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OAK RIDGE NATIONAL LABORATORY INSTITUTIONAL PLAN FY 1984-FY 1989

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

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LIST OF ACRONYMS

AEC	Atomic Energy Commission
AID	Agency for International Development
AIM	Accelerator Improvement and Modification
AMSL	Analytical Mass Spectrometry Laboratory
ANL	Argonne National Laboratory
AR&TD	Advanced Research and Technology Development
ARIM	Accelerator and Reactor Improvement and Modification
ASCE	Assistant Secretary for Conservation and Renewable Energy
ASDP	Assistant Secretary for Defense Programs
ASEP	Assistant Secretary for Environmental Protection, Safety, and Emergency Preparedness
ASFE	Assistant Secretary for Fossil Energy
ASMA	Assistant Secretary for Management and Administration
ASNE	Assistant Secretary for Nuclear Energy
ATF	Advanced Toroidal Facility
AVLIS	Atomic Vapor Laser Isotope Separation
BER	Building Equipment Research
BES	Basic Energy Sciences
BLM	Bureau of Land Management
BRET	Breeder Reprocessing Engineering Test
BTESIM	Building Thermal Envelope Systems and Insulating Materials
CAD/CAM	computer-aided drafting/computer-aided manufacturing
CESAR	Center for Engineering Systems Advanced Research
CFRP	Consolidated Fuel Reprocessing Program
CRBR	Clinch River Breeder Reactor
DHHS	Department of Health and Human Services
DOD	Department of Defense
DOE	Department of Energy
DOI	Department of the Interior
DOT	Department of Transportation
EBT	Elmo Bumpy Torus
EBT-P	EBT-proof-of-principle
EBT-S	EBT-scale
EEDB	Energy Economic Data Base
EIA	Energy Information Administration
EPA	Environmental Protection Agency
EPRI	Electric Power Research Institute

ERAB	Energy Research Advisory Board
ETP	Emergency Technology Program
FBC	fluidized-bed combustion
FDA	Food and Drug Administration
FEDC	Fusion Engineering Design Center
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FFTF	Fast Flux Test Facility
FTE	full-time equivalent
GCEP	Gas Centrifuge Enrichment Program
GPE	General Purpose Equipment
GPP	General Plant Project
HBCU	historically black colleges and universities
HEDL	Hanford Engineering Development Laboratory
HFIR	High Flux Isotope Reactor
HHIRF	Holifield Heavy Ion Research Facility
HPRR	Health Physics Research Reactor
HTGR	high-temperature gas-cooled reactor
HTML	High Temperature Materials Laboratory
IAEA	International Atomic Energy Agency
IDB	Integrated Data Base
IET	Integrated Equipment Test
INTOR	International Tokamak Reactor
JAERI	Japanese Atomic Energy Research Institute
JET	Joint European Torus
LCTF	Large Coil Test Facility
LLNL	Lawrence Livermore National Laboratory
LMFBR	liquid-metal fast-breeder reactor
LSSFP	Life Sciences Synthetic Fuels Program
LWR	Light-Water Reactor
MFTF-B	Mirror Fusion Test Facility
MGPF	Multiprogram General Purpose Facilities
MIT	Massachusetts Institute of Technology
MMS	Minerals Management Service
NASA	National Aeronautics and Space Administration
NCI	National Cancer Institute
NCSASR	National Center for Small Angle Scattering Research
NEPA	National Environmental Policy Act
NERP	National Environmental Research Park
NLM	National Library of Medicine
NRC	Nuclear Regulatory Commission
NSF	National Science Foundation
NSIC	Nuclear Safety Information Center
NSLS	National Synchrotron Light Source
NTP	National Toxicology Program

OER	Office of Energy Research
OHER	Office of Health and Environmental Research
ORAU	Oak Ridge Associated Universities
ORELA	Oak Ridge Electron Linear Accelerator
ORIC	Oak Ridge Isochronous Cyclotron
ORNL	Oak Ridge National Laboratory
ORO	Oak Ridge Operations
ORR	Oak Ridge Research Reactor
ORTA	Office of Research and Technology Applications
PIUS	Process Inherent Ultimate Safety
PPPL	Princeton Plasma Physics Laboratory
RASCA	Remedial Action Survey and Certification Activity
RCS	Residential Conservation Service
rf	radio frequency
RPI	Rensselaer Polytechnic Institute
SANS	small-angle neutron scattering instrument
SAXS	small-angle x-ray-scattering camera
SCSS	Sequence Coding and Search System
SFC	Synthetic Fuels Corporation
SNL	Sandia National Laboratory
TFTR	Tokamak Fusion Test Reactor
THORS	Thermal Hydraulic Out-of-Reactor Safety
TIC	Technical Information Center
TVA	Tennessee Valley Authority
UCC-ND	Union Carbide Corporation-Nuclear Division

DIRECTOR'S OVERVIEW

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DIRECTOR'S OVERVIEW

The primary indicator of an Administration's science policy is its research and development (R&D) budget and particularly its incremental changes. In what is still very much an austere budget climate, R&D is scheduled this year to receive a very healthy increase in overall funding—amounting to about 13.5% after inflation. Although much of this increase will be dedicated to defense work, the basic research component of nondefense R&D will also receive a substantial boost. The FY 1984 budget explicitly favors basic research in the physical sciences, mathematics, and engineering. Thus, the general picture for R&D funding, as represented by the Administration's budget, is an upbeat one. The FY 1984 budget is a reflection of the growing national consensus that scientific research is the essential underpinning for the technological innovation that is our best hope for breaking the cycle of economic stagnation.

Because of these factors and additional positive reviews of the Department of Energy (DOE) laboratories this year, it is exciting to be a part of the system during a time of reaffirmation of the importance of national scientific and technological resources. The mounting support for a more concerted effort to encourage high-technology development for the sake of the nation's economic future provides us with both an enormous challenge and an enormous opportunity. In this plan, Oak Ridge National Laboratory (ORNL) continues to be committed to scientific and technological research that is based on technical excellence and innovation and that provides a foundation for and a stimulus to broader and more sustained economic growth. We are asking DOE to assist us in establishing a new program for Laboratory cooperation with industry, beginning with an initial focus on materials science, an area which is both one of traditional ORNL expertise and which the Administration has identified as among the top priorities for economic revitalization. The current *Institutional Plan* thus projects growth in the materials science area as well as in other basic physical science areas and suggests a new initiative designed to extend all of our various technology transfer activities and to make them more effective by using ORNL as the trial Laboratory for some of these different approaches.

On the other hand, the emphasis in Washington has been shifting away from support for other important scientific fields. For example, the increases in R&D funding in the physical sciences comes at the expense of areas such as the life sciences. The trend in support for biomedical and environmental research has been downward for the last several years. At ORNL many years have been spent in building substantial basic research endeavors in the energy-related life sciences disciplines. The recent history of funding reductions of more than 30% has substantially weakened many ongoing projects, compromised our ability to perform work in well-established programs, and resulted in the complete elimination of some important program elements. Clarification of where the emphasis will be in DOE's long-range commitment to biological and environmental research and its relation to the energy mission is urgently needed. Without major guidance from DOE, significant questions about the maintenance of a unique and experienced research staff and of important facilities cannot be effectively resolved.

ORNL would like to see the recommendation of the Energy Research Advisory Board (ERAB) that Congress adopt a rolling two-year appropriation for energy R&D actually implemented, and ORNL supports the Secretary's efforts to do so. Nevertheless, we also recognize that the sluggish condition of the national economy and the enormous federal budget deficits projected for this year and future years will continue to have an impact on ORNL. Based on this recognition, this *Institutional Plan* projects a stable future for ORNL—with only modest amounts of growth in selected areas of research for the FY 1984–FY 1989 planning cycle. Tables 1 and 2 provide summaries of the overall picture of the proposed budget and personnel levels for the current planning cycle.

Table 1. Laboratory funding summary^a

(\$ in Millions)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
DOE Effort	269.7	273.9	268.6	269.9	278.7	288.8	341.4	313.1	316.0	315.4	315.9	315.1	316.6	316.0	318.4	317.8
Work for Others	55.9	54.1	56.4	58.7	79.6	76.4	85.0	78.2	85.8	83.1	86.1	84.7	85.6	85.7	84.8	85.4
Total Operating	325.6	328.0	325.0	328.6	358.3	365.2	426.4	391.3	401.8	398.5	402.0	399.8	402.2	401.7	403.2	403.2
Capital Equipment	22.2		23.7		24.8		35.3		24.6		24.4		24.1		24.3	
Program Construction																
Funded/budgeted	27.9		5.0		13.6		9.0		2.6							
Proposed ^b	0.0		3.5		5.6		11.1		18.2		36.2		8.5		3.5	
General Purpose																
Facilities																
Funded	2.6		3.6		4.7		0.9									
Budgeted/proposed					1.8		6.0		18.1		47.4		34.0		27.0	
General Plant	4.3		3.5		4.2		9.0		14.0		20.0		21.0		21.0	
Projects																
General Purpose	3.3		4.0		4.4		4.7		6.0		7.5		8.0		8.0	
Equipment																
Total Laboratory funding	387.4		368.3		417.4		502.4		485.3		537.5		497.8		487.0	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986–FY 1989 amounts are in constant FY 1985 dollars.

^bIncludes Waste Management General Plant Projects (GPPs) and Energy Conservation GPPs.

Table 2. Laboratory personnel summary

(in FTEs ^a)	FY 1982	FY 1983	FY 1984	FY 1985	FY 1986	FY 1987	FY 1988	FY 1989
Direct								
DOE Effort	1662.9	1578.9	1562.7	1600.1	1622.5	1643.3	1653.2	1665.6
Work for Others	451.0	378.6	455.9	451.8	462.9	458.0	454.7	450.7
Isotopes	54.0	43.0	44.0	45.0	45.0	45.0	45.0	45.0
Total Direct	2167.9	2000.5	2062.6	2096.9	2130.4	2146.3	2152.9	2161.3
Indirect	2557.1	2442.5	2516.4	2558.2	2599.1	2618.5	2626.5	2636.8
Total Laboratory personnel	4725.0	4443.0	4579.0	4655.1	4729.5	4764.8	4779.4	4798.1

^aFTEs = full-time equivalents.

**ROLE STATEMENT OF THE
OAK RIDGE NATIONAL LABORATORY**

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ROLE STATEMENT OF THE OAK RIDGE NATIONAL LABORATORY

The primary role of ORNL is to conduct R&D in support of the objectives of DOE. Our major efforts are devoted to the performance of scientific research and technology development for fission and fusion energy. Although the nuclear fields represent the largest share of ORNL's endeavors, the Laboratory also makes important contributions in other areas of energy R&D, such as fossil energy and conservation. The scope of our activities also includes basic and applied research in the physical and life sciences and generating technical and scientific data (e.g., energy-related health, safety, and environmental data) that are broadly needed in the national energy R&D effort. The emphasis is on high-risk, high-payoff technology development and scientific research that are nationally important but that are not appropriate for the private sector or universities to undertake.

The philosophy of reinforcing fundamental thrusts in a few, well-chosen technologies (multiprogram) with broad, long-term, and more basic research in a variety of pertinent disciplines (multidiscipline) characterizes ORNL as a multiprogram Laboratory. ORNL's role as a performer of R&D is also broadened by virtue of the Laboratory's stewardship of many unique or rare national research facilities and resources. These include reactors, animal research laboratories, heavy-ion facilities, and the National Environmental Research Park.

In addition to DOE activities, ORNL also does work for other federal agencies and, to a lesser extent, for state and local governments and for the private sector. This "Work for Others" is conducted in areas where the Laboratory has special expertise or facilities and where the work is consistent with DOE program interests. Work for the U.S. Nuclear Regulatory Commission (NRC) constitutes the single largest non-DOE effort, but a significant amount of work is done for other agencies such as the Department of Health and Human Services (DHHS) and the Environmental Protection Agency (EPA). The Work for Others component amounts to about 20% of the Laboratory's programs.

A significant non-R&D role performed by ORNL is the manufacture and sale of radioactive and stable isotopes that are not available from the private sector. The Laboratory is a major national source of radioactive and stable isotopes, which are distributed for use by the medical, industrial, and research communities.

ORNL expends special effort to transfer technology to the private sector; to involve industry, where appropriate, in ORNL programs; and to encourage cooperative uses of facilities, both formally in users' groups and informally through professional contacts and participation. Similarly, ORNL provides universities with ready access to major research facilities and programs. At ORNL, university guests may use state-of-the-art research capabilities and training facilities for faculty and students and may participate in collaborative research by using facilities and techniques that are not otherwise available to universities.

Finally, ORNL plays a special regional role for energy-related activities in the southeastern United States by supporting and collaborating with other institutions—state and local governments and organizations such as the Tennessee Valley Authority (TVA)—that are primary R&D influences in the area. ORNL is also linked to and supports other DOE-sponsored development activities in the area, such as the Clinch River Breeder Reactor, the uranium enrichment programs, and DOE's Oak Ridge Operations Office.

SCIENTIFIC PROGRAMS

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SCIENTIFIC PROGRAMS

OVERVIEW

Since 1979 DOE's Office of Energy Research (OER) has been our largest single supporter. Since DOE's 1981 reorganization, this office has been funding over 40% of our total effort (Fig. 1). The Director of OER also has overall responsibility for the Laboratory. The Office of the Assistant Secretary for Nuclear Energy, the Office of the Assistant Secretary for Defense Programs (which funds ORNL's defense waste work), the Office of the Assistant Secretary for Conservation and Renewable Energy, and the Office of the Assistant Secretary for Fossil Energy also support large efforts at the Laboratory.

The major areas of work at ORNL are in fission energy, magnetic fusion, basic physical sciences, biological and environmental sciences, conservation, and fossil energy (Figs. 2 and 3). Most of these areas are supported by several sources including both DOE and non-DOE organizations. For example, in 1983 ORNL's fission funding came from the Assistant Secretary for Nuclear Energy, NRC, the Assistant Secretary for Defense Programs (for our defense waste work), and other sources.

Numerous non-DOE sponsors currently fund the work of almost 20% of the Laboratory's direct full-time equivalents (FTEs) (Fig. 4). Supporting 179 direct FTEs in FY 1983, NRC is our largest non-DOE funding source. Our research support for this agency is mandated by the Energy Reorganization Act of 1974. The second largest non-DOE sponsor is currently the Department of Defense (DOD). While FY 1983 DOD funding supported about 43 direct FTEs, this work is expected to expand to a level of about 97 FTEs by FY 1985. Many of our other non-DOE sponsors, including the EPA and DHHS, fund various life sciences programs at ORNL. The relatively large EPA support has resulted, in part, from transfers of funds from DOE to EPA in 1979.

The Laboratory and DOE have benefited greatly from these non-DOE programs. Through these efforts, we have been able to enter or develop new areas of research that have proven useful to DOE. Non-DOE funding has been particularly valuable in complementing DOE research in the life sciences. Each program from other sponsors is approved by DOE and complements DOE's own programs; thus, DOE receives significant benefit while the Laboratory is able to maintain institutional and programmatic flexibility. The current proportion of non-DOE work is expected to remain about the same throughout the planning cycle.

Summaries of ORNL funding and personnel by assistant secretarial level offices are presented in Tables 3 and 4.

Fig. 1. The OER supports over 40% of ORNL's direct FTEs. Other major DOE sponsors include the Assistant Secretaries for Nuclear Energy, Defense Waste Programs, Conservation and Renewable Energy, and Fossil Energy.

Fig. 2. As a percentage of FTEs, Fission Energy is the largest ORNL program area, but large efforts are carried out in many other areas. (These program areas are defined internally by ORNL and do not necessarily correspond directly with DOE's program structure.)

ORNL-DWG 83C-18321

Fig. 3. The distribution of ORNL's operating budget is similar to the distribution of personnel except in areas (e.g., the Fusion and the Conservation programs) where considerable funding is spent outside the Laboratory.

ORNL-DWG 83C-18322

Fig. 4. NRC sponsors about one-half of ORNL's non-DOE work.

