**Fossil Energy Environmental Project
Annual Report
FY 1977**

MASTER

OAK RIDGE NATIONAL LABORATORY
OPERATED BY UNION CARBIDE CORPORATION • FOR THE DEPARTMENT OF ENERGY

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FOSSIL ENERGY ENVIRONMENTAL PROJECT
ANNUAL REPORT
FY 1977

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Fossil Energy Program Administration
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FOSSIL ENERGY ENVIRONMENTAL PROJECT ANNUAL REPORT

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ABSTRACT

During the past year the Fossil Energy Environmental Project (FEEP) has provided technical support to the Fossil Energy Program Administration of the Department of Energy (DOE/FE) in its coal conversion demonstration program. Work was focused in four principal areas: environmental assessment; guidance to demonstration plant contractors regarding environmental obligations; experimental studies of stored solids from coal conversion; and interactive assistance to contractors regarding environmental monitoring needs.

Four major documents were prepared, two guidelines for contractors and two environmental analyses. An experimental program using both laboratory and field-scale testing was initiated to study leachates from both stored coal and coal conversion wastes. Technical assistance tasks early in the year consisted primarily of quick-response activities. However, after initial demonstration plant contracts were signed, advisory activities increased — the latter part of the year saw the start of frequent interactions with contractors regarding environmental monitoring of coal conversion demonstration-plant sites.

INTRODUCTION

The Fossil Energy Environmental Project (FEEP) of the Oak Ridge National Laboratory (ORNL) provides the Fossil Energy Program Administration of the Department of Energy (DOE/FE) with an environmental assessment and technical support program necessary to the early realization of advanced fossil fuel facilities. Assessment and solution of potential environmental problems, activities that are vital to the successful development of new fossil technologies, require a diversified program capable of addressing both environmental and engineering questions. Reflecting this diversification, FEEP work during the past year focused on problems from four principal perspectives: environmental assessment, guidance to contractors, experimental studies, and interactive technical assistance activities. In all endeavors, the emphasis has been on coal conversion, especially gasification, and on demonstration-size facilities.

The four major documents that were produced can be divided into two categories — guidelines for contractors and environmental analyses. All have at least some degree of generic character in that they apply to a number of potential coal conversion processes and sites, but much of the effort relates to the demonstration of gasification. The guidelines documents, *Environmental Considerations for Inclusion in Program Opportunity Notices, Requests for Proposals, and Environmental Reports: Fossil Energy Demonstration Plants*¹ and *Environmental Monitoring Handbook for Coal Conversion Facilities*,² address environmental obligations and monitoring needs. Of the two analysis documents, *Environmental Analyses for Pipeline Gas Demonstration Plants*³ takes a broad view of possible impacts from high-Btu coal gasification whereas *Environmental and Health Aspects of Disposal of Solid Wastes from Coal Conversion*⁴ focuses on a specific area of impact — solid waste disposal. FEEP experimental work was initiated with laboratory leaching studies on

solid wastes from gasification processes. Technical assistance to DOE/FE involved primarily advisory interactions with DOE contractors for demonstration plants to produce pipeline (high-Btu) gas.

Figure 1 illustrates the relationship of the Fossil Energy Environmental Project to the development of pipeline gas commercial plants. Input from FEEP occurs all along the development pathway, but as the demonstration project develops, the character of FEEP input varies. At the direction of DOE, input that precedes the Environmental Report (ER) is frequent, active, and advisory. The industrial partner is apprised of his environmental responsibilities, of potential environmental hazards, and of means for monitoring and dealing with potential environmental problems. After the ER is prepared and before construction begins, the environmental responsibility transfers to DOE/FE and input from FEEP becomes active and participatory — preparing the EIS and defending it at hearings. After the hearings FEEP again assumes an advisory capacity and becomes primarily passive and responsive to queries.

The coming year will see a shift in emphasis. More effort will be expended on site-specific environmental-impact-statement preparation, interactions with demonstration plant contractors, and experimental studies. This shift reflects both the needs of DOE and a maturing of the project.

The multidisciplinary nature of the project is evident in Table 1, which lists personnel in the task groups for the major tasks performed this year. Five ORNL divisions and at least eleven distinct disciplines are represented.

Fig. 1. Environmental path to commercialization - coal to pipeline gas.

