MASTER

CORRELATION OF AES FY 1978 PROGRAM WITH ENERGY-RELATED ENVIRONMENTAL RESEARCH NEEDS

Prepared by
Environment and Safety Group

August 1976

Prepared for
Office of the Assistant Administrator for Environment and Safety
ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION
Washington, D. C. 20545

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Environment and Energy Conservation Division
THE AEROSPACE CORPORATION

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Germantown, Maryland 20767

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CONTENTS

<u>Section</u>		<u>Page</u>
	ACKNOWLEDGMENT	ii
1	INTRODUCTION	1-1
	A. Identification of Energy-Related Environmental Issues	1-1
	B. Correlation of AES FY 78 Research With the Environmental Issues	1-3
	C. AES Research Classification	1-4
	D. Tabulation of Results	1-5
2	FUNDING SUMMARY	2-1
3	FOSSIL-GENERAL	3-1
4	COAL	4-1
5	OIL AND GAS	5-1
6	OIL SHALE	6-1
7	SOLAR	7-1
8	GEOTHERMAL	8-1
9	HYDROELECTRIC	9-1
10	CONSERVATION	10-1
11	FISSION	11-1
12	FUSION	12-1
13	MULTI-TECHNOLOGY	13-1
14	GENERAL SCIENCE	14-1
15	MEDICAL APPLICATIONS	15-1

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SECTION 1

INTRODUCTION

This report has a two-fold objective: 1) to identify major energy-related environmental concerns, needs, and problem areas, and 2) to show the relationship of the planned FY 78 research program of the ERDA Assistant Administrator of Environment and Safety (AES) to those environmental issues. The document is organized into sections addressing each major energy form. Each section identifies environmental issues of an energy form and indicates the level of planned FY 78 AES research addressing each issue, thus delineating the links between environmental research and the needs of energy research, development, and demonstration (RD&D).

A. Identification of Energy-Related Environmental Issues

The environmental needs or issues compiled here for each energy form have been substantially drawn from published ERDA documents. The intent was not to establish an AES view of energy-related environmental needs, but to summarize the needs expressed throughout ERDA which AES research might support. The specific ERDA documents reviewed in order to identify expressed environmental needs, concerns, and problem areas are listed in Table 1-1. These documents include the ERDA National Plan, Program Approval Documents (PADs), and the AES Balanced Program Plan. Also included are environmental concerns expressed by the Office of Technology Assessment (OTA) and the Council on Environmental Quality (CEQ) in their reviews of ERDA environmental RD&D activities.

TABLE 1-1. SOURCES FOR ENVIRONMENTAL ISSUES

1. A National Plan for Energy Research, Development, and Demonstration: Creating Energy Choices for the Future, 1976 (ERDA 76-1), Volume 1; The Plan, April 15, 1976
2. A National Plan for Energy Research, Development, and Demonstration: Creating Energy Choices for the Future, 1976 (ERDA 76-1), Volume 2; Program Implementation, February 6, 1976 Draft
3. Balanced Program Plan (BPP), Volume 1 - Overview and Summary (ERDA - 116), October 1975
4. Balanced Program Plan (BPP), Preliminary Guide for Implementation, February 1976
5. AES Program Approval Documents (PADs)
 - a. Biomedical and Environmental Research
 - b. Safety, Standards, and Compliance
 - c. Environmental Control Technology
6. AES written comments (letters to other AAs) on drafts of other Assistant Administrators' PADs relative to Environment and Safety adequacy.
7. Program Approval Documents (PADs) of ERDA Assistant Administrators (AAs) responsible for energy RD&D:
 - a. Fossil Energy Development
 - 1) Coal
 - 2) Petroleum and Natural Gas
 - 3) Oil Shale
7. - continued
 - b. Solar, Geothermal, and Advanced Energy Systems Development
 - 1) Solar Energy Development
 - 2) Geothermal Energy Development
 - 3) Physical Research
 - 4) Fusion Power Research and Development
 - c. Conservation Research and Development
 - 1) Transportation and Energy Conversion
 - 2) Electric Energy Systems
 - 3) Buildings Conservation
 - 4) Conservation in Industry
 - 5) Conservation Research and Technology
 - d. Nuclear Energy Development - Fission
 - 1) Liquid Metal Fast Breeder Reactor Technology Program
 - 2) Clinch River Breeder Reactor Program
 - 3) Advanced Isotope Separation Technology
 - 4) Light Water Breeder Reactor Program
 - 5) Space Nuclear Systems
 - 6) Uranium Enrichment and Resource Assessment
 - 7) Special Materials Production
 - 8) Fuel Cycle R&D
8. Office of Technology Assessment's review of ERDA 76-1 (Draft)
9. Council on Environmental Quality Report on 1975 Public Hearings, 9 April 1976
10. AES recognized environmental issues not mentioned by previous sources

The environmental issues compiled from these sources are listed in subsequent Sections of this report for each major energy form. The source from which each issue was derived is shown in the tables by "Xs" placed under the appropriate reference. The number of "Xs" appearing after each issue does not indicate a priority, but simply the number of source documents in which the issue was found. This type of presentation permits the reader to select those environmental issues associated with a specific reference(s) in which he may be interested.

Since the environmental issues have been drawn from a number of sources of varying detail, the compilation has overlaps as well as gaps in the content of the issues. Many of the statements of environmental issues are also lacking in detail or specificity desired by the planner attempting to formulate responsive research. No attempt was made by the authors to refine these issues. They have been compiled using statements conveying, as close as possible, the environmental need, concern, or problem expressed in the reference.

B. Correlation of AES FY 78 Research With the Environmental Issues

The planned AES FY 78 research program is composed of over 1,000 projects. This report correlates each of those projects with the previously mentioned environmental issues. The alignment of each individual project with specific statements of environmental issues was accomplished by AES divisional staff members who were familiar with the planned research. The project-issue correlation for a small percentage of the projects, including all Environmental Control Technology Division projects, was accomplished by The Aerospace Corporation technical staff in order to fill data gaps resulting largely from project changes caused by evolution of the FY 78 research program. This project-issue correlation is a judgmental process which is made difficult in many instances by the lack of specificity in the statement of the environmental issue. The resulting correlations, although imperfect, are felt to provide an indication of the approximate level of research directed at each environmental issue.

C. AES Research Classification

The planned AES research projects have, in general, been classified according to the major energy forms being addressed by ERDA. Although the energy categories are relatively straightforward and self-explanatory, it is felt that a more specific definition of four of them is needed here.

The Fossil-general category includes projects with essentially equal applicability to all fossil fuel energy forms. Heretofore, most of these projects have been classified in AES program descriptions as coal, with some also classified as oil and gas, oil shale, or multi-technology. Their categorization as Fossil-general indicates more distinctly the broad applicability of this research to fossil fuel RD&D.

A Multi-Technology category is designated to include all environmental research having broad applicability to several energy forms and without focus on a specific energy form.

The category of General Science contains research not directly related to energy technology development. A portion of this research is an outgrowth of ERDA assuming research responsibilities of the former Atomic Energy Commission.

In the Energy Reorganization Act of 1974 (Section 2b) it states:

"Establish an Energy Research and Development Administration to bring together and direct federal activities relating to research and development on the various sources of energy, to increase the efficiency and reliability in the use of energy, and to carry out the performance of other functions, including but not limited to the Atomic Energy Commission's military and production activities and its general basic research activities."

The fourth category, Medical Applications of Nuclear Technology, is not related to environmental research, but is a continuation of research previously conducted by the former Atomic Energy Commission.

D. Tabulation of Results

Tables of standardized format are presented in the following sections of the report for each major energy form. The first table in each section summarizes the planned environmental research associated with the specific energy form being discussed in that section. A subprogram level breakout is presented to show the level of activity for each major environmental discipline. Human Health and Biological studies have been combined into a single subprogram item. Recent transfers of projects between Human Health and Biological subprograms, resulting from AES program restructuring that occurred during the course of this effort, has not permitted a clear separation of these two research areas for this reported effort.

Education and Training activities, totaling \$6 million for the planned FY 78 AES program, are addressed in the first table of each section. Since this funding is intended for educational activities and does not directly address the energy-related environmental issues identified in this report, it has not been included in the project-by-project correlation with the environmental issues in subsequent tables.

Tables of this report have classified planned research as either "focused" or "supportive" for a specific energy form. Each planned research project had been previously categorized by the AES divisional staff as supporting Coal, Oil and Gas, Oil Shale, Solar, Geothermal, Hydroelectric, Conservation, Fusion, Fission, Multi-technology, General Science, or Medical Applications of Nuclear Technology. For purposes of this report, projects were classified as "focused" on the energy form based upon this earlier categorization by the AES divisional staff unless a reclassification was indicated by the AES staff when making the correlation of projects with the listed environmental issues. It was recognized, however, that a given project could be focused toward one energy form and also provide support to others as well. For example, many projects which were "focused" toward Coal also provided data applicable to Oil and Gas. Such a project would be listed both as "focused" in the Coal program and "supportive" in the Oil and Gas program. All projects

categorized as Multi-technology were correlated with specific energy forms and given a "supportive" classification. Where a project was assigned as "supportive" to more than one energy form, the total funding of that project was included in the supportive research table for each applicable energy form. Determination of the level of fractional support of each project to all environmental issues is a highly judgmental task and the compilation of such fractional assignments is complex. Such a determination was not attempted in this report.

The tabular listing of environmental issues presented in this report has been organized into sublists for Integrated Systems Analysis, Physical and Technological, Health, and Environment. Integrated Systems Analysis includes issues associated with environmental data integration, safety, energy materials transportation, social, cultural, and economic impacts. Physical and Technological includes radiological and chemical physics; physical and chemical pollutant studies; and characterization, measurement, and monitoring. The Health listings include biological issues. Environmental issue listings include atmospheric sciences; land/freshwater sciences; and marine sciences.

The second table in each "energy-specific" section of this report presents the correlation of the research summarized in the first table with the environmental issues identified for that energy form. Note: The columns showing numbers of projects and funding levels in these "second" tables are non-additive. Summation of these values is without meaning since 1) the environmental issues are not mutually exclusive, and 2) many research projects have been formulated to address multiple issues and, therefore, are correlated (relisted in each table) with all appropriate issues.

