate carcinogenicity and toxicity testing.	Acute and chronic testing with aquatic organisms and terrestrial systems. Determination of environmental fate, transfer and bioaccumulation.	To begin 3-4Q/80
<u>Oak Ridge National Labs</u>						
• Toxicity testing of slag produced by Texaco gasification of SRC-II vacuum bottoms.	Gasifier slag.	Texaco Pilot Plant; 1Q/80	ASTM/EPA leach testing, chemical analysis of leachates for trace metals, priority pollutants. Organic extraction of slag for trace organic characterization.	--	Lysimeter testing to determine mobility and fate of slag leachates.	Acute toxicological testing of slag leachates on aquatic organisms and terrestrial systems.
<u>Hydroscience, Inc.</u>						
• Physical, chemical and biological treatment of process waters from Texaco gasification of SRC-II vacuum bottoms.	Quench blow-down and clarifier overflow water.	Texaco Pilot Plant; 1Q/80	Chemical characterization of sludges produced during physical, chemical, biological treatment. Dewatering and incineration drying tests. Toxicity testing of sludges, trace metals.	--	--	Toxicity testing of treated waters and sludge leachates using aquatic organisms.
<u>STUDIES ON SRC-II PRODUCTS</u>						
<u>Battelle Northwest Labs</u>						
• Baseline chemical, biomedical and environmental characterization of upgraded naphtha.	Product Naphtha.	SRC-II Pilot Plant; 2Q/80	Chemical fractionation and analysis for active compound classes.	Full range biomedical testing.	Acute and chronic testing with aquatic organisms and terrestrial systems. Determination of environmental fate, transfer and bioaccumulation.	To begin by late 1980
• Baseline chemical, biomedical and environmental characterization of SRC-II fuel oil.	SRC-II fuel oil blend, ratio not determined.	SRC-II Pilot Plant; 2Q/80	Chemical fractionation and analysis for active compound classes.	Full range biomedical testing.	Acute and chronic testing with aquatic organisms and terrestrial systems. Determination of environmental fate, transfer and bioaccumulation.	To begin by 4Q/80

TABLE 3 (CON'T)

Organization/Program	Material	Source (a)	Summary of Studies				Status
			Chemistry (b)	Health & Safety (c)	Abiotic Environment	Biotic Environment (d)	
<u>Gulf Mineral Resources Co.</u>							
• Toxicological testing of SRC-13 product fuel oil.	SRC-11 light fuel oil (middle distillate).	SRC-11 Pilot Plant; 2Q/80	--	Acute, oral, dermal toxicity; inhalation toxicology; animal skin painting, carcinogenesis; mutagenesis, DNA synthesis.	--	--	To begin by 3Q/80

Footnotes:

(a) Facilities include:

- SRC 11 Pilot Plant - 30 tons per day capacity located at Fort Lewis, Washington.
- SRC 11 PBU - 1 ton per day capacity located at Harmarville, Pennsylvania
- Texaco Pilot Plant Gasifier - 12 tons per day capacity located at Montebello, California.

(b) Chemical fractionation performed using acid/base/neutral extraction, column partition chromatography, Thin Layer Chromatography or High Performance Liquid Chromatography. Detailed chemical analysis can include High Resolution Mass Spectroscopy, combined Gas Chromatography/Mass Spectroscopy, Nuclear Magnetic Resonance, Ultraviolet or Infra-red Spectroscopy.

(c) Full-range biomedical testing can include both lower tier and long term testing, depending upon the extent of the screening study database. Lower-tier tests can include Ames Salmonella, mammalian cell mutagenesis and transformation, prophage induction, recombination, acute oral and dermal toxicity and teratogenicity. Long-term tests can include carcinogenicity, inhalation toxicology, developmental toxicity and neuro-behavior.

(d) Aquatic organisms used in tests typically include species representing primary producers (e.g., algae), sediment dwelling organisms (e.g., insect larvae) and fish species.

(e) Interagency program; Hittman Associates funded by U.S. EPA.