Table 1. Task Groups

<p>Task Group 1: Environmental Analysis for Pipeline Gas Demonstration Plants</p> <p>L. H. Stinton, Leader</p> <p>J. N. Baird, Consultant Engineer</p> <p>L. W. Barnthouse, Ecologist</p> <p>L. G. Berry, Socioeconomist</p> <p>H. M. Braunstein, Engineer/Chemist</p> <p>S. G. DeCicco, Chemical Engineer</p> <p>R. J. Haynes, Ecologist</p> <p>D. L. Kaserman, Economist</p> <p>D. W. Lee, Fluids Engineer</p> <p>B. D. Murphy, Atmospheric Physicist</p> <p>K. M. Oakes, Ecologist</p> <p>R.G.S. Rao, Hydrological Engineer</p> <p>L. W. Rickert, Information Specialist</p> <p>R. D. Roop, Ecologist</p> <p>R. J. Raridon, Air Quality Analyst</p> <p>M. S. Salk, Ecologist</p> <p>W. P. Staub, Geologist</p> <p>G. W. Suter, Ecologist</p> <p>D. J. Wilkes, Information Specialist</p>	<p>Task Group 4: Environmental Monitoring Handbook for Coal Conversion Facilities</p> <p>M. S. Salk</p> <p>L. H. Stinton } Leaders</p> <p>S. G. DeCicco</p> <p>L. G. Berry, Socioeconomist</p> <p>H. M. Braunstein, Engineer/Chemist</p> <p>R. M. Cushman, Ecologist</p> <p>G. A. Dailey, Microbiologist</p> <p>R. J. Haynes, Ecologist</p> <p>D. L. Kaserman, Economist</p> <p>D. K. Kumar, Biostatistician</p> <p>D. W. Lee, Fluids Engineer</p> <p>F. L. Moore, Analytical Chemist</p> <p>B. D. Murphy, Atmospheric Physicist</p> <p>R.G.S. Rao, Hydrological Engineer</p> <p>L. W. Rickert, Information Specialist</p> <p>R. D. Roop, Ecologist</p> <p>F. S. Sanders, Ecologist</p> <p>R. K. Schreiber, Ecologist</p> <p>G. W. Suter, Ecologist</p> <p>W. P. Staub, Geologist</p> <p>D. J. Wilkes, Information Specialist</p>
<p>Task Group 2: Environmental and Health Aspects of Disposal of Solid Wastes</p> <p>H. M. Braunstein, Leader</p> <p>J. N. Baird, Consultant Engineer</p> <p>L. W. Barnthouse, Ecologist</p> <p>H. F. Hartman, Engineer</p> <p>R. J. Haynes, Ecologist</p> <p>R. E. Kuhlman, Engineer</p> <p>R.G.S. Rao, Hydrological Engineer</p> <p>L. W. Rickert, Information Specialist</p> <p>R. D. Roop, Ecologist</p> <p>M. S. Salk, Ecologist</p> <p>F. S. Sanders, Ecologist</p> <p>L. H. Stinton, Environmental Engineer</p> <p>D. J. Wilkes, Information Specialist</p>	<p>Task Group 5: Experimental Study of Leachates from Stored Solids</p> <p>W. J. Boegly, Jr., Leader</p> <p>H. S. Arora, Soil Chemist</p> <p>H. M. Braunstein, Engineer/Chemist</p> <p>E. Davis, Environmental Engineer/Graduate Student</p> <p>S. G. DeCicco, Chemical Engineer</p> <p>R.G.S. Rao, Hydrological Engineer</p> <p>H. W. Wilson, Laboratory Technician</p>
<p>Task Group 3: Environmental Considerations for Fossil Energy Demonstration Plants</p> <p>M. S. Salk, Leader</p> <p>J. N. Baird, Consultant Engineer</p> <p>L. W. Barnthouse, Ecologist</p> <p>L. G. Berry, Socioeconomist</p> <p>R. D. Roop, Ecologist</p> <p>F. S. Sanders, Ecologist</p>	<p>Task Group 6: Interaction with Contractors</p> <p>S. G. DeCicco, Leader</p> <p>L. G. Berry, Socioeconomist</p> <p>R. J. Haynes, Ecologist</p> <p>S. G. Hildebrand, Ecologist</p> <p>D. L. Kaserman, Economist</p> <p>D. W. Lee, Fluids Engineer</p> <p>B. D. Murphy, Atmospheric Physicist</p> <p>R.G.S. Rao, Hydrological Engineer</p> <p>R. M. Reed, Ecologist</p> <p>F. S. Sanders, Ecologist</p> <p>G. W. Suter, Ecologist</p>