SECTION 2

FUNDING SUMMARY

The planned FY 78 AES research program funding addressed in this report is summarized in Table 2-1. This table indicates the funding associated with each energy technology for the four AES Divisions. Although total and divisional funding shown here is consistent with AES program funding summaries presented elsewhere, the funding alignment with energy technologies shows some variation. These differences stem 1) from the inclusion of Fossil-general and Hydroelectric categories and 2) from the reassignment of energy technology categories for some projects by the AES technical staff members. These reassignments resulted from the close examination required to correlate each project with the numerous environmental issues.

A more detailed funding breakout, as well as a listing of the number of associated research projects, is presented for each energy technology in the first table of subsequent sections of this report. The funding summarized in Table 2-1 corresponds to the "focused" research presented in subsequent tables.

This report does not include the Reactor Safety program portion of the planned FY 78 AES budget. This activity, planned for a total FY 78 funding of \$21.3 million, is specifically oriented to the conduct of reactor safety confirmatory research required by the Nuclear Regulatory Commission (NRC). The funding request is for completion and operational checkout of the Loss of Fluid Test Facility (LOFT).

TABLE 2-1. FY 78 FUNDING SUMMARY
(Dollars in Thousands)

<u>AES Division</u>	<u>Fossil- General</u>	<u>Coal</u>	<u>Oil & Gas</u>	<u>Oil Shale</u>	<u>Solar</u>	<u>Geo- thermal</u>	<u>Hydro- electric</u>	<u>Conser- vation</u>	<u>Fission</u>	<u>Fusion</u>	<u>Multi- Technology</u>	<u>General Science</u>	<u>Medical Applications</u>	<u>TOTAL</u>
Overview and Assessment	703	1,980	400	400	400	632	1,000	471	905	80	20,584	-	-	27,555
Biomedical and Environmental	11,358	27,005	2,947	3,875	4,295	4,114	173	773	59,051	1,378	42,699	20,138	18,269	196,075
Environmental Control Technology	-	3,900	1,900	700	500	500	-	626	24,260	-	1,614	-	-	34,000
Safety, Standards, and Compliance	-	50	-	-	100	125	-	-	2,725	100	6,470	-	-	9,570
TOTAL	<u>12,061</u>	<u>32,935</u>	<u>5,247</u>	<u>4,975</u>	<u>5,295</u>	<u>5,371</u>	<u>1,173</u>	<u>1,870</u>	<u>86,941</u>	<u>1,558</u>	<u>71,367</u>	<u>20,138</u>	<u>18,269</u>	<u>267,200</u>

SECTION 3

FOSSIL-GENERAL

The category of "Fossil-general" includes research supportive of all fossil fuel energy technologies, but without focus on a specific fossil fuel. For example, research on the health or environmental impacts of NO_x , SO_x , CO_x , and particulates may often be classified as Fossil-general. Most research classified here as Fossil-general has, in previous AES program summaries, been classified as coal or multi-technology. Projects were included in this classification when they addressed issues in all fossil energy forms and when they had been previously assigned this Fossil-general category by the ERDA Laboratory and field office personnel. The Fossil-general classification is used here to indicate more explicitly its wide-applicability to fossil energy RD&D.

A listing of environmental issues expressed in ERDA documents has not been included in this section. The compilation of environmental issues from the referenced sources found that issues were addressed in the context of a specific fossil fuel; and, therefore, these issues have been tabulated in the Coal, Oil and Gas, and Oil Shale sections of this report.

The planned level of FY 78 funding and number of Fossil-general research projects are summarized in Table 3-1. Environmental Control Technology and Safety, Standards, and Compliance activities have been oriented to specific fossil fuel issues, and, consequently, no funding is shown here. The funding is indicated as "focused" on Fossil-general research. In subsequent sections of the report, this research is correlated with statements of environmental issues and will appear wherever applicable in the "supportive" research column of those tables. No research focused on other energy technologies is shown as "supportive" for Fossil-general since no environmental issues were identified for Fossil-general to which other technology research could be correlated.

TABLE 3-1. FOSSIL-GENERAL RESEARCH SUMMARY

<u>Subprogram</u>	<u>Research</u>	<u>Projects</u>
	<u>Number of Projects</u>	<u>Dollars in Thousands</u>
Overview and Assessment	7	703
Health and Biological	40	6,871
Environmental	16	3,077
Physical and Technological	7	1,410
Education and Training	-	-
Environmental Control Technology	-	-
Safety, Standards, and Compliance	-	-
TOTAL	<u>70</u>	<u>12,061</u>

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SECTION 4

COAL

A summary of the planned FY 78 AES research categorized as "Coal" is presented in Table 4-1. The data indicate that over one-half of the total funding for research focused on Coal addresses the time-urgent problems associated with health and environmental impacts of coal production and use. A substantial fraction of funding (12 percent) is focused on environmental control technologies.

The funding listed as supportive of coal research represents program activities focused on other energy technologies that also have secondary applicability to environmental issues associated with coal. Only a fraction of the supportive research funding shown can be attributed to resolution of coal issues.

The coal-related environmental needs, concerns, and problems found in the referenced ERDA documents are listed in Table 4-2. This table also shows the correlation of all planned FY 78 coal research, both focused and supportive, with the environmental issues. As discussed previously the funding columns in Table 4-2 are non-additive since individual issues are not mutually exclusive and projects may correlate with more than one issue, and, therefore, be entered more than once. Total funding levels are indicated, however, in Table 4-1.

TABLE 4-1. COAL RESEARCH SUMMARY

Subprogram	Research		Projects	
	Focused		Supportive*	
	Number of Projects	Dollars in Thousands	Number of Projects	Dollars in Thousands
Overview and Assessment	6	1,980	50	17,116
Health and Biological	56	10,021	70	12,903
Environmental	71	11,131	102	12,309
Physical and Technological	13	3,138	46	6,473
Education and Training	3	2,715	-	-
Environmental Control Technology	12	3,900	11	1,614
Safety, Standards, and Compliance	<u>1</u>	<u>50</u>	<u>3</u>	<u>380</u>
TOTAL	<u>162</u>	<u>32,935</u>	<u>282</u>	<u>50,795</u>

*These values are only fractionally applicable to this energy form.

TABLE 4-2
MAJOR ISSUES - COAL

ISSUE	REFERENCE SOURCES										RESEARCH PROJECTS				
	ERDA 76-1		BPP		PADs			OTA	CEQ	AES	Focused		Supportive		
	Vol 1	Vol 2	Vol 1	Impl	AES	Cmts	AAs				No. of Projects	Dollars in Thousands	No. of Projects	Dollars in Thousands	
<u>INTEGRATED SYSTEMS ANALYSIS</u>															
C1 Definition of national, regional, and local socio-economic impact including:	X	X	X	X	X				X	X		5	1,780	23	5,427
C2 -- Impact of large scale surface mining; impacts in the Missouri/Colorado River basins; impact on farming and ranching in the Midwest; and impact on forestry, agriculture, and water in the East									X			3	1,749	2	120
C3 -- Expansion of efforts in education and training of social scientists									X			--	--	--	--
C4 -- Elimination of shortages of skilled manpower especially in health effects research										X		--	--	--	--
C5 Definition of baseline demographic data to permit formulation of models of population growth and assessment of community impact					X							1	40	10	2,180
C6 Establishment of siting selection criteria and accomplishment of associated risk/benefit assessment, including social and institutional constraints.		X	X						X			2	1,320	23	8,539

TABLE 4-2
MAJOR ISSUES - COAL
(continued)

ISSUE	REFERENCE SOURCES										RESEARCH PROJECTS			
	ERDA 76-1		BPP		PADs			OTA	CEQ	AES	Focused		Supportive	
	Vol 1	Vol 2	Vol 1	Impl	AES	Cmts	AA's				No. of Projects	Dollars in Thousands	No. of Projects	Dollars in Thousands
<u>INTEGRATED SYSTEMS ANALYSIS - continued</u>														
C7 Preparation of regional hydrological data bases and models, considering				X							1	200	8	2,661
C7a -- Collection of estimates of leaching, runoff, and erosion from disposal mining areas				X										
C8 Impact of development on aesthetics (e.g., visual, olfactory)					X						--	--	4	2,295
C9 Estimation of potential toxic wastes and facility accident risks				X							--	--	5	435
C10 Evaluation of potential of coal and syntfuel facility accidents					X						4	751	9	1,470
C10a Compile, organize, and disseminate data and information as it affects the environment										X	15	1,530	--	--
C10b Assessment of needs of improved environmental control procedures, processes, systems, and strategies										X	12	3,900	--	--
C10c Maintain catalog of R&D projects										X	2	190	--	--
C10d Provide for coordination of environment and safety activities, within ERDA, with other federal, state, and local agencies, with the general public, and with industry.										X	1	2,000	--	--

TABLE 4-2
MAJOR ISSUES - COAL
(continued)

ISSUE	REFERENCE SOURCES										RESEARCH PROJECTS			
	ERDA 76-1		BPP		PADs			OTA	CEQ	AES	Focused		Supportive	
	Vol 1	Vol 2	Vol 1	Impl	AES	Cmts	AAs				No. of Projects	Dollars in Thousands	No. of Projects	Dollars in Thousands
<u>INTEGRATED SYSTEMS ANALYSIS - continued</u>														
C10e Assessment of transportation for fossil fuels										X	--	--	1	200
<u>PHYSICAL AND TECHNOLOGICAL</u>														
C11 Development of techniques for monitoring and evaluating noise pollution from extraction processing				X							--	--	1	100
C12 Estimation of atmospheric pollution emission using advanced long-range models				X							9	1,318	16	4,686
C13 Definition of impact of toxic wastes including:			X	X							8	1,762	39	5,944
C14 -- Understanding of pollutant pathways, both terrestrial and aquatic			X	X							9	1,568	45	5,645
C15 -- Characterization of the physical and chemical properties of wastes			X	X							25	4,373	40	7,427
C15a -- Development of instrumentation and calibration techniques for assessment of work environment										X	1	30	--	--
<u>HEALTH</u>														
C16 Better understanding of the effects of extraction, combustion, and conversion products and effluents		X	X	X	X				X		33	6,208	83	13,109

TABLE 4-2
MAJOR ISSUES - COAL
(continued)