Table 3. Funding by assistant secretarial level office

(\$ in Millions)	FY 1983		FY 1984 ^a		FY 1985 ^a		FY 1986 ^b		FY 1987 ^b		FY 1988 ^b		FY 1989 ^b	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Assistant Secretary for Fossil Energy														
Total Operating	9.0	10.2	9.8	10.7	16.5	15.1	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6
Capital Equipment	0.1		0.5		0.6		0.7		0.7		0.7		0.7	
Total Asst. Secretary	9.2		10.3		17.1		17.3		17.3		17.3		17.3	
Assistant Secretary for Nuclear Energy														
Total Operating	42.8	45.5	51.4	49.9	53.6	52.6	55.3	54.5	58.0	57.4	58.5	58.3	59.2	59.0
Capital Equipment	5.1		6.5		12.3		5.4		5.5		5.2		5.4	
Total Asst. Secretary	47.9		57.9		65.9		60.6		63.5		63.7		64.6	
Assistant Secretary for Conservation and Renewable Energy														
Total Operating	27.1	28.0	32.0	34.1	33.0	33.5	34.8	35.1	34.8	34.8	34.8	34.8	34.8	34.8
Capital Equipment	1.4		1.6		1.4		0.4		0.4		0.4		0.4	
Construction	0.0		9.0		9.0		2.6		0.0		0.0		0.0	
Total Asst. Secretary	28.5		42.6		43.4		37.9		35.3		35.3		35.3	
Office of Policy, Planning, and Analysis														
Total Operating	0.0	0.1	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Office of Energy Research														
Total Operating	147.3	141.4	144.5	151.5	190.6	165.4	168.2	167.6	169.5	169.1	170.8	170.4	172.1	171.8
Capital Equipment	14.4		12.4		16.5		14.9		14.9		14.9		14.9	
Construction	0.0		0.6		0.0		0.0		0.0		0.0		0.0	
Total Asst. Secretary	161.8		157.5		207.2		183.2		184.4		185.7		187.1	
Assistant Secretary for Defense														
Total Operating	24.2	23.6	28.4	28.9	34.2	32.8	28.1	28.7	24.0	24.4	22.9	23.0	22.6	22.6
Capital Equipment	1.3		1.5		1.8		1.4		1.1		1.1		1.1	
Construction	5.0		4.0		0.0		0.0		0.0		0.0		0.0	
Total Asst. Secretary	30.5		34.0		36.0		29.5		25.1		24.0		23.7	
Assistant Secretary for Protection, Safety, and Environmental Energy Preparation														
Total Operating	3.5	3.8	2.4	2.3	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Capital Equipment	0.1		0.0		0.1		0.1		0.1		0.1		0.1	
Total Asst. Secretary	3.6		2.5		2.8		2.8		2.8		2.8		2.8	
Federal Energy Regulatory Commission														
Total Operating	0.3	0.3	0.7	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Energy Information Administration														
Total Operating	0.5	4.9	1.4	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
Assistant Secretary for Management and Administration														
Total Operating	0.9	0.9	1.1	1.0	1.2	1.2	1.3	1.2	1.3	1.3	1.4	1.3	1.4	1.4
Capital Equipment	0.1		0.1		0.1		0.0		0.0		0.0		0.0	
Total Asst. Secretary	1.0		1.2		1.3		1.3		1.3		1.4		1.4	
DOE Contractors and Operations Offices														
Total Operating	12.8	11.3	6.9	7.3	6.4	6.8	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9
Capital Equipment	0.1		0.1		0.1		0.1		0.1		0.1		0.1	
Total Program	12.9		7.0		6.5		6.0		6.0		6.0		6.0	

Table 3 (continued)

(\$ in Millions)	FY 1983		FY 1984 ^a		FY 1985 ^a		FY 1986 ^b		FY 1987 ^b		FY 1988 ^b		FY 1989 ^b	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total DOE Programs														
Total Operating	268.6	269.9	278.7	288.8	341.4	313.1	316.0	315.4	315.9	315.1	316.6	316.0	318.4	317.8
Capital Equipment	22.5		22.8		32.8		23.0		22.9		22.5		22.8	
Construction	5.0		13.6		9.0		2.6		0.0		0.0		0.0	
Total DOE Programs	296.1		315.1		383.2		341.6		338.8		339.1		341.2	
Nuclear Regulatory Commission														
Total Operating	28.9	31.1	29.6	31.7	31.4	28.9	31.5	30.8	31.3	30.9	30.8	30.9	30.2	30.9
Capital Equipment	1.1		0.0		0.0		0.0		0.0		0.0		0.0	
Total Program	30.0		29.6		31.4		31.5		31.3		30.8		30.2	
Department of Defense														
Total Operating	7.7	7.7	20.8	15.5	25.6	21.3	26.0	24.0	26.5	25.5	26.5	26.5	26.5	26.5
Capital Equipment	0.1		1.9		2.5		1.6		1.5		1.5		1.5	
Total Program	7.7		22.7		28.1		27.6		28.0		28.0		28.0	
Other Federal Agencies														
Total Operating	16.7	16.7	22.8	22.8	24.0	24.0	23.8	23.8	23.8	23.8	23.8	23.8	23.6	23.6
Nonfederal Agencies														
Total Operating	3.2	3.2	6.4	6.4	4.0	4.0	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Total Work for Others														
Total Operating	56.4	58.7	79.6	76.4	85.0	78.2	85.8	83.1	86.1	84.7	85.6	85.7	84.8	85.5
Capital Equipment	1.2		2.0		2.5		1.7		1.6		1.6		1.6	
Total Work for Others Programs	57.6		81.5		87.5		87.5		87.7		87.2		86.4	
General Purpose Facilities														
Funded, budgeted, and proposed	3.6		6.5		6.9		18.1		47.4		34.0		27.0	
General Purpose Projects	3.5		4.2		9.0		14.0		20.0		21.0		21.0	
General Purpose Equipment	4.0		4.4		4.7		6.0		7.5		8.0		8.0	
Proposed Program Construction	3.5		5.6		11.1		18.2		36.2		8.5		3.5	
Total Laboratory Funding	368.3		417.4		502.4		485.3		537.5		497.8		487.0	

^aEscalation factors from FY 1983 to FY 1984 and from FY 1984 to FY 1985 are both 8.5%.^bFigures from FY 1986 through FY 1989 are in constant FY 1985 dollars.

Table 4. Personnel by assistant secretarial level office

(in FTEs)	FY 1983	FY 1984	FY 1985	FY 1986	FY 1987	FY 1988	FY 1989
Assistant Secretary for Fossil Energy Direct Personnel	51.4	47.3	62.6	69.6	69.6	69.6	69.6
Assistant Secretary for Nuclear Energy Direct Personnel	266.4	289.3	312.2	333.6	353.1	357.3	361.8
Assistant Secretary for Conservation and Renewable Energy Direct Personnel	113.0	126.6	109.2	95.9	93.9	93.9	93.9
Office of Policy, Planning, and Analysis Direct Personnel	0.2	0.5	0.8	1.0	1.0	1.0	1.0
Office of Energy Research Direct Personnel	862.5	867.2	885.2	900.4	913.2	924.4	935.3
Assistant Secretary for Defense Direct Personnel	159.9	162.6	168.8	160.6	151.1	145.6	142.6
Assistant Secretary for Environmental Protection, Safety, and Energy Preparedness Direct Personnel	24.3	10.3	12.2	12.2	12.2	12.2	12.2
Federal Energy Regulation Commission Direct Personnel	2.4	3.6	3.5	3.5	3.5	3.5	3.5
Energy Information Administration Direct Personnel	14.5	9.0	9.0	9.0	9.0	9.0	9.0
Assistant Secretary for Management and Administration Direct Personnel	0.4	0.0	0.0	0.0	0.0	0.0	0.0
DOE Contractors and Operations Offices Direct Personnel	83.9	46.3	36.6	36.7	36.7	36.7	36.7
Total DOE Programs Direct Personnel	1578.9	1562.7	1600.1	1622.5	1643.3	1653.2	1665.6
Nuclear Regulatory Commission Direct Personnel	179.0	180.2	166.6	175.6	173.7	170.4	167.7
Department of Defense Direct Personnel	42.6	81.1	97.3	99.0	96.0	96.0	96.0
Other Federal Agencies Direct Personnel	137.3	157.0	157.4	158.4	158.4	158.4	157.1
Nonfederal Agencies Direct Personnel	19.7	37.6	30.5	29.9	29.9	29.9	29.9
Total Work for Others Direct Personnel	378.6	455.9	451.8	462.9	458.0	454.7	450.7
Isotopes	43.0	44.0	45.0	45.0	45.0	45.0	45.0
Total Direct Personnel	2000.5	2062.6	2096.9	2130.4	2146.3	2152.9	2161.3
Total Indirect Personnel	2442.5	2516.4	2558.2	2599.1	2618.5	2626.5	2636.8
Total Laboratory Personnel	4443.0	4579.0	4655.1	4729.5	4764.8	4779.4	4798.1

DOE PROGRAMS

Office of Energy Research

The OER is the largest single sponsor of research at ORNL. Over 40% of ORNL's operating budget comes from this office. The Laboratory conducts major research programs for OER in the basic physical sciences, fusion energy, and biomedical and environmental sciences areas (see Table 5).

Table 5. OER Major Program summary^a
(\$ in Millions—BA)

B&R code	Major programs	FY 1983	FY 1984	FY 1985
AT	Magnetic Fusion	76.04 ^b	64.22	88.10 ^b
HAO2	Biological and Environmental Research	25.92	28.25	31.05
KA	High Energy Physics	0.64	0.62	0.99 ^b
KB	Nuclear Physics	9.66	10.85	14.43 ^b
KC	Basic Energy Sciences	48.05	52.35	71.35 ^b
KD	Energy Research and Analysis	1.25	1.05	1.05
KE	University Research Support	0.19	0.19	0.23
Total		161.75	157.53	207.20 ^b
Percent of total Laboratory funding—BA		45.7	39.7	44.0

^aFigures include operating BA, capital equipment, and funded/budgeted construction.

^bIncludes forward financing.

AT—Magnetic Fusion

The Fusion Program at ORNL is a significant component of the U.S. national fusion program, and it encompasses nearly all aspects of magnetic fusion research. The goal of the national fusion program is to determine whether the nuclear energy of the light elements, mainly hydrogen isotopes and lithium, can be released in a useful fashion. The key issues at the current stage of the program are the understanding of the behavior of high-temperature hydrogen isotope plasmas; the development of magnetic configurations that confine plasma effectively and have attractive engineering features; the development of the technologies for producing, heating, and controlling such plasmas; the design of future confinement facilities; and the development of the technologies that will be required for magnetic fusion to move through the engineering phase into the commercial phase.

To accomplish these goals, the major divisions of the ORNL Magnetic Fusion Program are Applied Plasma Physics (AT 05), Confinement Systems (AT 10), and Development and Technology (AT 15).

The Applied Plasma Physics subprogram includes theoretical studies to formulate and apply models of plasma behavior in various confinement systems [tokamak, stellarator, and Elmo Bumpy Torus (EBT)]. This activity also encompasses the development of a data base for atomic physics and the

development of diagnostic devices and technologies. Substantial advances have been made in all areas. Two new and exciting magnetic configurations have been realized, each of which shows theoretical promise for improved confinement and beta capability. The Advanced Toroidal Facility (ATF) stellarator configuration, which was developed in collaboration with the toroidal experiment group, is the first configuration identified with direct access to the so-called "second" stability regime. A modular version of this device, the "Symmotron," was developed and patented at ORNL. The Elmo Bumpy Square is a variant of the EBT with improved confinement properties. Further studies directed at realizing the full potential of these developments will continue. Significant progress—notably in the areas of excitation-autoionization and low-energy charge exchange—has been achieved in measuring and developing a theoretical base for important atomic cross sections. For the future program, an improved source of multiply charged ions is being constructed.

The Confinement Systems activities include experimental and design studies in both the toroidal and EBT plasma configurations. In the toroidal studies, the investigation of beta limitations with the ISX-B tokamak will continue through mid-FY 1984. The main new features of this program are (1) the addition of a new neutral beam system to allow co-plus counter injection, (2) improved diagnostics to measure the toroidal rotation speed, which can now be varied, and (3) a diagnostic heavy-ion beam for radial potential measurements—a collaborative program with Rensselaer Polytechnic Institute (RPI). In early FY 1985, the Impurity Study Experiment (ISX-B) will be dismantled in preparation for the installation of the ATF torsatron. During the period mid-FY 1984 through early FY 1986, the main part of the toroidal experimental team will move to Princeton Plasma Physics Laboratory (PPPL), where ORNL's researchers will play a major role in the Tokamak Fusion Test Reactor (TFTR) tokamak program. Key personnel in the expanding stellarator program will remain to work on the ATF project with Union Carbide Corporation-Nuclear Division (UCC-ND) engineering. The ATF experimental program will start in early FY 1987. The ATF is a flexible machine designed to make major contributions to the improvement of the toroidal confinement concept in the areas of high beta and steady-state operation.

Several new EBT-like configurations have been developed which offer the promise of substantially improved confinement. In parallel, recent experiments on EBT-Scale (EBT-S) indicate that while the confinement scaling is consistent with neoclassical models, the magnitude of confinement is less than previous estimates. Together with overall fusion budget constraints these factors have led to a postponement of EBT-P construction. To compensate for this action, the next year will be devoted to an increased emphasis on the EBT-S experiments and an extensive study in collaboration with the national EBT community to identify an improved configuration for a subsequent experiment.

The ORNL Development and Technology Program continues to make progress on all fronts. In the neutral-beam area, the program is close to successfully completing a prototype source for the Mirror Fusion Test Facility (MFTF-B) mirror machine at Lawrence Livermore National Laboratory (LLNL). Current DOE plans call for termination of the beam activity in FY 1984. The ORNL Plasma Technology section—following its selection by the DOE Office of Fusion Energy to lead this activity—will then turn its attention to the development of radio frequency (rf) systems. An rf test facility, which is based upon the prototype superconducting EBT-P coils, has been approved and will be in operation in 1985. The pellet-injector program has developed both pneumatic and mechanical injectors capable of repetitively providing pellets at speeds of about 1 km/s. These injectors are in use at the Massachusetts Institute of Technology (MIT), ORNL, and

PPPL. The next phase of the program will concentrate on higher velocity pellets and will develop a tritium pellet injector for TFTR.

The Large Coil Test Facility (LCTF) is ready to begin the two-coil test of the large-coil program undertaken through the International Energy Agency. The six superconducting coils of various designs each have an inner bore of 2.5 m by 3.5 m and will generate an 8-T magnetic field in a toroidal array. The two-coil test will utilize the Japanese coil, which was built by Hitachi, and the first U.S. coil, from General Dynamics. The final decision on the extent of work which should be undertaken to complete the General Electric coil will be made shortly. It is hoped that all six coils, including those from Westinghouse, Siemens (European Economic Community), and Brown-Boveri (Switzerland) should be delivered on installed during FY 1984. Also in the superconducting area, prototype EBT-proof-of-principle coils were developed successfully with General Dynamics-Convair Division.

The plasma materials program has been successful in demonstrating control of plasma density by a pumped limiter in ISX-B—a procedure developed in a collaboration with Sandia National Laboratory (SNL). In the radiation materials area, work continues in the High Flux Isotope Reactor (HFIR) and the Oak Ridge Research Reactor (ORR) to test candidate first-wall and blanket materials. An agreement has been made with the Japanese Atomic Energy Research Institute (JAERI) to test materials for the Japanese program. A collaboration with Argonne National Laboratory (ANL) is under way to test tritium production in a lithium-aluminate blanket. In the neutronics area, work continues in assembling computer codes and in calibrating the codes against model experiments with a 14-M(e)V neutron source. A collaborative program for neutronics on TFTR is under way with PPPL. The technical basis document for an Environmental Impact Statement will also be issued shortly. Further work will continue on finalizing a Generic Environmental Impact Statement for fusion.

The Fusion Engineering Design Center (FEDC), which is hosted by ORNL, involves a major collaboration with a number of U.S. industries, national laboratories, and universities. The FEDC developed the engineering design for the Fusion Engineering Device and for the U.S. contribution to the International Atomic Energy Agency-International Tokamak Reactor (IAEA-INTOR) activity. During the past year, the program has expanded. The design center continues to collaborate with PPPL in the engineering of the next phases of the toroidal program. In addition, in collaboration with LLNL, approximately 50% of its effort is now devoted to the engineering of the next phase of the tandem mirror program. This work is expected to continue for a number of years, and it may well be extended to include supporting studies for other concepts.

AT—Magnetic Fusion Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	55.8	55.3	67.9 ^b	58.5	59.0	63.5	80.1 ^b	68.2	68.2	68.2	68.2	68.2	68.2	68.2	68.2	68.2
Capital Equipment	9.5		8.1		5.2		8.0		6.7		6.7		6.7		6.7	
Construction	19.4		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for major programs	84.7	55.3	76.0	58.5	64.2	63.5	88.1	68.2	74.9	68.2	74.9	68.2	74.9	68.2	74.9	68.2
Direct Personnel	176.5		187.0		175.0		175.0		175.0		175.0		175.0		175.0	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986–FY 1989 amounts are in constant FY 1985 dollars.

^bIncludes approximately \$13M in forward financing for FY 1984.

HAO2—Biological and Environmental Research

OER's Office of Health and Environmental Research (OHER) continues to provide the largest portion of funding (56%) for the biomedical and environmental sciences program at ORNL. During the past several years, many program elements have been lost, and the size of the staff has been reduced significantly due to reduced budgets and less than cost-of-living increases in many areas. However, we believe that this trend has leveled out. Beginning in FY 1984, the HAO2 (Environmental Research and Development) and HB (Life Sciences Research and Nuclear Medicine Applications) programs will be consolidated under the single activity code HAO2 (Biological and Environmental Research).

The goals of the HAO2 program are to study the interaction of energy-related physical and chemical agents with living organisms, including their transport, chemical evolution, adverse health effects, and ultimate fate in man and his environment; to develop knowledge through basic research programs; and to transfer research findings and technological developments outside the Laboratory. Areas of research include radiation biology, radiation and chemical dosimetry, carcinogenesis, mutagenesis, genetics, epidemiology, health and environmental risk analysis, physical and chemical characterization of pollutants and their interactions at the molecular level, development of advanced instrumentation for sensitive detection and monitoring of chemical species, carbon dioxide effects research and assessment, and nuclear medicine. In addition, two unique research resources are supported by the HAO2 budget: the Health Physics Research Reactor (HPRR) and the Oak Ridge National Environmental Research Park (NERP). We are also currently developing plans for a biotechnology user facility at ORNL which would integrate resources in the Biology and Chemical Technology divisions. Physical resources would include bioreactors, a flow cytometry laboratory, large-volume fermenters, and centrifugal analyzers. Users of all of these facilities include staff of industry and national laboratories and students and staff of universities.