ENVIRONMENTAL ANALYSES

Because environmental problems are now widely recognized as having the same level of importance as technological problems, solving environmental problems is currently an integral part of technology development including coal conversion. But because coal conversion is an emerging technology with an abundance of process options, potential environmental problems are abundant and even preliminary data on which to evaluate the problems are exceedingly scarce. Thus, there is an urgent need not only for comprehensive overviews such as those described below but also for more specific assessment studies, especially those that bridge the gap between health and ecological considerations and the technical, engineering control options.

Environmental Analyses for Pipeline Gas Demonstration Plants

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The objectives of the pipeline gas environmental analysis were twofold: (1) to provide DOE with information on the potential environmental and socioeconomic impacts of constructing and operating pipeline gas demonstration plants and (2) to prepare a general reference source to be used as basic input for future site-specific assessments and statements. In order to provide specific quantitative insight into associated impacts in the absence of a specific site, the approach taken relied on specific site descriptions based upon carefully selected surrogate sites.

Three coal regions were selected for evaluation — Eastern Province, Interior Province, and Northern Great Plains Province (Fig. 2). A large number of potential sites within each province were examined as possibilities for describing and disseminating needed impact information, and the three indicated in Fig. 2 were selected. The sites provide significant contrasts in physical, ecological, and socioeconomic settings.

The document produced as a result of the FEEP study, *Environmental Analyses for Pipeline Gas Demonstration Plants*,³ contains detailed descriptions of high-Btu gasification processes and

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Fig. 2. Surrogate sites and major coal fields of the United States. Source: Modified from National Petroleum Council, *U.S. Energy Outlook: Coal Availability*, 1973.

unit operations in relation to their associated effluents. The section describing the effects of facility construction and operation is organized according to the part of the environment impacted. Two types of impact arise — those common to all the sites and those unique to a specific site. Because the three sites selected provide significant contrasts in ecological and socioeconomic settings, a view of the probable range of impacts is given. The section on coordination between various levels of government provides a generalized list of permits, licenses, and approvals which represent typical actions and coordination that may be required at any site.

Principal findings are summarized in the environmental impact section of the document. In general, impacts due to construction of a high-Btu gas demonstration plant will be similar to those associated with construction of a chemical plant of similar size. These impacts are identified and contrasted for the surrogate sites selected. Many impacts are site-related; if the site is selected properly, the impact will be minimal.

Despite the similarities, operation of a high-Btu gas demonstration plant has several unique aspects that differentiate it from that of an ordinary chemical plant. Offsite development (surface mining) and disposal of large quantities of waste solids constitute important sources of potential impact. Although expected to be small, air emissions will require monitoring for trace metals, polycyclic aromatic hydrocarbons, phenols, and possibly other as-yet-unidentified emissions. The potential biological impacts from long-term exposure to these emissions are unknown, and additional research and data analysis may be necessary to determine these effects. Present plans often call for no liquid discharge from demonstration facilities, but in the event that discharge is planned, the occurrence of chemical contaminants in liquid effluents and the bioaccumulation of these contaminants in aquatic organisms will need to be

examined. Socioeconomic impacts are expected to be similar to those of an equivalent size chemical plant.

Environmental and Health Aspects of Disposal of Coal Conversion Solid Wastes

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The disposal of solid waste from coal conversion has the potential for causing adverse environmental impacts. If disposed of on land, for example, the principal impact would occur by transport of waste leachate through the soil into groundwater. Because natural groundwater movement is usually slow and because draining and recharging a polluted aquifer is impractical, groundwater contamination is considered virtually irreversible. Protection of this resource is of the utmost importance. It was essential, therefore, that possible problems resulting from land disposal of conversion solid wastes be assessed long before occurrence of an unacceptable situation. Thus, a study was undertaken to draw together and assess a wide variety of relevant information to provide an environmental source book on solid waste disposal from coal conversion technologies:

The study was dually structured: first, to address those considerations that bear on the possibility of environmental impact — the wastes, the macroscopic hydrogeologic process, the microscopic leaching mechanisms, and the bioenvironment; and second, to develop some insight into the possible environmental aspects of the trace substances associated with conversion-derived solid wastes. Table 2 outlines the major sections of the study's report.⁴

It was concluded that "with reliable results from definitive studies there is a good likelihood that coal conversion solid wastes can be deposited safely, economically, and permanently by landfilling."⁴ However, the application of sound scientific, engineering, and construction principles will be necessary to ensure a secure landfill.

