EPA-600/9-76-006
February 1976

MEETING REPORT-
ADVANCED FOSSIL FUELS SECTOR GROUP
RESEARCH TRIANGLE PARK
13 NOVEMBER 1975

Office of Energy, Minerals, and Industry
Office of Research and Development
U.S. Environmental Protection Agency
Washington, D.C. 20460

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RESEARCH TRIANGLE PARK
13 NOVEMBER 1975

Prepared by:

Stanford Research Institute
1611 N. Kent Street
Arlington, Virginia 22209

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Task 026

Technical Monitors:

Dr. Gary J. Foley, Chairman
Mr. William N. McCarthy, Jr.
Advanced Fossil Fuels Sector Group
Office of Energy, Minerals and Industry
U.S. Environmental Protection Agency
Washington, D.C. 20460

Project Officer:

Mr. Albert Pines

PREPARED FOR:

U.S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF RESEARCH AND DEVELOPMENT
OFFICE OF ENERGY, MINERALS AND INDUSTRY
WASHINGTON, D.C. 20460

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ADVANCED FOSSIL FUELS SECTOR GROUP
RESEARCH TRIANGLE PARK
13 NOVEMBER 1975

Morning Session

Mr. Robert Hangebrauck, sector group member from EPA's Industrial Environmental Research Laboratory (IERL/RTP) introduced Dr. John Burchard, IERL Director, who welcomed the group and pointed out that IERL was conducting environmental research for all new energy sources except oil shale.

Dr. Gary Foley of the Office of Energy, Minerals and Industry (OEMI), EPA, the meeting chairman, reviewed events leading to the establishment of EPA's new energy R&D program and the Advanced Fossil Fuels Sector Group. The major function of the Advanced Fossil Fuels Sector Group is to identify the interests of all groups involved in R&D or commercialization in order to produce timely and useful environmental R&D results. Opinions and recommendations from group participants were solicited.

The first speaker, Mr. James Durham, of EPA's Emission Standards and Engineering Division, discussed air pollution standards, emphasizing the importance of setting these standards early in the development process. He noted that EPA is required to define standards in terms of emission control taking control costs into consideration, although not in terms of health and welfare cost benefit trade offs, and that standards are not static.

Next, Mr. Harold Coughlin of the Effluent Guidelines Division, EPA, discussed the philosophy and process for establishing effluent limitations and standards under the 1972 amendments to Public Law 92-500. The effluent standards are technology based--either on best practicable technology (BPT) or best available technology (BAT)--with deadline dates of 1977 and 1983 for compliance. It was mentioned that zero discharge of pollutants into streams by 1985 was an ultimate goal, with the 1983 standards aiming at achieving swimmable and fishable waters. Coordination of comprehensive limits on air and water standards for a single facility was also discussed. Considerable discussion about standards and their relevance followed these two talks.

The chairman introduced Mr. Robert Hangebrauck and Mr. Kelly Janes, IERL, who are managing the EPA R&D program in synthetic fuel with a multimedia approach, treating the industry as a whole and taking local environmental goals and pollutant effects into consideration. An approach to control technology development was presented which assumed similar control technology would be used for similar operations--i.e., preparation, reaction, purification, upgrading, etc.--independent of process or product type.

Dr. Myron Gottlieb from ERDA's Office of the Assistant Administrator for Environment and Safety (AES) indicated that his office addresses problems of environment and safety across all of the line divisions of ERDA including fossil fuels. Dr. Gottlieb represents a new group in AES whose primary responsibility is to monitor, review and evaluate the activities of developers of new energy technology and to serve as an overview and assessment group to ensure that environmental adequacy is developed in parallel with the development of the technology. He stated that specific coordination links with EPA are now being developed.

The next speaker, Mr. Milton Beychok, a consulting engineer, gave an industrial viewpoint of environmental control technology development. He feels that industry is quite willing to accept emission regulations if they are based on realistic data and commercially viable technology. He voiced some disagreement with current procedures and made suggestions for improvement of interactions between regulatory agencies and industry. He also presented a brief case study of the WESCO design for coal gasification plants in New Mexico and indicated that there was excellent cooperation between the State of New Mexico and WESCO resulting in standards which have not been contested by the strong environmental groups in New Mexico. He further discussed the WESCO sulfur control system and stated that the single standard concept for sulfur emissions does not fit all situations.

The general discussion following the morning session involved: fugitive emissions, the problems of multiple sources in close geographic proximity, and the integration of ERDA and EPA roles in the development of acceptable control technology along with new energy production technology.

Afternoon Session

The afternoon session was introduced by Dr. Stephen Gage, who emphasized the importance of the Advanced Fossil Fuels Sector Group, particularly in view of the continuing large-scale demonstration program and recent executive and legislative proposals. Mr Gerald Rausa, in charge of health effects planning at the Office of Energy, Minerals and Industry, EPA, chaired the afternoon session.

Mr. Karl Bombaugh of Radian Corporation presented an engineering approach developed for EPA for prioritizing pollutants by extrapolating effects from known emission streams and drawing analogies.

Dr. Max Samfield, IERL/RTP, discussed individual pollutants, their sources and the establishment of acceptable levels. Discussion followed this talk concerning the status and results of this work.

Dr. John Cleland of Research Triangle Institute indicated that only 500 chemical compounds out of thousands which are potentially toxic to humans have had standards set, and emphasized the importance of prioritizing pollutants in order to conserve research funds. He also showed different methods of prioritization and the lack of correlation among the results.

Dr. Murray Schulman of ERDA reviewed the key elements of their biomedical research program which included: (1) rapid *in vitro* and *in vivo* bioassay to identify agents capable of producing carcinogenic, mutagenic, teratogenic or pathophysiological effects; (2) determination of the uptake, translocation, deposition, or excretion and enzymatic modification of chemical agents identified as toxigenic; (3) quantitation of risk estimate for carcinogenic, mutagenic, teratogenic, and pathophysiological effects in model, short-lived experimental animals; (4) acquisition and analysis of all human information relevant to metabolism and effects of fossil energy-related chemical agents; and (5) development of theoretical and animal models to insure the extrapolation of the animal information to man.

Dr. Robert G. Tardiff of the Water Quality Division, EPA, Cincinnati, discussed problems of organic compounds in drinking water. He suggested three classes of factors that are important in prioritization--chemical, human (i.e., the population-at-risk) and response (or toxicity) factors.

He observed that it is difficult to weigh the relative importance of different classes of criteria, and in the final analysis, best professional judgments by experts were used to define the final research priorities.

Following the afternoon presentations, the following points were discussed: Impact of EPA and ERDA R&D programs on industry; the need for more direct communication between EPA and ERDA; the importance of research and development on environmental effects to identify those pollutants causing the greatest damage, since total removal of all pollutants would be too costly; the importance of knowing the extent to which a pollutant will occur in the emissions from commercial plants; the need for social impact inputs; the current stage of development of new source standards for the Lurgi-type processes (especially the need for actual operations data); the importance of establishing the population-at-risk in any prioritization method; and the relevance of research to the standards-setting process.

The general meeting was then adjourned and the Executive Committee met to summarize the major points and draw conclusions pertinent to the R&D program.