The ORNL HAO2 program is among the largest life sciences research programs in the country. It covers a broad range of both basic and applied studies. The work is carried out primarily by the staff of four divisions and one program: the Biology, Environmental Sciences, Health and Safety Research, and Information divisions and the Life Sciences Synthetic Fuels Program (LSSFP), with additional assistance from numerous other ORNL divisions. Overall, the HAO2 program at ORNL is expected to experience little or no real growth in this planning cycle, although some subprogram elements are proposing modest expansion. The most significant change currently projected concerning the research carried out in the Biology Division is a redirection of our biophysics efforts to concentrate on the study of genetic materials, including deoxyribonucleic acid (DNA) adduct formation with energy-related chemicals. We are using electron microscope tomography and small-angle scattering (neutron and x-ray) to study macromolecular structure. We think that it is important to maintain a biophysics program that could be built back up as new funds become available. We also anticipate increases in neutron radiobiology.

Environmental research is designed to increase the ability to predict transport and effects of energy-related contaminants in the environment. Basic knowledge is obtained on mechanisms that control and influence total ecosystems, on their resiliency, and on the critical elements within them. Through utilization of model compounds, radionuclides, and mathematical models, data and techniques are developed which will enhance the ability to site and operate energy systems in a

cost-effective and environmentally safe manner. We will continue to expand our expertise in hydrology and geochemistry in support of the developing DOE programs in hazardous waste disposal.

Assessments of potential health and environmental risks associated with new and existing energy technologies require knowledge of the interaction of potentially hazardous agents with biological and environmental systems and the technical capability for characterizing and quantitatively measuring such agents in various settings. The physical and technological components of the program consist of studies involving the structure and properties of materials of biological or environmental importance, the physical mechanisms that govern transport and chemical evolution of pollutants in the atmosphere, and the interaction of harmful agents with biological materials. The scope of work includes unique applications of laser optical techniques to atomic and molecular physics studies and solid-state and surface physics studies, and the development of advanced instrumentation for characterizing and sensitively detecting a wide variety of chemical species.

In addition to studying the properties of energy-related compounds and how the agents move in the environment and might affect ecosystems, we conduct experimental work to contribute to our understanding of potential health risks to man and other organisms. We use a range of test agents: ultraviolet and ionizing radiation, and numerous chemical pollutants and toxic compounds, including atmospheric halogenated hydrocarbons and compounds produced from the use and conversion of fossil fuels. The study systems employed include bacteria, viruses, fruit flies, mice, and many types of human and animal cells in culture.

The Nuclear Medicine Program involves the design and preclinical testing of new radiopharmaceuticals for use in clinical nuclear medicine and other radiolabeled agents for fundamental biomedical research. A new gamma camera is being installed to provide imaging capability. Current research focuses on the development of radiolabeled fatty acids, phosphonium, and related cations for the evaluation of heart disease and on the perfection of a generator for the production of radioactive iridium from osmium-191. The iridium-191m radionuclide has a short half-life (5 s) and is an effective agent for evaluating congenital heart disease in children, allowing rapid repeat studies with very low radiation doses absorbed by the patient. A key strength of this program is the strong synthesizing capability; a variety of new, improved radiolabeling techniques are also being developed. An important outreach is the vigorous medical cooperative program with prestigious clinical research groups, such as the Massachusetts General Hospital, to which these new agents are supplied.

The activities of the LSSFP will continue to shift away from site- or technology-specific studies toward more basic, generic research involving a change in program emphasis—if adequate support is available—from short-term acute exposures to long-term chronic exposures. We will, however, continue to monitor specific synthetic fuel industry plants to ensure transfer of relevant information and techniques to prospective users. The erosion of support and the uncertainty in national energy priorities are impediments to LSSFP program planning. However, OHER planning, in which ORNL has had a major role, should help clarify directions for the LSSFP. Emphasis will likely be placed on the genetic and toxicological effects produced by complex mixtures and pure compounds identified within these mixtures.

During the next five years, the global carbon cycling program activities will undergo a significant expansion to encompass new research in terrestrial carbon dynamics and global carbon cycle

modeling, as well as new responsibilities in carbon cycle research management for DOE. Research efforts will be focused on assembling and implementing disaggregated (multidimensional) models of the global carbon cycle. Management activities will involve the gradual assimilation of a greater share of contract execution activities for the DOE Carbon Cycle Research Program, particularly in the areas of oceanic and atmospheric data collection and analysis. This broad array of activities and expertise is necessary to develop the information and models necessary to provide accurate projections of CO₂ buildup in the atmosphere over the next century from both natural and anthropogenic sources.

The Carbon Dioxide Information Center, one of 17 specialized information centers at ORNL, supports the nation's Carbon Dioxide and Climate Research Program by providing a focal point for compilation and distribution of CO₂-related information under systematic quality control. The prototype center, which was established in FY 1982 and FY 1983, is intended to expand to a fully operational information analysis center in the near future. Expansion is necessary to allow incorporation of data from more research areas and to achieve international—rather than only national—coverage of CO₂ research.

HAO2—Biological and Environmental Research Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	27.9	27.9	24.1	27.0	26.8	29.3	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5
Capital Equipment	1.9		1.8		1.5		1.6		1.6		1.6		1.6		1.6	
Construction ^b	1.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for major programs	30.8	27.9	25.9	27.0	28.3	29.3	31.1	29.5	31.1	29.5	31.1	29.5	31.1	29.5	31.1	29.5
Direct Personnel	227.1		198.0		200.0		200.0		200.0		200.0		200.0		200.0	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986-FY 1989 amounts are in constant FY 1985 dollars.

^bDoes not include proposed construction.

Program Construction. ORNL is proposing five line-item construction projects for the HAO2 program.

HAO2—Proposed construction summary

(\$ in Millions)	FY 1983	FY 1984	FY 1985	FY 1986	FY 1987	FY 1988	FY 1989	TEC
Hazardous Waste Incinerator		1.8						1.8
Health and Safety Research Laboratory			3.0					3.0
Upgrade Air Supply System			3.0					3.0
Toxic Substances Laboratory and Animal Facility				5.8	28.2	1.5		35.5
Upgrade Air Supply System, Genetics Facility, Phase II				3.0				3.0

The largest item, the Toxic Substances Laboratory and Animal Facility, is a new facility for handling toxic materials. The purpose of the project is to provide specialized laboratories and space for animals to be used in investigating acute and chronic effects of energy-related toxic chemicals and metals. The development and maintenance by DOE of a program to study toxic effects of such materials are essential to future protection of energy industry workers, the general public, and the environment. DOE's recently established toxicology program requires that we have new laboratory and animal space designed specifically to enable personnel to handle toxic materials safely. This proposed construction is also consistent with the Laboratory's long-range goal to consolidate to the maximum extent the life sciences research facilities at the west end of the ORNL (X-10) site. Further discussion of the intention to move the Biology Division from Y-12 to ORNL is included in the Site Development and Facilities Management section of this plan.

KA, KB, KC—Basic Physical Sciences

Nine ORNL divisions conduct basic research that is supported by the OER. Activities include nuclear and high-energy physics and a broad spectrum of research in the nuclear, chemical, materials, engineering, and mathematical sciences and geosciences. The eight national user facilities for basic physical science research at ORNL hosted over 350 outside researchers during FY 1983.

KA—High Energy Physics

The High Energy Physics group maintains experimental programs at several accelerator facilities. In addition, the group provides an essential service to the physics community by measuring and calculating multigroup cross sections and transport phenomena for a wide variety of applications. Nuclear cross-section models and nucleon-meson transport methods are developed that facilitate the design of high-energy particle detection systems such as ionization calorimeters and total absorption calorimeters. Design data as well as detailed designs are provided to outside experimental groups engaged in detector construction. A parallel effort provides the information required for meeting radiation shielding requirements.

KA—High Energy Physics Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA ^b	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	0.55	0.62	0.6	0.6	0.6	0.6	0.9	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Capital Equipment	0.05		0.05		0.03		0.13		0.13		0.13		0.13		0.13	
Construction	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for major programs	0.60	0.62	0.7	0.6	0.6	0.6	1.0	0.7	0.8	0.7	0.8	0.7	0.8	0.7	0.8	0.7
Direct Personnel	5.0		4.5		5.3		5.3		5.3		5.3		5.3		5.3	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986–FY 1989 amounts are in constant FY 1985 dollars.

^bIncludes approximately \$0.2M in forward financing for FY 1986.

KB—Nuclear Physics

The principal activities in the Nuclear Physics Program are centered on the Holifield Heavy Ion Research Facility (HHIRF). The HHIRF is operated as a unique resource for heavy-ion research for the national and international user communities, and it forms the basis of a vigorous in-house nuclear physics research program.

The resources available to users of the HHIRF continue to grow. Laboratory space has been augmented significantly by the completion of a 3500-ft² addition to the experimental halls, constructed under FY 1983 General Plant Projects (GPP) auspices. An additional 2400-ft² extension is planned as an FY 1984 GPP project to accommodate heavy-ion applications and accelerator-based atomic physics experiments. Construction funded by the State of Tennessee has begun on a 6000-ft² building that will house laboratories, offices, and a conference facility. Combined with the continued development in the KB program of state-of-the-art detectors, data acquisition electronics, computing facilities, and additional accelerated ion-species, these projects have greatly enhanced the capabilities of the HHIRF. A major effort is currently under way to bring the Holifield tandem accelerator to full operating voltage.

Experiments with the spin spectrometer in the past year revealed for the first time evidence for shape changes in highly excited nuclei at very high angular momentum. In another significant accomplishment, time scales for heavy-ion reactions were measured using the phenomenon of channeling in diamond crystals.

A near-term goal for facility improvement is to provide ion beams spanning the periodic table at energies exceeding the uranium Coulomb barrier—5 MeV/nucleon—by converting the Oak Ridge Isochronous Cyclotron (ORIC) coils to superconducting windings.

As a longer range thrust, we are developing concepts for a relativistic heavy-ion accelerator capable of producing the high-energy densities required to form a quark-gluon plasma in nuclear matter. While the ultimate goal of the project would thus be to study quark deconfinement, the facility would provide for forefront research in a variety of fields.

KB—Nuclear Physics Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA ^b	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	8.7	8.9	8.7	9.0	9.6	9.6	13.1	11.0	11.4	11.3	11.7	11.6	12.0	11.9	12.4	12.3
Capital Equipment	1.0		1.0		1.3		1.4		1.4		1.4		1.5		1.5	
Construction ^c	0.5		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for major programs	10.2	8.9	9.7	9.0	10.9	9.6	14.5	11.0	12.8	11.3	13.1	11.6	13.5	11.9	13.9	12.3
Direct Personnel	91.0		73.8		79.3		82.3		85.6		88.9		92.1		96.0	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986-FY 1989 amounts are in constant FY 1985 dollars.

^bIncludes approximately \$2.1M in forward financing for FY 1986.

^cDoes not include proposed construction.

Program Construction. An Accelerator Improvement and Modification (AIM) project is proposed for HHIRF as follows:

KB—Proposed construction summary

(\$ in Millions)	FY 1983	FY 1984	FY 1985	FY 1986	FY 1987	FY 1988	FY 1989	TEC
AIM-HHIRF				0.5				0.5
Total proposed construction				0.5				0.5

KC—Basic Energy Sciences (BES)

Major components of work in the nuclear sciences are the production, separation, and study of actinide elements; the measurement of neutron cross sections relevant to fusion and fission reactor development; and the preparation of special isotopes.

Several important scientific questions are being addressed in research with transuranium elements and compounds. The possible involvement of the 5f electrons (of the actinide series) in chemical bonding has been investigated in magnetic studies of the metals and compounds of americium through einsteinium at low temperatures, and in structural studies of berkelium and californium metals at high pressures. The results so obtained indicate weaknesses in present-day theories of actinides in the solid state. Investigations of actinides in solution are focusing on hydration, hydrolysis, complexation phenomena, and searches for unusual oxidation states in order to establish the limits of chemical stability of these elements. Chemical behavior under conditions that are relevant to nuclear waste isolation is being emphasized with regard to chemical speciation in the environment and to preparation of potential alternate crystalline waste forms. Measurements of neutron cross sections have indicated that an approximate tenfold increase in the production of 276-d ^{254}Es is possible at the ORNL HFIR. Multimicrogram amounts of ^{254}Es are needed for accelerator targets in new superheavy-element searches and in chemical studies of elements 101 through 106. Other new research areas that are being developed include high-temperature thermodynamic and kinetic studies with a dedicated mass spectrometer with Knudsen effusion cell; neutron scattering of solutions at HFIR; and scattering of variable-energy X rays from solutions at the National Synchrotron Light Source (NSLS).

Although the Oak Ridge Electron Linear Accelerator (ORELA) has been the world's leading facility for time-of-flight measurements using intermediate-energy (keV) neutrons, improvements in two European facilities are bringing them close to parity with ORELA. A study is now under way that examines the many recent advances in accelerator development to determine whether major increases in the pulsed-neutron source strength can be achieved at reasonable cost. The interim finding is that tenfold to hundredfold advances would be quite expensive but might meet multiple objectives. Cost-effective but relatively minor improvements in ORELA facilities are being sought currently.

Stable isotope production continues to be a highly important nuclear science program. Efforts continue to develop funding mechanisms that can accommodate fluctuations in sales and ensure replenishment of inventories.

Materials science is the largest BES program and is shared among the Solid State, Metals and Ceramics, Chemical Technology, and Chemistry divisions. This program, which is guided by the needs of the DOE missions, deals with fundamental studies of mechanical, physical, chemical, optical, electrical, and magnetic properties of materials.

Important basic experimental research is performed on diverse problems having to do with energy-related materials, such as radiation effects in fission and fusion reactor materials, photovoltaic conversion in solar cells, storage of nuclear wastes in minerals, fast-ion conduction in solid electrolytes for batteries and fuel cells, and flux-line pinning effects in type II superconductors for magnets. Closely coupled to the experimental work are theoretical studies that involve state-of-the-art investigations, including relevant extensions of existing theories as well as the development of new concepts, theories, and procedures, when appropriate. The theoretical research falls very generally under the classifications of electronic and magnetic properties, lattice dynamics, surface physics, particle-solid interactions, laser annealing, and theory of alloys.

Materials preparation and characterization are major components of the program. Ceramic processing emphasizes designing materials for use at elevated temperatures and developing an understanding of mechanical properties at elevated temperatures. Metallic alloys based on Ni_3Al are being prepared, and their properties are being controlled by thermal-mechanical processing as well as by microalloying. Titanium diboride is being prepared by homogeneous nucleation from gaseous phases, and various techniques are being used to improve the mechanical, high-temperature properties of this ceramic.

Ion-implantation doping and pulsed-laser annealing are being used to modify the surface properties of many types of materials. These surface modifications significantly affect such phenomena as friction, wear, corrosion, catalysis, and superconductivity, as well as the electronic properties of semiconductors. Recent studies of ion-implanted ceramic materials have demonstrated that the mechanical properties of ceramic surfaces can be controlled by selective implantations and thermal annealing. The continuing development of laser-annealing techniques has resulted in routine laboratory production of very high efficiency, single-crystal silicon solar cells. The strong interest in the alteration and analysis of surfaces of materials by both in-house and outside users has resulted in a flourishing national user facility for surface modification and characterization research.

Several large, unique facilities are available at ORNL for research in the materials sciences. Included among them are (1) a variety of neutron-scattering facilities at the HFIR, which furnishes the most intense beams of thermal neutrons now available for research; (2) facilities at the Bulk Shielding Reactor for closely controlled investigations of radiation effects at very low temperatures; (3) several accelerators for research in ion-radiation damage, ion implantation, ion scattering, and ion channeling; (4) high-voltage and high-resolution electron microscopes; and (5) a unique 10-m, small-angle, X-ray-scattering camera. User groups have been formed for many of these facilities so that they will be readily accessible to scientists both within and outside ORNL. Architectural engineering work is beginning on the new High Temperature Materials Laboratory (HTML). Completion of the building to house HTML is anticipated for the second quarter of FY 1987. HTML will be a state-of-the-art facility for materials science research and will be available to Laboratory, industry, and university scientists.

Synchrotron radiation is rapidly becoming a major tool for materials science research. For example, fundamental studies of melting processes and other transient phenomena are made possible by

diffraction measurements with synchrotron X rays. ORNL has built equipment to be installed at the NSLS. The NSLS will have a flexible X-ray-scattering facility with a very efficient focusing device and a multipurpose facility on the vacuum uv ring for surface studies.

Chemical sciences work is conducted in four ORNL divisions. Analytical research in the Analytical Chemistry Division currently emphasizes microwave, positron, optoacoustic, and mass spectroscopic measurements. Laser-based techniques are prominent.