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Table 2. Summarization of *Environmental and Health Aspects of the Disposal of Solid Wastes from Coal Conversion* (ORNL-6157)

CHARACTERIZATION OF COAL CONVERSION WASTES

Identification and quantification
 Gasification, liquefaction
 Physical and chemical properties
 Coal, ash, filter cake, sulfur, organic residues, slag

ENVIRONMENTAL CONSIDERATIONS

Transport and transformation in the disposal environment
 Translocation
 Solubility

BIOLOGICAL CONSIDERATIONS

Trace elements
 Uptake, release, accumulation, toxicity to aquatic organisms, ecological implications, toxicity to man, carcinogenicity
 Polycyclic aromatic hydrocarbons in aquatic systems
 Uptake, metabolism, excretion, bioconcentration, toxicity, carcinogenicity

LAND DISPOSAL OF SOLID WASTES

Selection of site
 Soils and geology, hydrology and climatology
 Disposal methods

LEGAL ASPECTS OF SOLID WASTE DISPOSAL

Federal laws
 Resource Conservation and Recovery Act, Toxic Substances Control Act, Coastal Zone Management Act, Clean Air Act Amendments, Federal Water Pollution Control Act Amendments
 State laws
 Local laws

CHARACTERISTICS OF COAL CONVERSION PROCESSES

ENVIRONMENTAL CHARACTERISTICS OF TRACE SUBSTANCES (includes environmental chemistry; background levels in air, water, soil and rocks, seawater, groundwater; soil interactions; plant interactions; and health effects for aluminum, aromatic hydrocarbons, antimony, arsenic, beryllium, boron, cadmium, chromium, copper, lead, mercury, nickel, selenium, uranium, vanadium, zinc)

SOLUBILITIES OF TRACE ELEMENTS AND THEIR COMPOUNDS

TOXICITIES OF TRACE ELEMENTS TO AQUATIC ORGANISMS

ENVIRONMENTAL GUIDES FOR CONTRACTORS

Successful demonstration of coal conversion processes depends strongly on the industrial contractor to DOE, who is heavily challenged not only by the newly emerging technology but also by ever-changing environmental obligations. Thus, it is important to provide maximum environmental guidance to the contractor, from the initial request for proposals through all the stages of facility development to the final operating commercial plant. Two documents were prepared to provide some of this guidance: *Environmental Considerations for Inclusion in Program Opportunity Notices, Requests for Proposals, and Environmental Reports: Fossil Energy Demonstration Plants*¹ and *Environmental Monitoring Handbook for Coal Conversion Facilities*.² The documents describe both the environmental responsibilities of potential contractors and the monitoring criteria for ascertaining environmental information.

Environmental Considerations for Fossil Energy Demonstration Plants

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F. S. Sanders^a

Environmental analysis and environmental protection, which are an integral responsibility of DOE contractors, include protecting human health and the physical, biological, and socio-economic environment. The contractor's consideration of and commitment to avoiding adverse environmental impacts must be demonstrated at every stage of the process from planning through construction to operation. ORNL was asked to prepare a document for DOE/FE that could be included in requests for proposals and that would describe the environmental responsibilities of potential contractors. The document, *Environmental Considerations for Inclusion in Program Opportunity Notices, Requests for Proposals, and Environmental Reports: Fossil Energy Demonstration Plants*,¹ is divided into three parts corresponding to the separate stages of project development:

1. responding to Program Opportunity Notices (PON) and Requests for Proposals (RFP);
2. performing baseline data collection and environmental impact assessment that results in the production of an Environmental Report (ER) for use by DOE in the preparation of an Environmental Impact Statement (EIS) in accordance with the requirements of 10 CFR Part 711; and
3. continuing environmental considerations that should include monitoring and assessment during construction and operation.

Part 1 of this document,¹ entitled "Environmental Factors to be Addressed in Response to Program Opportunity Notices and Requests for Proposals for Fossil Energy Demonstration Plants,"

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describes those factors the prospective contractor should address to show that environmental matters have been considered in the initial project plans and that environmentally sound criteria for site selection have been or will be used. Part 1 also indicates how the prospective contractor should demonstrate that environmental protection will be considered during the planning process, plant construction, and plant operation.