MEETING REPORT
ADVANCED FOSSIL FUELS SECTOR GROUP
RESEARCH TRIANGLE PARK (RTP)
13 NOVEMBER 1975

MINUTES

Morning Session

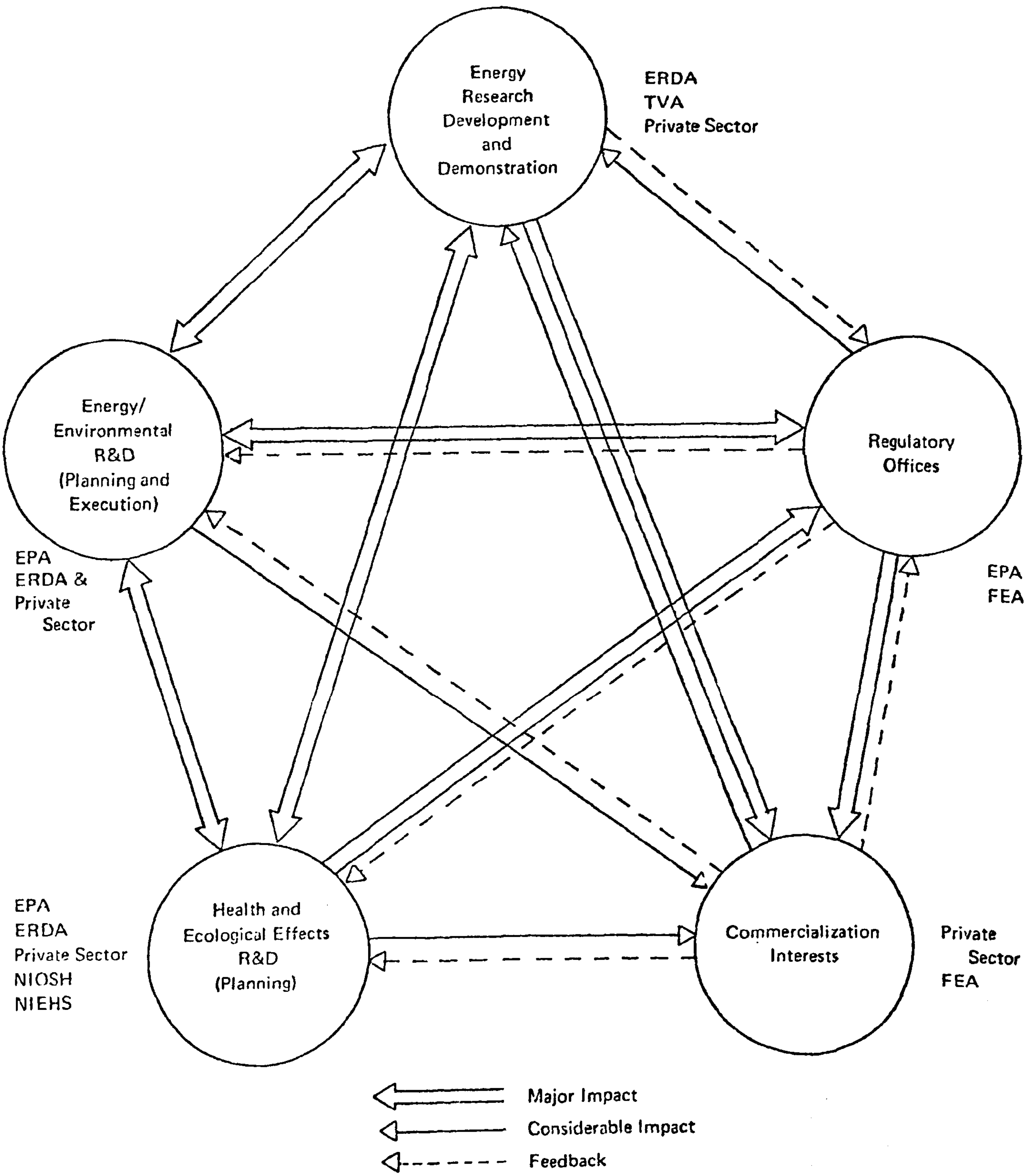
The Director of EPA's Industrial Environmental Research Laboratory (IERL), Dr. John Burchard, was introduced by Mr. Robert Hangebrauck, also of IERL. Dr. Burchard pointed out that Research Triangle Park was conducting environmental research for all new energy sources except oil shale. They have major programs underway for both the development of environmental control technology and the evaluation of effects of energy related pollutants.

The chairman of the meeting, Dr. Gary Foley of the Office of Energy, Minerals and Industry (OEMI), EPA, reviewed the events leading up to the establishment of EPA's new energy R&D program. The first energy study was conducted in 1960 and resulted in the conclusion that energy supplies were adequate to meet the needs of the country since they were considered nearly inexhaustible. In 1967 an energy policy office was established in the Executive Office. In 1971 the President delivered his first energy message to Congress. In 1973 a report was produced under the chairmanship of Dr. Dixie Lee Ray that recommended a five-year $10 billion energy research and development program. In part, the result of that program recommendation was a request for an expenditure in FY 75 of $191 million for environmental R&D. This request was subsequently reduced in budget negotiations to $134 million. In 1974 the Office of Management and Budget organized two interagency task forces--one under Dr. King in health and environmental effects and the other under Dr. Gage which studies programs of control technology. Both of these reports recommend major interagency programs.

The research and development problems discussed in these reports are many and stem from uncertainties related to emissions, toxicity, control technology capabilities and environmental effects. There are also many different groups involved (Figure 1)--those who set environmental standards at both Federal and State levels, those who conduct research and development

Figure 1

INTERACTION DIAGRAM



in both production and emission control technology and environmental effects and the industry that must implement the control technology and develop the energy resources.

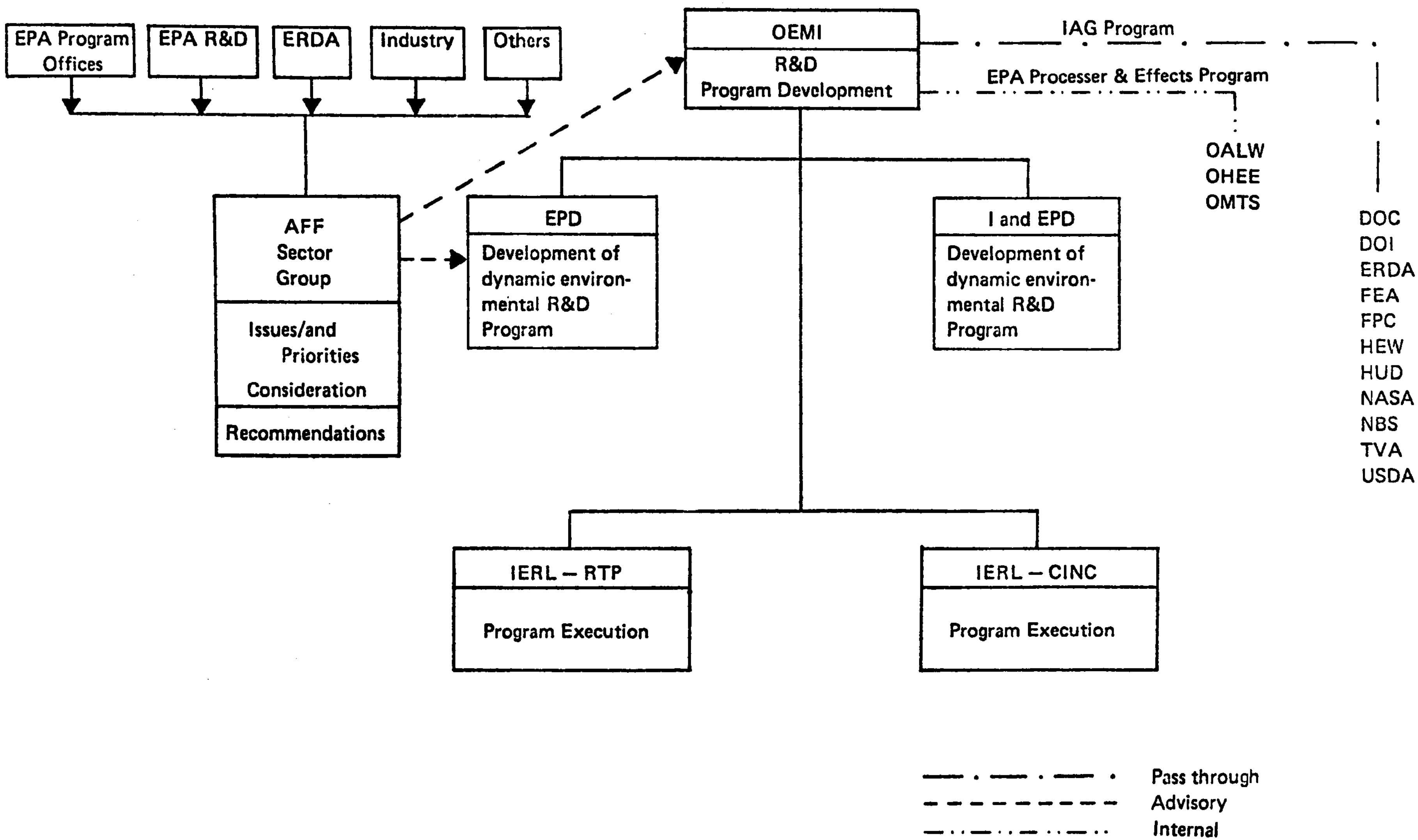
It was indicated that the major function of the Advanced Fossil Fuels Sector Group is that of identifying the interests of all of the groups involved in the process to produce timely and useful results (Figure 2). Specific recommendations from group participants for EPA research were solicited.

Dr. Foley pointed out that the Sector Group is composed of an executive board of EPA representatives and members from other Federal agencies who are involved in energy R&D. Historically, the first organizational meeting was held in March 1975. Since that time application has been made to become an official Federal advisory committee, but the Office of Management and Budget decided that there are, in its opinion, already too many advisory committees. However, it is planned that Sector Group activities are to continue by limiting membership to Federal agency representatives and obtaining industrial inputs through contractors and consultants.

Two documents had been prepared to assist in formulating recommendations for the EPA R&D program. One is a status report on the overall research in advanced fossil fuels and the other describes the environmental problems and associated research programs. Copies of these reports were sent to participants prior to the meeting. Comments on the usefulness and recommendations for modification of these documents were solicited.