In the Chemistry Division there are diverse activities. A unique combination of techniques is used to obtain basic thermodynamic and kinetic data on aqueous solutions under the high pressures and temperatures common to energy-production facilities. Recent work has shown that heats of dilution can be enormous in some electrolyte solutions at high temperatures and has given evidence for ion association. These results are important for the theoretical understanding of water and its solutions, and they also provide a basis for detailed descriptions for systems important to steam generation, nuclear coolants, geochemical and hydrothermal processes, waste transport, nuclear accident assessment, and supercritical fluid processing. Results of studies of the high-temperature chemistry of sodium sulfate provide a basis for evaluation of its precipitation behavior within steam generator crevices and its potential for enhancing corrosion. Hydrolysis studies have advanced the understanding of iodine solution chemistry relevant to reactor accident conditions.

Basic research on coal attempts to ensure that this resource is used to best advantage. A combination of instrumental and chemical techniques is used to elucidate the structures of the organic molecules in coal and their functional groups and reactions. Work with model compounds is an integral part of the approach because native coals are too complicated to understand otherwise. Recent results have included the development of ultrahigh-resolution nuclear magnetic resonance techniques for studying functional groups and carbon structures in native, chemically modified, and thermally altered coals; the use of electron spin resonance to study free radical processes in pyrolyzing hydrocarbons; and the elucidation of molten salt catalytic mechanisms in hydrogen shuffling and condensation reactions of model compounds for coal.

Basic research on the chemistry of solvent extraction is being conducted for the separation of metals. Emphasis is on the principles controlling the selectivity of extractants on the molecular level and application of these principles in devising new and more selective extractants. Recent work has provided structural information on species related to the extracted complex in the diethylhexyl phosphoric acid-trioctyl phosphine oxide (DEPA-TOPO) process for uranium extraction from phosphoric acid.

In a program of far-reaching significance, electron spectroscopy at synchrotron sources is now providing the best and most comprehensive basis for evaluating molecular orbital theory and photoelectron dynamics. Experiments on core as well as valence orbitals hold a promise for a new approach to the study of chemical bonding. Recently, studies have been completed on diverse gaseous systems including metallic vapors such as gallium and on relatively complicated multiatom organic molecules such as dichloroethylene nitrous oxide.

The BES programs in the Chemical Technology Division involve chemical and engineering research in separations science and technology, energy production, and conservation. Fuel cycle chemistry is an important component of the separations program and is essential to closing the fuel cycle. Research on the biophotolysis of water is another important and promising area receiving emphasis.

The BES Division of Engineering, Mathematical, and Geosciences supports a variety of programs at ORNL. The Geosciences Program addresses the broad areas of hydrothermal and silicate fluids, which promote transportation and redistribution of materials in the earth's crust. A new facility enables the study of oxidation and reduction processes in geologic materials under conditions simulating depths to 18 km. The main component of the facility is an internally heated pressure vessel capable of operating at hydrogen pressures up to 500 MPa and temperatures to 1400°C. Also, in a program on hydrothermal mobility, the first experimental study on the behavior of tungsten in solution at high temperatures was completed at ORNL. The results provide the basis for a comprehensive model for the mobility and deposition of tungsten over a wide range of conditions.

The principal objective of our mathematics research is to develop methodology and tools applicable to the solution of currently intractable problems in computational linear algebra, moving boundary problems, stochastic analysis, and statistical methods. Emphasis is placed on the design and analysis of algorithms for large-scale sparse matrix computations and for the design of critical experiments. The computer remains a central element in the research program, and a Research Computing Facility based on a VAX 11/780 has been established to provide an experimental laboratory for testing new algorithms on simulated future computer architectures.

The Center for Engineering Systems Advanced Research (CESAR) is a program initiative within the BES. CESAR is a center of multidisciplinary research within which advances in mathematics and mechanical, electrical, and computing systems are integrated for the long-range development of energy-related intelligent control systems. Potential applications include emergency situations, remote operations, resource exploration, transportation systems, and large-scale power generation systems.

KC—BES Program resource summary

(\$ in Millions) ^{a,b} (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA ^b	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	40.3	41.5	44.6	45.2	47.3	47.4	65.9	54.9	57.2	56.7	58.2	57.9	59.2	58.9	60.1	59.8
Capital Equipment	3.5		3.4		4.4		5.5		5.1		5.0		5.0		5.0	
Construction ^c	0.0		0.0		0.6		0.0		0.0		0.0		0.0		0.0	
Total for major programs	43.8	41.5	48.0	45.2	52.3	47.4	71.4	54.9	62.3	56.7	63.2	57.9	64.2	58.9	65.1	59.8
Direct Personnel	376.6		393.5		399.1		414.1		426.0		435.5		443.5		450.5	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986-FY 1989 amounts are in constant FY 1985 dollars.

^bIncludes approximately \$11.0M in forward financing for FY 1986.

^cDoes not include proposed construction.

Program Construction. Two AIM projects are budgeted for the KC program as follows:

KC—Budgeted construction summary

(\$ in Millions)	FY 1983	FY 1984	FY 1985	FY 1986	FY 1987	FY 1988	FY 1989	TEC
AIM-Calutron		0.3						0.3
AIM-ENTANDEM		0.3						0.3
Total budgeted construction		0.6						0.6

In addition, four items are proposed for construction under KC: an AIM project to upgrade the ORELA; a new Analytical Mass Spectrometry Laboratory (AMSL); and two Accelerator and Reactor Improvements and Modifications Projects (ARIM) for upgrading HFIR—an ARIM-HFIR Critical Facility and an ARIM-HFIR Remote Sampling Facility.

KC—Proposed construction summary

(\$ in Millions)	FY 1983	FY 1984	FY 1985	FY 1986	FY 1987	FY 1988	FY 1989	TEC
AIM-ORELA				0.6				0.6
AMSL				2.8				2.8
ARIM-HFIR Critical Facility			0.3					0.3
ARIM-HFIR Remote Sampling Facility			0.3					0.3
Total proposed construction			0.6	3.4				4.0

KD—Energy Research and Analysis

Energy Research and Analysis activities support OER in technical and economic assessments of energy-related technologies; provide technical, logistic, and administrative support for ERAB; and fund technical analyses and other support for OER's continuing assessment of national R&D on the effects of acid deposition on natural and man-influenced environments. No significant growth is projected for this program.

KD—Energy Research and Analysis Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	1.4	1.6	1.3	1.0	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Capital Equipment	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Construction	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for major programs	1.4	1.6	1.3	1.0	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Direct Personnel	7.4		5.2		6.0		6.0		6.0		6.0		6.0		6.0	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986–FY 1989 amounts are in constant FY 1985 dollars.

KE—University Research Support

The University Research Support Program seeks to stimulate cooperative research by the university community in ORNL activities. Support is provided to involve students and faculty from the Southern College University Union and the Great Lakes College Association/Associated Colleges of the Midwest in ORNL research programs as well as to support student and faculty participation in the Reactor Training Cooperative Experiments and the Environmental Sciences Cooperative Curriculum. KE funds previously used for the MIT Practice School are now allocated to a special

summer program for black undergraduate students to perform research at ORNL. This program is expected to remain stable through FY 1989.

KE—University Research Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	0.21	0.18	0.19	0.14	0.19	0.19	0.23	0.22	0.23	0.22	0.23	0.22	0.23	0.22	0.23	0.22
Capital Equipment	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Construction	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for major programs	0.21	0.18	0.19	0.14	0.19	0.19	0.23	0.22	0.23	0.22	0.23	0.22	0.23	0.22	0.23	0.22
Direct Personnel	0.9		0.5		2.5		2.5		2.5		2.5		2.5		2.5	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986-FY 1989 amounts are in constant FY 1985 dollars.

Assistant Secretary for Nuclear Energy (ASNE)

The ASNE is the major sponsor of applied nuclear research and the second largest sponsor at ORNL. Programs funded through this office are multidisciplinary in nature and include as major activities advanced nuclear systems, breeder reactor systems, converter reactor systems, remedial action programs, nuclear waste management, and nuclear fuel cycle programs. Some budget increases are expected; these are mostly due to increases for the Breeder Reprocessing Engineering Test and for the Light-Water Reactor (LWR) subprogram under Converter Reactor Systems (see Table 6). In addition, the Remedial Action Survey and Certification Activity (RASCA) has been transferred to ASNE under Remedial Action Programs.

Table 6. ASNE Major Program summary^a
(\$ in Millions—BA)

B&R code	Major programs	FY 1983	FY 1984	FY 1985
AE	Advanced Nuclear Systems	2.70	3.27	3.35
AF	Breeder Reactor Systems	10.93	9.94	10.33
AG	Converter Reactor Systems	7.11	9.69	9.51
AH	Remedial Action Programs	1.52	3.93	3.61
AP	Commercial Nuclear Waste Management	0.24	0.10	0.10
AS	Nuclear Fuel Cycle	24.29	28.57	35.58
CD	Uranium Enrichment	0.40	0.05	0.06
DA	Nuclear Waste Disposal Activities	0.0	0.0	0.0
DB	Nuclear Waste Fund	0.67	2.32	3.33
Total		47.86	57.87	65.87
Percent of total Laboratory funding—BA		13.5	14.6	14.0

^aFigures include operating BA, capital equipment, and funded/budgeted construction.

AE—Advanced Nuclear Systems

Improved materials for space missions and terrestrial applications which utilize heat generated by isotopic power devices are being developed and evaluated. Activities include the production of iridium-alloy-cladding blanks to contain the heat-generating radioisotopes and carbon-bonded, carbon-fiber (CBCF) insulators to achieve the 1300°C operating temperature. Technology improvements being pursued include a process to produce CBCF from a new starting rayon product, a consumable arc-melting technique for the iridium alloy, publication of an Isotope Space Power Materials Handbook, and nondestructive-examination support for manufacture of advanced thermoelectric elements.

Efforts are also under way to establish a substantial role for ORNL in the DOD-DOE-National Aeronautics and Space Administration (NASA) space nuclear reactor systems program in the following technology areas: refractory alloys, Rankine cycle, reactor shielding, controls and measurements, and core design support. ORNL is expected to assume a lead role in the refractory alloys development program and important support roles in the other technology areas cited. Concept design and systems analysis are being handled exclusively by industrial contractor organizations.

AE—Advanced Nuclear Systems Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	1.7	2.7	2.6	3.1	2.7	2.6	3.2	3.2	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Capital Equipment	0.1		0.05		0.6		0.1		0.1		0.1		0.1		0.1	
Construction	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for major programs	1.8	2.7	2.7	3.1	3.3	2.6	3.3	3.2	4.1	4.0	4.1	4.0	4.1	4.0	4.1	4.0
Direct Personnel	21.0		22.0		17.8		21.7		32.0		32.0		32.0		32.0	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986–FY 1989 amounts are in constant FY 1985 dollars.

AF—Breeder Reactor Systems

This program supports the liquid-metal fast-breeder reactor (LMFBR) concept with continued efforts in the traditional base-technology areas of materials and structures, measurements and controls, physics, and safety. In each of these areas, increased emphasis is being placed on activities that will contribute toward a more inherently safe and economically competitive breeder concept. In addition, the program provides technical support to specific projects, such as the Clinch River Breeder Reactor Plant (CRBRP).

As lead laboratory for the national Materials and Structures Program, we will continue efforts to develop and code-qualify advanced alloys, to obtain a greater understanding of the behavior of materials in LMFBR environments, and to develop improved design methods and criteria. Management of the national program will continue through the ORNL Materials and Structures Technology Management Center.

Measurements and controls activities will support the development and proof testing of key high-risk, high-payoff components and systems such as high-temperature fission counters and automated

noise surveillance and diagnostic systems. The physics work will concentrate on analysis and validation of shield designs and determination of nuclear physics data. In the reactor safety area, thermal hydraulics data pertinent to the understanding and management of shutdown heat removal will be obtained from the Thermal Hydraulic Out-of-Reactor Safety (THORS) facility. Also, computerized data bases for safety analysis (SACRD) and component reliability (CREDO) will continue to be maintained.

The Nuclear Standards Management Center, which is part of the Program Assurance effort in the LMFBR Program, will continue to promote the development of consensus industrial standards—augmented by special program standards as required—to ensure that the information and experience gained in all nuclear programs—including fuel recycle and waste management—are documented appropriately and made available to the private sector. Program support for DOE's unusual-occurrence-report activities will be continued.

AF—Breeder Reactor Systems Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	12.4	11.5	10.8	12.9	9.3	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Capital Equipment	0.6		0.07		0.6		0.3		0.3		0.3		0.3		0.3	
Construction	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for major programs	13.0	11.5	10.9	12.9	9.9	10.0	10.3	10.0	10.3	10.0	10.3	10.0	10.3	10.0	10.3	10.0
Direct Personnel	85.0		83.0		72.8		72.8		72.8		72.8		72.8		72.8	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986-FY 1989 amounts are in constant FY 1985 dollars.

AG—Converter Reactor Systems

The primary mission of this activity is to provide technological expertise in support of the national program to develop high-temperature gas-cooled reactors (HTGRs) for cogeneration and high-temperature process heat. The technical activities include: (1) performing qualification tests of HTGR fuel behavior under design and off-design reactor conditions; (2) providing basic data on the mechanical, physical, and chemical behavior of HTGR materials, including metals, ceramics, graphite, and concrete; (3) performing component testing and development on the core support structure and on the ceramic pads on which the core parts rest; (4) providing experimental evaluation of the shielding effectiveness of the lower portions of the HTGR core region; (5) developing welding techniques for cladding steam generator tube sheets and for attaching tubing to the tube sheets; and (6) providing technical evaluations and assessments in specific as well as broad areas.

An ancillary task, a part of the LWR subprogram, is to reexamine the advantages of a small LWR in meeting the growth requirements of the utility industry. Other LWR tasks include annual updating of the Energy Economic Data Base (EEDB), economic analyses of nuclear vs other energy sources, and a region-specific study of the electric utility industry. The latter is aimed at assurance of adequate future electric power. The increases in funding for the AG program reflect a modest increase in the evaluation and assessment activities and consolidation of funding in this area. Funding for the HTGR program is expected to be static.

Activities in the Converter Reactor Systems Program have achieved several major accomplishments this year. The Component Flow Test Loop has been modified to accommodate the Core Support Performance Test. This modification will allow study of the response of the HTGR core support structure to simulated long-term reactor behavior. We have also carried out experimental shielding studies of the lower regions of the HTGR core support and found that the design fluence of thermal neutrons should be increased by about a factor of 10. Finally, we have applied fracture mechanics and statistical theory to graphite. This research has resulted in graphites with greater strengths and in reduced variances in strength throughout a graphite log.

Recognizing the extended delay in LWR plant orders and the eventual need for more advanced reactor systems, we propose new activity to examine several new and modified concepts. Emphasis will be placed on lower costs, improved fuel utilization, application to process and district heating, improved siting capability, and improved thermal efficiency. Concepts to be considered include sodium- and gas-cooled reactors and modified LWRs, such as the Process Inherent Ultimate Safety (PIUS) concept proposed by Sweden. This modest effort will be coordinated with similar studies by TVA, the Electric Power Research Institute (EPRI), and other segments of industry.

AG—Converter Reactor Systems Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	5.1	5.8	5.8	6.1	7.4	6.5	7.7	7.5	8.2	7.9	7.9	7.9	7.9	7.9	7.9	7.9
Capital Equipment	0.9		1.3		2.3		1.8		1.8		2.0		1.8		2.0	
Construction	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for major programs	6.0	5.8	7.1	6.1	9.7	6.5	9.5	7.5	10.0	7.9	9.9	7.9	9.7	7.9	9.9	7.9
Direct Personnel	39.1		34.7		38.1		38.3		41.3		41.3		41.3		41.3	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986–FY 1989 amounts are in constant FY 1985 dollars.

AH—Remedial Action Program

The major activities in this program involve work associated with former DOE/Atomic Energy Commission (AEC) sites and with management of surplus DOE facilities. Increased funding is anticipated in the latter program beginning in FY 1988 and continuing through FY 1989 as the decommissioning of two ORNL facilities, the Molten Salt Reactor Experiment and the Fission Product Development Laboratory, will be initiated.

The substantial increase in funding between FY 1983 and FY 1984 is due to the addition of the RASCA task, which will be transferred to this program in FY 1984. It will continue to perform radiological surveys at sites formerly used under contract with the AEC, at inactive uranium mill sites, surplus DOE sites, and private properties in the vicinity of these sites. The funding for this task is expected to be stable throughout the planning period.

AH—Remedial Action Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	0.4	0.6	1.5	1.1	3.9	3.4	3.6	3.6	3.6	3.6	3.6	3.6	4.5	4.3	5.1	4.9
Capital Equipment	0.0		0.0		0.03		0.01		0.1		0.1		0.0		0	
Construction	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for major programs	0.04	0.6	1.5	1.1	3.9	3.4	3.6	3.6	3.7	3.6	3.7	3.6	4.5	4.3	5.1	4.9
Direct Personnel	5.8		6.2		18.5		18.5		18.5		18.5		21.5		25.0	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986-FY 1989 amounts are in constant FY 1985 dollars.

AP—Commercial Nuclear Waste Management

Two main tasks have been partially funded under this program: the Integrated Data Base (IDB) and Waste Transportation Studies. Effective in mid-FY 1983, the latter task was transferred to a new program (DB). The IDB is expected to remain stable. The low level of effort listed in AP for the IDB reflects the fact that this task is also funded under other program codes (AF, AH, AR, and AS), with the Assistant Secretary for Defense Programs being the major sponsor.