Part 2, entitled "General Requirements for Environmental Reports for Fossil Energy Demonstration Plants," describes the contractor's initial responsibilities if awarded a contract from DOE. The contractor will be required to plan and implement a monitoring program to collect baseline data for use in predicting the beneficial and adverse impacts of constructing and operating the proposed facility. This information will be submitted to DOE in the form of an ER with sufficient detail so that DOE can fulfill its requirements under NEPA to prepare an EIS. This ER preparation will require that the contractor make a complete analysis of the interaction between the proposed demonstration facility and the prevailing environment, both natural and socioeconomic.

Finally, Part 3, entitled "Continuing Environmental Responsibilities of Contractors for Fossil Energy Demonstration Plants," describes ongoing environmental monitoring and impact assessment for which the contractor will be responsible during construction and operation. The purpose of this requirement is to determine which, if any, adverse or beneficial environmental impacts have occurred, including both those that are postulated prior to the project and those that are unsuspected. This consideration includes a possible need for mitigating adverse impacts as they are encountered during the construction and operational phases of the demonstration plant activity. The contractor must operate the plant in compliance with all Federal, state, and local laws and regulations. Finally, the contractor should be aware of ongoing research that may affect the project.

Environmental Monitoring Handbook for Coal Conversion Facilities

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G. A. Dailey ^e	R. D. Roop ^a
R. J. Haynes ^a	F. S. Sanders ^a
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D. K. Kumar ^a	G. W. Suter ^a
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A logical outgrowth of the study of the environmental considerations for fossil energy demonstration plants was the development of the *Environmental Monitoring Handbook for Coal*

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*Conversion Facilities*² (henceforth called *Handbook*). The *Handbook* describes the strategy, the scope, and the techniques for environmental monitoring in the areas of air quality and meteorology, surface and groundwater hydrology, water quality, aquatic and terrestrial ecology, and socio-economics.

The *Handbook* provides guidance to contractors in developing environmental and socioeconomic monitoring programs for coal conversion facilities and helps design programs to

- predict the potential impacts of the construction and operation of a coal conversion facility at a specific site;
- detect whether these or any other impacts actually occur during construction and operation; and
- determine if mitigating measures are adequately protecting the environment.

The *Handbook* describes the parameters that should be included in monitoring aquatic and terrestrial systems — water quality, habitat characteristics, meteorology, geology, socioeconomics, and land and water use. Its loose-leaf format facilitates its modification as new information is developed relative to significant potential impacts of coal conversion technologies. The *Handbook* was written in three sections to correspond to the different phases of monitoring necessary during the development of a facility. The three sections and subjects addressed are (1) preconstruction monitoring, (2) construction monitoring, and (3) operational monitoring.

The preconstruction monitoring section describes measurements needed to quantify existing or baseline environmental conditions and includes all environmental, social, and economic information collected during the period from the initial site survey to the beginning of construction. This phase of the monitoring effort, which is considered ecologically the most important and which is, in some ways, the most difficult, is often neglected. It provides site-specific information that allows

- an assessment of existing levels of environmental disturbance and the social and economic conditions in the site area;
- establishment of an information base for prediction of potential impacts from construction and operation of the facility and suggestions for mitigating measures to avoid those impacts; and
- an evaluation of any changes in the site environmental quality that occur during facility construction and operation.

Detailed knowledge of construction plans and of the location of potential effluents and their form (i.e., gaseous, liquid, or solid) is necessary to design a baseline monitoring program that will provide data adequate for these three tasks.

The construction monitoring section, which addresses monitoring programs necessary during site preparation as well as during plant construction, permits an assessment of construction impacts and provides additional data for comparison with that of the operation-phase monitoring. This section includes a detailed analysis of erosion and sedimentation that can occur during construction with possible impacts on ecological systems.

The operational monitoring section describes monitoring necessary during plant operation. It is intended that sufficient data will be accumulated during this phase of process demonstration to assess, by comparison with baseline data, the environmental and health impacts of routine and accidental releases of plant effluents. Extensive operational monitoring at the demonstration plant stage should provide useful information for adapting these technologies to a commercial scale in an environmentally safe, timely, and cost-effective manner. Obtaining adequate data for

process effluent characterization, for definition of pollutant source and concentrations, and for environmental impact analyses requires two distinct areas of investigation: monitoring contaminants in a process stream and at the process/environment interface; and determining the presence and effects of contaminants in the environment.