The first speaker, Mr. James Durham of EPA's Emission Standards and Engineering Division, discussed air pollution standards. He stated that Section 111 of the Clean Air Act of 1970 requires EPA to establish new source performance standards, and emphasized the importance of setting these standards early in the development process to ensure uniform standards and regulations, to reduce development costs and times, and to assist in early financing. He noted that EPA is required to define standards in terms of the best technical system of emission control with cost taken into consideration, and that the standards are not static but are continuously reviewed and subject to modification. It was further pointed out that:

ADVANCED FOSSIL FUEL SECTOR GROUP RELATIONSHIP



- more technical judgment is involved than is required in more established industries.

- the standards group is not required to conduct economic cost-benefit analyses before setting standards. That is, the Agency need not evaluate the health and welfare cost-benefits that would be derived from the emissions reductions that would result from a standard.

- EPA must demonstrate that the standard can be technically achieved and that the technology is available.

- the emission reductions achieved by the standards are reasonable when compared to the economic and environmental costs of applying the technology.

Mr. Durham's talk was followed by a question and answer period that focused on the following points:

- Both liquid and solid wastes are considered when emissions standards are set. However, the allowable liquid effluents are set by water standards.

- The Agency's preliminary thoughts regarding standards for sulfur emissions from coal gasification plants will be publicly reviewed early next year. This review procedure will provide ample opportunity for industry comment before proposed standards are published in the Federal Register.

- National emission standards will be uniform and will not be site-specific.

- The emission standards are based on the capabilities of the best demonstrated control technology, and with consideration of the reasonableness of costs and not directly on the environmental effects of air pollutants from a cost-benefit point of view.

- The goal is not to run cost-benefit analyses on the benefits to the environment, but to reduce mass emission by a certain tonnage, unrelated to the number of lives and structures saved or the number of plants that will live as a result. This type of analysis is not required under the standards.

- A control technology is considered to be "demonstrated" when it can reasonably be expected to achieve specific levels of pollutant reduction at reasonable cost. It is not necessary to obtain actual emission data on commercial installations to prove the standard can be achieved, although this is most desirable. So, technical judgment is heavily involved. The objective is to set attainable levels (allowing latitude for error) using current control technology. However, as more data are generated, the criteria relative to attainable standards may change in the future.
- Feedstock variation is a major consideration and standards will not necessarily preclude development of gasification plants using high sulfur coal. Unless impractical, a single nationwide standard will be set considering the fuels and feedstock which are available throughout the country.
- One of the factors considered in the selection of sources of pollutants is the overall reductions that will be achieved. Section 110 of the Act provides for States to prepare plans to comply with national air quality standards--that is where health and welfare efforts play a stronger role in Federal regulations, but not under new source standards.

Next, Mr. Harold Coughlin of the Effluent Guidelines Division of EPA Headquarters, discussed the philosophy and process for establishing effluent limitations and standards. He stated that the requirements for direct dischargers are established by several sections of the 1972 amendments to Public Law 92-500, and like the air quality standards, the effluent standards are technology based.

Existing industrial point sources must meet best practicable technology (BPT) by July 1, 1977 and must meet best available technology (BAT) by

July 1, 1983. BPT is the average of the best technology; BAT is the best plan within an industry category or subcategory.

New sources (defined as any construction beginning after the day a regulation is proposed) must use best demonstrated technology.

However, effluent quality requirements can be overriden in specific geographic areas if more stringent limitations are needed to achieve state and local water quality standards. Additional requirements may also be imposed if the effluents contain pollutants that have been established to be toxic in amounts above a certain level. As with air quality emission regulations, no cost-benefit analysis regarding impact on fish or wildlife is required as regards environmental impact. Consideration will be given to the total cost of BPT application in relation to the effluent reduction benefits to be achieved.

The following points were discussed during the question and answer period that followed Mr. Coughlin's presentation:

- The idea behind BPT was not to set a number that everyone could meet, or there would be no purpose in setting that number in the first place. The fact that half are above and half below, was not felt to be contrary to congressional intent. This point was challenged by the example of the development of petroleum industry guidelines. Of 173 petroleum plants surveyed, five had best technology available. The questioner felt that the intent of Congress was that the remaining 168 should be brought up to the level of those five, not to a median level of the total 173 plants.

- Effluent guidelines for coal mines are now published as preliminary values in the regulation preamble. The current data base was felt to support the numbers in the preamble, and they will be moved to the actual regulation after the economic impact study is finished.

- It is important that the data base for both water pollutant emissions and in-stream water quality take seasonal variations into account.

- The Act sets zero discharge of pollutants into the streams as a water quality goal for 1985. A lot of effluent discharges are zero. However, some retreat from the 1977 objective has been suggested by the National Commission on Water Quality. Zero discharge is defined as the complete absence of liquid waste at the end of the pipe discharging water into U.S. navigable waters. Standards for discharge quality may be related to the quality of the input waters at the discretion of the Regional Administrator.
- Effluent standards allow the mixing of effluent streams of different types before they are discharged. The effluent regulations are designed to apply to the end point only.
- The water quality guidelines for 1977 cannot be expected to apply to new synthetic fuel plants because most plants have five-year permits now. The big question is what standards will be required for 1983 in order to achieve swimmable and fishable waters. Emphasis will probably be on new source standards where there is high growth potential.
- With regard to coordination of comprehensive limits on air and water standards for a single facility, the laws under which EPA is operating and the court decisions on these laws, give some indication of what EPA can do under the Act. EPA is not presently structured to develop air and water standards at the same time. It was not felt that this was retarding development of badly needed energy. The Office of Planning and Evaluation is doing an overview study of about six industries to assess the impact and cost of the Agency's total environmental regulatory activity in those industires. This may result in an Agency policy to integrate the different areas. There is concern at EPA about this potential problem.

Mr. Robert Hangebrauck, Division Director, and Mr. Kelly Janes, Branch Chief, IERL, manage the EPA R&D programs in synthetic fuels, advanced oil processing and coal cleaning. They made the following points:

- The EPA R&D program is a multi-media approach to environmental problems. The industry is treated as a whole, unlike the media-oriented standards program, to determine what kinds of control technology requirements should be applied and/or developed.

- Local environmental goals and pollutant effects are considered.

- Each industrial sector is asked four basic questions:
  (1) Can control technology achieve existing standards and operating practices?
  (2) Can control technology meet existing ambient standards?
  (3) Are the projected environmental effects acceptable?
  (4) Is it possible to eliminate waste streams?

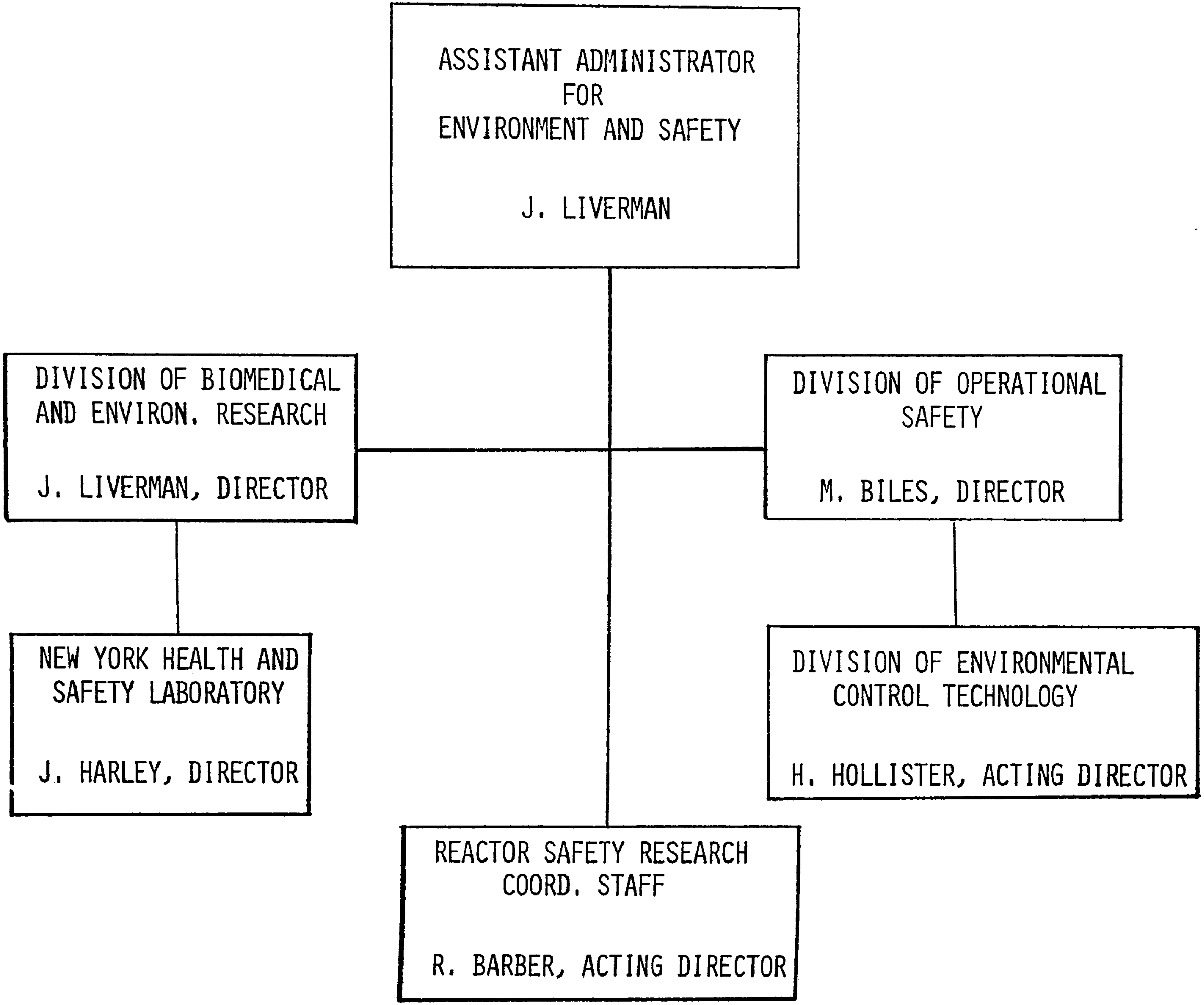
- The environmental impact analysis is conducted for alternative control technologies based on the expected outcomes of specific R&D projects.