In addition, under the AP activity code, ORNL will provide consultation to the State of Kentucky for a demonstration of in-situ grouting of a low-level waste trench. The Field-Scale Demonstration will show that an existing trench can be successfully and safely stabilized. ORNL will consult on overall planning, grout selection and emplacement, data evaluation, and postgrout testing.

AP—Commercial Nuclear Waste Management Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	1.0	1.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Capital Equipment	0.2		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Construction	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for major programs	1.2	1.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Direct Personnel	9.4		0.0		0.6		0.6		0.6		0.6		0.6		0.6	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986-FY 1989 amounts are in constant FY 1985 dollars.

AS—Nuclear Fuel Cycle

The predominant activity under the Nuclear Fuel Cycle Program is development of nuclear fuel reprocessing. Reprocessing development, centered on the Consolidated Fuel Reprocessing Program (CFRP), is one of ORNL's most important efforts. ORNL manages the national effort in reprocessing R&D for DOE in the CFRP. ORNL's experienced designers and engineers have made, and will continue to make, significant contributions to this technology with their innovative improvements. The Breeder Reprocessing Engineering Test, a major new DOE initiative, provides a clear focal point for this development program.

BRET will demonstrate advanced reprocessing technology and closing of the fuel cycle with spent fuel from the Fast-Flux Test Facility (FFTF) and other demonstration reactors. The project, a joint effort with the Hanford Engineering Development Laboratory (HEDL), will be installed in an existing facility at Hanford, Washington. It will be a limited-scale, 100-kg/d facility. BRET will be both a technical and administrative challenge. From the technical standpoint, several major ongoing development activities must be completed and process equipment must be installed in an existing confined space on a reasonably short schedule. Hot operation is planned for the early 1990s. Because advanced remote maintenance methods must be used, the related R&D at ORNL must be successful and timely. ORNL will design, procure, and test the bulk of the processing equipment before it is sent to HEDL. The Integrated Equipment Test (IET) Facility at ORNL will be instrumental in this development and proof testing.

The administrative challenge of BRET has two aspects. First, organization and responsibility for BRET must be divided between two field offices (Oak Ridge Operations and Richland Operations) and two contractors (ORNL and HEDL). The resulting complex management situation will require continued attention and thoughtful cooperation to ensure success of the project. Second, the current funding strategy for BRET involves a combination of operating, equipment, and capital funds. This funding method will require careful planning and coordination among the project participants and with DOE and congressional staffs to ensure that appropriations are supplied, as needed, over the life of the project.

With the overall slower pace of the breeder program in the United States, the BRET project provides an outstanding opportunity for closing the fuel cycle for existing reactors and an excellent test bed for many of the advanced concepts that have been under development for several years at ORNL. BRET will be the focal point of the fuel cycle efforts for the next 10 to 15 years. Beyond this time frame, activities will depend on future decisions with respect to the breeder program. Efforts to foster international collaboration and examine the merits of cooperative fuel cycle projects in the future will continue. Major new agreements signed this past year with Japan enable collaboration in experimental criticality work and in application of remote technology to reprocessing. Japan (Power Reactor and Nuclear Fuel Development Corporation) will provide major funding for the criticality program. Activities under the United Kingdom exchange have continued.

A small part of the AS Program funding provides a portion of the total funding for the IDB. The AS portion amounts to about 5% of the IDB total. Support for the IDB cuts across many functional areas, with the AR [Assistant Secretary for Defense Program (ASDP)] Program representing the largest single source of funding (50%).

AS—Nuclear Fuel Cycle Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	22.9	22.6	20.7	21.1	25.6	25.3	25.6	25.3	25.7	25.4	26.4	26.4	26.4	26.4	26.5	26.5
Capital Equipment	3.0		3.6		3.0		10.0		3.0		3.0		3.0		3.0	
Construction	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for major programs	25.9	22.6	24.3	21.1	28.6	25.3	35.6	25.3	28.7	25.4	29.4	26.4	29.4	26.4	29.5	26.5
Direct Personnel	131.6		115.3		130.2		142.4		145.4		152.4		152.4		153.4	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986–FY 1989 amounts are in constant FY 1985 dollars.

CD—Uranium Enrichment

This program is concerned with recovery of uranium as a by-product from wet-process phosphoric acid production in the fertilizer industry. Although the method is being used extensively in the commercial sector, ORNL is seeking further improvements to make the process more amenable to the smaller operator. This activity will be terminated after FY 1985.

CD—Uranium Enrichment Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	0.5	0.4	0.4	0.5	0.05	0.05	0.06	0.06	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Capital Equipment	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Construction	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for major programs	0.5	0.4	0.4	0.5	0.05	0.05	0.06	0.06	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Direct Personnel	1.0		0.8		0.3		0.4		0.0		0.0		0.0		0.0	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986-FY 1989 amounts are in constant FY 1985 dollars.

DA/DB—Nuclear Waste Disposal Activities/Nuclear Waste Fund

Program DA was created in FY 1983 to fund terminal isolation development studies and environmental characterization of selected regions considered eligible for siting of nuclear waste repositories. This work was funded in FY 1982 in Program AP but is included here for the purpose of continuity. In mid-FY 1983 the entire program was folded into a new program, DB, which was created to accommodate the tasks involved in the Nuclear Waste Fund Program established by the National Waste Policy Act of 1982. The principal new task, which is planned to commence in FY 1984, will be generic in nature; its major thrust will be to examine the feasibility of utilizing argillaceous rock that occurs in the eastern United States as a host medium for the storage of radioactive waste. The investigation will begin with an extensive literature survey followed by a careful selection of suitable candidates for detailed physical and chemical characterization. Operating costs are expected to be \$1.9M in FY 1984, with a step to \$2.8M in FY 1985.

DA—Nuclear Waste Disposal Activities Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	0.8	0.8	0.0	0.09	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Capital Equipment	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Construction	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for major programs	0.8	0.8	0.0	0.09	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Direct Personnel	6.5		0.0		0.0		0.0		0.0		0.0		0.0		0.0	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986-FY 1989 amounts are in constant FY 1985 dollars.

DB—Nuclear Waste Fund Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	0.0	0.0	0.7	0.5	2.3	1.9	3.3	2.8	3.7	3.5	6.0	5.4	5.6	5.6	5.6	5.6
Capital Equipment	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Construction	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for major programs	0.0	0.0	0.7	0.5	2.3	1.9	3.3	2.8	3.7	3.5	6.0	5.4	5.6	5.6	5.6	5.6
Direct Personnel	0.0		4.4		11.0		17.5		23.0		35.5		36.7		36.7	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986–FY 1989 amounts are in constant FY 1985 dollars.

Assistant Secretary for Defense Programs

The major effort for this office is in defense waste management and may be divided into two main categories: (1) management of wastes generated at ORNL and (2) materials production involving administration of the national repository for uranium-233 and (in the short term) conversion of 100 kg of uranium from liquid to inert solid. The ORNL Fusion Program will also receive some funding through the ASDP for a gyrotron development project for FY 1984–FY 1986. This funding is incorporated in the GE Program budget (see Table 7) but will be subcontracted.

Table 7. ASDP Major Program summary^a
(\$ in Millions—BA)

B&R code	Major programs	FY 1983	FY 1984	FY 1985
AR	Defense Waste Management	24.76	24.73	25.14
GC	Verification and Control Technology	0.07	0.03	0.03
GD	Nuclear Materials Security and Safeguards	0.04	0.0	0.0
GE	Materials Production	5.65	9.20	10.86
Total		30.52	33.96	36.03
Percent of total Laboratory funding—BA		8.6	8.6	7.7

^aFigures include operating BA, capital equipment, and funded/budgeted construction.

AR—Defense Waste Management

The long-term objective of the ORNL waste management operations program is to ensure that radioactive waste generated at ORNL will be stored or disposed of in a safe and environmentally acceptable manner. The operating expense budget authority is scheduled to increase between FY 1984 and FY 1985 primarily because of intensified activity in the storage and disposal operations and decontamination and decommissioning areas. A significant drop is expected in FY 1986, after which time the budget will remain constant.

AR—Defense Waste Management Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	15.7	16.3	18.5	18.3	19.3	19.6	23.5	22.7	21.5	21.6	21.0	21.2	20.5	20.6	20.2	20.2
Capital Equipment	0.5		1.3		1.4		1.6		1.2		1.0		0.9		0.9	
Construction ^b	7.0		5.0		4.0		0.0		0.0		0.0		0.0		0.0	
Total for major programs	23.2	16.3	24.8	18.3	24.7	19.6	25.1	22.7	22.7	21.6	22.0	21.2	21.4	20.6	21.1	20.2
Direct Personnel	120.6		126.5		128.0		132.0		129.0		128.0		127.0		124.0	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986–FY 1989 amounts are in constant FY 1985 dollars.

^bDoes not include proposed construction.

Program Construction. The Radioactive Waste Facilities Improvement project is funded and ongoing. A Central Waste Disposal Facility is proposed as an FY 1986 line-item project. In addition, FY 1983–FY 1989 waste management GPP funding is, for the purposes of this plan, treated as proposed construction.

AR—Funded construction summary

(\$ in Millions)	FY 1982	FY 1983	FY 1984	FY 1985	FY 1986	FY 1987	FY 1988	FY 1989	TEC
Radioactive waste facilities improvements	7.0	5.0	4.0						22.3
Total funded construction	7.0	5.0	4.0						22.3

AR—Proposed construction summary

(\$ in Millions)	FY 1982	FY 1983	FY 1984	FY 1985	FY 1986	FY 1987	FY 1988	FY 1989	TEC
Central Waste Disposal Facility					1.0	3.5	3.0		7.5
Waste Management GPP	0.8	2.0	1.8	2.5	2.5	2.5	2.5	2.5	NA ^a

^aNA = not applicable.

GC—Verification and Control Technology

This program is a very minor effort but will continue as long as various agencies remain interested in the general area of verification and control of technology. The program is expected to continue on a yearly basis throughout the planning cycle.

GC—Verification and Control Technology Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	0.06	0.05	0.07	0.05	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Capital Equipment	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Construction	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for major programs	0.06	0.05	0.07	0.05	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Direct Personnel	0.5		0.4		0.1		0.1		0.1		0.1		0.1		0.1	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986–FY 1989 amounts are in constant FY 1985 dollars.

GD—Nuclear Materials Security and Safeguards

Funding in this program is expected to be terminated with the completion of the resin bead loading verification tests.

GD—Nuclear Materials Security and Safeguards Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	0.20	0.17	0.04	0.04	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Capital Equipment	0.03		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Construction	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for major programs	0.23	0.17	0.04	0.04	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Direct Personnel	1.4		0.5		0.0		0.0		0.0		0.0		0.0		0.0	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986–FY 1989 amounts are in constant FY 1985 dollars.

GE—Materials Production

This program primarily encompasses ORNL's uranium-233 activities; these are divided into two tasks. The first is routine operation of the uranium-233 National Repository, which supplies various experimenters in the United States with the isotope, as directed by DOE through ORO. Any unused material from scrap generated by experimental studies is also recovered. This effort is expected to remain at the current level for the foreseeable future and will be the major contribution to this program in FY 1988 and FY 1989.

The second activity is the installation and operation of a facility capable of converting 1000 kg of uranium (composed mainly of the fissile isotopes of uranium) from a liquid to an inert solid. Engineering design and fabrication of the processing equipment have been completed, and installation and check-out are scheduled for completion in FY 1985. Processing is expected to begin in FY 1985, and the project is expected to be completed by FY 1987.

Additional funding amounting to \$2 million in FY 1984 and \$2.5 million in FY 1985 and FY 1986 has been incorporated into the GE program budget to cover a new gyrotron development task. The

ORNL Fusion Program will receive this funding through the ASDP to combine with the existing program funded by the Office of Fusion Energy. The application is for isotope separation for military fuel processing. All of this funding is scheduled to be subcontracted.

GE—Materials Production Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	5.2	5.8	5.6	5.2	9.1	9.4	10.7	10.1	6.6	7.0	3.0	3.1	2.4	2.4	2.4	2.4
Capital Equipment	0.2		0.04		0.14		0.14		0.16		0.16		0.16		0.16	
Construction	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for major programs	5.4	5.8	5.6	5.2	9.2	9.4	10.8	10.1	6.8	7.0	3.2	3.1	2.6	2.4	2.6	2.4
Direct Personnel	49.0		32.5		34.5		36.7		31.5		23.0		18.5		18.5	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986-FY 1989 amounts are in constant FY 1985 dollars.

Assistant Secretary for Conservation and Renewable Energy (ASCE)

ORNL's activities for ASCE encompass ten program categories covering a diversity of conservation and renewable energy topics. In general, renewable energy categories have been receiving decreasing emphasis, while conservation categories have become strongly focused on long-range generic research (see Table 8). The substantial increase in the budget for FY 1984 is due to the construction of the HTML.

Table 8. ASCE Major Program summary^a
(\$ in Millions—BA)

B&R code	Major programs	FY 1983	FY 1984	FY 1985
AK	Electric Energy Systems	4.58	4.47	4.80
AL	Energy Storage Systems	1.61	1.28	1.43
AM	Geothermal	0.03	0.59	0.65
CE	Hydropower	0.60	0.0	0.0
EB	Solar Energy	3.81	5.24	5.26
EC	Buildings and Community Systems	10.52	10.36	9.26
ED	Industrial	0.55	1.88	2.46
EE	Transportation	2.66	14.71	15.75
EF	State/Local	0.60	0.86	0.50
EG	Multisector	3.50	3.24	3.30
Total		28.46	42.63	43.41
Percent of total Laboratory funding—BA		8.0	10.7	9.2

^aFigures include operating BA, capital equipment, and funded/budgeted construction.

AK—Electric Energy Systems

Most of the activities in the AK program deal with power systems technology. The purpose is to investigate new concepts and develop future technology for the electric utility industry. These technologies offer opportunities to improve the efficiency of the electric energy system both economically and through resource conservation. The activities are currently organized into seven major task areas: gaseous dielectrics, automation and control, new technology integration, electric power delivery, materials, electromagnetic pulse, and human-risk analysis. Significant accomplishments during the year were the development of improved metal oxide varistors and the measurement of peak temperature along an optical fiber for detection of transformer hot spots. In the future, the tasks related to electric power delivery and technology integration will be deemphasized, while the electromagnetic pulse and risk analysis work will increase.

AK—Electric Energy Systems Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	3.8	5.9	3.2	5.3	4.5	7.5	4.8	5.3	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Capital Equipment	0.1		1.4		0.0		0.9		0.0		0.0		0.0		0.0	
Construction	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for major programs	3.9	5.9	4.6	5.3	4.5	7.5	4.8	5.3	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Direct Personnel	15.6		14.4		18.7		18.3		17.2		17.2		17.2		17.2	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986–FY 1989 amounts are in constant FY 1985 dollars.

AL—Energy Storage Systems

In the area of thermal energy storage, ORNL has been assigned responsibility for building heating and cooling applications and for industrial applications. Program objectives have been identified as follows: to develop (1) concepts allowing heat pump thermal storage, (2) allowing significantly increased reuse of high-temperature industrial reject heat, (3) concepts suitable for passive solar heat storage and (4) a data base for new heat storage materials and processes.

AL—Energy Storage Systems Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	1.5	3.4	1.6	2.4	1.2	1.4	1.4	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Capital Equipment	0.10		0.0		0.08		0.03		0.03		0.03		0.03		0.03	
Construction	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for major programs	1.6	3.4	1.6	2.4	1.3	1.4	1.4	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Direct Personnel	10.8		7.4		4.2		5.2		5.0		5.0		5.0		5.0	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986–FY 1989 amounts are in constant FY 1985 dollars.

AM—Geothermal

Our contributions to geothermal research are in two areas. First, we investigate experimentally and analytically the potential for enhanced heat transfer to improve the performance of systems operating with relatively low temperature differences. Second, we examine proposed installations to ensure that the associated environmental impacts are within acceptable limits. Geothermal program work is expected to remain stable at a level of 3.7 FTEs.

AM—Geothermal Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	0.21	0.43	0.03	0.25	0.59	0.57	0.65	0.62	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63
Capital Equipment	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0	
Construction	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for major programs	0.21	0.43	0.03	0.25	0.59	0.57	0.65	0.62	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63
Direct Personnel	3.7		1.9		3.7		3.7		3.7		3.7		3.7		3.7	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986-FY 1989 amounts are in constant FY 1985 dollars.

CE—Hydropower

The purpose of our work in the CE program is to provide technical assistance to DOE for resolution of specific environmental issues associated with small hydropower development. The focus of the FY 1984 work will be to continue our instream flow research and turbine-related fish mortality studies. At this time, FY 1985 support remains uncertain.

CE—Hydropower Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	0.40	0.36	0.6	0.5	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Capital Equipment	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Construction	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for major programs	0.40	0.36	0.6	0.5	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Direct Personnel	3.3		4.5		2.5		0.0		0.0		0.0		0.0		0.0	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986-FY 1989 amounts are in constant FY 1985 dollars.