I S S U E	REFERENCE SOURCES										RESEARCH PROJECTS				
	ERDA 76-1		BPP		PADs			OTA	CEQ	AES	Focused		Supportive		
	Vol 1	Vol 2	Vol 1	Impl	AES	Cmts	AAs				No. of Projects	Dollars in Thousands	No. of Projects	Dollars in Thousands	
<u>HEALTH - continued</u>															
C17 Definition and evaluation of protective measures against atmospheric pollutants impact; considering	X	X		X	X				X			15	3,266	14	2,431
C18 -- SO _x , NO _x , CO, CO ₂ , hydrocarbons, trace elements, amines, phenols, particulates, radioactive isotopes	X			X						X		48	8,997	93	17,464
C19 -- Dose effects				X								17	3,917	17	3,842
C20 -- Metabolism				X								9	4,140	8	1,440
C21 -- Physiological effects				X								33	4,629	22	2,873
C22 -- Determination of chronic and acute effects on biota			X	X								2	781	1	53
C23 Development of models to relate quantity of pollutant released to actual environmental and health impact									X			5	1,619	17	4,282
C23a Determination of organ burdens										X		3	241	1	60
C23b Investigations relative to combating detrimental effects										X		3	1,292	1	60
C23c Development of early indicators of health hazards										X		3	1,194	2	118

TABLE 4-2
MAJOR ISSUES - COAL
(continued)

I S S U E	REFERENCE SOURCES										RESEARCH PROJECTS				
	ERDA 76-1		BPP		PADs			OTA	CEQ	AES	Focused		Supportive		
	Vol 1	Vol 2	Vol 1	Impl	AES	Cmts	AAs				No. of Projects	Dollars in Thousands	No. of Projects	Dollars in Thousands	
<u>ENVIRONMENT</u>															
C24 Evaluation of impact on water quality and availability considering:	X	X	X	X	X				X	X		5	571	9	1,138
C25 -- Leachates impact				X								5	1,622	2	117
C26 • Sulfates, ammonium, nitrates, acids, trace metals, suspended solids				X								4	1,524	15	4,230
C27 -- Rupture or spill from gasification/liquefaction process				X								1	180	3	3,042
C28 -- Quantity of water needed to maintain quality for aquatic biota				X								1	180	8	943
C29 Identification and characterization of toxic wastes disposal and treatment considering:		X		X	X							20	3,119	17	3,278
C30 -- Ash, sulfur sludge, isotopes				X								--	--	7	3,143
C31 -- Waste heat management strategies			X	X								--	--	20	4,058
C32 -- Acute and chronic effects on terrestrial and aquatic species			X	X								2	158	20	2,699
C33 -- Hazardous biotransformation products				X								3	346	9	1,416

TABLE 4-2
MAJOR ISSUES - COAL
(continued)

I S S U E	REFERENCE SOURCES										RESEARCH PROJECTS			
	ERDA 76-1		BPP		PADs			OTA	CEQ	AES	Focused		Supportive	
	Vol 1	Vol 2	Vol 1	Impl	AES	Cmts	AAs				No. of Projects	Dollars in Thousands	No. of Projects	Dollars in Thousands
<u>ENVIRONMENT - continued</u>														
C34 Examination of land disruption impact due to extraction and waste including:		X	X	X	X						6	1,557	3	123
C35 -- Evaluation of effects of erosion and runoff					X						4	1,128	6	2,566
C36 -- Development of techniques for revegetation					X						8	1,315	2	103
C37 -- Development of plant succession and revegetation models					X						6	1,190	2	103
C38 Determination of the effects of extraction, combustion, and effluents considering:			X	X							8	1,189	3	379
C39 -- Impact on agriculture and wildlife			X	X							13	1,526	13	1,119
C40 Determination of climate impact (long-term) due to CO ₂ , SO _x , NO _x , and heat including:								X			14	2,689	7	3,129
C41 -- Evaluation of potential for large scale changes								X			14	2,709	3	439
C42 -- Identification of constraints on energy-development scenarios								X			--	--	9	535
C43 -- Baseline characterizations of flora and/or fauna										X	2	248	28	2,781
C44 -- Theoretical analysis of model populations										X	--	--	4	213

SECTION 5

OIL AND GAS

A summary of the planned FY 78 AES research which has been categorized as "Oil and Gas" is presented in Table 5-1. Since most of the energy technology research in the field of oil and gas is directed toward the extraction of resources, most of the research is directed along environmental lines. Note that 90 percent of the "Focused" environmental research funds are applied in the areas of environmental effects and environmental control technology.

As mentioned in Section 4, Coal, the supportive research programs for Oil and Gas have primary applicability to other energy forms. Therefore, only a fraction of the funds shown for supportive research are applicable to Oil and Gas issues.

The correlation of the Oil and Gas research to the environmental issues drawn from ERDA documentation is shown in Table 5-2.

TABLE 5-1. OIL AND GAS RESEARCH SUMMARY

Subprogram	Research		Projects	
	Focused		Supportive*	
	Number of Projects	Dollars in Thousands	Number of Projects	Dollars in Thousands
Overview and Assessment	1	400	38	14,525
Health and Biological	1	150	37	4,787
Environmental	14	2,797	80	13,003
Physical and Technological	-	-	2	219
Education and Training	-	-	-	-
Environmental Control Technology	6	1,900	11	1,614
Safety, Standards, and Compliance	-	-	-	-
TOTAL	<u>22</u>	<u>5,247</u>	<u>168</u>	<u>34,148</u>

*These values are only fractionally applicable to this energy form.

TABLE 5-2
MAJOR ISSUES - OIL AND GAS

I S S U E	REFERENCE SOURCES										RESEARCH PROJECTS			
	ERDA 76-1		BPP		PADs			OTA	CEQ	AES	Focused		Supportive	
	Vol 1	Vol 2	Vol 1	Impl	AES	Cmts	AAs				No. of Projects	Dollars in Thousands	No. of Projects	Dollars in Thousands
<u>INTEGRATED SYSTEMS ANALYSIS</u>														
O1 Assessment of impact of development on the Outer Continental Shelf		X					X				6	1,600	32	5,080
O2 Analysis of socioeconomic effect of petroleum shortages			X	X	X		X				1	400	1	510
O3 Assessment of impact of accidents on coastal zones (oil spill)					X						8	1,763	36	8,429
O4 Conduct cost effectiveness analysis of controls vs energy needs						X			X		1	400	--	--
O5 Conduct environmental assessment of energy transportation					X		X				5	1,088	9	1,447
O6 Coordination of E&S policies, standards, guidelines, and criteria considering:					X						--	--	12	5,805
O7 -- Occupational safety					X						--	--	7	770
O8 -- Clean Air and Water Quality Act compliance					X						--	--	2	220
O9 -- Accident prevention					X						--	--	6	670

TABLE 5-2
MAJOR ISSUES - OIL AND GAS
(continued)

I S S U E	REFERENCE SOURCES										RESEARCH PROJECTS			
	ERDA 76-1		BPP		PADs			OTA	CEQ	AES	Focused		Supportive	
	Vol 1	Vol 2	Vol 1	Impl	AES	Cmts	AAs				No. of Projects	Dollars in Thousands	No. of Projects	Dollars in Thousands
<u>INTEGRATED SYSTEMS ANALYSIS - continued</u>														
O10 Perform multi-technology investigations relative to oil spills in marine environment considering:			X					X			5	518	24	6,248
O11 -- Prevention and cleanup			X								--	--	1	65
O12 -- Control technology				X							--	--	1	60
O13 Accomplish baseline measurements in oil field vicinities				X							1	214	4	2,237
O14 Accomplish baseline measurements for Outer Continental Shelf lease areas									X		8	1,488	38	7,936
O14a Assessment of needs of improved environmental control procedures, processes, systems, and strategies for complete fuel cycle										X	6	1,900	--	--
O14b Definition of national, regional, and local socio-economic impact of development										X	--	--	1	45
O14c Compilation, organization, and dissemination of data related to development and its impacts on the environment										X	--	--	2	190
O14d Inventory and data base management of oil and gas RD&D projects										X	--	--	1	200

TABLE 5-2
MAJOR ISSUES - OIL AND GAS
(continued)

I S S U E	REFERENCE SOURCES										RESEARCH PROJECTS			
	ERDA 76-1		BPP		PADs			OTA	CEQ	AES	Focused		Supportive	
	Vol 1	Vol 2	Vol 1	Impl	AES	Cmts	AAs				No. of Projects	Dollars in Thousands	No. of Projects	Dollars in Thousands
<u>INTEGRATED SYSTEMS ANALYSIS - continued</u>														
O14e Provide for coordination of E&S activities within ERDA; with other federal, state, and local agencies; with the public, and with industry										X	--	--	1	2,000
O14f Monitor, review, and coordinate environmental assessments and Environmental Impact Statements										X	--	--	1	3,000
<u>PHYSICAL AND TECHNOLOGICAL</u>														
O15 Development of oil spill characterization models				X	X						5	518	9	1,074
O16 Establishment of acceptable methods for transport and disposal of brine		X		X			X				--	--	1	125
O17 Characterization of transport and disposal of gaseous emissions				X	X						--	--	27	4,991
<u>HEALTH</u>														
C18 Determination of effects of gaseous emissions on oil and gas employees including:	X			X							--	--	13	2,106
O19 -- Carcinogenic potential of hydrocarbons				X							--	--	30	6,029
O20 Definition of health effects on refinery workers			X								--	--	5	935

TABLE 5-2
MAJOR ISSUES - OIL AND GAS
(continued)

ISSUE	REFERENCE SOURCES										RESEARCH PROJECTS			
	ERDA 76-1		BPP		PADs			OTA	CEQ	AES	Focused		Supportive	
	Vol 1	Vol 2	Vol 1	Impl	AES	Cmts	AAs				No. of Projects	Dollars in Thousands	No. of Projects	Dollars in Thousands
<u>HEALTH - continued</u>														
O21 Definition of physiological stresses and delayed effects on Outer Continental Shelf divers			X		X						--	--	1	70
O22 Investigation of direct combustion effects including:			X		X						--	--	12	2,105
O23 -- Contributory factors in human disease etiologies					X						--	--	5	526
O24 Development of rapid system for bio-identification					X						--	--	12	1,528
<u>ENVIRONMENT</u>														
O25 Investigation of geologic disturbance potential from fluid injection which may restrict implementation		X	X		X		X				--	--	1	35
O26 Investigation of geologic formation fracturing effects		X					X				--	--	--	--
O27 Investigation of effects of tertiary recovery on geologic structures, subsidence, and seismic activities which may restrict implementation	X		X		X						--	--	--	--
O28 Investigation of effects of noise, solid waste, heat, dissolved and suspended solids	X			X	X		X				--	--	7	1,194
O29 Determination of ground and surface water contamination effects due to development	X				X						--	--	2	138

TABLE 5-2
MAJOR ISSUES - OIL AND GAS
(continued)

I S S U E	REFERENCE SOURCES										RESEARCH PROJECTS			
	ERDA 76-1		BPP		PADs						Focused		Supportive	
	Vol 1	Vol 2	Vol 1	Impl	AES	Cmts	AAs				No. of Projects	Dollars in Thousands	No. of Projects	Dollars in Thousands
<u>ENVIRONMENT - continued</u>														
O30 Evaluation of gaseous emissions impact on aquatic and terrestrial systems	X			X	X						3	675	4	581
O31 Establishment of impact of brine runoff into surface water		X			X		X				1	214	1	140

OIL SHALE

SECTION 6

OIL SHALE

A summary of the planned FY 78 AES research which has been categorized as "Oil Shale" is presented in Table 6-1. Basically, the research programs in the FY 78 program are directed toward the health and environmental effects from the extraction/processing phases of the oil shale energy cycle. The large level of supportive research comes primarily from the applicability of Fossil-general and Coal research activities to Oil Shale issues. Only a fraction of the supportive research funding shown can be related directly to Oil Shale research needs.