TABLE 4

SUMMARY OF PROPOSED COMPONENT 3 ACTIVITIES:
PARAMETRIC STUDIES ON SRC-II RELATED ACTIVITIES

Organization/Program	Material	Source (a)	Summary of Studies			Status
			Chemistry (b)	Health & Safety (c)	Abiotic Environment	
<u>STUDIES ON SRC-II PROCESS INTERMEDIATES</u>						
<u>Battelle Northwest Labs</u>						
• Variation of chemical and biological properties of SRC-II materials with changes in process conditions and configuration, including: coal type, distillate endpoint, reactor configuration, and operating modes and conditions.	Coal, coal and recycle slurries naphtha, middle and heavy distillates, process water, vacuum bottoms.	SRC-II Pilot Plant, SRC-II PDU; 1981-1984	Chemical fractionation and analysis for active compound classes.	Lower-tier biomedical testing, longer term extensive testing based on comparison with results of baseline studies.	Testing in environmental and ecological systems limited to use of acute and chronic screening assays, based upon results of baseline studies.	To be conducted, 1981-1984
<u>Washington State Univ.</u>						
• Characterization of the fate and form of trace metals released from coal during the SRC-II coal liquefaction process.	Coal, coal and recycle slurries, naphtha, middle and heavy distillates, process waters, vacuum bottoms, gas streams, Stretford sulfur.	SRC-II Pilot Plant; 1979-1Q/81	Trace metal analysis.			Ongoing, thru 1Q/81
<u>STUDIES ON ENVIRONMENTAL CONTROL SYSTEMS</u>						
<u>Battelle Northwest Labs</u>						
• Chemical and biomedical characteristics of treated SRC-II process waters.	Process waters: Nity removal, tur acid removal, and biological treatment.	Byproduct recovery pilot units Bench-scale biotreatment units 1981 and later	Chemical fractionation/ extraction and analysis for active compound classes.	Lower-tier biomedical testing, long term testing based upon results of lower-tier tests and baseline studies.	Environmental and ecological testing limited to use of acute and chronic screening assays, further work based on comparison to baseline results.	To be conducted, 1981 and later
• Chemical and biomedical characteristics of offgases from controlled combustion testing of SRC-II hydrocarbon materials.	Coal and recycle slurries, distillates and vacuum bottoms. Particulates, offgases.	SRC-II Pilot plant; 4Q/80 and later. Combustor PDU's, 4Q/80 and later.	Chemical fractionation/ extraction and analysis of particulate-borne hydrocarbons, gaseous hydrocarbons. Trace metal characterization, conventional pollutant characterization.	Limited lower-tier biomedical testing where quantities available.		To be conducted, 1981 and later

TABLE 4 (CON'T)

Summary of Studies							
Organization/Program	Material	Source (a)	Chemistry (b)	Health & Safety (c)	Abiotic Environment	Biotic Environment (d)	Status
Hittman Associates (e)							
• Detailed characterization of SRC-II pilot plant Stratford unit performance.	Acid and offgas streams, absorber solution, vents, product sulfur.	SRC-II Pilot Plant; -1981	Chemical fractionation and analysis: trace metals, trace organics, minor inorganic, and contaminants, and elemental composition.	--	--	--	To be conducted ~ 1981
STUDIES ON SOLID WASTE AND DISPOSAL							
Battelle Northwest Labs							
• Chemical and biomedical characteristics of solid wastes/sludges produced from the SRC-II process.	Treatment system wastes: chemical, biological, and byproduct recovery. Incinerator solids. Combustor solids.	Treatment system testing units; evaporator/incinerator units controlled combustors.	Chemical fractionation and analysis for organics, inorganics, trace metals, leach testing of potential solids for disposal.	Lower-tier biomedical testing, further testing based on comparison to baseline studies.	Environmental and ecological system testing limited to use of acute and chronic screening assays, further work based on comparison to baseline results.		To be performed 1981 and later
STUDIES ON SRC-II BYPRODUCT MATERIALS							
Battelle Northwest Labs							
• Chemical and biomedical characteristics of SRC-II byproducts.	Tar acids	Byproduct recovery pilot units; 1981 and later.	Chemical fractionation and analysis for trace organics and metals.	Lower-tier biomedical testing.	Environmental and ecological system testing limited to use of acute and chronic screening assays.		To be conducted, 1981 and later
STUDIES ON SRC-II PRODUCT MATERIALS							
Battelle Northwest Labs							
• Effects of hydrotreatment on the chemical and biomedical properties of SRC-II product materials.	Raw and hydro-treated distillates: naphtha, middle, heavy, and fuel oil blend.	Hydrotreatment pilot units; 4Q/80 and later	Chemical fractionation and analysis for active compound classes.	Lower-tier biomedical testing.	--	--	To be conducted, 1981 and later
• Effects of refinery upgrading on the chemical and biomedical properties of SRC-II product materials.	Raw and upgraded distillates: naphtha, middle, heavy, and fuel oil blend.	Refinery upgrading pilot units; 1981 and later	Chemical fractionation and analysis for active compound classes.	Lower-tier biomedical testing.	--	--	To be conducted, 1981 and later