EB—Solar Energy

The principal ORNL activity in solar energy is the technical management of the Short Rotation Woody Crops Program, which consists of long-term research on the production of woody and herbaceous biomass. Research concentrates on species screening and genetic studies, stand establishment and management, and economic studies. The program also includes regional resource

evaluations, nutrient utilization studies, the evaluation of environmental effects of whole-tree harvesting, and participation in international cooperative agreements. Much of the work is subcontracted. After FY 1985, the Short Rotation Woody Crops Program will be evaluated vis-à-vis the respective roles of government and industry.

ORNL participation in other solar programs is limited to tasks in which specific expertise is available, including technical assistance on photovoltaic projects, analysis of wind energy systems, and environmental analysis for alcohol fuels projects. Both the Solar Applications for Buildings (EB01) and the Alcohol Financial Assistance (EB11) programs are expected to be phased out after FY 1984 and FY 1983, respectively. The Solar Applications for Industry (EB02) component is projected to continue as the major focus of the program throughout the planning cycle along with a small but constant effort in Solar Applications for Power (EB03).

EB—Solar Energy Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	5.0	5.9	3.8	3.9	5.2	4.7	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
Capital Equipment	0.2		0.01		0.05		0.05		0.05		0.05		0.05		0.05	
Construction	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for major programs	5.2	5.9	3.8	3.9	5.2	4.7	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
Direct Personnel	21.4		8.3		7.9		6.0		6.0		6.0		6.0		6.0	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986–FY 1989 amounts are in constant FY 1985 dollars.

EC—Buildings and Community Systems

ORNL has been assigned technical management responsibility for three programs in the buildings area: Building Thermal Envelope Systems and Insulating Materials (BTESIM), Building Equipment Research (BER), and Residential Conservation Service (RCS). The BTESIM Program was initiated in response to the need of the insulation and building communities for relevant technical information on the thermal performance of building-envelope systems and in recognition of the impact that improved thermal performance of buildings would have on energy conservation. A National Program Plan, which was developed jointly by DOE, ORNL, and National Bureau of Standards (NBS) with the assistance of industry, forms the basis for selection of research projects. The BER Program seeks to conserve energy by developing improved heating and cooling systems and appliances. BER activities include analytical studies, development of analytical tools, and laboratory and field experiments. The major program areas are vapor-compression systems, nonazeotropic refrigerant mixtures, ground-coupled heat pumps, absorption and Stirling cycle systems, internal-combustion (IC)-engine-driven heat pumps, fossil-fueled water heaters, and advanced insulation. The RCS program consists of providing DOE with the technical management functions for implementation of the congressionally mandated building-retrofit program. It is expected that ORNL participation in R&D in this program will end in FY 1984. Other activities in the Buildings and Community Systems area include development of the anaerobic packed-bed bioreactor (ANFLOW) process and projects in energy-use analysis.

EC—Buildings and Community Systems Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	13.0	13.5	10.5	10.8	9.5	10.1	8.8	8.9	9.0	9.3	9.0	9.0	9.0	9.0	9.0	9.0
Capital Equipment	0.05		0.0		0.86		0.46		0.10		0.10		0.10		0.10	
Construction	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for major programs	13.0	13.5	10.5	10.8	10.4	10.1	9.3	8.9	9.1	9.3	9.1	9.0	9.1	9.0	9.1	9.0
Direct Personnel	44.4		43.0		45.4		36.5		23.0		21.0		21.0		21.0	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986-FY 1989 amounts are in constant FY 1985 dollars.

ED—Industrial

ORNL is currently responsible for two projects under Industrial Energy Conservation. The first of these, Materials for Waste Heat Utilization, provides materials technology support to the Waste Energy Utilization Branch and its contractors in support of recuperator development and in developing improved ceramic technologies. In the second project, Chemical Heat Pumps, the objective is to develop chemical heat-pump technology for recovering industrial and process waste heat. In this project, an innovative absorption heat pump for industrial waste heat recovery has been designed and tested. Activities under the ED02 activity code (Industrial Process Efficiency) are being phased out, while ED01 (Waste Energy Reduction) activities project an increase to an annual level of \$2.4 million, which is to be maintained throughout the planning cycle.

ED—Industrial Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	2.1	0.8	0.6	1.4	1.8	2.0	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Capital Equipment	0.0		0.0		0.08		0.06		0.06		0.06		0.06		0.06	
Construction	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for major programs	2.1	0.8	0.6	1.4	1.9	2.0	2.5	2.4	2.5	2.4	2.5	2.4	2.5	2.4	2.5	2.4
Direct Personnel	4.6		9.0		11.5		10.0		10.0		10.0		10.0		10.0	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986-FY 1989 amounts are in constant FY 1985 dollars.

EE—Transportation

Programs for the Office of Vehicles and Engines Research and Development include the development of ceramic technology for advanced heat engines and the analysis of transportation data related to energy use. A principal activity of the heat-engine ceramics program has been the preparation of a multiyear program plan. Implementation of the plan will involve five principal program elements: program management and coordination, materials and processing, material design methodology, data base/life prediction, and technology transfer.

Funding for construction of the HTML is currently budgeted under this program. It is anticipated that extensive use of the new laboratory will also be made under the KC02 (Materials Sciences) Program funded by OER.

EE—Transportation Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	0.6	0.3	2.7	1.1	5.5	3.9	6.6	6.3	8.0	8.0	08.0	8.0	8.0	8.0	8.0	8.0
Capital Equipment	0.0		0.0		0.2		0.2		0.2		00.2		0.2		0.2	
Construction	0.0		0.0		9.0		9.0		2.6		0.0		0.0		0.0	
Total for major programs	0.6	0.3	2.7	1.1	14.7	3.9	15.8	6.3	26.5	8.0	8.2	8.0	8.2	8.0	8.2	8.0
Direct Personnel	2.7		11.1		14.2		15.1		18.0		18.0		18.0		18.0	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986–FY 1989 amounts are in constant FY 1985 dollars.

EE—Budgeted construction summary

(\$ in Millions)	FY 1983	FY 1984	FY 1985	FY 1986	FY 1987	FY 1988	FY 1989	TEC
High Temperature Materials Laboratory		9.0	9.0	2.6				20.6

EF—State/Local Programs

ORNL assignments in State/Local Programs have been to assist DOE in the evaluation of the effectiveness of several of the programs. These have included State Energy Conservation programs and the Schools and Hospitals Program. Work projected for the future includes evaluations of the Weatherization Program and continuing assistance to DOE in conducting cross-program evaluations.

EF—State/Local Programs Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	0.4	0.9	0.6	0.5	0.9	0.8	0.5	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Capital Equipment	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Construction	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for major programs	0.4	0.9	0.6	0.5	0.9	0.8	0.5	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Direct Personnel	3.7		4.3		6.0		4.0		3.0		3.0		3.0		3.0	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986–FY 1989 amounts are in constant FY 1985 dollars.

EG—Multisector

ORNL has been assigned technical management responsibility for the Materials Project and the Tribology Project—both in the area of Energy Conversion and Utilization Technology. Under the Materials Project, research is being conducted on high-temperature materials, lightweight materials, and materials properties modeling. Accomplishments in this project include the recovery of

automobile scrap materials for use as binder fibers in plastic molding and contributions to the development of a ductile form of the intermetallic compound, Ni_3Al . Under the Tribology Project, the work elements are mechanisms and design. Both projects consist of exploratory and applied research efforts that are often conducted by experts in universities and industry. An additional project within the Multisector Program is the evaluation of results obtained through the Energy Related Inventions Program. Only the EG05 (Energy Conversion Technology) Program component is expected to maintain a major level of activity throughout the planning cycle.

EG—Multisector Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	1.1	0.9	3.5	2.0	2.9	2.9	2.7	2.8	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
Capital Equipment	0.14		0.0		0.3		0.6		0.0		0.0		0.0		0.0	
Construction	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for major programs	1.2	0.9	3.5	2.0	3.2	2.9	3.3	2.8	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
Direct Personnel	4.4		9.1		12.5		10.4		10.0		10.0		10.0		10.0	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986-FY 1989 amounts are in constant FY 1985 dollars.

Assistant Secretary for Fossil Energy (ASFE)

ORNL's programs for the ASFE cover three major areas—coal, petroleum, and alternate fuels. The Coal Program (AA) is, however, the primary focus of the Laboratory's fossil energy activities (see Table 9). The coal budget is anticipated to increase substantially with the addition of the Fossil Energy Technology Environmental Program.

Table 9. ASFE Major Program summary^a
(\$ in Millions—BA)

B&R code	Major programs	FY 1983	FY 1984	FY 1985
AA	Coal	8.97	10.14	16.44
AB	Gas	0.1	0.0	0.0
AC	Petroleum	0.005	0.0	0.0
CH	Alternate Fuels Production	0.06	0.15	0.62
Total		9.14	10.29	17.06
Percent of total Laboratory funding—BA		2.6	2.6	3.6

^aFigures include operating BA, capital equipment, and funded/budgeted construction.

AA—Coal

ORNL's work in the Coal Program involves several areas of activity. In the Control Technology and Coal Preparation subprogram (AA05), current work is being closed out, but a small effort

(about 2 FTEs) is projected to resume in analysis and evaluation of coal preparation technology. The Advanced Research and Technology Development (AR&TD) effort (AA15) is a well-established activity covering research, analysis, and evaluation of coal-conversion technologies; strategic planning support; and management (with ORO) of the National Fossil Energy Materials Program. This area also provides some support for environmental and effluent control technology tasks. Overall support in AA15 is projected to increase somewhat (to about 25 FTEs) as additional process technology research is carried out to help maintain a balanced effort at ORNL and an appropriate in-house expertise to support analysis tasks.

Work in the Liquefaction subprogram (AA25) currently involves primarily research on the bioactivity of coal liquids, with some R&D related to process technology and components. In addition, the FY 1982–FY 1987 ORNL *Institutional Plan* contained a new initiative titled “Environmental Control Technology.” This initiative has been pursued by ORNL in subsequent years. Funding is now beginning to develop in this area, which currently bears the title, “Fossil Energy Technology Environmental Program.” A substantial increase to about 34 FTEs is projected for this area by FY 1986. Some relatively minor support for materials R&D in liquefaction is also projected in this area.

In the Combustion Systems subprogram (AA35), the current effort is a closeout of analytic studies of pressurized and atmospheric fluidized-bed combustion (FBC) systems. Currently, no additional work is projected for this area. The small effort of the Heat Engines and Heat Recovery subprogram (AA55) is projected to end FY 1984. Work on the Surface Coal Gasification subprogram (AA85) currently involves components technology and materials technology. Only the materials effort is continuing in FY 1984, and a generally stable support level (of about 6 FTEs) is anticipated for that work.

AA—Coal Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	11.4	13.3	8.9	10.1	9.6	10.4	15.9	14.7	15.9	15.9	15.9	15.9	15.9	15.9	15.9	15.9
Capital Equipment	0.2		0.1		0.5		0.5		0.7		0.7		0.7		0.7	
Construction	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for major programs	11.6	13.3	9.0	10.1	10.1	10.4	16.4	14.7	16.6	15.9	16.6	15.9	16.6	15.9	16.6	15.9
Direct Personnel	72.7		51.0		45.7		60.8		66.2		66.2		66.2		66.2	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986–FY 1989 amounts are in constant FY 1985 dollars.

AB—Gas

Minor funding was provided in this area in FY 1983 for a task to be performed in FY 1984. This task is related to economic and technical evaluations of processes. Further funding in this area is not currently anticipated.

AB—Gas Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Capital Equipment	0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Construction	0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for major programs	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Direct Personnel	0.0		0.0		0.0		0.0		0.0		0.0		0.0	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986-FY 1989 amounts are in constant FY 1985 dollars.

AC—Petroleum

This work involved research on amphiphilic compounds for use in the micellar flood approach to enhanced oil recovery. The FY 1983 effort represented a closeout of prior activity.

AC—Petroleum Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	0.2	0.1	0.0	0.03	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Capital Equipment	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Construction	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for major programs	0.2	0.1	0.0	0.03	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Direct Personnel	0.7		0.2		0.0		0.0		0.0		0.0		0.0		0.0	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986-FY 1989 amounts are in constant FY 1985 dollars.

CH—Alternate Fuels Production

This activity provides support to the Morgantown Energy Technology Center in mathematical modeling of coal gasification process technologies. This effort is expected to recover to a level of about 3 FTEs.

CH—Alternate Fuels Product Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	0.3	0.2	0.06	0.55	0.14	0.18	0.6	0.4	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Capital Equipment	0.0		0.0		0.01		0.02		0.02		0.02		0.02		0.03	
Construction	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for major programs	0.3	0.2	0.06	0.55	0.15	0.18	0.6	0.4	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Direct Personnel	0.9		0.2		0.7		1.8		3.4		4.3		3.4		3.4	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986-FY 1989 amounts are in constant FY 1985 dollars.

Energy Information Administration (EIA)

ORNL provides both research and management support for EIA to help meet the needs of energy policymakers. Our EIA activities are considerably reduced from previous levels, and now encompass only two program codes (TA and TB) (see Table 10).

Table 10. Energy Information Administration Major Program summary^a
(\$ in Millions—BA)

B&R code	Major programs	FY 1983	FY 1984	FY 1985
TA	Collection, Production and Analysis	0.50	1.00	1.80
TB	Program Services	0.0	0.40	0.39
Total		0.50	1.40	2.19
Percent of total Laboratory funding—BA		0.1	0.4	0.5

^aFigures include operating BA, capital equipment, and funded/ budgeted construction.

TA—Collection, Production, and Analysis; TB—Program Services

In the past, ORNL's programs in support of EIA have drawn upon multidisciplinary teams from both inside and outside the Laboratory. The work has consisted of evaluation, assembly, and analysis of data and information relevant to production and use of energy in the United States. Support has been provided to each EIA office that does work in areas where the Laboratory has both interest and experience. A major accomplishment this year was the in-house review of a requirements data study, *Alternate Fuels Information Review of Requirements*. In the future, these programs are expected to decrease and to primarily involve analysis and assessment activities for which in-house expertise is available. Funding for a task which is being reprogrammed from ASNE to EIA is expected to begin this year, however. This work will entail doing a uranium industry viability study, and will continue through the planning cycle.

TA/TB—EIA Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982 ^b		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	9.7	6.4	0.5	4.9	1.4	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
Capital Equipment	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Construction	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for major programs	9.7	6.4	0.5	4.9	1.4	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
Direct Personnel	10.8		14.5		9.0		9.0		9.0		9.0		9.0		9.0	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986–FY 1989 amounts are in constant FY 1985 dollars.

^bIncludes all EIA B&R codes.

Assistant Secretary for Environmental Protection, Safety, and Emergency Preparedness (ASEP)

The ORNL programs funded by ASEP cover environmental monitoring, research, analysis, and emergency preparedness support (Table 11). In the past, the largest component was the RASCA Program; however, the responsibility for RASCA will be transferred to the Assistant Secretary for Nuclear Energy for FY 1984.

Table 11. ASEP Major Program summary^a
(\$ in Millions—BA)

B&R code	Major programs	FY 1983	FY 1984	FY 1985
HA01	Environment, Safety, and Health	3.61	2.05	2.57
UB02	Power Supply and Reliability	0.0	0.40	0.25
Total		3.61	2.45	2.82
Percent of total Laboratory funding—BA		1.0	0.6	0.6

^aFigures include operating BA, capital equipment, and funded/budgeted construction.

HA01—Environment, Safety, and Health

No major shifts are expected in the remaining programs for environmental policy studies and analysis and environmental technical assistance. For six years, ORNL has supported the Office of Environmental Analyses in DOE in the development of energy resource assessment models and in the provision of background research for various energy policy issues. This support will continue. The sponsors of the Emergency Technology Program (ETP) plan to increase the research component of the program. Under the ETP, ORNL personnel review and assist in emergency planning and preparedness for environmental protection and public safety.

A new program, the Computation Performance Assessment Program, is utilizing existing expertise at ORNL in nuclear criticality safety analysis to examine a long-standing discrepancy between critical experiments with aqueous solutions of fissile materials and calculations of the experiments. The assessment requires research in the physics of criticality, modeling neutronics, computer programming, and calculations. The program is scheduled to run through the first quarter of FY 1984. Funding is also expected for a complementary program that entails experimentally testing the applicability of the ²⁵²Cf-source-driven neutron noise analysis method for monitoring for the criticality safety of large arrays of interacting units. Demonstration of feasibility for this application would allow implementation of this subcriticality monitoring method to a variety of nuclear fuel plant applications associated with chemical processing and fuel storage.

HA01—Environment, Safety, and Health Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	6.0	5.8	3.5	3.8	2.0	2.0	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Capital Equipment	0.01		0.08		0.05		0.07		0.1		0.1		0.1		0.1	
Construction	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for major programs	6.0	5.8	3.6	3.8	2.1	2.0	2.6	2.5	2.6	2.5	2.6	2.5	2.6	2.5	2.6	2.5
Direct Personnel	36.5		24.3		10.0		12.0		12.0		12.0		12.0		12.0	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986–FY 1989 amounts are in constant FY 1985 dollars.

UB02—Power Supply and Reliability

During FY 1981 and FY 1982, ORNL supported the Office of Energy Emergencies in the analysis of various energy emergency preparedness options, and this support will resume in FY 1984. Activities will include studies of electrical equipment availability in the event of a major equipment accident or incident.