The correlation of this Oil Shale research with expressed environmental issues is shown in Table 6-2.

TABLE 6-1. OIL SHALE RESEARCH SUMMARY

Subprogram	Research		Projects	
	Focused		Supportive*	
	Number of Projects	Dollars in Thousands	Number of Projects	Dollars in Thousands
Overview and Assessment	1	400	34	13,975
Health and Biological	9	1,336	77	11,992
Environmental	9	2,059	18	2,308
Physical and Technological	3	480	46	6,473
Education and Training	-	-	-	-
Environmental Control Technology	3	700	11	1,614
Safety, Standards, and Compliance	-	-	-	-
TOTAL	<u>26</u>	<u>4,975</u>	<u>186</u>	<u>36,362</u>

*These values are only fractionally applicable to this energy form.

TABLE 6-2
MAJOR ISSUES - OIL SHALE

I S S U E		REFERENCE SOURCES									RESEARCH PROJECTS				
		ERDA 76-1		BPP		PADs						Focused		Supportive	
		Vol 1	Vol 2	Vol 1	Impl	AES	Cmts	AAs				No. of Projects	Dollars in Thousands	No. of Projects	Dollars in Thousands
<u>INTEGRATED SYSTEMS ANALYSIS</u>															
L1	Definition of national, regional, and local impacts of development including	X	X	X	X	X		X	X	X		1	400	17	7,625
L2	-- Consequences of land use				X							1	400	1	100
L3	-- Economic barriers to development	X										--	--	1	100
L4	-- Community supportive services for incoming workers		X									1	400	2	275
L5	Definition of demographic patterns and collection of data to permit formulation of models of population growth				X							1	400	--	--
L6	Review of federal, state, and local policies for conflict in development	X							X			1	400	10	5,700
L7	Determination of selection criteria for optimal site specific mining and retorting			X								1	400	2	270
L8	Preparation of Environmental Development Plans					X	X					1	550	1	116
L9	Establishment of aesthetic requirements for land use and reclamation					X						1	400	1	2,000
L10	Development of predictive models for human risk due to pollutants			X								1	400	5	695

TABLE 6-2
MAJOR ISSUES - OIL SHALE
(continued)

ISSUE	REFERENCE SOURCES										RESEARCH PROJECTS			
	ERDA 76-1		BPP		PADs			OTA	CEQ	AES	Focused		Supportive	
	Vol 1	Vol 2	Vol 1	Impl	AES	Cmts	AAs				No. of Projects	Dollars in Thousands	No. of Projects	Dollars in Thousands
<u>INTEGRATED SYSTEMS ANALYSIS - continued</u>														
L10a Compilation, organization, and dissemination of data and information relative to developmental effects on the environment										X	--	--	14	1,485
L10b Inventory and data base management of oil shale RD&D projects										X	--	--	2	190
L10c Coordination of E&S activities with activities within ERDA; with other federal, state, and local agencies; with the public; and with industry										X	--	--	1	2,000
L10d Monitor, review, and coordinate environmental assessments and Environmental Impact Statements										X	--	--	1	3,000
L10e Assessment of needs of improved environmental control procedures, processes, systems, and strategies for complete fuel cycle										X	4	700	--	--
<u>PHYSICAL AND TECHNOLOGICAL</u>														
L11 Obtain qualitative and quantitative data on potential toxicants				X							6	1,330	18	4,321
L12 Accomplishment of water quality measurements	X	X		X							2	494	4	430
L13 Characterization of atmospheric emissions from demonstration plants			X	X							2	830	8	3,142

TABLE 6-2
MAJOR ISSUES - OIL SHALE
(continued)

ISSUE	REFERENCE SOURCES										RESEARCH PROJECTS			
	ERDA 76-1		BPP		PADs			OTA	CEQ	AES	Focused		Supportive	
	Vol 1	Vol 2	Vol 1	Impl	AES	Cmts	AAs				No. of Projects	Dollars in Thousands	No. of Projects	Dollars in Thousands
<u>HEALTH</u>														
L14 Definition of effects from extraction and processing	X	X	X	X	X		X	X	X		9	1,376	26	4,251
L15 -- Consideration of hazardous organic compounds (polyaromatic hydrocarbons and trace elements)	X	X		X							8	1,176	49	8,624
L16 -- Consideration of occupational hazards (polyaromatics, inorganic, and trace elements)			X								8	1,276	19	4,143
L17 -- Determination of mutagenicity of organic compounds			X	X							1	68	14	6,874
L18 Definition of effects of direct combustion of oil shale required			X								7	1,208	12	2,798
L19 -- Consideration of population exposed to sulfates, nitrates, NO _x , organic compounds, oxidants, and trace elements			X								7	988	16	3,025
L20 -- Development of early indicators of stress and damage			X								6	888	7	885
L21 -- Identification of hazardous agents			X								8	1,323	16	2,704
L22 -- Understanding of physiological processes and responses			X								8	1,056	25	3,550
L23 -- Conduct chemical and epidemiological studies			X								1	335	3	325

TABLE 6-2
MAJOR ISSUES - OIL SHALE
(continued)

I S S U E	REFERENCE SOURCES										RESEARCH PROJECTS			
	ERDA 76-1		BPP		PADs			OTA	CEQ	AES	Focused		Supportive	
	Vol 1	Vol 2	Vol 1	Impl	AES	Cmts	AAs				No. of Projects	Dollars in Thousands	No. of Projects	Dollars in Thousands
<u>ENVIRONMENT</u>														
L24 Definition of degradation of limited water resources	X	X	X	X	X		X	X	X		4	910	2	210
L25 -- Evaluation of impact of diversion of water resources from agriculture				X							1	100	--	--
L26 -- Evaluation of impact of increased salinity of water				X							2	160	--	--
L27 -- Evaluation of impact of quality of aquifers and surface waters	X		X								2	300	--	--
L28 -- Investigation of recovery and recycling of waste water	X	X									1	100	--	--
L29 Determination of impact of high quality air degradation due to pollutants, including:	X		X	X	X		X	X	X		3	1,060	3	2,354
L30 -- Consideration of emissions of particulates NO _x , SO _x , HC, CO, aldehyde				X							2	750	42	5,925
L31 Definition of land disruption due to extraction and processing, including:	X	X	X	X		X		X	X		3	850	1	2,000
L32 -- Consideration of disposal of spent shale	X	X		X				X			2	560	1	81
L33 -- Research on revegetation	X		X								1	400	--	--
L34 -- Consideration of land subsidence impact	X										--	--	--	--

TABLE 6-2
MAJOR ISSUES - OIL SHALE
(continued)

I S S U E	REFERENCE SOURCES										RESEARCH PROJECTS			
	ERDA 76-1		BPP		PADs			OTA	CEQ	AES	Focused		Supportive	
	Vol 1	Vol 2	Vol 1	Impl	AES	Cmts	AAs				No. of Projects	Dollars in Thousands	No. of Projects	Dollars in Thousands
<u>ENVIRONMENT - continued</u>														
L35 -- Investigation of productivity changes	X	X		X							1	400	--	--
L36 Definition of the effects of extraction, combustion and conversion products, and effluents					X						2	160	3	218

SECTION 7

SOLAR

A summary of the planned FY 78 AES research which has been categorized as "Solar" is presented in Table 7-1. It is evident that the major thrust of the program is in the Health and Biological area where the emphasis is on photosynthetic and biomass processes. A high level of supportive research for this technology from planned Overview and Assessment activities reflects the broad applicability of integrated assessments of environmental impacts, and social, cultural, and economic studies to be conducted on local, regional, and national levels.

The correlation of the Solar research to the major environmental issues drawn from ERDA documentation is presented in Table 7-2.

TABLE 7-1. SOLAR RESEARCH SUMMARY

Subprogram	Research Projects			
	Focused		Supportive*	
	Number of Projects	Dollars in Thousands	Number of Projects	Dollars in Thousands
Overview and Assessment	1	400	36	15,005
Health and Biological	37	3,324	24	3,203
Environmental	4	971	47	7,459
Physical and Technological	-	-	1	154
Education and Training	-	-	-	-
Environmental Control Technology	1	500	-	-
Safety, Standards, and Compliance	<u>1</u>	<u>100</u>	<u>-</u>	<u>-</u>
TOTAL	<u>44</u>	<u>5,295</u>	<u>108</u>	<u>25,821</u>

*These values are only fractionally applicable to this energy form.