TABLE 4 (CON'T)

Organization/Program	Material	Source (a)	Summary of Studies			Status	
			Chemistry (b)	Health & Safety (c)	Abiotic Environment		Biotic Environment (d)
<u>STUDIES ON SRC-II PRODUCT END-USE TESTING</u>							
<u>Battelle Northwest Labs</u>							
• Environmental effects of utilizing SRC-II product fuel oils in end-use testing systems.	Middle and heavy distillates, full boiling range fuel oils. Particulates and offgases.	SRC-II pilot plant; 1981 and later. End use testing pilot units: boilers, and turbines.	Chemical fractionation and analysis for trace organic and metal contaminants, gaseous and particulate-borne hydrocarbons, conventional pollutant characterization.	Lower tier biomedical characterization if ample quantities of particulates generated.	--	--	To be conducted, 1981 and later

Footnotes:

(a) Facilities include:

- SRC II Pilot Plant - 30 tons per day capacity located at Fort Lewis, Washington.
- SRC II PDU - 1 ton per day capacity located at Harnarville, Pennsylvania
- Texaco Pilot Plant Gasifier - 12 tons per day capacity located at Montebello, California.

(b) Chemical fractionation performed using acid/base/neutral extraction, column partition chromatography, Thin Layer Chromatography or High Performance Liquid Chromatography, Detailed chemical analysis can include High Resolution Mass Spectroscopy, combined Gas Chromatography/Mass Spectroscopy, Nuclear Magnetic Resonance, Ultraviolet or Infra-red Spectroscopy.

(c) Lower-tier biomedical testing can include Ames Salmonella, mammalian cell mutagenesis and transformation, acute oral and dermal toxicity and teratogenicity.

(d) Aquatic organisms used in tests typically include species representing primary producers (e.g., algae), sediment dwelling organisms (e.g., insect larvae) and fish species.

(e) Interagency program: Hittman Associates funded by U.S. EPA.

TABLE 5

SUMMARY OF CURRENT COMPONENT 4 ACTIVITIES: MONITORING STUDIES

Organization/Program	Material	Source	Summary of Studies				Status
			Chemistry	Health & Safety	Abiotic Environment	Biotic Environment	
<u>FORT LEWIS PILOT PLANT STUDIES</u>							
<u>Battelle Northwest Labs</u>							
• Industrial hygiene monitoring.	In-plant contaminants.	Fort Lewis	--	Early warning system development.	Levels of contaminants characteristic of plant stream product fugitive emissions.	--	Ongoing
• Ecological assessment.	Plant liquid, solid and emission releases.	SRC-II process	--	Adapt existing models	(source-transfer) to the SRC-II process in general.		1980 to 1981
• Terrestrial vegetation contact toxicity.	Product and slag.	Fort Lewis 1979	--	--	--	Determine vegetation response to atmospheric releases of SRC-II product and solid waste.	1979
	Gasifier bottoms, process water, incinerator solids, liquid products.	Fort Lewis 1980	Routine analytical testing of toxic components.	--	Organic and inorganic transfer from foliage to seeds.	Biomass response.	1980 to 1981
<u>Pittsburg & Midway Coal Mining Company</u>							
• Air quality data collection.	Area air quality.	Fort Lewis Site	--	--	15 monitoring stations - air quality characteristics and wind speed/direction.	Vegetation response.	1972 to Ongoing
• Surface water quality.	Area water quality.	Fort Lewis Site	--	--	Surface water quality monitoring at 3 stations - physical, organic and inorganic characteristics.	Bacteria.	1972 to ongoing
• Foliage monitoring.	Vegetation.	Fort Lewis Area	--	--	--	Foliage from 3 leeward and 1 upwind sites.	1976, 1978 to ongoing
<u>Electric Power Research Institute</u>							
• Health, personnel protection and regulatory considerations in the electric utility use of coal-derived fuels	--	--	--		Evaluation and potential use of existing health and environmental regulations - study results to the handling of coal derived fuel oils. Define areas for additional research. Estimate exposure effects. Draft guidelines and procedures.		ongoing