- The approach to control technology development will be based upon the assumption that similar control technology will be used for similar unit operations independent of process or product type. These unit operations would be preparation, feeding, reaction, purification, product upgrading, waste treatment and byproduct recovery.

The Chairman asked the audience to be thinking about comments on EPA's approach to control technology development. He asked if it should be more process specific and stated that these points would be discussed at the end of the morning session. He then introduced Dr. Myron Gottlieb representing ERDA's Environmental Control Technology Division (ECT) which was established in July 1975.

Dr. Gottlieb initially described the overall ERDA organizational chart. He explained that ECT has concerns that cut across the ERDA organizational chart (Figure 3). These concerns include coal extraction, combustion,

Figure 3


ASSISTANT ADMINISTRATOR FOR ENVIRONMENT AND SAFETY
J. LIVERMAN
DIVISION OF BIOMEDICAL AND ENVIRON. RESEARCH
J. LIVERMAN, DIRECTOR
DIVISION OF OPERATIONAL SAFETY
M. BILES, DIRECTOR
NEW YORK HEALTH AND SAFETY LABORATORY
J. HARLEY, DIRECTOR
DIVISION OF ENVIRONMENTAL CONTROL TECHNOLOGY
H. HOLLISTER, ACTING DIRECTOR
REACTOR SAFETY RESEARCH COORD. STAFF
R. BARBER, ACTING DIRECTOR

gasification and liquefaction, petroleum and natural gas, oil shale, marine oil spills, geothermal, conservation, and solar technologies. They recognize the fact that the developers of energy technology are in the best position to provide environmentally acceptable energy systems. They expect that this work will be done during the development of the energy technology and that retrofits may be required to respond to new environmental requirements. Their primary responsibility is to monitor, review, and evaluate the activities of developers of new energy technology. Where necessary, selected R&D will be supported. They conduct assessments by: (1) identifying the nature and extent of the problem, (2) defining control technologies or strategies applicable to these problems, (3) evaluating the efficacy and practicability of control options, and (4) recommending a control option for the systems, or, if there is a gap, a development program to close that gap. They plan to ensure that environmental adequacy is developed in parallel with the development of the technology.

The following points were made during the discussion:

- The Division of ECT was started in July 1975, and coordination links with EPA are being developed.
- ECT expects to use existing emission standards and to establish required levels of control and will initially rely heavily on existing data on environmental controls.
- Health and ecological effects are being considered primarily by the Division of Biomedical and Envrionmental Research, Assistant Administrator for Environment and Safety, ERDA.
- ERDA has specific legislative authority for carrying out the environmental functions for new energy technologies.
- It is not clear yet how results from the ERDA regional studies will be incorporated into ECT activities but ECT will follow their progress.
- A primary function of ECT is to serve as an overview and assessment group.

The Chairman then asked the participants to compare the EPA and ERDA approaches to control technology development and be prepared to discuss these points at the discussion period which would follow the next speaker. He then introduced Mr. Milton Beychok, a consulting engineer, who presented a talk on the industrial viewpoint of environmental control technology development.

Mr. Beychok felt that the industry is quite willing to accept emission regulations if they are, in fact, based on realistic data and upon control technology that has been demonstrated to be commercially viable. However, he felt it was insufficient to rely on the 30 to 60 day comment period that is provided for a proposed regulation. The industry must be involved early in the standard-setting process because of the long lead times required for control technology development. He felt that an understanding established in the early stages of the energy technology development would greatly reduce the amount of court litigation that would follow. He drew a sharp distinction between first and second generation gasification technologies. He stated that there were currently 10 gasification processes that were ready for full-scale commercial development. These processes are based primarily on the first generation technology. Specifically, the WESCO process has received approval by the Federal Power Commission and the State of New Mexico. The Environmental Impact Statement is currently being prepared. Equipment specifications have been developed. All that is needed is some form of Federal financial assistance that is now being worked out. He felt that EPA should establish emission standards based on the first generation plants that are already designed. A great deal of money has already been spent by these 10 industrial developers. They have paid careful attention to environmental control technology. EPA R&D programs could not make significant new contributions to this effort. However, the standards should not yet include second generation demonstration plants. Instead, the EPA should wait until the wide variety of new demonstration plants have been tested and their commercialization has been clearly established.

A brief case study of the WESCO design was then presented. He stated that the environmental standards for the specific site and specific design had been worked out with the State of New Mexico and that these were the only existing standards for coal gasification plants (Figure 4). In 1971, the New Mexico Environmental Improvement Agency asked WESCO to assist them with establishing reasonable standards. Both groups drafted standards which, after a public review, were redrafted and finally adopted by the Board in 1973. They were subsequently accepted by WESCO which was then granted a permit. Excellent cooperation was achieved by both parties and the standards have not been contested by the strong environmental groups that exist in New Mexico.

The sulfur control system was then discussed in detail (Figure 5). The net result is that the total gasification plant sulfur emissions amount to only 0.7 percent of the sulfur in the total gasifier coal feedstock. He stated that the single national standard concept for sulfur emissions does not fit all situations. New Mexico has emission standards 2-3 times more stringent than the Federal regulations. It is also important to consider the number and diversity of gas streams. In the case of WESCO there are 13, which makes it particularly difficult to simplify to a single regulation expressed as a point source concentration in parts per million. He recommended that the regulations not be stated in parts per million. They should include all sulfur species, including carbonyl sulfide. The emission standard should be related to the feedstock sulfur content and to regional differences in sulfur content (Figure 6).

The discussion after his talk made the following points:

- The design of the WESCO plant results in 70 Btu's output for every 100 Btu's of input of 70 percent efficiency in gas production.
- WESCO has been severely criticized for accepting the New Mexico regulations because of the precedent that it might set for higher sulfur coals in other regions. Even though less stringent sulfur emissions were recommended for Eastern coals, they're still very much better than direct burning.

Figure 4

EMISSIONS VS. REGULATIONS
(SLIDE 2)

Gasifier Coal Heating Value
= (24,820)(2000)(8,325)
= 413,253 x 10^6 BTU/day

Gasification Plant Sulfur Emissions
= 0.08 + 1.23 + 0.21
= 1.52 tons/day
= (1.52)(2000)/413,253
= 0.0074 pounds/10^6 BTU (New Mexico regulation = 0.0080)

Boiler Plant Coal Fines Heating Value
= (3,870)(2000)(10,040)
= 77,710 x 10^6 BTU/day

Boiler Plant SO_2 Emissions (from coal-firing)
= (3.23)(2)
= 6.46 tons/day
= (6.46)(2000)/77,710
= 0.166 pounds/10^6 BTU (New Mexico regulation = 0.340)
(Federal regulation = 1.20)

Superheater Fuel Oil Heating Value
= (224)(2000)(17,250)
= 7,728 x 10^6 BTU/day

Superheater SO_2 Emissions (from oil-firing)
= (0.20)(2)
= 0.40 tons/day
= (0.40)(2000)/7,728
= 0.104 pounds/10^6 BTU (New Mexico regulation = 0.340)
(Federal regulation = 0.80)