TABLE 7-2
MAJOR ISSUES - SOLAR

ISSUE		REFERENCE SOURCES										RESEARCH PROJECTS			
		ERDA 76-1		BPP		PADs			OTA	CEQ	AES	Focused		Supportive	
		Vol 1	Vol 2	Vol 1	Impl	AES	Cmts	AAs				No. of Projects	Dollars in Thousands	No. of Projects	Dollars in Thousands
<u>INTEGRATED SYSTEMS ANALYSIS</u>															
S1	Definition of national, regional, and local socio-economic impact including:	X	X	X	X	X	X	X	X	X		1	400	11	2,280
S2	-- Determination of relative heating and cooling investment	X	X		X							--	--	--	--
S3	-- Population trends to large facilities		X									--	--	--	--
S4	-- Radio and TV interference		X		X							--	--	--	--
S5	-- Large land requirements		X		X							--	--	--	--
S6	Implementation of program for end user education and information dissemination	X						X				1	100	16	1,935
S7	Implementation of planning for land use and associated regulations	X	X	X				X		X		1	400	1	2,000
S8	Definition of air, sun, and sea rights	X	X									--	--	--	--
S9	Evaluation of impact of building codes and measurement standards	X	X						X	X		--	--	10	5,700
S10	Ensure availability of pertinent data to industry		X						X	X		1	100	2	450
S11	Definition of impact of development on aesthetics	X	X		X					X		1	400	1	254
S12	Assessment of impact of commercialism upon development	X	X					X	X			1	400	--	--

TABLE 7-2
MAJOR ISSUES - SOLAR
(continued)

ISSUE	REFERENCE SOURCES										RESEARCH PROJECTS			
	ERDA 76-1		BPP		PADs			OTA	CEQ	AES	Focused		Supportive	
	Vol 1	Vol 2	Vol 1	Impl	AES	Cmts	AAs				No. of Projects	Dollars in Thousands	No. of Projects	Dollars in Thousands
<u>INTEGRATED SYSTEMS ANALYSIS - continued</u>														
S13 Definition of selection criteria for land use			X	X							1	400	2	2,055
S13a Inventory and data base management of solar RD&D activities										X	--	--	3	300
S13b Coordination of environment and safety activities within ERDA; with other federal, state, and local agencies; with the public; and with industry										X	--	--	1	2,000
S13c Monitoring, review, and coordination of environmental assessments and environmental impact statements										X	--	--	1	3,000
<u>PHYSICAL AND TECHNOLOGICAL</u>														
S14 Definition of impact of release of toxic materials including:		X	X	X	X			X	X		2	900	26	4,807
S15 -- Quantification of residuals, movement, and physical/chemical transformation			X	X							1	500	11	1,665
S16 Definition of climatological alterations including:		X	X	X	X			X			1	400	--	--
S17 -- Baseline climatological descriptions; and effects due to radiation and evaporation alterations			X	X							--	--	1	60

TABLE 7-2
MAJOR ISSUES - SOLAR
(continued)

ISSUE	REFERENCE SOURCES										RESEARCH PROJECTS				
	ERDA 76-1		BPP		PADs			OTA	CEQ	AES	Focused		Supportive		
	Vol 1	Vol 2	Vol 1	Impl	AES	Cmts	AAs				No. of Projects	Dollars in Thousands	No. of Projects	Dollars in Thousands	
<u>HEALTH</u>															
S18 Definition of the impact of the release of toxic effluents on health for:		X	X	X	X					X		1	400	12	2,485
S19 -- Bioconversion (organic compounds, sulfates, NO _x , trace elements, pesticides)		X	X	X								--	--	46	6,758
S20 -- Photovoltaic (Cd, Si)		X	X	X								--	--	2	490
S21 -- Dose-effect of short and long term acute and chronic exposure on humans and animals			X	X								--	--	3	515
S22 Evaluation of impact of unprocessed wastes from biomass		X	X	X								--	--	4	1,026
<u>ENVIRONMENT</u>															
S23 Definition of impact of toxic material release for:		X	X	X	X							1	400	7	1,602
S24 -- Biomass (organic compounds, sulfates, NO _x , pathogens)		X	X	X								--	--	17	5,180
S25 -- Photovoltaic (Cd, Si, propane, eutectic salts)		X	X	X	X							--	--	--	--
S25 -- Adverse ecological effect			X	X								--	--	10	2,035

TABLE 7-2
MAJOR ISSUES - SOLAR
(continued)

I S S U E	REFERENCE SOURCES										RESEARCH PROJECTS				
	ERDA 76-1		BPP		PADs			OTA	CEQ	AES	Focused		Supportive		
	Vol 1	Vol 2	Vol 1	Impl	AES	Cmts	AAs				No. of Projects	Dollars in Thousands	No. of Projects	Dollars in Thousands	
<u>ENVIRONMENT - continued</u>															
S27	Definition of impact of potential climate alterations caused by albedo/wind disturbances, local heat rejection, energy balance, combustion, pyrolysis, and soil runoff including:			X	X	X	X		X			--	--	2	200
S23	-- Impact on local biota				X	X						--	--	12	2,553
S29	Definition of impact of developments on aquatic and terrestrial biota for:		X		X	X	X					--	--	9	3,575
S30	-- Biomass (organic compounds, sulfates, pesticides, pathogens)				X	X						--	--	6	2,981
S31	-- Photovoltaic (Cd, Si, propane, eutectic salts)		X		X	X						--	--	--	--
S32	Evaluation of biomass waste disposal techniques		X		X	X	X					--	--	1	40
S33	Assurance of long-term productivity of tree farming including:							X	X			4	971	1	40
S34	-- Resin production								X			1	214	1	40
S35	Investigations of basic photosynthesis processes for biomass		X				X		X			37	4,290	7	949
S36	Determination of impact of wind energy disturbances on wild life and bird population					X						--	--	--	--

SECTION 8

GEOHERMAL

A summary of the planned FY 78 AES research program which has been categorized as "Geothermal" is presented in Table 8-1. It is evident that approximately 40 percent of the focused research program is in the environmental effects area which emphasizes the ecological impact of the energy development. In the supportive projects, the major support is from Overview and Assessment where investigations of such areas as determination of methods for socioeconomic impact assessment and strategies for managing socioeconomic impacts are applicable to geothermal issues.

A correlation of the planned Geothermal projects with environmental issues is presented in Table 8-2.

TABLE 8-1. GEOTHERMAL RESEARCH SUMMARY

Subprogram	Research		Projects	
	Focused		Supportive*	
	Number of Projects	Dollars in Thousands	Number of Projects	Dollars in Thousands
Overview and Assessment	4	632	34	14,015
Health and Biological	3	340	12	1,695
Environmental	9	2,114	1	130
Physical and Technological	3	1,660	34	4,925
Education and Training	-	-	-	-
Environmental Control Technology	2	500	-	-
Safety, Standards, and Compliance	<u>1</u>	<u>125</u>	<u>-</u>	<u>-</u>
TOTAL	<u>22</u>	<u>5,371</u>	<u>81</u>	<u>20,765</u>

*These values are only fractionally applicable to this energy form.

TABLE 8-2
MAJOR ISSUES - GEOTHERMAL

ISSUE		REFERENCE SOURCES										RESEARCH PROJECTS			
		ERDA 76-1		BPP		PADs			OTA	CEQ	AES	Focused		Supportive	
		Vol 1	Vol 2	Vol 1	Impl	AES	Cmts	AAs				No. of Projects	Dollars in Thousands	No. of Projects	Dollars in Thousands
<u>INTEGRATED SYSTEMS ANALYSIS</u>															
G1	Evaluation of physical and social constraints to geothermal developments		X						X			3	607	7	1,485
G2	Modification of EIS requirements and federal and state policies to stimulate exploration		X					X	X			--	--	--	--
G3	Definition of analysis and assessment methodologies and site selection criteria		X				X		X			2	507	2	2,125
G4	Establishment of uniformity between federal, state, and local regulations		X					X				--	--	10	5,725
G5	Establishment and coordination of E&S standards and guidelines including:	X	X				X					--	--	14	6,130
G6	-- Consideration of impact analysis							X				--	--	2	555
G7	-- Consideration of occupational safety				X	X						--	--	5	775
G8	-- Consideration of Clean Air and Water Quality Act compliance				X	X						--	--	1	80
G9	-- Consideration of accident prevention				X							--	--	3	345
G10	Conduct baseline and operational measurements of gases and trace element emissions				X							--	--	3	2,140
G11	Conduct baseline measurements at potential sites	X			X							3	1,545	3	2,190

TABLE 8-2
MAJOR ISSUES - GEOTHERMAL
(continued)

I S S U E	REFERENCE SOURCES										RESEARCH PROJECTS			
	ERDA 76-1		BPP		PADs			OTA	CEQ	AES	Focused		Supportive	
	Vol 1	Vol 2	Vol 1	Impl	AES	Cmts	AAs				No. of Projects	Dollars in Thousands	No. of Projects	Dollars in Thousands
<u>INTEGRATED SYSTEMS ANALYSIS - continued</u>														
G11a Establish capabilities for data base management and coordination										X	--	--	2	190
G11b Compilation, organization, and dissemination of information relative to geothermal energy and its impact on the environment										X	--	--	19	2,312
G11c Coordination of environment and safety activities within ERDA; with other federal, state, and local agencies; with the public, and with industry										X	--	--	1	2,000
G11d Monitoring, review, and coordination of environmental assessments and environmental impact statements										X	--	--	1	3,000
<u>PHYSICAL AND TECHNOLOGICAL</u>														
G12 Prediction of atmospheric and hydrologic pollutants transport				X							--	--	2	365
G12a Consideration of the chemical transformation of effluents										X	--	--	--	--
<u>HEALTH</u>														
G13 Definition of impact of non-condensable gases and trace elements				X	X						2	200	13	1,857

TABLE 8-2
MAJOR ISSUES - GEOTHERMAL
(continued)

ISSUE	REFERENCE SOURCES										RESEARCH PROJECTS			
	ERDA 76-1		BPP		PADs			OTA	CEQ	AES	Focused		Supportive	
	Vol 1	Vol 2	Vol 1	Impl	AES	Cmts	AAs				No. of Projects	Dollars in Thousands	No. of Projects	Dollars in Thousands
<u>HEALTH - continued</u>														
G14 Conduct clinical studies for morbidity and mortality trends				X							--	--	1	60
G15 Conduct animal dose studies for coupling with clinical results				X	X						1	125	1	250
G16 Investigation of biological effects which are major unknowns, (but appear few and controllable)		X			X						--	--	2	71
<u>ENVIRONMENT</u>														
G17 Determination of pollutant effects on water quantity and quality		X		X				X	X		5	1,018	2	2,080
G18 Consideration of effects of noise on environment					X						2	160	--	--
G19 Assessment of the impact of release of noxious gases (H ₂ S, in particular)		X		X	X		X				1	133	3	414
G20 Assessment of effects on flora and fauna		X		X							2	1,226	2	2,094
G21 Consideration of transport and disposal of brine water and salt spray	X			X	X						1	90	2	2,100
G22 Collection of data required to predict subsidence rates and seismic activities	X	X			X		X	X			3	1,371	--	--
G23 Analyze and measure potential effects of water injection	X										1	154	--	--

TABLE 8-2
MAJOR ISSUES - GEOTHERMAL
(continued)

I S S U E	REFERENCE SOURCES										RESEARCH PROJECTS			
	ERDA 76-1		BPP		PADs			OTA	CEQ	AES	Focused		Supportive	
	Vol 1	Vol 2	Vol 1	Impl	AES	Cmts	AAs				No. of Projects	Dollars in Thousands	No. of Projects	Dollars in Thousands
<u>ENVIRONMENT - continued</u>														
G24 Conduct measurements at pilot plants				X							7	2,229	1	2,000
G25 Accomplish evaluation of characteristics of high temperature and high salinity					X						1	1,010	1	2,000
G26 Development of environmental control technology	X	X					X				2	500	--	--
G27 -- Consideration of types of controls and treatment							X	X			2	500	1	125
G28 -- Consideration of emissions (H ₂ S, in particular) and subsidence	X		X		X	X					--	--	29	3,987
G29 -- Consideration of brine water			X						X		--	--	1	60
G30 -- Investigation of cost effectiveness vs energy development									X		--	--	1	510

SECTION 9

HYDROELECTRIC

A summary of the planned FY 78 AES research projects which have been categorized as "Hydroelectric" is presented in Table 9-1. The planned funding for Overview and Assessment is intended for integrated analyses and overview of environmental studies within ERDA, including socioeconomic impacts. In the Health and Environmental area the programs concern themselves with health effects of reservoirs and ecological impact on rivers.