TABLE 5 (CON'T)

Organization/Program	Material	Source	Summary of Studies				Status
			Chemistry	Health & Safety	Abiotic Environment	Biotic Environment	
<u>FORT LEWIS PILOT PLANT STUDIES</u>							
<u>Battelle Northwest Labs</u>							
• Industrial hygiene monitoring.	In-plant contaminants.	Fort Lewis	--	Early warning system development.	Levels of contaminants characteristic of plant stream product fugitive emissions.	--	Ongoing
• Ecological assessment.	Plant liquid, solid and emission releases.	SRC-II process	--	Adapt existing models (source-transfer) to the SRC-II process in general.			1980 to 1981
• Terrestrial vegetation contact toxicity.	Product and slag.	Fort Lewis 1979	--	--	--	Determine vegetation response to atmospheric releases of SRC-II product and solid waste.	1979
	Gasifier bottoms, process water, incinerator solids, liquid products.	Fort Lewis 1980	Routine analytical testing of toxic components.	--	Organic and inorganic transfer from foliage to seeds.	Biomass response.	1980 to 1981
<u>Pittsburg & Midway Coal Mining Company</u>							
• Air quality data collection.	Area air quality.	Fort Lewis Site	--	--	15 monitoring stations - air quality characteristics and wind speed/direction.	Vegetation response.	1972 to Ongoing
• Surface water quality.	Area water quality.	Fort Lewis Site	--	--	Surface water quality monitoring at 3 stations - physical, organic and inorganic characteristics.	Bacteria.	1972 to ongoing
• Foliage monitoring.	Vegetation.	Fort Lewis Area	--	--	--	Foliage from 3 leeward and 1 upwind sites.	1976, 1978 to ongoing
<u>Electric Power Research Institute</u>							
• Health, personnel protection and regulatory considerations in the electric utility use of coal-derived fuels	--	--	--	Evaluation and potential use of existing health and environmental regulations - study results to the handling of coal derived fuel oils. Define areas for additional research. Estimate exposure effects. Draft guidelines and procedures.			ongoing
<u>Gulf Mineral Resources Company</u>							
• Workplace personnel monitoring.	Workplace.	Fort Lewis	--	Personnel and area monitoring. Skin contamination.	Particulates, organic compounds, noise, illumination	--	Ongoing

TABLE 5 (CON'T)

Organization/Program	Material	Source	Summary of Studies				Status
			Chemistry	Health & Safety	Abiotic Environment	Biotic Environment	
● SRC-II industrial hygiene procedures, methods and protective devices.	Workplace.	Fort Lewis	--	Personnel training in the use of protective clothing, first aid, personal hygiene, disciplinary program.	--	--	Ongoing
● SRC-II clinical monitoring.	Personnel.	Fort Lewis	--	Pre-employment physical, annual physical, and periodic pulmonary function and skin tests.	--	--	Ongoing
<u>Oak Ridge National Labs</u>							
● Computerized data management for environmental effects data.	--	SRC-II	--	Computerized data management to catalogue data results. System capabilities to include merging, statistical analyses and graphical-tabular displays.			1979 to ongoing
<u>Nadian Corporation</u>							
● Ground water quality, hydrology and remedial action plan.	Product	Fort Lewis pilot plant	--	Evaluate human health consequences of product spill.	Ground water quality and hydrology characterization. Installation of monitoring system. Development of remedial product spill plan.	Evaluate ecological consequences of product spill.	ongoing 1980
<u>PRE-CONSTRUCTION DEMONSTRATION PLANT STUDIES</u>							
<u>Pittsburg & Midway Coal Mining Company</u>							
<u>CONSAD Research Corp.</u>							
● Socioeconomic baseline investigations.	--	Morgantown site area	--	--	Site accessibility, regional economy, housing, community services and fiscal capabilities.	Demographics, labor availability and anticipated impacts.	1978 to 1979
<u>Stearns-Roger</u>							
● Surface water investigations.	--	Morgantown site area	--	--	Seasonal monitoring of all surface drainages. Complete range of physical and chemical characteristics.	--	1978 to 1979
● Noise Investigations.	--	Morgantown site area	--	--	Background noise levels. Seasonal, day and night, 24 hour.	--	1979