Figure 5

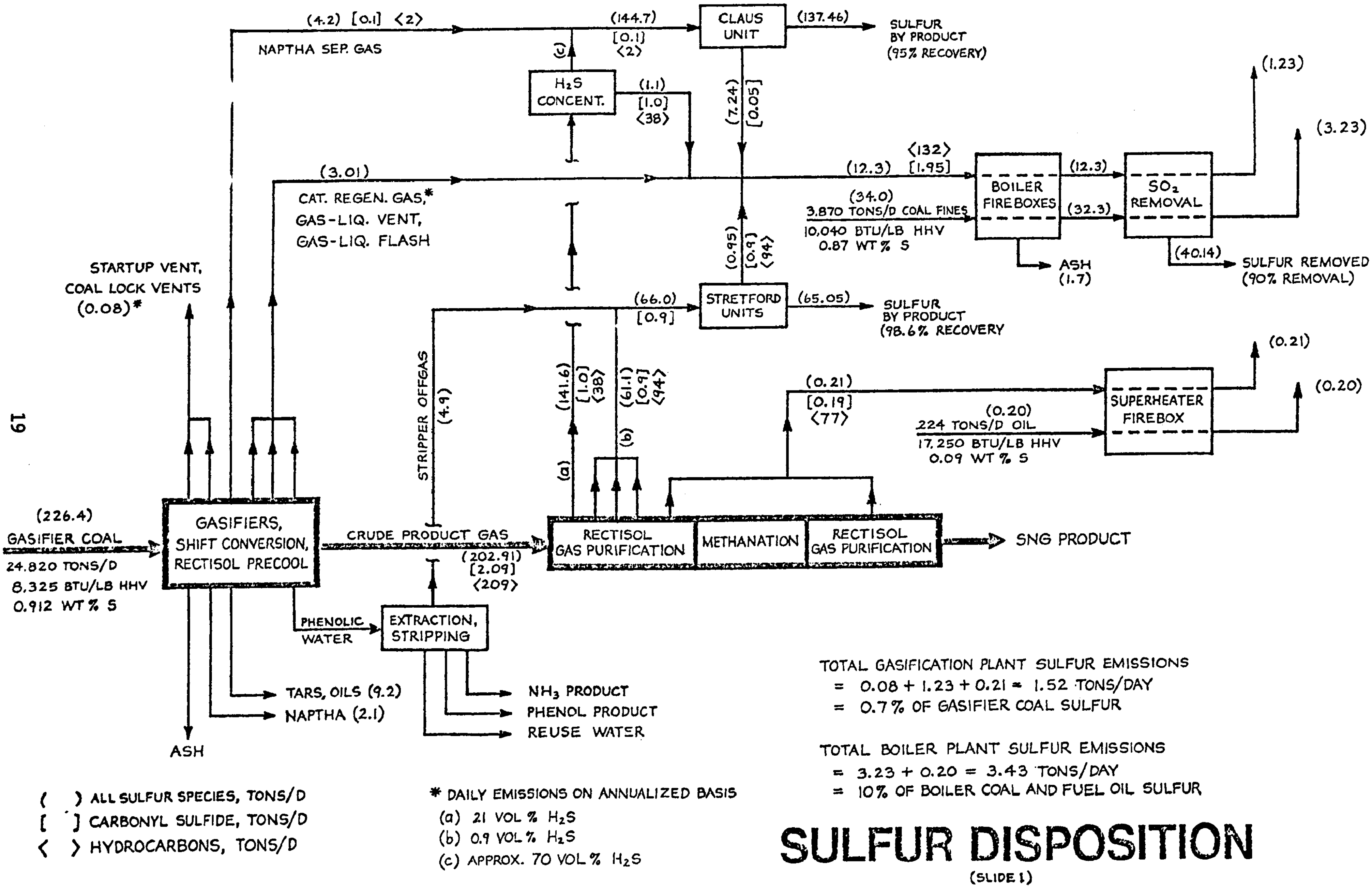

(4.2) [0.1] ⟨2⟩
NAPTHA SEP. GAS
(144.7)
[0.1]
⟨2⟩
CLAUS UNIT
(137.46)
SULFUR BY PRODUCT (95% RECOVERY)
(c)
H2S CONCENT.
(1.1)
[1.0]
⟨38⟩
(7.24)
[0.05]
(3.01)
CAT. REGEN. GAS,*
GAS-LIQ. VENT,
GAS-LIQ. FLASH
⟨132⟩
(12.3) [1.95]
BOILER FIREBOXES
(12.3)
(32.3)
SO2 REMOVAL
(1.23)
(3.23)
(34.0)
3,870 TONS/D COAL FINES
10,040 BTU/LB HHV
0.87 WT % S
ASH (1.7)
(40.14)
SULFUR REMOVED (90% REMOVAL)
(0.95)
[0.9]
⟨94⟩
STARTUP VENT,
COAL LOCK VENTS
(0.08)*
(66.0)
[0.9]
STRETFORD UNITS
(65.05)
SULFUR BY PRODUCT (98.6% RECOVERY)
STRIPPER OFFGAS
(4.9)
(141.6)
[1.0]
⟨38⟩
(61.1)
[0.9]
⟨94⟩
(a)
(b)
(0.21)
[0.19]
⟨77⟩
(0.20)
224 TONS/D OIL
17,250 BTU/LB HHV
0.09 WT % S
SUPERHEATER FIREBOX
(0.21)
(0.20)
(226.4)
GASIFIER COAL
24,820 TONS/D
8,325 BTU/LB HHV
0.912 WT % S
GASIFIERS, SHIFT CONVERSION, RECTISOL PRECOOL
CRUDE PRODUCT GAS
(202.91)
[2.09]
⟨209⟩
RECTISOL GAS PURIFICATION
METHANATION
RECTISOL GAS PURIFICATION
SNG PRODUCT
PHENOLIC WATER
EXTRACTION, STRIPPING
TARS, OILS (9.2)
NAPTHA (2.1)
ASH
NH3 PRODUCT
PHENOL PRODUCT
REUSE WATER
TOTAL GASIFICATION PLANT SULFUR EMISSIONS
= 0.08 + 1.23 + 0.21 = 1.52 TONS/DAY
= 0.7% OF GASIFIER COAL SULFUR
TOTAL BOILER PLANT SULFUR EMISSIONS
= 3.23 + 0.20 = 3.43 TONS/DAY
= 10% OF BOILER COAL AND FUEL OIL SULFUR
( ) ALL SULFUR SPECIES, TONS/D
[ ] CARBONYL SULFIDE, TONS/D
⟨ ⟩ HYDROCARBONS, TONS/D
* DAILY EMISSIONS ON ANNUALIZED BASIS
(a) 21 VOL % H2S
(b) 0.9 VOL % H2S
(c) APPROX. 70 VOL % H2S
SULFUR DISPOSITION
(SLIDE 1)

Figure 6

RECOMMENDATIONS

(SLIDE 3)

1 -- Regulations should not be in terms of concentrations (i.e. ppm by volume).

2 -- Regulations for gasification should not include auxiliary steam boilers and superheaters. Burning of coal, oil and gas in steam plants is covered by existing EPA regulations.

3 -- The gasification plant regulations should include all sulfur species from all vents and stacks (including annualized intermittent operations).

4 -- Carbonyl sulfide emissions should not be "excused".

5 -- Recommended wording for high-Btu gasification regulation:

"THE TOTAL EMISSION OF ALL SULFUR SPECIES IN ALL VENTS AND STACKS FROM A COAL GASIFICATION PLANT (EXCLUDING ANY STEAM GENERATION FACILITIES) SHOULD NOT EXCEED 1.5 - 3.0 PERCENT OF THE SULFUR CONTAINED IN THE GASIFIER FEEDSTOCK COAL"

The 1.5 - 3.0% should be sub-categorized for regional differences in coal sulfur contents. Thus, low-sulfur coals might be limited to 1.5% emission and high-sulfur coals to 3% emission.

- The cost for all environmental controls, both air and water, has been estimated to be \$70-80 million out of a total plant cost of \$800 million, approximately 10 percent of the cost.
- All solid residuals, including trace elements, are planned to be returned to the strip mine pits during reclamation. There is a possibility of leaching, which is under study, but now real problems are expected.

General Discussion

The general discussion following the morning session involved the following points:

- EPA regulations have not yet been set for fugitive dust emissions. New Mexico has such regulations for mining operations, but not plant operations as yet.
- The problems of multiple sources in close geographic proximity is the states' responsibility. They must develop their own standards for maintaining ambient air quality. Department of the Interior analyses of seven coal gasification units and two major electric power plants in close geographic proximity in New Mexico, processing over 200,000 tons of coal per day have clearly indicated that the SO_x, NO_x and particulates standards would not be violated. There are potential problems with hydrocarbons, but the WESCO design has effectively dealt with them.
- An ERDA representative felt that acceptable environmental control technology would be developed along with the new energy production technology. It is difficult to integrate outside agencies in the process. The EPA role is not clear, and ERDA developers are suspicious of the role that EPA might play. The development of control technology was felt to be an integral part of the process for the development of the primary energy technology.

Afternoon Session

The afternoon session was introduced by Dr. Stephen Gage. He stated that the activities of the Advanced Fossil Fuels Sector Group were very important, particularly in view of the continuing large demonstration program and recent executive and legislative proposals. He referred to the \$11.5 billion incentives program designed to spur early development of commercial-scale synthetic fuel plants*, and to the \$100 billion energy independence program proposed by the President, observing that a dynamic Sector Group is required to keep up with these various events. The Chairman for the afternoon was Mr. Gerald Rausa who is in charge of health effects planning at the Office of Energy, Minerals and Industry.