The correlation of the Hydroelectric research to the major environmental issues drawn from ERDA documentation is presented in Table 9-2.

TABLE 9-1. HYDROELECTRIC RESEARCH SUMMARY

Subprogram	Research		Projects	
	Focused		Supportive*	
	Number of Projects	Dollars in Thousands	Number of Projects	Dollars in Thousands
Overview and Assessment	1	1,000	34	14,010
Health and Biological	1	86	-	-
Environmental	1	87	-	-
Physical and Technological	-	-	-	-
Education and Training	-	-	-	-
Environmental Control Technology	-	-	-	-
Safety, Standards, and Compliance	-	-	-	-
TOTAL	<u>3</u>	<u>1,173</u>	<u>34</u>	<u>14,010</u>

*These values are only fractionally applicable to this energy form.

TABLE 9-2
MAJOR ISSUES - HYDROELECTRIC

I S S U E	REFERENCE SOURCES										RESEARCH PROJECTS			
	ERDA 76-1		BPP		PADs			OTA	CEQ	AES	Focused		Supportive	
	Vol 1	Vol 2	Vol 1	Impl	AES	Cmts	AAs				No. of Projects	Dollars in Thousands	No. of Projects	Dollars in Thousands
<u>INTEGRATED SYSTEMS ANALYSIS</u>														
H1 Integrated analyses of environmental impacts and accomplishment of associated risk, benefit assessment, including social and institutional constraints										X	1	1,000	34	14,010
<u>HEALTH</u>														
H2 Assessment of health impact of proposed hydroelectric reservoirs										X	1	86	--	--
<u>ENVIRONMENT</u>														
H3 Assessment of effect of hydroelectric generation on riverine ecology										X	1	87	--	--

SECTION 10

CONSERVATION

A summary of the planned FY 78 AES research which has been categorized as "Conservation" is presented in Table 10-1. It is to be noted that the major emphasis of the program is in the Environmental Control Technology and Physical and Technological areas. The reduced level of Conservation focused research shown here compared with that presented in other AES budget summaries results from the separate break out of Hydroelectric research and the inclusion in Solar of biomass work previously assigned to Conservation.

The correlation of the Conservation research to the major environmental issues drawn from ERDA documentation is presented in Table 10-2.

TABLE 10-1. CONSERVATION RESEARCH SUMMARY

Subprogram	Research Projects			
	Focused		Supportive*	
	Number of Projects	Dollars in Thousands	Number of Projects	Dollars in Thousands
Overview and Assessment	1	471	35	15,010
Health and Biological	-	-	20	2,944
Environmental	1	50	25	4,348
Physical and Technological	3	723	35	5,055
Education and Training	-	-	-	-
Environmental Control Technology	5	626	-	-
Safety, Standards, and Compliance	-	-	-	-
TOTAL	<u>10</u>	<u>1,870</u>	<u>115</u>	<u>27,357</u>

*These values are only fractionally applicable to this energy form.

TABLE 10-2
MAJOR ISSUES - CONSERVATION

I S S U E	REFERENCE SOURCES										RESEARCH PROJECTS			
	ERDA 76-1		BPP		PADs			OTA	CEQ	AES	Focused		Supportive	
	Vol 1	Vol 2	Vol 1	Impl	AES	Cmts	AAs				No. of Projects	Dollars in Thousands	No. of Projects	Dollars in Thousands
<u>INTEGRATED SYSTEMS ANALYSIS</u>														
V1 Definition of the national, regional, and local socioeconomic impact of development including	X	X	X	X	X	X	X	X	X		1	471	9	2,950
V2 -- Capital availability to support higher risk and higher cost demonstrations aimed at commercialization- end use and electric	X	X									--	--	--	--
V3 -- Public acceptance of life cycle costs rather than initial cost - end use.	X	X									1	471	--	--
V4 -- Market penetration which may be impeded by environmental, human health, and safety conditions	X										1	471	1	50
V5 -- Life style which may be affected by reduced gasoline consumption	X										1	471	--	--
V6 Investigation of new standards and regulations which may deter vendors - end use and electricity storage	X	X	X								--	--	--	--
V7 Definition of special facilities and modifications to local permits and labor practices required for stored energy vehicles		X									--	--	1	50
V8 Definition of impact on band requirements due to high voltage overhead transmission lines		X									1	75	--	--

TABLE 10-2
MAJOR ISSUES - CONSERVATION
(continued)

I S S U E	REFERENCE SOURCES										RESEARCH PROJECTS			
	ERDA 76-1		BPP		PADs			OTA	CEQ	AES	Focused		Supportive	
	Vol 1	Vol 2	Vol 1	Impl	AES	Cmts	AAs				No. of Projects	Dollars in Thousands	No. of Projects	Dollars in Thousands
<u>INTEGRATED SYSTEMS ANALYSIS - continued</u>														
V9 Definition of impact of pollution control standards for end user utilization.		X									--	--	1	80
V9a Definition and standardization of conservation criteria and regulations										X	4	500	9	5,600
V9b Compilation, organization, and dissemination of information relative to energy conservation and its impact on the environment										X	--	--	14	1,485
V9c Inventory and data base management for conservation RD&D activities										X	--	--	2	190
V9d Coordination of environment and safety activities within ERDA; with other federal, state, and local agencies; with the public; and with industry										X	--	--	1	2,000
V9e Monitoring, review, and coordination of environmental assessments and environmental impact statements										X	--	--	1	3,000
<u>PHYSICAL AND TECHNOLOGICAL</u>														
V10 Definition of hazards resulting from the combustion and conversion of urban waste	X	X	X	X	X						3	723	7	1,099

TABLE 10-2
MAJOR ISSUES - CONSERVATION
(continued)

I S S U E	REFERENCE SOURCES										RESEARCH PROJECTS			
	ERDA 76-1		BPP		PADs			OTA	CEQ	AES	Focused		Supportive	
	Vol 1	Vol 2	Vol 1	Impl	AES	Cmts	AAs				No. of Projects	Dollars in Thousands	No. of Projects	Dollars in Thousands
<u>PHYSICAL AND TECHNOLOGICAL - continued</u>														
V11 -- Quantification of emissions and waste pollutants			X	X							3	723	43	8,648
V12 -- Development of models of potential pollutants (SO _x , NO _x , particulates) movement and fate			X	X							--	--	16	4,332
<u>HEALTH</u>														
V13 Definition of health hazards from the combustion and conversion of urban waste (toxic emissions and pathogens) including:			X	X	X						--	--	14	2,448
V14 -- Screening for biological activity			X	X							--	--	9	2,779
V15 -- Determination of impact on population			X	X							--	--	2	150
V16 Consideration of impact of reduced air flow in buildings including:	X	X	X	X	X						1	500	1	75
V17 -- Increased exposure to toxic agents (carbons, pyrolysis, aerosols, CO ₂ , toxic fibers from insulation materials)	X		X	X							--	--	2	135
V18 -- Increased exposure to communicable diseases (viruses)			X	X							--	--	1	75
V19 Definition of transport and control of emissions (SO _x)	X	X							X		1	500	--	--

TABLE 10-2
MAJOR ISSUES - CONSERVATION
(continued)

ISSUE	REFERENCE SOURCES										RESEARCH PROJECTS			
	ERDA 76-1		BPP		PADs						Focused		Supportive	
	Vol 1	Vol 2	Vol 1	Impl	AES	Cmts	AAs	OTA	CEQ	AES	No. of Projects	Dollars in Thousands	No. of Projects	Dollars in Thousands
<u>HEALTH - continued</u>														
V20 Definition of impact of high voltage transmission effects including:		X			X						--	--	1	125
V21 -- Impact on brain waves and blood forming processes		X									--	--	--	--
<u>ENVIRONMENT</u>														
V22 Definition of hazards from combustion and conversion of urban waste including		X	X	X	X						1	50	4	255
V23 -- Effects on terrestrial ecosystems (biological activity)		X	X	X							1	50	2	2,094
V24 Determination of impact of exotic technologies and fuels including	X	X			X			X			--	--	1	2,000
V25 -- Evaluation of high temperature combustion emissions (NO _x)	X										--	--	1	80
V26 -- Evaluation of high temperature waste water	X										--	--	1	2,000
V27 -- Evaluation of increased material deterioration	X										--	--	--	--
V28 Consideration of possible ecological unbalances resulting from nutrient management techniques			X								1	50	5	1,287

TABLE 10-2
MAJOR ISSUES - CONSERVATION
(continued)

I S S U E	REFERENCE SOURCES										RESEARCH PROJECTS			
	ERDA 76-1		BPP		PADs			OTA	CEQ	AES	Focused		Supportive	
	Vol 1	Vol 2	Vol 1	Impl	AES	Cmts	AAs				No. of Projects	Dollars in Thousands	No. of Projects	Dollars in Thousands
<u>ENVIRONMENT - continued</u>														
V29 Definition of biological effects of high voltage transmission lines		X		X							--	--	--	--
V30 Consideration of the transport and storage of high energy fuels				X							--	--	1	126

SECTION 11

FISSION

A summary of the planned FY 78 AES research, which has been categorized as "Fission" is presented in Table 11-1. The major thrust of the planned Fission program is directed toward the Health and Biological and the Environmental Control Technology areas. Note that approximately 72 percent of the overall program is oriented toward these two areas. A major portion of the Health and Biological projects concern animal experiments and the impact of radiation.