UB02—Power Supply and Reliability Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	0.0	0.4	0.0	0.0	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Capital Equipment	0.0		0.0	0.0	0.0		0.0		0.0		0.0		0.0		0.0	
Construction	0.0		0.0	0.0	0.0		0.0		0.0		0.0		0.0		0.0	
Total for major program	0.0	0.4	0.0	0.0	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Direct Personnel	0.0	1.8	0.0	0.0	0.3		0.2		0.2		0.2		0.2		0.2	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986–FY 1989 amounts are in constant FY 1985 dollars.

Office of Policy, Planning, and Analysis

Work for the Office of Policy, Planning, and Analysis is at a very modest level and is not expected to increase significantly. It involves work on energy-demand models and analyses that apply in the transportation and industrial sectors as well as work on an oil cartel model. Under sponsorship of the Division of Policy and Strategic Planning (under ASFE), ORNL and its subcontractors (Decision Focus, Inc., and Lewin and Associates) have also developed computer models of liquid and gaseous fuel supplies. These models provide a quantitative assessment of competitive supply technologies. They thus contribute to the development of the knowledge base required to reduce the vulnerability of the U.S. energy supply to disruptions potentially resulting from reliance on scarce and increasingly expensive conventional petroleum reserves. Only a single B&R code (PE01) is involved.

PE—Policy, Analysis, and Systems Studies Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	0.2	0.3	0.04	0.08	0.15	0.10	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Capital Equipment	0.0		0.0		0.01		0.0		0.0		0.0		0.0		0.0	
Construction	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for major programs	0.2	0.3	0.04	0.08	0.16	0.10	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Direct Personnel	0.3		0.2		0.5		0.8		1.0		1.0		1.0		1.0	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986-FY 1989 amounts are in constant FY 1985 dollars.

Federal Energy Regulatory Commission (FERC)

ORNL's efforts for FERC are very modest, but they are projected to be stable throughout the planning cycle. Work primarily involves technical support to the Office of Electric Power Regulation in the area of National Environmental Policy Act (NEPA) compliance. This year, ORNL began a Draft Environmental Impact Statement for the Susitna hydroelectric project in Alaska. Budget authorization is currently under only one B&R code (VP). ORNL is, however, prepared to expand its work for FERC should the need for additional support become clear.

VP—FERC Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	0.0	0.03	0.3	0.3	0.7	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Capital Equipment	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Construction	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for major programs	0.0	0.03	0.3	0.3	0.7	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Direct Personnel	0.0		2.4		3.6		3.5		3.5		3.5		3.5		3.5	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986-FY 1989 amounts are in constant FY 1985 dollars.

^bCovers VI01 program, which has no new BA in FY 1983.

Assistant Secretary for Management and Administration (ASMA)

ORNL currently has a minor amount of funding from ASMA under two B&R codes (LA01 and WB00). The LA01 category covers activity related to DOE's Technical Information Center (TIC). This funding is expected to increase moderately throughout the planning cycle. The WB00 category covers an In-House Energy Management activity, which is scheduled for phaseout in FY 1984.

LA/WB—ASMA Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	1.0	0.7	0.9	0.9	1.1	1.1	1.2	1.2	1.3	1.2	1.3	1.3	1.4	1.3	1.4	1.4
Capital Equipment	0.1		0.06		0.1		0.1		0.0		0.0		0.0		0.0	
Construction			0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for ASMA programs	1.1	0.7	1.0	0.9	1.2	1.1	1.3	1.2	1.3	1.2	1.3	1.3	1.4	1.3	1.4	1.4
Direct Personnel	0.3		0.4		0.0		0.0		0.0		0.0		0.0		0.0	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986–FY 1989 amounts are in constant FY 1985 dollars.

For purposes of this plan, Energy Conservation GPP is categorized as proposed construction under program WB. The distribution of this funding over the planning cycle is shown as follows:

WB—Proposed construction summary

(\$ in Millions)	FY 1982	FY 1983	FY 1984	FY 1985	FY 1986	FY 1987	FY 1988	FY 1989
Energy Conservation GPP (WB Program)	0.7	1.5	2.0	2.0	2.0	2.0	1.5	1.0

WORK FOR OTHER DOE INSTALLATIONS

Roughly, \$12.9 million (3.6%) of ORNL's FY 1983 operating and capital equipment BA was categorized as work for other DOE contractors and operations offices. The distribution of funds in this category over the planning cycle by major ORNL program area is given in Table 12.

Table 12. Other DOE contractors and operations offices^a

Program area	FY 1982	FY 1983	FY 1984	FY 1985	FY 1986	FY 1987	FY 1988	FY 1989
Fission	4.3	6.9	5.4	5.4	4.6	4.6	4.6	4.6
Biomedical and Environmental	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5
Basic Physical Sciences	0.2	0.9	0.2	0.3	0.2	0.2	0.2	0.2
Fusion	0.0	0.1	0.2	0.2	0.2	0.2	0.2	0.2
Fossil	2.5	2.8	0.6	0.0	0.0	0.0	0.0	0.0
Assessment and Analysis	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Conservation	0.1	1.6	0.1	0.1	0.5	0.5	0.5	0.5
Total	7.5	12.9	7.0	6.5	6.0	6.0	6.0	6.0
Percent of total Laboratory funding—BA	1.9	3.6	1.9	1.4	1.4	1.4	1.4	1.4

^aFigures include operating BA and capital equipment.

Funding is substantial in only one of these areas. In the Fission area, ORNL is supplying technical assistance to several DOE contractors for a variety of projects. For example, personnel are being used (1) to perform safety analyses for Y-12 facilities used in the weapons program, (2) to contribute to the Gas Centrifuge Enrichment Program (GCEP) and Atomic Vapor Laser Isotope Separation (AVLIS) programs at K-25, and (3) to carry out a series of activities relating to operating LWRs for SNL. Continued funding in such programs is uncertain but is expected to show a gradual decrease through FY 1986 and then remain constant.

In the Fossil area, ORNL has provided substantial additional support to ASFE through activities funded by ORO. This work currently emphasizes technical support for process, materials, and environmental control technologies. This work is, however, expected to be phased out in FY 1984, while further funding for environmental work in fossil energy will be performed under the AA25 B&R code.

Funding in other program areas covers miscellaneous small projects for a large number of DOE contractors and other operations offices.

WORK FOR OTHERS

Nuclear Regulatory Commission

NRC is the largest single non-DOE supporter of ORNL activities. Almost 9% of ORNL's FY 1983 operating and capital equipment budget authorization came from the NRC, and this amounted to over 50% of all the Laboratory's Work for Others.

Through its various programs at ORNL, NRC receives research and technical support in areas in which the Laboratory has demonstrated significant expertise. These areas include structural analysis, materials evaluation, fission product behavior, accident sequence analysis, advanced instrumentation and diagnostics, human factors, reliability and operating data analysis, integrated risk assessment, and radiation dose and health effects. Based on the current NRC budget projections, which show an almost constant level of support for NRC over the next few years, ORNL's effort is expected to remain constant or increase only slightly (see Table 13).

Table 13. NRC Major Program summary
(\$ in Millions—Operating and Capital Equipment BA)

Major program office	FY 1983	FY 1984	FY 1985
Nuclear Reactor Regulation	2.62	2.38	1.73
Administration	0.43	0.42	0.44
Nuclear Materials Safety and Safeguards	2.66	2.67	2.64
Nuclear Regulatory Research	22.08	21.29	22.85
Analysis and Evaluation of Operational Data	1.51	1.78	2.22
Other Offices	0.69	1.04	1.56
Total	29.99	29.58	31.44
Percent of total Laboratory funding	8.5	7.5	6.7

The following descriptions of ORNL activities for NRC are divided into six categories reflecting work for the different offices funding the efforts.

Nuclear Reactor Regulation

As this activity's major task, ORNL assists in administering operator examinations for the Operator Licensing Branch of NRC. Also, the Laboratory provides technical consultation and specialized measurements to test methods for detecting anomalous behavior in LWRs.

Administration

The Laboratory furnishes technical support for this facet of NRC operations through the Radiation Shielding Information Center and the Technical Data Management Center. Both programs are well established and are expected to remain stable through FY 1989.

Nuclear Materials Safety and Safeguards

Our efforts in this area include shipping-cask analysis, environmental assessments of fuel cycle facilities, technical support in geochemical areas related to the licensing of radioactive waste repositories, and survey of metabolic data appropriate to high-level-waste dosimetry. Small increases in funding are expected in environmental assessment tasks and waste management.

Nuclear Regulatory Research

Support for the Office of Nuclear Regulatory Research is the largest NRC program at ORNL. Relatively large efforts are under way for obtaining an improved data base for behavior of fission products and aerosols in severe reactor accident situations and for the long-term behavior of reactor pressure vessels. A slight decrease in ORNL's effort is expected after FY 1985.

The Laboratory is proposing the funding of two new activities in LMFBR research which are logical extensions of our capabilities in LWR safety analyses. The thrust of the first proposal, the LMFBR operational safety program, is to establish a well-planned basic program that integrates diverse technologies such as reactor instrumentation, human factors in operations and maintenance, systems analysis, thermal hydraulics, and probabilistic risk assessment. The main objective is to perform analyses that will reveal operational precursors for serious safety incidents so that technical fixes can be incorporated in the reactor design prior to construction. Initial funding, beginning in FY 1984, is proposed to be \$250K and grow to \$2.5M by FY 1989.

In the LMFBR fission product source-term program, the second proposal, ORNL would thoroughly assess accident progression and determine consequences to operating personnel and to the public by studying fission product chemistry and the behavior of aerosols of fission products and other interacting core and basic materials. Of particular importance is the effect of sodium on the behavior of these chemical systems under a wide range of conditions. Funding is proposed to begin in FY 1984 at \$500K and increase to \$2.5M by FY 1989.

Analysis and Evaluation of Operational Data

Over 70% of the funds from this office support the Sequence Coding and Search System (SCSS) and the Nuclear Safety Information Center (NSIC). The SCSS task involves the development and application of a new system for increasing the usefulness of the descriptive text contained in Licensee Event Reports. The NSIC work provides a focal point for the collection, storage, analysis, and dissemination of operating experimental data relevant to NRC-licensed activities. A moderate increase in funding is forecast for this office in the near term.

To expand and use fully the expertise available in this program, ORNL proposes a new activity using the various data bases from areas such as the Licensee Event Reports and plant maintenance reports. This reliability assurance system would broaden the data bases and the evaluation activities, thus increasing the usefulness of the total system both for NRC and the utilities. When fully implemented, the system is expected to be a user facility. The task will begin in FY 1984 at \$150K and increase to \$500K by FY 1986.

Other Offices

The Laboratory provides technical assistance in the conduct of inventory verification, analysis of special nuclear materials samples, and preparation of site-specific material standards. A slight increase in funding is anticipated.

NRC Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	28.1	27.8	28.8	31.1	29.6	31.7	31.4	28.9	31.5	30.8	31.3	30.9	30.8	30.9	30.2	30.9
Capital Equipment	0.0		0.1		0.0		0.0		0.0		0.0		0.0		0.0	
Construction	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for NRC programs	28.9	27.8	29.9	31.1	29.6	31.7	31.4	28.9	31.5	30.8	31.3	30.9	30.8	30.9	30.2	30.9
Direct Personnel	179.0		179.0		180.2		166.6		175.6		173.7		170.4		167.7	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986-FY 1989 amounts are in constant FY 1985 dollars.

Department of Defense (DOD)

ORNL performs work for four primary branches of DOD—the Army, Navy, Air Force, and Defense Nuclear Agency. This work is projected to grow to a small but significant fraction of the Laboratory's total budget in this planning cycle (see Table 14).

Table 14. DOD Major Program summary
(\$ in Millions—Operating and Capital Equipment BA)

Major program office	FY 1983	FY 1984	FY 1985
Army	2.81	6.52	9.35
Navy	3.70	15.00	17.21
Air Force	0.70	0.73	0.97
Defense Nuclear Agency	<u>0.49</u>	<u>0.50</u>	<u>0.53</u>
Total	7.70	22.75	28.06
Percent of total	2.3	5.7	6.0
Laboratory funding			

Army

ORNL's research for the Army primarily involves physical, chemical, and toxicological characterization of chemicals (and their degradation products) of interest to the Army. Examples include diesel fuel, synthetic and alternative fuels, fog oil, dyes, phosphorus formulations, explosives, and sorbent compounds. Funding for Army programs at ORNL has increased from \$1.6 million in FY 1981 to \$2.8 million in FY 1983, with further increases expected in the coming years. Studies of the adverse health and environmental effects of diesel fuel and military obscurants will be completed in early FY 1984, but we anticipate receiving new work on other substances in the future.

ORNL also began new activities in data management and analysis for the Army in FY 1983. New work for the Military Traffic Management Command focuses on implementation of concepts and tools to allow agencies such as the Army Material Development and Readiness Command and the Army Civilian Personnel Center to integrate state-of-the-art hardware and software data systems into key programs. The aim is to allow such agencies to keep pace with rapidly developing technology vital to effective management, decision-making, and strategic planning.

Other ORNL efforts for the Army include studying the feasibility of using U.S. Army high-volume hazardous waste streams as supplementary feedstocks in industrial boilers, validating data for the Energy Conservation Investment Program, and performing a development study for an Energy Conservation Technical Information and Analysis Center. Our assistance with analysis of environmental matters for the Army Corps of Engineers and the Waterways Experiment Station continues. We have studied possible health and environmental effects of munition wastes and in FY 1984 will begin an assessment of munition production waste disposal methods.

Navy

ORNL work for the Navy continues at steady modest levels in the areas of waste disposal, heat-pump improvements, radiac instruments, and scientific tasks for the Office of Naval Research. Work is growing in the areas of electronic data processing, validation, and methodology for the Navy Regional Data Automation Center, the Navy Sea Systems Command, Naval Air Systems Command, Naval Military Personnel Command, Naval Civilian Personnel Command, and in the Navy Weapons Engineering Support activity. Work has also been initiated for the Navy Material Command on buildings energy use and technology transfer issues, and technology R&D is being

conducted at a low level for the Fuels Technology, Materials Handling, and Information Systems programs in the Navy Supply Systems Command.

In providing research and technical assistance to develop and improve automated data systems, there is an expansion of work at ORNL to bring Navy systems to state of the art in integrated hardware/software technologies. R&D being supported by the Navy also includes concept and methodology development and original research on the building blocks of artificial intelligence and its use, including expert systems, decision support systems, knowledge acquisition, and representation techniques. R&D on data system design, data modeling, and information architecture to improve the quality and responsiveness of technical information systems and models to match increasing demands represents key aspects of technology development in the area. Combining data base management methodology with predictive systems analysis techniques is an integral part of Navy technical support activities. ORNL activities will be enhanced during FY 1984 and FY 1985, with funding being available to establish a data systems resources management laboratory that will consist of advanced data processing and management tools that can be used for system experimentation and prototype system design efforts.

Air Force

As part of a rapidly growing effort, the regional and national cartographic data bases developed and maintained at ORNL are being analyzed to provide a site-screening capability for the MX missile program. Growth is also anticipated in the study of charged-particle interactions with communications materials. Work on computation techniques for sparse matrices is expected to continue at a constant level. Other sizeable Air Force-sponsored projects include an investigation of the suitability of HTGR power sources for deep-based MX missile sites and the development of a generic chemical characterization protocol for hazardous waste disposal practices at DOD facilities.

Defense Nuclear Agency

The major activities in this area are associated with the Radiation Shielding Information Center and with radiation transport studies. Analytical methods and related nuclear data sets for calculating the transport of weapons radiations are developed, evaluated, and disseminated. In addition, specific design-support analyses for difficult problems in radiation shielding are provided. These activities are projected to continue at essentially constant levels.

DOD Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	4.0	4.0	7.7	7.7	20.8	15.5	25.6	21.3	26.0	24.0	26.5	25.5	26.5	26.5	26.5	26.5
Capital Equipment	0.1		0.05		1.9		2.5		1.6		1.5		1.5		1.5	
Construction	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for DOD programs	4.1	4.0	7.7	7.7	22.7	15.5	28.1	21.3	27.6	24.0	28.0	25.5	28.0	26.5	28.0	26.5
Direct Personnel	40.4		42.6		81.1		97.3		99.0		96.0		96.0		96.0	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986-FY 1989 amounts are in constant FY 1985 dollars.

Department of the Interior (DOI)

ORNL conducts research for several DOI organizations: the Bureau of Mines, Office of Water Research and Technology, Office of Surface Mining, U.S. Geological Survey, Bureau of Land Management (BLM), Fish and Wildlife Service, and the National Park Service. A new interagency agreement was initiated in September 1983 to provide BLM with technical assistance and research support in the areas of natural resource management; analysis and assessment; and data system design, development, and implementation. This new work will substantially increase ORNL's total funding from DOI to a level of about \$2.5 million in FY 1984. In addition, work was initiated for the Minerals Management Service's (MMS's) Royalty Management Program in October 1982 and the Laboratory may also be asked to assume a support role for the Bureau of Indian Affairs in the preparation of environmental compliance documents required under NEPA.

During FY 1983, a major effort was completed for DOI's Office of Surface Mining. This was the inventory of abandoned mine land which was done in collaboration with TVA, East Tennessee State University, and Lockheed.