The first speaker was Mr. Karl Bombaugh of the Radian Corporation. He presented a systematic approach to the problem of characterizing the emission potential of energy conversion processes which they developed for EPA. He defines systems approach as "an engineering approach to analytical chemistry". Since there are no commercial coal conversion plants in operation in the United States, their approach was to extrapolate effects from known emission streams and draw analogies. They first defined the expected stream composition from the simile process and developed a modular strategy for analysis that could be extrapolated to the new stream. An oil refinery was selected as having emission streams most like those expected from synthetic fuel processes. Procedures that could be applied to the new process as system modules were developed for collecting samples, preserving them, and preparing them for analysis by spectrometry. Each pollutant is identified at the source or at the point of highest concentration and then traced downstream. This strategy was preferred to one identifying traces of compounds in either final gas streams or in the fugitive emissions where they may be present at very low concentrations.

There were no questions.

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*Viewed as highly likely to be passed at that time, but which failed to pass the legislature. It is still a strong indication of things to come in the future.

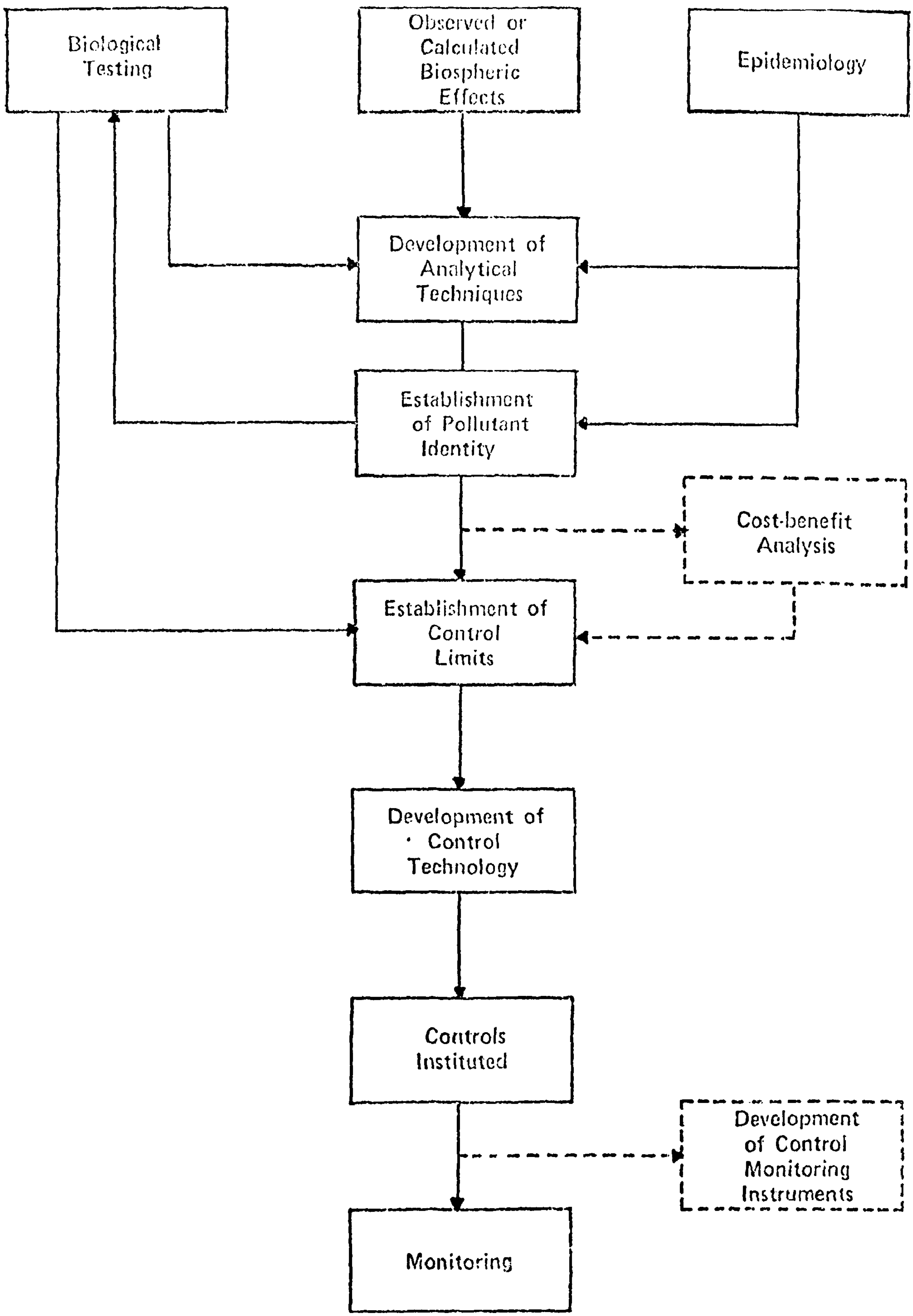
Dr. Max Samfield of the IERL/RTP Special Studies Staff discussed individual pollutants, their sources, and the establishment of acceptable levels (Figure 7). He identified three primary questions to be addressed: (1) What are the pollutants of concern? (2) What are the pollution sources of concern? (3) As a guide to control technology, to what level must these pollutants be reduced to provide an adequate measure of safety for the general public? It was pointed out that this was a particularly difficult task because of the many thousands of chemical compounds that were potentially toxic. They have used models for human respiration and liquid ingestion to forecast pollutant levels in the body as a function of exposure. IERL intends to use the proposed model as a guide to the development of control technology for pollutants for which no standards have been set.

Questions following his presentation brought out the following points:

- There is a list being compiled by RTP of Threshold Limit Values (TLV) for pollutants that are likely to be associated with the synthetic fuel processes. It is not yet complete.
- IERL is presently developing a computerized list of pollutants of interest to IERL. They are primarily interested in putting in mass spectra to assist in analytical work.
- Some pesticides are included in the RTP list. No claim is made that the RTP model works for carcinogenic or mutagenic substances; they were surprised at close agreement with some of these compounds. The only comparison made was with proposed standards or those that have been set.

Dr. John Cleland of Research Triangle Institute began his presentation with a lengthy list of synonyms for the word "prioritize." He illustrated that it is not clear exactly what the word means. He pointed out that there were about 500 chemical compounds that have standards set for them. However, there are many thousands of substances that are potentially toxic to

Figure 7


Biological Testing
Observed or Calculated Biospheric Effects
Epidemiology
Development of Analytical Techniques
Establishment of Pollutant Identity
Cost-benefit Analysis
Establishment of Control Limits
Development of Control Technology
Controls Instituted
Development of Control Monitoring Instruments
Monitoring

humans, and it can require approximately \$500,000 and 1 3/4 man-years of effort per substance to develop criteria upon which a standard can be based (Figure 8). It is therefore extremely important to prioritize the pollutants to conserve research funds. He presented a list of 27 factors that could be used as criteria for prioritizing pollutants (Figure 9). They were classified as being health-oriented, location-oriented, by type of source and type of substance. He pointed out that all methods for prioritization use some level of judgment and opinion. He compared three different methods that had been used and observed that there was little correlation among the resulting priority lists. The most widely-used method today is what he referred to as the "wise-man" approach, where a group of knowledgeable researchers agree on the best strategy for toxicity research. He stated that RTI had catalogued 400 substances into a convenient format. When asked if enough data were available, he replied emphatically, "No." There were no other questions.

Dr. Murray Schulman of ERDA's Division of Biomedical and Environmental Research (DBER) noted that the goal of biomedical and environmental research programs in coal conversion is to evaluate processes and materials to determine potential biomedical/environmental problems and to communicate the results to cognizant managers of related environmental programs. Two basic "populations" are addressed--the industrial workers subjected to chronic, medium level exposures of untransformed pollutants and the general public which may be exposed to lower levels of dispersed and possibly transformed effluents.

Research for ensuring safety of industrial workers is both more easily implemented and of more immediate concern than that necessary to evaluate potential effects on the general public and the environment, because information on environmental transport and transformation is not necessary. Initially, acute effects studies must be conducted to determine carcinogenic and toxic potential of process, products, and effluent materials. These tests should be concerned with determining the concentration of materials necessary to produce specific health effects as well as the effect produced by expected ambient concentrations. Initial toxicological screening can probably be done using a hierarchical tier (composite materials, fractions, specific compounds).