As also indicated in Table 11-1, the major portion of supportive research falls into the Overview and Assessment, Health and Biological, and Environmental projects.

The correlation of the planned Fission research to the environmental issues drawn from ERDA documentation is shown in Table 11-2.

TABLE 11-1. FISSION RESEARCH SUMMARY

Subprogram	Research		Projects	
	Focused		Supportive*	
	Number of Projects	Dollars in Thousands	Number of Projects	Dollars in Thousands
Overview and Assessment	5	905	37	15,170
Health and Biological	162	38,599	61	10,860
Environmental	82	12,057	108	14,814
Physical and Technological	49	7,075	15	1,962
Education and Training	6	1,320	-	-
Environmental Control Technology	46	24,260	11	1,614
Safety, Standards, and Compliance	<u>15</u>	<u>2,725</u>	<u>19</u>	<u>2,180</u>
TOTAL	<u>365</u>	<u>86,941</u>	<u>251</u>	<u>46,600</u>

*These values are only fractionally applicable to this energy form.

TABLE 11-2
MAJOR ISSUES - FISSION

I S S U E	REFERENCE SOURCES										RESEARCH PROJECTS			
	ERDA 76-1		BPP		PADs			OTA	CEQ	AES	Focused		Supportive	
	Vol 1	Vol 2	Vol 1	Impl	AES	Cmts	AAs				No. of Projects	Dollars in Thousands	No. of Projects	Dollars in Thousands
<u>INTEGRATED SYSTEMS ANALYSIS</u>														
F1 Definition of criteria, regulations, and standards including:								X			7	1,135	16	7,210
F2 -- Determination of adequacy of current radiation protection standards for plutonium and other transuranics								X			61	24,181	9	1,464
F3 -- Standardization of regulations and "standards" needed among states on such subjects as:		X						X			--	--	1	160
F4 • Allowable nuclide release, cooling water uptake, temperature increase, discharges to streams		X									2	455	2	2,100
F5 -- Development of criteria for waste forms and packaging	X	X									1	140	2	225
F6 -- Development of LMFBR plant safety standards and regulations (acceptable to public and various regulatory agencies)		X					X				2	550	4	444
F7 Development and experimental verification of probabilistic models of fuel cycle processing accidents		X					X				10	2,542	5	544
F8 Accomplishment of economic-engineering studies on most cost effective ways to improve plant safety							X				6	1,957	4	305

TABLE 11-2
MAJOR ISSUES - FISSION
(continued)

I S S U E		REFERENCE SOURCES									RESEARCH PROJECTS				
		ERDA 76-1		BPP		PADs			OTA	CEQ	AES	Focused		Supportive	
		Vol 1	Vol 2	Vol 1	Impl	AES	Cmts	AAs				No. of Projects	Dollars in Thousands	No. of Projects	Dollars in Thousands
<u>INTEGRATED SYSTEMS ANALYSIS - continued</u>															
F9	Determination of public perceptions vs actual safety, health, and environmental impacts			X	X			X				7	1,215	10	3,385
F10	Determination of EIS background data for nuclear ships and offshore sites		X									7	1,353	30	7,158
F11	Development of a central data source to provide fission technology programs with current, balanced information on environmental and health impacts		X									30	12,338	18	2,316
F12	Quantification of impacts of radioisotope releases (accidental or chronic) considering:		X		X				X			42	7,017	40	8,419
F13	-- Disposition and resuspension of particles		X		X				X			16	2,453	13	4,307
F14	-- Food web analyses		X		X				X			28	3,571	46	7,133
F15	-- Inhalation studies		X		X				X			23	9,264	3	340
F16	-- Organ burdens vs effects		X		X				X			37	12,041	--	--
F17	-- Rates of movement - pathways		X		X				X			29	5,637	56	12,798
F18	-- Chemical transformations and zones of accumulation		X		X				X			24	3,523	28	4,003
F19	Determination of reprocessing facility radionuclide releases needed								X			--	--	3	2,584

TABLE 11-2
MAJOR ISSUES - FISSION
(continued)

ISSUE	REFERENCE SOURCES										RESEARCH PROJECTS			
	ERDA 76-1		BPP		PADs			OTA	CEQ	AES	Focused		Supportive	
	Vol 1	Vol 2	Vol 1	Impl	AES	Cmts	AAs				No. of Projects	Dollars in Thousands	No. of Projects	Dollars in Thousands
<u>INTEGRATED SYSTEMS ANALYSIS - continued</u>														
F19a Inventory and data base management for fission RD&D projects										X	--	--	2	190
F19b Definition of the national, regional, and local socio-economic impacts of development of fission energy										X	--	--	2	555
F19c Coordination of environmental and safety activities within ERDA; with other federal, state, and local agencies; with the public; and with industry										X	--	--	1	2,000
F19d Monitoring, review, and coordination of environmental assessments and Environmental Impact Statements										X	--	--	1	3,000
F19e Assessment of safety, ecology, and economic benefits of multi-use transport systems										X	3	395	--	--
F19f Evaluation of criteria for transportation systems and assessment of risks										X	2	230	--	--
F19g Testing of full scale transport vehicles and large shipping casks										X	2	720	--	--
F19h Development of standards, guides, exhibits, and films for design, test, and operation of transport systems										X	4	415	--	--

TABLE 11-2
MAJOR ISSUES - FISSION
(continued)

I S S U E	REFERENCE SOURCES										RESEARCH PROJECTS			
	ERDA 76-1		BPP		PADs						Focused		Supportive	
	Vol 1	Vol 2	Vol 1	Impl	AES	Cmts	AAs				No. of Projects	Dollars in Thousands	No. of Projects	Dollars in Thousands
<u>PHYSICAL AND TECHNOLOGICAL</u>														
F20 Development of monitoring systems for internal and external radiation exposure				X	X						20	2,783	3	2,300
F21 Establish relationship of current measurement technology to ERDA safety activities		X					X				7	581	4	2,420
F22 -- Development of advanced instruments for current and advanced energy technologies		X					X				13	1,200	4	2,655
F23 Development of on-line monitoring systems for detection and location of fuel and steam generator leaks			X								--	--	--	--
F24 Development of safety procedures and technology associated with decommissioning, decontamination of fission fuel cycle facilities		X					X				36	19,600	8	4,300
F25 Development of the measurement and interpretation capability to predict transport of radionuclides into and within hydrologic systems		X		X							16	2,258	17	5,899
F26 Development of fully remote methods and tools for replacement and repair of radiation contaminated equipment		X									--	--	--	--
F26a Development of methods and procedures to reduce accidental or chronic releases of radioactive materials										X	1	100	--	--

TABLE 11-2
MAJOR ISSUES - FISSION
(continued)

ISSUE	REFERENCE SOURCES										RESEARCH PROJECTS			
	ERDA 76-1		BPP		PADs						Focused		Supportive	
	Vol 1	Vol 2	Vol 1	Impl	AES	Cmts	AA's	OTA	CEQ	AES	No. of Projects	Dollars in Thousands	No. of Projects	Dollars in Thousands
<u>HEALTH</u>														
F27 Development and validation of rapid biological and automated cytochemical screening techniques to identify hazardous radiation conditions and agents		X									9	918	7	1,205
F28 Development of early indicators of fission damage to human populations		X									7	1,050	11	1,963
F29 Investigation of radiation impact on plutonium worker epidemiology			X								20	8,793	3	690
F30 Identification of human sub-populations' susceptibility to radiation damage		X									20	8,783	8	1,701
F31 Clarification of human dose-response relationship for low level radiation exposure				X	X	X					72	28,576	11	3,900
F32 Accumulation of data on human organ radionuclide burdens vs effects		X	X	X							13	1,846	29	4,007
F33 Accomplishment of basic research on mechanisms of radiation damage and repair including		X	X		X						30	3,715	19	2,697
F34 -- Extrapolation of dose-effects relations from model systems to man					X						65	19,096	17	3,691
F35 Definition of methodology on entire problem of extrapolation of animal data to man		X		X	X						56	17,968	10	1,542

TABLE 11-2
MAJOR ISSUES - FISSION
(continued)

I S S U E	REFERENCE SOURCES										RESEARCH PROJECTS			
	ERDA 76-1		BPP		PADs			OTA	CEQ	AES	Focused		Supportive	
	Vol 1	Vol 2	Vol 1	Impl	AES	Cmts	AAs				No. of Projects	Dollars in Thousands	No. of Projects	Dollars in Thousands
<u>HEALTH - continued</u>														
F36 Accomplishment of basic research on radiation interaction with living cells		X						X			21	2,476	33	5,122
F36a Investigation of combating detrimental effects of internal emitters and heavy metals										X	--	--	--	--
<u>ENVIRONMENT</u>														
F37 Definition of high level and low level waste disposal impacts including:	X	X		X							26	3,394	17	1,796
F38 -- Less soluble, more monolithic (safer) waste forms	X	X		X							3	249	2	1,042
F39 -- Complete geologic studies of deep-stable formations for waste disposal sites - location, quantity, stability	X			X							1	140	1	100
F40 -- Reduction of measurement uncertainties of low concentration, high volume waste streams		X									1	140	3	195
F41 -- Development of methods and procedures for handling high level wastes							X				4	4,065	--	--
F42 Definition of LMFBR co-location (Nuclear Park) siting problems including:								X			--	--	1	85
F43 -- Seismic problems, all sites		X						X			1	120	3	300

TABLE 11-2
MAJOR ISSUES - FISSION
(continued)

ISSUE	REFERENCE SOURCES										RESEARCH PROJECTS			
	ERDA 76-1		BPP		PADs			OTA	CEQ	AES	Focused		Supportive	
	Vol 1	Vol 2	Vol 1	Impl	AES	Cmts	AAs				No. of Projects	Dollars in Thousands	No. of Projects	Dollars in Thousands
<u>ENVIRONMENT - continued</u>														
F44 Restoration procedures for land contaminated by plutonium must be assessed								X			9	1,481	6	630
F45 Impact of wet or dry cooling towers on environment		X	X	X							1	300	4	355
F46 Accumulation of data for evaluation of environmental (and particularly hydrologic) impacts of thermal and nuclide discharges from nuclear plants including:		X		X	X						36	4,071	43	7,438
F47 -- Both accidental and chronic discharges				X							9	1,431	12	3,055
F48 Investigations of post accident heat removal		X									--	--	--	--
F49 Accomplishment of basic research of radiation effects on plants including		X		X							1	35	--	--
F50 -- Control of adverse impacts of radiation on ecology		X									3	717	3	183
F51 -- Development of plant cell and tissue culture assays for investigation of potential mutagens and carcinogens		X									--	--	--	--
F52 Development of methods and procedures to mitigate harmful effects of accidental or chronic radiation releases				X				X			2	1,157	8	4,245
F53 Categorization of chemical and physical forms in natural systems										X	14	1,764	2	163

TABLE 11-2
MAJOR ISSUES - FISSION
(continued)

I S S U E	REFERENCE SOURCES										RESEARCH PROJECTS			
	ERDA 76-1		BPP		PADs			OTA	CEQ	AES	Focused		Supportive	
	Vol 1	Vol 2	Vol 1	Impl	AES	Cmts	AAs				No. of Projects	Dollars in Thousands	No. of Projects	Dollars in Thousands
<u>ENVIRONMENT - continued</u>														
F54 Definition of transportation of nuclides through systems (watersheds) and plant uptake from soil										X	27	3,913	14	1,320
F55 Investigations of baseline and natural radiation environment										X	1	159	--	--

SECTION 12

FUSION

A summary of the planned FY 78 AES research which has been categorized as "Fusion" is presented in Table 12-1. The magnitude of the "focused" research funds when compared to other energy forms is low. This is attributed to: 1) the fact that fusion energy development is in an early stage and potential environmental impacts are yet to be defined and 2) considerable elementary research applicable to Fusion is also applicable to Fission and has been or will be conducted as Fission focused research. The large level of supportive research shown in Table 12-1 reflects the applicability to Fusion issues of a significant fraction of the planned Fission research.