As part of operational monitoring, the process monitoring section contains details of the program development from its initial stage to the final sampling and analysis. The monitoring of process streams has a threefold purpose: (1) to characterize discharges into the environment for impact analysis and to satisfy regulatory agencies by establishing compliance with legislated discharge standards; (2) to assess the capability and efficiency of pollution abatement equipment and to detect unanticipated effluents; and (3) to investigate those components of the process that generate pollutant species so that process modifications can be made during the demonstration program and can be included in the planning for scale-up designs to commercial plants.

The process monitoring section describes a methodology whereby a complex process, such as coal gasification, is partitioned into discrete process modules. Methods for selecting sampling locations, sampling techniques, and analytical schemes are described. Finally, procedures and techniques for data evaluation are included to help evaluate the precision of sampling results and the correlation of measured data with process design variables. This section will be valuable to the design contractor. It provides the details needed to design and construct the facility with attention to process monitoring. In addition, the data obtained during the preoperational investigation will permit the designer to modify the process design to abate pollution problems, rather than adding costly tail-end pollution control devices.

The section that describes the monitoring program for the environment itself during operation is divided into three main parts: the physical-chemical environment, which includes the atmospheric, aquatic, and terrestrial environment; the biotic environment, which includes both aquatic and terrestrial ecology; and the socioeconomic environment, which includes both facility and community characteristics. Monitoring any segment of the environment initially requires a thorough characterization of its structure, dynamics, and stable state. Reconnaissance surveys provide the initial field information for outlining sampling locations, whereas well-known statistical principles help establish sampling regimes, which are detailed in the *Handbook*.

The *Handbook* was not designed to be a "cookbook" that could be applied dutifully to all monitoring situations without modification. Much of any monitoring program must be derived from site-specific considerations that require judgmental analyses of environmental assessment needs for the particular receiving system under investigation. The *Handbook* was intended to serve as a conceptual tool or guide to a portion of the site-specific monitoring needs; the remainder must be supplied by the expertise of the monitoring personnel. Table 3 is an example of the general steps recommended to establish a monitoring program.

The *Handbook* is not a static document; it will evolve as coal conversion technology and monitoring techniques develop. Second-generation coal conversion processes have reached only the process-development unit or pilot-plant stage. The next step is to ascertain the feasibility of the processes in demonstration plants before building commercial-scale facilities. In addition to suggesting and testing refinement, operation of demonstration plants will provide experience in managing environmental quality and information about effluents. As experience is gained, the *Handbook* will be revised to facilitate the most effective monitoring of subsequent demonstration and commercial-scale facilities.

Table 3. Initial steps for establishing an environmental and socioeconomic monitoring program

Collect preliminary information	
1.	Review information, from the existing literature and from preliminary site-selection survey(s), on:
a.	Process effluents
b.	Construction procedures
c.	Potential impacts
d.	Regional environmental and socioeconomic data
2.	Establish the goals of the monitoring program based on an analysis of potential impacts. For example, information should be provided to:
a.	Detect impacts of construction and operation
b.	Determine if waste-treatment systems function properly
c.	Determine if effluent emission controls conform to applicable standards
3.	Determine time and monetary resources available
4.	Conduct initial synoptic (reconnaissance) survey(s), as needed
Design the sampling program	
5.	On the basis of steps 1–4, select:
a.	Parameters to be measured
b.	Level of accuracy required for each parameter
c.	Tentative sampling stations
6.	Select data-gathering and analytical techniques on the basis of steps 3 and 4:
a.	Appropriate sampling methods
b.	Sample preservation and analytical techniques and instruments
c.	Data management methods
7.	Prepare the detailed sampling program, including items such as the determination of:
a.	Sampling frequency
b.	Sampling intensity
c.	Permanent sampling stations
8.	Submit proposed program to DOE
9.	Modify program on basis of step 8
Conduct sampling program(s)	
10.	Conduct baseline sampling program
11.	Prepare construction and operational monitoring programs information from baseline program monitoring data and any new information obtained on process effluents and potential impacts. Additional programs involving real effluents and sections of receiving environs may also be necessary

EXPERIMENTAL STUDY OF LEACHATES FROM STORED SOLIDS

Large quantities of solids must be stored onsite at coal conversion plants. Normally a two- to three-month supply of coal will be stored, and large amounts of solid waste remaining after conversion will also have to be stored — presumably in landfills. The purpose of this study is to examine both potential leachates from these two sources and attenuation of the leachate by soils. An attempt is made to simulate planned demonstration plant situations as closely as possible by using representative solids, soils, and ambient conditions.