TABLE 5 (CON'T)

Organization/Program	Material	Source	Summary of Studies				Status
			Chemistry	Health & Safety	Abiotic Environment	Biotic Environment	
• Aquatic Ecology.	--	Morgantown site area	--	--	--	Monogahela River, 1978 to Robinson Run, 1979 Crooked Run, Crafts Run. Fish, ichthyoplankton, benthic macroinvertebrates, macrophytes, periphyton phytoplankton and zooplankton.	
• Vegetation Investigations	--	Morgantown site area	--	--	--	Mapping and characterization of vegetation communities. Species identification and composition.	1978 to 1979
• Terrestrial animal investigations.	--	Morgantown site area	--	--	--	Mammals, birds, reptiles and amphibians, species composition, habitat, relative abundances, and distribution.	1978 to 1979
• Soils investigation. (West Virginia Univ., CDM Labs, NUS Corp., and Gulf Science and Technology Company)	--	Morgantown site area	--	--	--	Types - location, Trace elements, hydrocarbons, physical characteristics. Soil salvage-reclamation.	1979
• Groundwater investigations. (D'Appolonia Consulting Engineers, Inc.)	--	Morgantown site area	--	--	--	Occurrence, hydraulic characteristics, and water quality (organic and inorganic - Level I hydrocarbon).	1978 to 1979
• Geology investigations. (D'Appolonia Consulting Engineers, Inc.)	--	Morgantown site area	--	--	--	Stratigraphy, lithology, structure, hazards, seismic history, risk, and mineral resources.	1979

TABLE 5 (CON'T)

Organization/Program	Material	Source	Summary of Studies				Status
			Chemistry	Health & Safety	Abiotic Environment	Biotic Environment	
• Meteorology and air quality investigations. (DeNardo and McFarland Weather Service)	--	Morgantown site area	--	--	Continuous monitoring of wind speed direction, air temperature, humidity, precipitation, potential pollutants.	--	1978 to 1979
• Archeological, historical and paleontological investigations. (West Virginia Geological and Economic Survey)	--	Morgantown site area	--	--	--	Identification of archeological, historical and paleontological characteristics.	1978 to ongoing
<u>PRE-OPERATIONAL DEMONSTRATION PLANT STUDIES</u>							
<u>Pittsburgh & Midway Coal Mining Co.</u>							
<u>Gulf Mineral Resources Company</u>							
• Air monitoring research	Plant emissions.	--	--	Data to be used for industrial hygiene program.	Develop more sensitive tests for aromatic amines, cyanides, thiocyanates, and heterocyclics.	--	Ongoing
• Hi-Volume PNA silver membrane filter solid sorbent sampling research.	Plant emissions.	--	--	Data to be used for industrial hygiene program.	Develop more sensitive PNA monitoring system.	--	Ongoing
• SRC uniforms and protective clothing.	Plant pollutants.	--	--	Uniform and protective clothing for personnel.	--	--	Ongoing
<u>Stearns-Roger</u>							
• Socioeconomics.	--	Morgantown site area	--	--	Economic conditions.	Labor migration and demographics.	Ongoing
• Soils.	--	Morgantown site area	--	--	Agronomic trace element and hydrocarbon analyses at 6 locations. Development of operational monitoring test plots.	Development of vegetation operational monitoring test plots.	Ongoing

TABLE 5 (CON'T)