The correlation of the planned Fusion related research with the environmental issues expressed in ERDA documentation is shown in Table 12-2.

TABLE 12-1. FUSION RESEARCH SUMMARY

Subprogram	Research		Projects	
	Focused		Supportive*	
	Number of Projects	Dollars in Thousands	Number of Projects	Dollars in Thousands
Overview and Assessment	1	80	34	14,875
Health and Biological	6	703	21	4,209
Environmental	6	575	3	440
Physical and Technological	1	100	-	-
Education and Training	-	-	-	-
Environmental Control Technology	-	-	11	1,614
Safety, Standards, and Compliance	<u>1</u>	<u>100</u>	<u>3</u>	<u>145</u>
TOTAL	<u>15</u>	<u>1,558</u>	<u>72</u>	<u>21,283</u>

*These values are only fractionally applicable to this energy form.

TABLE 12-2
MAJOR ISSUES - FUSION

I S S U E	REFERENCE SOURCES										RESEARCH PROJECTS			
	ERDA 76-1		BPP		PADs			OTA	CEQ	AES	Focused		Supportive	
	Vol 1	Vol 2	Vol 1	Impl	AES	Cmts	AAs				No. of Projects	Dollars in Thousands	No. of Projects	Dollars in Thousands
<u>INTEGRATED SYSTEMS ANALYSIS</u>														
U1 Definition of environmental advantages and economic potential						X					1	80	6	2,730
U2 Coordination of E&S plant standards and guidelines including:					X	X					--	--	17	6,145
U3 -- Occupational safety					X	X					2	180	7	665
U4 -- Accident prevention					X	X					--	--	3	170
U5 -- Clean Air and Water Quality Act compliance					X						--	--	1	2,000
U6 Dissemination of information to transportation offices concerning operational aspects including:					X						--	--	17	2,790
U7 -- Transportation functions					X						--	--	--	--
U8 -- Risk assessments					X						1	80	2	265
U8a Compilation, organization, and dissemination of information relative to fusion energy and its impact on the environment					X						--	--	14	1,485
U8b Inventory and data base management for fusion RD&D activities					X						--	--	2	190
U8c Definition of the national, regional, and local socioeconomic impact of development of fusion energy					X						--	--	--	--

TABLE 12-2
MAJOR ISSUES - FUSION
(continued)

I S S U E	REFERENCE SOURCES										RESEARCH PROJECTS			
	ERDA 76-1		BPP		PADs			OTA	CEQ	AES	Fccused		Supportive	
	Vol 1	Vol 2	Vol 1	Impl	AES	Cmts	AAs				No. of Projects	Dollars in Thousands	No. of Projects	Dollars in Thousands
<u>INTEGRATED SYSTEMS ANALYSIS - continued</u>														
U8d Coordination of environment and safety activities within ERDA; with other federal, state, and local agencies; with the public; and with industry										X	--	--	1	2,000
U8e Monitoring, review, and coordination of environmental assessments and Environmental Impact Statements										X	--	--	1	3,000
<u>PHYSICAL AND TECHNOLOGICAL</u>														
U9 Investigations of safety technology including:		X									1	100	3	170
U10 -- Completion of safety analysis reports for tritium handling		X									--	--	--	--
U11 -- Development of research program on particulate and gaseous containment and cleanup		X									--	--	--	--
U12 Definition of surplus contaminated facilities management procedures					X						--	--	5	2,550
U13 Examination of public safety requirements		X									--	--	3	500

TABLE 12-2
MAJOR ISSUES - FUSION
(continued)

ISSUE	REFERENCE SOURCES										RESEARCH PROJECTS			
	ERDA 76-1		BPP		PADs			OTA	CEQ	AES	Focused		Supportive	
	Vol 1	Vol 2	Vol 1	Impl	AES	Cmts	AA's				No. of Projects	Dollars in Thousands	No. of Projects	Dollars in Thousands
<u>HEALTH</u>														
U14			X								2	385	--	--
U15					X						5	670	4	1,125
U16					X						5	670	16	3,089
U17					X						7	730	18	3,224
<u>ENVIRONMENT</u>														
U18	X										--	--	--	--
U19	X										--	--	1	100
U20			X								3	304	2	159
U21					X						3	60	4	330
U22					X						--	--	3	440

TABLE 12-2
MAJOR ISSUES - FUSION
(continued)

I S S U E	REFERENCE SOURCES										RESEARCH PROJECTS			
	ERDA 76-1		BPP		PADs			OTA	CEQ	AES	Focused		Supportive	
	Vol 1	Vol 2	Vol 1	Impl	AES	Cmts	AAs				No. of Projects	Dollars in Thousands	No. of Projects	Dollars in Thousands
<u>ENVIRONMENT - continued</u>														
U23 Assessment of radiation interaction with biological systems					X						4	65	2	120
U24 Evaluation of effects of vibration which could produce ecological disturbances			X								--	--	--	--
U25 Development of control technology for laser fusion		X									--	--	--	--
U26 Development of control technology for tritium releases (either chronic or accidental)			X								2	185	3	2,185
U27 Assessment of the impact of beryllium and its fluoride released from designs using molten salts			X								1	70	1	70

SECTION 13

MULTI-TECHNOLOGY

Planned research having applicability to several energy technologies and without focus on a specific technology has been classified as "Multi-technology". As shown in Table 13-1 the Overview and Assessment activities which include environmental data integration; policy analysis; social, cultural, and economic impacts at local, regional, and national levels are highly Multi-technology oriented and make-up the largest fraction of the planned Multi-technology budget. A substantial level of Multi-technology oriented health and environmental effects research is also planned.

The compilation of environmental issues from the referenced sources found that these issues were addressed in terms of specific energy technologies. Therefore, no listing of Multi-technology oriented issues is included in this section. The research focused on Multi-technology objectives shown in Table 13-1 has been correlated with the environmental issues listed in other "energy-specific" sections of this report. It has been included in the supportive research column of tables in all sections where issues appeared to which the planned research is addressed.

TABLE 13-1. MULTI-TECHNOLOGY RESEARCH SUMMARY

<u>Subprogram</u>	<u>Research</u>	<u>Projects</u>
	<u>Number of Projects</u>	<u>Dollars in Thousands</u>
Overview and Assessment	56	20,584
Health and Biological	73	16,106
Environmental	158	18,846
Physical and Technological	40	5,782
Education and Training	5	1,965
Environmental Control Technology	11	1,614
Safety, Standards, and Compliance	<u>39</u>	<u>6,470</u>
TOTAL	<u>382</u>	<u>71,367</u>

SECTION 14

GENERAL SCIENCE

The General Science portion of the planned FY 78 AES program encompasses research not directly related to energy technology development. This research provides basic knowledge and a foundation essential for the conduct of other energy-related RD&D. General Science research is conducted within the Biomedical and Environmental Research Division. A subprogram level summary of the planned research is presented in Table 14-1.

Since this research is not directly relatable to energy technology development it has not been possible to include it in the correlation with energy-related environmental issues tabulated in preceding sections. Correlation of the planned General Science program with specific research needs was not attempted as a part of the reported effort.

TABLE 14-1. GENERAL SCIENCE RESEARCH SUMMARY

<u>Subprogram</u>	<u>Research</u>	<u>Projects</u>
	<u>Number of Projects</u>	<u>Dollars in Thousands</u>
Metabolic, pathophysiological, and embryotoxic effects on experimental animals	14	1,662
Detection and characterization of damage in physiological, cellular, and molecular systems	100	13,141
Genetics	46	3,400
Basic atmospheric, terrestrial, and marine processes	6	236
Basic physical and technological studies	8	1,184
Characterization, measurement, and monitoring	<u>2</u>	<u>515</u>
TOTAL	<u>176</u>	<u>20,138</u>

SECTION 15
MEDICAL APPLICATIONS OF NUCLEAR TECHNOLOGY

Research in this area is a continuation of work conducted by the former Atomic Energy Commission. It includes studies to discover, develop, and perfect new technology, procedures, and medical devices to provide unique applications of radiation and radionuclides in the diagnosis and treatment of human diseases.

A summary of the planned funding for the Medical Applications activities in FY 78 is presented in Table 15-1. These planned projects have not been correlated with statements of environmental issues in other sections since those issues did not include medical applications, needs, and problems.

TABLE 15-1. MEDICAL APPLICATIONS OF NUCLEAR TECHNOLOGY SUMMARY

<u>Subprogram</u>	<u>Research</u>	<u>Projects</u>
	<u>Number of Projects</u>	<u>Dollars in Thousands</u>
General Use of Nuclear Technology in Medicine	10	3,310
Radioisotope Development	8	2,596
Development of Radiopharmaceuticals	8	1,818
Clinical Applications	28	8,679
Stable Isotopes	3	742
Medical Device Development	1	175
Radiation Damage in Biological Systems	1	16
Measurement Technology	<u>8</u>	<u>933</u>
TOTAL	<u>67</u>	<u>18,269</u>