FIGURE 8

NUMBER OF SUBSTANCES

KNOWN	3×10^6
ANNUAL ADDITION	$10^4 - 10^5$
TOXICITY INFORMATION	1×10^5
TOXICITY LIMITS	$1\frac{1}{2} \times 10^4$
STANDARDS	5×10^2

$500,000 + $1\frac{3}{4}$ MANYEARS/SUBSTANCE

FIGURE 9

PRIORITIZATION FACTORS

HEALTH ORIENTED	LOCATION ORIENTED
CARCINOGENCITY	POPULATION DENSITY
TOXICITY, HAZARD	SOURCE—POPULATION DISTANCE
SEVERITY OF EFFECT	BACKGROUND CONCENTRATIONS
DISEASE LIKELIHOOD	MEASURED CONCENTRATIONS
FIRE, EXPLOSION, ETC.	TOPOGRAPHY, METEOROLOGY
STANDARDS, LIMITS	WATER USE
	MEDICAL RECORDS
	GROWTH

SOURCE ORIENTED	SUBSTANCE ORIENTED
RAW MATERIALS, PRODUCTS	PERSISTANCE
HAZARDOUS MATERIALS	MOBILITY
CAPACITIES	SOLUBILITY
EFFLUENT MEDIA	DECAY
EMISSION HEIGHTS	OTHER CHEMICAL—PHYSICAL PROPERTIES
MEASURED EMISSION RATES	
MEDICAL RECORDS	
GROWTH	

The main known hazard for personnel involved directly in coal conversion is exposure to carcinogenic polyaromatic hydrocarbons (PAH). However, there are a number of other materials, including phenols, organosulfur compounds, and others to which such personnel may be exposed. Little is known about the long-term effects of chronic medium level exposure to the complex organic mixtures produced during coal conversion processes. Thus, both rapid screening tests, longer term tests, and quantitative dose-effect determinations will be required to assure that industrial personnel are not being exposed to undue hazards. As long as coal conversion is in the pilot plant stage the number of exposed individuals will be too small to allow detection of any but the most obvious and ubiquitous effects, but medical surveillance and epidemiological studies with personnel involved in established fossil fuel processes may give valuable information.

While research related to the health of coal conversion workers is the most immediate need, it may not answer the questions affecting the ultimate acceptability of the coal conversion technologies. The biomedical and environmental research which may be most important centers on the effects of chronic exposures of large segments of the population and general environment to low level effluent concentrations. Biomedical and environmental research needed to evaluate these risks requires a long leadtime and cannot be forced easily into the short-term time constraints necessary for quick technology development. Such research will follow some of the classical pathways initiated in evaluating potential radiation effects, but is more complex, in that analytical capabilities are less well understood and biological transformation products exist. In particular, the synthetic crude oil produced by coal conversion has a considerably higher concentration of PAH's than does natural crude oil. Such materials represent a potential hazard, since there is some indication from work with lower organisms that they may not only be carcinogenic but mutagenic as well.

The key elements of research will be: (1) rapid *in vitro* and *in vivo* bioassay to identify agents capable of producing carcinogenic, mutagenic, teratogenic or pathophysiological effects; (2) determination of the uptake, translocation, deposition, or excretion and enzymatic modification of chemical agents identified as toxigenic; (3) quantitation of risk estimate for carcinogenic, mutagenic, teratogenic, and pathophysiological effects in model short-lived experimental animals; (4) acquisition and analysis of all human information relevant to metabolism and effects of fossil energy-related chemical agents, and (5) development of theoretical and animal models to insure the extrapolation of the animal information to man. It may be expected that much of this research will be applicable to the estimation of health hazards for industrial workers and to the general public including the development of tests for identifying and quantitatively evaluating hazards, analysis of damage-producing mechanisms, and studies of how biological systems may repair or recover from the damage. Since it is not economically or scientifically feasible to evaluate the pollutants emitted from every coal conversion process, some research must be directed toward developing classification techniques whereby similar materials (e.g., PAH) may be grouped for testing.

Dr. Robert G. Tardiff of EPA's Health Effects Research Laboratory in Cincinnati discussed problems of organic compounds in drinking water. The priority system they have developed is sufficiently general to apply to pollutants from several different sources and several different routes of exposure. He suggested three different classes of factors that were important in prioritization--chemical, human (i.e., the population-at-risk) and response (or toxicity) factors--and defined them in detail.

- Chemical factors deal with the identification of the kinds of materials to which people are exposed, their bioaccumulation potential measured by their liquid solubility, their structural class as a predictor of possible biological responses, obligatory contaminents, chemical stability in different media. Other chemical factors include those relating to the manufacture, use, and disposal of chemicals.

- Human factors were those of concentration (the total number of people exposed), exposure intensity (the integrated amount by the various routes of exposure), chronic exposures, and special problems raised by pulsed exposures, and the duration of the exposure (the total time and the point of life, e.g., fetal, geriatric, etc., in which the individual is exposed).

- Human response or toxicity data are the compounds' structure and activity relationships, their metabolites, micro-molecular bindings and the effects resulting from the use of biological screens, maintenance of toxicity files, and professional observations. Analysis of these factors suggested criteria for further testing. He observed that it is difficult to weigh the relative importance of different classes of criteria, and in the final analysis, best professional judgments by experts were used to define final research priorities.

General Discussion

The following points were made in the discussion that followed the afternoon presentations.

- It is still not clear how industry will be affected by the EPA and ERDA R&D program structures. The Standards Programs have specific legal requirements, and their philosophies are structured accordingly. It is not clear to the majority of people outside of EPA how the R&D program is related to the standard-setting process. There is absolutely no evidence of a working communications system.

- There is too much subjective internal debate, little communication between EPA and ERDA, and it is important to make these links much more direct.

- There has been too much emphasis on the adversary approach which tends to cloud any clear understanding of the technical issues.

- The presentations by representatives of the Standards Program gave no requirements for the R&D program.

- Mr. Beychok's talk illustrated the benefits of maintaining a dialogue with open and early communication between a company and the State in which it is located in setting standards.

- If best control technology currently available were applied, without emphasis on characterization of pollutants, how serious would the consequences be? Control technologies will go on and will do just what has been suggested--apply the current state-of-the-art. The challenge for the health and the control technology people is to find ways of decreasing cost. Total removal of all pollutants would be too costly.
- The seriousness of fugitive emissions of pollutants from accidents should be studied in the R&D program.
- It is very important to characterize the pollutants in emission streams from actual commercial-sized plants as soon as possible. The development of control strategies for individual pollutants is premature without a good knowledge of the extent to which that pollutant will occur in the emission streams. Early definitions of when and what control are very important.
- Concern was expressed that so much time is being spent prioritizing pollutants when they have not yet been identified. Control criteria should be applied to specific systems and not in general. What is the use of these lists? More emphasis should be put on what these compounds are, analyzing them, building process development units to simulate the kind of emissions coal gasification will produce and find out what the real problems are. No one appears to be doing this.
- In response to these concerns about the need for interagency communication, it was asserted that a great deal of communication is taking place. An interagency meeting with regard to energy-related health effects studies is in the planning stages now.
- With regard to carcinogen policy, Dr. Albert, Deputy Assistant Administrator for Health and Ecological Effects, has been assigned responsibility for developing EPA's policy.

- Standards (regulations) are not simply based on technical data but are essentially socially developed and the technical data base is only a component of that .

- The question was raised as to when new source standards will be set for Lurgi-type processes. What stages are they in now? It was stated by Mr. Durham that EPA's Emission and Standards Division is in the preliminary stages of standard development for coal gasification plants and that the current schedule calls for a first draft of a Standard Support Environmental Impact Statement to be put out for general industry comment this spring.

- The procedure for developing new source standards was explained. First, information is obtained by the authority of the Clean Air Act through formal information requests, visiting the people concerned. Then a technical document is put together summarizing what can be done today, the costs--environmental and economic--the projected achievable emission levels, and the standards recommended as a result. This is all printed in a "Standard Support Environmental Impact Statement" which is distributed to interested parties. It is then reviewed by an open national committee, the National Air Pollution Control Techniques Advisory Committee, which all interested parties are invited to attend. Comments received are then analyzed to determine what, if any, changes are necessary. In many cases new information must be gathered. Once it is felt that all the issues are in hand, it is published in the Federal Register as a proposed standard. It is not an arbitrary process.

Meeting Recommendations

The meeting chairman, Dr. Foley, reiterated that the primary purpose of the meeting was to obtain recommendations on what the EPA R&D program should be doing. He stated that the meeting minutes would be analyzed to extract indirect recommendations, but he asked for direct recommendations. This invitation was responded to with the following points.

- It is important to point out the population-at-risk in any pollutant prioritization method.
- It is important to establish the degree of relevancy in research tasks, to separate that which is of purely academic interest from that which is truly useful input to the standards-setting process.
- It is important to gain access to operating Lurgi plants to find out what the emissions actually are. Commercial plants currently operational are in foreign countries, particularly South Africa and Poland. These plants are at a smaller scale than commercial plants proposed for the United States, and it is very difficult to gain access to operational data. There are problems making the necessary political arrangements.
- It is important to specify specifically how the research and development program should be involved in the standard-setting process. Working relationships must be improved.
- The analytical strategy developed for coal gasification was based on the third report* of the Radian Corporation study and on addressing the variety of gasification sources and clean-up systems, taking the composition of the gas streams and probable composition of all of the water streams from data reported to EPA.