Organization/Program	Material	Source	Summary of Studies				Status
			Chemistry	Health & Safety	Abiotic Environment	Biotic Environment	
• Terrestrial ecology.	--	Morgantown site area	--	--	--	Establishment of permanent study plots to monitor vegetation and animal populations. Vegetation monitoring 3 times/year, mammals 2 times/year.	Ongoing
• Aquatic ecology.	--	Morgantown site area	--	--	Chlorophyll content of phytoplankton and periphyton.	Sampling 2 times/year for fish, ichthyoplankton, benthic macroinvertebrates, phytoplankton, zooplankton, periphyton and macrophytes. Species composition, abundance and distribution.	Ongoing
• Surface water and sediments.	--	Morgantown site area	--	--	Seasonal water quality analyses for 38 characteristics. Seasonal sediment analyses for 30 characteristics.	--	Ongoing
• Groundwater.	--	Morgantown site area	--	--	Establishment of 4 monitoring wells. Quarterly analyses.	--	Ongoing
• Noise.	--	Morgantown site area	--	--	Baseline and construction noise level measurements.	--	Ongoing
• Meteorology and air quality.	--	Morgantown site area	--	--	Continuous measurement of wind speed-direction, temperature, relative humidity and precipitation. Air quality monitoring in accordance with US EPA.	--	Ongoing
<u>Pittsburgh Energy Technology Center</u>							
• Texas GC PNA sampling system.	PNA.	--	--	--	Data to be used for industrial hygiene program.	Development of more sensitive PNA sampling device.	Ongoing

TABLE 5 (CON'T)

Organization/Program	Material	Source (a)	Summary of Studies			Status	
			Chemistry (b)	Health & Safety (c)	Abiotic Environment		Biotic Environment (d)
<u>PRESENTLY ANTICIPATED DEMONSTRATION PLANT STUDIES</u>							
<u>Mettelle Northwest Labs</u>							
• Biological fate-aquatic system.	Water toxicants.	Morgantown site area	--	--	Physical-chemical characteristics.	Uptake and accumulation of toxicants by aquatic primary producers, benthic macroinvertebrates and fish in a sediment-water-organism test.	1984
• Terrestrial uptake.	Toxicants.	Morgantown plant	--	--	Physical-chemical characteristics. Soil sediment interaction.	Uptake and accumulation of toxicants by garden vegetables. Revegetation planning. Decomposition pathways.	1984
• Biological fate-solid waste Revegetation.	Solid wastes.	Morgantown plant	--	--	Chemical characterization of potential toxics.	Toxicity testing, vegetation toxicant uptake, accumulation and detoxification. Identify native and genetically improved species for revegetation.	1984
• Biological fate-terrestrial ecosystem.	Air emissions.	Morgantown plant.	--	--	Chemical characterization of potential toxics.	Toxic transfer from vegetation to small mammal and accumulation through food chain.	1984
• Biological fate - aquatic ecosystem.	Solid wastes.	Morgantown plant	--	--	Chemical characterization of leachates and sediments.	Aquatic organism uptake, accumulation and transfer.	1984
• Biological fate - atmospheric emissions.	Air emissions.	Morgantown plant	--	--	Physical and chemical characterization of potential toxicants.	Uptake and accumulation of toxicants.	1984

TABLE 5 (CON'T)

Organization/Program	Material	Source (a)	Summary of Studies				Status
			Chemistry (b)	Health & Safety (c)	Abiotic Environment	Biotic Environment (d)	
• Solid waste disposal.	Solid wastes.	Morgantown plant	Physical and chemical characterization.	--	Physical and chemical characterization of water and sediments in proximity to the disposal site.	--	1984
• Aquatic ecology baseline.	Biologically active pollutants.	Morgantown plant	--	--	Physical and chemical characterization of potential pollutants.	Determination of baseline and any elevated body burdens of pollutants in Monongahela River organisms.	1984
<u>Pittsburg & Midway Coal Mining Company</u>							
• Industrial hygiene program.	Emissions, solid waste and liquids.	Morgantown plant	--	Complete health-safety training and monitoring program.	Physical and chemical characterization and surveillance of potential pollutants.	--	1984