Leachates from Coal Storage Piles

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Leachate from coal storage piles may represent a source of trace elements and, possibly, organic compounds. Although leachate is a potential pollution source for any coal conversion or combustion facility, literature surveys reveal that little attention has been directed to this problem.

Laboratory leaching tests similar in format to the solid waste leaching experiments described below will be initiated on representative coal samples. Because ORNL is converting its steam plant from oil to coal in the near future, a full-scale facility should become available for detailed, controlled experimentation. Scheduling of this full-scale project (winter 1978) will require the construction of a small well-instrumented coal storage pile. This experimental coal pile will permit an evaluation of hydrologic models of water movement through coal storage piles, as well as an evaluation of the characteristics of both the surface water runoff and any groundwater pollution problems that may arise from infiltration under and around the coal pile. These studies will be followed by full-scale studies on the larger ORNL steam plant coal pile.

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Leachates from Landfill Disposal of Solid Wastes

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The solid waste information assessment indicated the need for experimental landfill studies. The assessment showed that little is known about the anticipated chemical and physical composition of the wastes from proposed processes and even less is known about their leachability. Solid wastes are being obtained from pilot plants that are studying various coal conversion processes, with the highest priority being given to those processes planned for early demonstration facilities. Although these wastes may differ from those produced by the same process when scaled up to demonstration or commercial size, it is felt that they are sufficiently representative to provide much-needed environmental information. The experimental program is outlined below.

This task benefits from ORNL's ongoing land-burial-waste-management program that already has made significant advances in establishing a bibliographic data base, in conducting field experiments, and in developing and testing subsurface transport models.

1. Leaching tests on waste samples

Laboratory leaching studies are an important means of examining the potential short- and long-term behavior of buried wastes. For coal conversion wastes these studies are especially important. Not only are the wastes variable and process-related in composition, but they also contain a wide variety of trace elements and possibly organic materials. Because little is known about their leaching behavior, controlled laboratory leaching studies should provide badly needed data.

Leaching is being conducted at a range of pH values to simulate various groundwater conditions. However, standard leaching procedures have not been established for coal conversion wastes. Therefore, while collecting leaching data, methods are being studied with the aim of recommending standard procedures.

Because leaching behavior of waste materials depends not only on the nature of the wastes but also on soil type and constitution, it is important to study different soil samples, especially those from demonstration plant sites. Data from laboratory experiments are being combined with existing information on distribution coefficients of trace elements in different soils as initial input for transport modeling studies.

2. Field-scale lysimeter testing of wastes using typical soils

Field-size lysimeters exposed to natural weather conditions have been used in conventional sanitary landfill studies as well as in examinations of burial ground behavior of radioactive solid wastes. Because they are built large (e.g., 6 ft in diameter by 10 to 12 ft in height) to accommodate considerable volumes of leachate, they provide an excellent transition from

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laboratory- to demonstration-size experiments (Fig. 3). The lysimeters used in the landfill experiment will be loaded with soil and waste to simulate a vertical cross section of a landfill trench and will be designed to prevent escape of leachate into the environment. Both soil and leachate will be sampled frequently.

NOTES:

1. MATERIALS OF CONSTRUCTION - FIBERGLASS, PVC, OR ALUMINUM
2. SAMPLING MAINLY AT BOTTOM; SOME LYSIMETERS WITH SAMPLING POINTS AT VARIOUS DEPTHS
3. RELYING ON NATURAL RAINFALL WHEN POSSIBLE
4. PLACED ABOVEGROUND INSTEAD OF UNDERGROUND TO SIMPLIFY SAMPLING AND TO REDUCE COSTS

Fig. 3. Typical lysimeter.

3. Hydrologic predictions and geologic input

It is anticipated that hydrological modeling (predictions of groundwater flows and pollutant movement) will be initiated early in FY 1978. Studies of this type are an ongoing activity at ORNL, having been initiated several years ago to characterize movements of low-level radioactive wastes from burial grounds. Use of existing groundwater models will eliminate the need for developing new models for this project. Data from laboratory leaching studies and lysimeter tests will be used to predict pollutant movement from full-scale conventional landfills. The hydrologic predictions will be verified by a monitoring program at the demonstration plant sites.