*K. J. Bombaugh, et al., "Sampling and Analytical Strategies for Compounds in Petroleum Refinery Streams," EPA Report No. 68-02-1882, September 15, 1975.

- It is clear that EPA does not have samples and must have them. EPA will be happy to take samples and run emission tests at any plant which is made available to them.
- It is important to document the results of this meeting and to specify how these results are used in the next meeting.

The general meeting was adjourned and the Executive Committee convened to summarize the major points and draw conclusions for the R&D program.

AGENDA
ADVANCED FOSSIL FUELS MEETING
Research Triangle Park, North Carolina
November 13, 1975

	Topic	Speaker
8:00	Registration and Coffee	
9:00	Opening Remarks	John Burchard, EPA, Director, Industrial Environmental Research Laboratory
9:15	How We Got To Where We Are	Gary J. Foley, Chairman EPA-Office of Energy, Minerals, and Industry
9:45	Introduction, R&D Strategies for Control Technology	Gary J. Foley, Chairman
10:00	Federal Regulation of Atmospheric Emissions from Advanced Fossil Fuel Conversion Facilities	James F. Durham, Chief, Performance Standards Section, Emission Standards and Engineering Division, EPA-RTP
10:20	Water Standards	Harold Coughlin, EPA-Effluent Guidelines Division
10:40	EPA Environmental Assessment and Control Technology Program	Robert Hangebrauck and Kelly Janes, EPA-Industrial Environmental Research Laboratory
11:00	ERDA Control Technology	Myron Gottlieb, ERDA-Environmental and Safety Research
11:20	Industrial Approaches to Control Technology	Milton Beychok, Consulting Engineer
12:30	Lunch	
1:40	Introduction, Pollutant Priorities	Gerald Rausa, EPA-Office of Energy, Minerals and Industry
1:40	A System Approach to the Problem of Characterizing the Emission Potential of Energy Conversion Processes	Karl J. Bombaugh, Radian Corporation
1:55	Estimation of Permissible Pollutant Concentrations for Air and Drinking Water	Max Samfield, EPA-Industrial Environmental Research Laboratory
2:10	Factors to be Considered in Prioritization of Pollutants	John Cleland, Research Triangle Institute
2:25	The ERDA Approach to Prioritizing Pollutants	Murray Schulman, ERDA-Division of Biomedical and Environmental Research

ATTACHMENT I (Continued)

	Topic	Speaker
2:40	Screening Prioritization Strategies	Robert G. Tardiff, Chief, Organic Contaminants Branch, Water Quality Division, Health Effects Research Laboratory, EPA-Cincinnati
3:00	Discussion	
4:00	Summary	Gary J. Foley, Chairman
4:15	Adjourn	
4:30	Executive Committee Meeting	
5:00	Adjourn	

ATTACHMENT II

LIST OF ATTENDEES
ADVANCED FOSSIL FUELS MEETING
Research Triangle Park, North Carolina
November 13, 1975

John H. Abrahams
Energy Research & Development Administration
20 Massachusetts Avenue
Washington, DC 20545

Milton R. Beychok
17709 Oak Tree Lane
Irvine, CA 92715

Julie F. Bishop
Stanford Research Institute
1611 N. Kent Street
Arlington, VA 22209

Karl J. Bombaugh
Radian Corporation
8500 Shoal Creek Blvd.
Austin, TX

Paul E. Brubaker
Greenfield, Attaway & Tyler, Inc.
Chief, Pathophysiology
98 Larkspur St.
San Rafael, CA

John K. Burchard
Director, Industrial Environmental Research Laboratory (MD-60)
Environmental Protection Agency
Research Triangle Park, NC 27711

John G. Cleland
Research Triangle Institute
Research Triangle Park, NC 27709

Harold Coughlin
EPA, Office of Water Planning & Standards
401 M Street, S.W. (WH-452)
Room 913, East Tower
Washington, DC 20460

Ronald L. Dickenson
Stanford Research Institute
333 Ravenswood Avenue
Menlo Park, CA 94025

James F. Durham
EPA, Office of Air Quality Planning & Standards (MD-13)
Research Triangle Park, NC 27711

Henry F. Enos
Deputy Director
Environmental Protection Agency
Athens, GA

George Erskine
MITRE Corporation
1820 Dolley Madison Blvd.
McLean, VA 22101

Gary J. Foley
EPA, Office of Energy, Minerals & Industry
Waterside Mall, RD-681
Washington, DC 20460

R. John Garner
EPA Health Effects Research Laboratory
Cincinnati, OH 45268

Myron Gottlieb
ERDA, Environment & Safety Research
Washington, DC 20545

Robert P. Hangebrauck
EPA, Industrial Environmental Research Laboratory (MD-61)
Research Triangle Park, NC 27711

Gerald Hollinden
Tennessee Valley Authority
503 Power Bldg
Chattanooga, TN 37401

ATTACHMENT II (Continued)

Charles W. Hulburt
Stanford Research Institute
1611 N. Kent Street
Arlington, VA 22209

T. Kelly Janes
EPA, Industrial Environmental
Research Laboratory (MD-61)
Research Triangle Park, NC 27711

James C. Johnson*
EPA, OEMI, Energy Processes Division
401 M Street, S.W.
Room 639, West Tower (RD-681)
Washington, DC 20460

John E. Johnston
U.S. Geological Survey
National Center Stop 956
Reston, VA 22092

James C. Jones
Director, Environmental Quality
Peabody Coal
301 N. Memorial Drive
St. Louis, MO 63102

John H. Knelson
EPA, Health Effects Research
Laboratory
Research Triangle Park, NC 27711

Kathleen Kozey
U.S. Geological Survey
Reston, VA 22092

William N. McCarthy, Jr.
EPA, OEMI, Energy Processes Division
401 M Street, S.W. (RD-681)
Room 639, West Tower
Washington, DC 20460

Rayburn Morrison
EPA, Office of Quality Planning &
Standards, SASD
Research Triangle Park, NC 27711

Jim Mulvihill
ERDA
4800 Forbes Avenue
Pittsburgh, PA 15213

William E. Pepelko
EPA, Health Effects Research
Laboratory
Cincinnati, OH 45268

Frank Princiotta
Acting Director
EPA Energy Processes Division
Washington, DC 20460

Gerald Rausa
EPA, Environmental Science
Washington, DC 20460

Robert H. Rea
Resource Planning Associates, Inc.
44 Brattle Street
Cambridge, MA 02138

Max Samfield
EPA, Industrial Environmental
Research Laboratory (MD-63)
Research Triangle Park, NC 27711

Frank C. Schora, Jr.
Vice-President, Process Research
Institute of Gas Technology
3424 South State Street
Chicago, IL 60606

Murray Schulman
ERDA, Division of Biomedical &
Environmental Research
Washington, DC 20545

Lowell Smith
EPA, OEMI
Washington, DC 20460

*New address: Office of Environment and Safety, ERDA, Fossil Energy,
20 Massachusetts Ave., N.W., Washington, DC 20545

ATTACHMENT II (Continued)

John O. Strakey
ERDA, Pittsburgh Energy Research
Center
4800 Forbes Avenue
Pittsburgh, PA 15213

Mark J. Stutsman
EPA, Industrial Environmental
Research Laboratory (MD-61)
Research Triangle Park, NC 27711

John Talty
National Institute for Occupational
Safety & Health
Chief, Engineering Branch
1014 Broadway
Cincinnati, OH 45202

Lloyd T. Taylor
EPA, Science Advisory Board Staff
401 M Street
Washington, DC 20460

Edythalena A. Tompkins
EPA, Health Effects Research
Laboratory
Research Triangle Park, NC 27711

Gene Tucker
EPA, Industrial Environmental Research
Laboratory (MD-63)
Research Triangle Park, NC 27711

Kurt Yeager
Program Manager,
Environmental Control
Electric Power Research Institute
P.O. Box 94303
Palo Alto, CA 94303

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15. SUPPLEMENTARY NOTES
EPA Contacts: Dr. Gary Foley -- (202) 755-0207
Mr. William McCarthy -- (202) 755-0635

16. ABSTRACT

The minutes of the second Advanced Fossil Fuels Sector Group Meeting cover the content of the presentations which were made as well as the discussion which followed. Two general areas of concern were addressed:

(1) R&D strategies for control technology and the relationships of control technology R&D to development of standards and in respect to impact on industry.

(2) Pollutant prioritization and the relationship of characterization and prioritization to control technology, standards and the impact on other government agencies and industry.

These areas of concern were considered in the context of current control technology versus that which may be required in the future, in particular as it relates to coal gasification and liquefaction.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Coal gasification Coal liquefaction Environmental control technology Pollutant prioritization Pollutant characterization Water standards Air standards	Environmental standards Control technology Pollutants	

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