4. Design of experimental landfill

Currently, disposal of coal conversion solid wastes is assumed to be performed using landfill methods similar to those used for conventional municipal or industrial solid wastes. Results of the laboratory- and field-scale lysimeter tests, when completed, will indicate whether this conventional method of solid waste disposal will be environmentally acceptable or whether unconventional designs will be required for disposal at conversion facilities. In addition, as indicated by the experimental results, mitigating measures will be developed to be commensurate with both the probability of escape of contaminants and the estimated risk associated with their possible escape. These measures will be designed into an experimental landfill.

TECHNICAL ASSISTANCE TO DOE

Effective technical support requires that FEEP function in three general capacities: (1) as a quick-response staff handling short-term-high-priority problems; (2) as a team interacting simultaneously with prime contractors, DOE, and environmental subcontractors; and (3) as a study unit to anticipate and assess questions before they arise as serious problems. During the past year, technical assistance tasks fell primarily into the first two categories — quick-response activities and interaction with contractors.

Quick-Response Activities

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The Department of Energy is the recipient of numerous draft documents, environmental reports, and other pertinent materials requiring critical evaluation. Part of the FEEP technical assistance obligation is to help referee and comment on this input. Last year, for example, several key documents, some from other agencies, were critically reviewed on a quick-turnaround basis. These documents, which usually involved either environmental analysis or impact assessment of coal conversion technologies, included:

- *Standards Support and Environmental Impact Statement, An Investigation of the Best Systems of Emission Reduction for Coal Gasification Plants*, EPA draft, July 1976.
- *Environmental Analysis Report for Clean Boiler Fuel Demonstration Project*, Coalcon draft, July 1976.
- *Preliminary Draft Environmental Impact Statement for the Coal Research Development and Demonstration Program*, ERDA draft, September 1976.

Unofficially, comments were also delivered on an assortment of other environmental matters.

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Interaction with Contractors

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The demonstration program for an emerging technology has the responsibility of demonstrating its technical feasibility, economic viability, and environmental acceptability. All three areas are of equal priority and require coordination, as do all the varied groups involved in implementation of the program.

Significant progress was made during the past year in DOE's coal conversion demonstration program. Contracts were signed with CONOCO Coal Development Company (CONOCO) and Illinois Coal Gasification Group (ICGG) for first-phase engineering design of two pipeline (high-Btu) gasification plants, slagging Lurgi by CONOCO and CUGAS by ICGG. Phase 1, which requires 22 months, is made up of two time segments. The first 12 months involves conceptual design and environmental evaluation. Because current funding will permit only one of these plants to be built, a decision will be made by DOE, upon completion of this segment, as to which concept to carry through. The remainder of phase 1 will be taken up with detail design. Phases 2 and 3 (construction and operation for a six-year period) will cost approximately \$400 million that will be shared equally by the contractor and DOE.

The plant sites are located in Noble County, Ohio (CONOCO), and in Perry County, Illinois (ICGG). As part of phase 1, baseline monitoring will be conducted at both plant sites and environmental reports (ERs) will be prepared. The ERs, along with many other technical and economic analyses, will form the bases for DOE's choice between these two plants.

The Department of Energy has asked ORNL to prepare the Environmental Impact Statement (EIS) for the successful plant design. Because the EIS is the ultimate decision document and because the ER provides the primary input to the EIS, it is critical that ORNL maintain a close interaction with the contractor during the entire ER process.

The first step in the ER process is to design an environmental monitoring plan, and ORNL has been heavily involved with the contractors in accomplishing this important task. This initial involvement required an interpretation of the *Handbook*² in terms of site-specific issues. ORNL's role is to make specific recommendations on the contractors' proposed monitoring plans using the *Handbook* as the principal guide. This highly important advisory activity will continue throughout the 12-month period required for preparation of the ERs.

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3. *Environmental Analyses for Pipeline Gas Demonstration Plants*, ORNL/TM-6235 (first draft, July 1977).
4. *Environmental and Health Aspects of Disposal of Solid Wastes from Coal Conversion: An Information Assessment*, ORNL-6157 (first draft, April 1977).

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