For several years, we have also provided technical assistance to the U.S.-Israel desalination project. More recently, we have prepared related technology transfer documents. This project is funded one-half by Israel and one-half by the U.S. Department of State. These State Department funds are transferred to the Office of Water Research, Bureau of Reclamation. This work is expected to continue through March 1984. Further work that may span several years will depend on the results of a current worldwide market survey for large desalination plants. This survey is also being managed by ORNL.

DOI Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	1.5	1.5	1.2	1.2	2.5	2.5	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Capital Equipment	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Construction	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for DOI programs	1.5	1.5	1.2	1.2	2.5	2.5	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Direct Personnel	4.0		5.3		8.0		8.0		8.0		8.0		8.0		8.0	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986-FY 1989 amounts are in constant FY 1985 dollars.

Department of Health and Human Services

DHHS supports research in carcinogenesis, genetics, and toxicology. DHHS funding is expected to remain reasonably constant over the next five years. The various branches of DHHS supporting our work include the National Cancer Institute (NCI); the National Institute of Environmental Health Sciences; the National Heart, Lung, and Blood Institute; the National Institute of General Medical Sciences; the National Institute of Child Health and Human Development; the National Institute on Drug Abuse; the Food and Drug Administration (FDA); the National Library of Medicine

(NLM); and the National Toxicology Program (NTP). We expect an expanded effort in radiation carcinogenesis research supported by NCI. For FDA, NLM, and NTP, we are developing nationally and internationally available data bases in the areas of genetic, reproductive, and general toxicology. We expect additional funding in FY 1984 from the DHHS portion of the superfund money for expansion of our toxicology data bases. This effort is designed to assist in assessing the potential human and environmental health risks of hazardous waste cleanup efforts.

A major issue concerning work done at ORNL for DHHS surfaced during late 1982. ORNL was informed that indirect costs for grants would no longer be allowed. The deficit for these indirect costs in 1983—approximately \$300,000—represented a major unanticipated cost. DOE/OHER has negotiated with DHHS, and the issue appears to have been partially resolved. We will be able to submit proposals for and accept new funds; however, the \$300,000 deficit remains an issue.

DHHS Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	5.9	5.9	5.0	5.0	5.4	5.4	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9
Capital Equipment	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Construction	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for DHHS programs	5.9	5.9	5.0	5.0	5.4	5.4	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9
Direct Personnel	58.2		48.4		41.0		41.0		41.0		41.0		41.0		41.0	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986-FY 1989 amounts are in constant FY 1985 dollars.

Environmental Protection Agency

Overall, our EPA program will continue at about the same level of effort throughout the planning cycle as in FY 1983, with some fluctuations in specific program areas. Our work for EPA addresses numerous health and environmental problems and issues—particularly research into the toxic effects of pollutants associated with energy-production processes and waste disposal. Quantitative mutagenicity testing is proceeding but at a lower level of effort than in previous years. EPA-supported research on environmental toxicology of trace contaminants is declining, whereas risk assessment and waste leachate characterization activities are expected to continue at present levels. Acidic precipitation research activities are increasing, with major emphasis on the effects of acidic precipitation on agricultural and natural systems and on ion mobility in soils. ORNL has been assisting the Environmental Results Branch of the Office of Management Systems and Evaluation in EPA to develop computer analysis capabilities that will allow EPA to better formulate environmental regulatory policy.

The development of data bases such as (1) Chemicals Identified in Human Biological Media, (2) Feral and Food Animals, and (3) Perinatal Organ Development of Humans and Laboratory Animals, along with the preparation of specialized reviews and assessment reports, assists EPA in assessing the potential health effects of chemicals and in extrapolating animal data to man. In addition to the continuing Gene-Tox Program for evaluating mutagenicity bioassay systems,

significant portions of the Environmental Mutagens, Teratogens, and Carcinogens Data Base development efforts are also being performed in support of EPA programs. The continuing turnover of EPA management, the reductions in funding, and the administrative problems resulting from these factors will continue to pose significant obstacles to smooth ORNL-EPA cooperation for the immediate future.

EPA Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	6.1	6.1	4.7	4.7	5.2	5.2	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7
Capital Equipment	0.01		0.0		0.01		0.01		0.03		0.03		0.03		0.03	
Construction	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for EPA programs	6.1	6.1	4.7	4.7	5.2	5.2	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7
Direct Personnel	60.0		43.9		50.0		50.0		50.0		50.0		50.0		50.0	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986-FY 1989 amounts are in constant FY 1985 dollars.

National Science Foundation (NSF)

The NSF, in conjunction with DOE, continues to provide support for the National Center for Small Angle Scattering Research (NCSASR). This is a national user-dedicated facility which makes two main instruments available to users: the NSF-constructed, 30-m small-angle neutron-scattering instrument (SANS) and the DOE-constructed, 10-m small angle X-ray scattering camera (SAXS). These instruments are intended to provide state-of-the-art capability for investigating structures of condensed matter on the scale of tens to hundreds of angstroms. These instruments are used extensively for materials science research, as well as research in biology, chemistry, polymer science, and diffraction physics.

Because of our unique position as a leader in systems and theoretical ecology, ORNL plays a strong role in these fields and works closely with various universities. NSF recognizes ORNL's leadership in ecosystem research and provides support for the study of material spiraling in stream ecosystems as an approach for the analysis of the transport and retention of nutrients and organic matter, for the study of the terrestrial biosphere's role in the global carbon cycle, and for the development and application of new methodologies for analyzing ecosystem-level problems. A slight increase in funds for our biotechnology program is also expected beginning FY 1985.

NSF Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	1.8	1.8	2.0	2.0	2.4	2.4	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Capital Equipment	0.07		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Construction	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for NSF programs	1.9	1.8	2.0	2.0	2.4	2.4	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Direct Personnel	15.9		12.6		15.0		17.0		17.0		17.0		17.0		17.0	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986-FY 1989 amounts are in constant FY 1985 dollars.

Tennessee Valley Authority

ORNL work for TVA has declined from levels of prior years. The largest fraction of current support is in the area of coal preparation and other fossil-energy applications. This work is followed by conservation evaluation work and then by a variety of miscellaneous analytical and testing services.

TVA Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	1.1	1.1	0.4	0.4	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Capital Equipment											0.0		0.0		0.0	
Construction	0.0		0.0		0.0						0.0		0.0		0.0	
Total for TVA programs	1.1	1.1	0.4	0.4	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Direct Personnel	8.2		2.5		5.7		5.5		5.5		5.5		5.5		5.5	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986-FY 1989 amounts are in constant FY 1985 dollars.

Federal Emergency Management Agency (FEMA)

Programs for FEMA involve research in support of national civil preparedness in the event of nuclear attack or emergency and other FEMA missions. Our areas of support include civil, electrical, and mechanical engineering; electronics; computer sciences; physics; and social sciences. Diverse topics are being studied, including designing, or adapting current designs, of earth-covered housing for blast and fallout protection; forecasting of radiation levels from fallout caused by multiple nuclear detonations; and developing concepts and handbooks to strengthen the national radiological defense system. ORNL is continuing to provide engineering assistance relative to radiation detection. This assistance includes the development of cheap, reliable, and rugged dosimeter chargers; technical assistance related to dosimeter manufacture; and consultation and assessment related to radiation detection instrumentation. Work for FEMA in these areas is expected to continue at a stable level in the future.

FEMA Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	1.9	1.9	1.4	1.4	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Capital Equipment	0.03		0.0		0.0		0.0		0.0		0.0		0.0	
Construction	0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for FEMA programs	1.9	1.9	1.4	1.4	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Direct Personnel	14.6		8.5		9.0		10.0		10.0		10.0		10.0	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986-FY 1989 amounts are in constant FY 1985 dollars.

Synthetic Fuels Corporation (SFC)

ORNL assisted SFC in planning environmental and socioeconomic studies as part of the work on the Recommended Comprehensive Strategy Report to Congress. These studies were to determine regional carrying and assimilation capacities and analyze regional environmental factors related to synthetic fuels. Future work for SFC is dependent upon the needs of SFC.

SFC Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	0.03	0.03	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Capital Equipment	0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Construction	0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for SFC	0.03	0.03	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
programs														
Direct Personnel	0.3		0.0		0.0		0.0		0.0		0.0		0.0	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986–FY 1989 amounts are in constant FY 1985 dollars.

Department of Transportation (DOT)

ORNL's Conservation and Renewable Energy Program performs work on several small projects for DOT, including studies of vehicle travel classification, laboratory testing of emissions as a function of fuel flow and manifold pressure, and analysis and modeling of traffic data. ORNL expects to continue to provide technical support to DOT for research related to transportation energy issues through the planning cycle.

DOT Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	0.3	0.4	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Capital Equipment	0.0		0.03		0.0		0.0		0.0		0.0		0.0		0.0	
Construction	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for DOT	0.3	0.4	1.5	0.4	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
programs																
Direct Personnel	3.4		2.7		2.7		2.3		3.0		3.0		3.0		3.0	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986–FY 1989 amounts are in constant FY 1985 dollars.

Other Federal Agencies

ORNL also does work for a variety of other federal agencies. The Consumer Product Safety Commission, NASA, the National Oceanic and Atmospheric Administration, and the Department

of Agriculture all support small amounts of life sciences research totaling approximately \$1.5 million in FY 1983. The Consumer Product Safety Commission primarily provides funds for our research on indoor air quality, which is expanding.

Some \$372,000 in support for FY 1983 also came from the U.S. Department of State for work performed for the Agency for International Development (AID) and the (IAEA). ORNL support for AID includes technical assistance with energy assessments, evaluations of technology options, and energy-related institution-building to meet the needs of less developed countries. The ORNL Fusion Program will also participate in toroidal-device studies for the government of Spain. Funding for the latter studies is expected to come through a U.S. federal agency, possibly AID.

Research support for data systems design, development, and implementation activities was initiated by the Immigration and Naturalization Service (INS) with \$350,000 in support for FY 1983. INS will expand this work in FY 1984 to include instrumentation R&D for remote-sensing, alarming, and logging systems; electronic signal processing; and development of analytical models for predicting immigration trends and patterns as well as population distribution studies.

Other Federal Agencies Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	2.1	2.1	1.2	1.2	4.9	4.9	4.4	4.4	4.3	4.3	4.3	4.3	4.3	4.3	4.1	4.1
Capital Equipment	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Construction	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for other federal programs	2.1	2.1	1.2	1.2	4.9	4.9	4.4	4.4	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
Direct Personnel	17.0		8.2		26.1		24.6		23.9		23.9		23.9		22.6	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986-FY 1989 amounts are in constant FY 1985 dollars.

NONFEDERAL ORGANIZATIONS

Electric Power Research Institute

Research sponsored by EPRI addresses critical national issues related to electric power generation. Major efforts in this area are directed at understanding the processes and mechanisms by which acidic deposition of energy-related pollutants impact nutrient cycling and sulfur and nitrogen dynamics of forest ecosystems; at discriminating the relative importance and effects of wet and dry deposition of acidic substances in both forest and agricultural systems; and at characterizing the role of potentially toxic aluminum mobilization in streams. Also included are projects on the effects of acidic deposition on fisheries and lakes, studies of the role of cooling towers in the ecology of Legionnaires' disease, and research on instrumentation and controls related to improved safety and availability of LWR systems. The Laboratory expects to continue these or other programs for EPRI and anticipates that this funding will expand during the course of the planning cycle.

EPRI Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	2.1	2.1	2.2	2.2	2.5	2.5	2.5	2.5	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Capital Equipment	0.0		0.01		0.01		0.01		0.02		0.02		0.02		0.02	
Construction	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for EPRI programs	2.1	2.1	2.2	2.2	2.5	2.5	2.5	2.5	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Direct Personnel	20.0		13.0		17.6		17.0		17.0		17.0		17.0		17.0	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986-FY 1989 amounts are in constant FY 1985 dollars.

Other Nonfederal Organizations

ORNL's unique expertise in many research areas results in a number of small or short-term projects being performed for many different nonfederal organizations. Such activities are beneficial to, and do not interfere with, DOE-sponsored work. Currently, nonfederal sponsors include such entities as the United Kingdom's Atomic Energy Agency, JAERI, the Gas Research Institute, Metropolitan Edison/General Public Utility, the University of Tennessee, the Massachusetts General Hospital, the Florida Institute of Phosphate Research, Gulf Oil, and the General Electric Corporation. As a new activity for FY 1984, the ORNL Fusion Program will receive funds from the Joint European Torus (JET) program in Europe for conducting a beryllium-limiter experiment in the ISX-B tokamak. The total amount of funding which was derived from such sources for FY 1983 was about \$1.0 million.

Other Nonfederal Organizations Program resource summary

(\$ in Millions) ^a (Personnel in FTEs)	FY 1982		FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Total Operating	2.3	2.3	1.0	1.0	3.8	3.8	1.6	1.6	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Capital Equipment	0.0		0.0		0.02		0.02		0.02		0.02		0.02		0.02	
Construction	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total for nonfederal programs	2.3	2.3	1.0	1.0	3.8	3.8	1.6	1.6	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Direct Personnel	18.5		6.7		20.0		13.5		12.9		12.9		12.9		12.9	

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986-FY 1989 amounts are in constant FY 1985 dollars.

LABORATORY RESOURCE DEVELOPMENT

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LABORATORY RESOURCE DEVELOPMENT

PROGRAM TRENDS

Figure 5 depicts the planned Laboratory effort in terms of direct personnel dedicated to assistant-secretary-level programs. Overall, the projections for the DOE programs can be generally described as indicating a virtually stable mix over the planning cycle. Variation, over time, is only a matter of 2 to 3% in any given program. The OER projection, for example, remains almost level at 43 or 44% of total direct FTEs for all years, while effort for ASNE is projected to increase slightly from about 14% to 17%. The proportion of total direct FTEs supported by non-DOE sponsors is also expected to remain stable at about 21 or 22% of the total.

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Fig. 5. Trends in Laboratory effort.

The breakdown of the Work for Others component will, however, change somewhat more noticeably (Fig. 6). While the absolute amount of support from traditional sponsors such as NRC and DHHS is not expected to decrease, the predominant trend will nevertheless be toward modest decreases in their proportion of total Work for Others support. These decreases will be offset by an increase in effort devoted to work for DOD from roughly 13% in FY 1983 to about 19% or 20% in the out years. The NRC will, nevertheless, remain our largest non-DOE sponsor—supporting a projected 38% of non-DOE direct FTEs even in FY 1989.

Fig. 6. Trends in Work for Others.

PERSONNEL RESOURCES

Figure 7 shows the overall trends in personnel levels from FY 1979 projected through FY 1989. Although peak employment at the Laboratory occurred in FY 1968, the total personnel levels of 1980 and 1981 prior to a reduction-in-force were also over 5000. The FY 1983 total of 4443 thus represents a substantial decrease in the Laboratory's labor force. Although some increase in personnel is projected over the planning cycle, growth will be modest. The total personnel projection for FY 1989 is only 4798 FTEs—well under the levels of 1980 and 1981.

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Fig. 7. Trends in personnel, levels, FY 1979-FY 1989.

SITE DEVELOPMENT AND FACILITIES MANAGEMENT

The goals of site development activities at ORNL during the next five years can be summarized as follows:

- provide for the efficient and reliable functioning of existing facilities,
- accommodate new program initiatives,
- review or replace age-deteriorated and obsolete facilities,
- improve utilization and eliminate overcrowding of existing facilities, and
- eliminate redundant and/or temporary facilities.

These five goals provide the basic framework and direction for ORNL's facilities planning. Implementation of these goals is a long-term project and will not be completed during the planning period but rather will require 10 to 20 years. The Site Development and Facilities Utilization Plan is currently being updated and will reflect an in-depth view of our five-point facilities planning strategy.

One of the most important elements of the current Site Development Plan concerns the future of ORNL facilities at Y-12. Currently, it is ORNL's intention to make the following major changes. The Fusion Energy and Engineering Technology divisions' activities will continue to be located at Y-12. Centralization of Fusion Energy and Engineering Technology will focus on Buildings 9201-3 and 9201-2—as funding permits. Again, depending upon available funding, the Biology Division will be relocated to the X-10 site in a phased manner over a 10–15-year period. The existing Biology Division buildings are not required in the long term for other ORNL activities and will ultimately be transferred back to Y-12 for reuse or demolition. The joint use of Building 9204-3 between ORNL's isotope activities and compatible Y-12 activities will take place as appropriate Y-12 programs are funded. ORNL's near-term consolidation efforts may permit the transfer of some existing space in scattered locations back to Y-12. In the future, no new ORNL programs will be located at the Y-12 site, unless absolutely necessary.

A deficit of adequate office/light laboratory space exists at ORNL while a surplus of offices and laboratories (light and heavy) exists in selected Y-12 facilities. Thus, while an adequate amount of total space exists to satisfy current and planned missions, not all of this existing space can be utilized cost effectively to satisfy our needs. Remote offices and laboratories at Y-12 cannot be used cost effectively by ORNL to solve its space deficit because such use would severely fragment user groups and reduce their functional effectiveness.

In the long run (10–20 years), the total space at ORNL is expected to decline by about 600,000 ft² to a total of about 3,400,000 ft². The decommissioning of inactive experimental reactors, the transfer of redundant space at Y-12, the demolition of selected small structures, and the consolidations and retirements of obsolete structures made possible through the construction of the line-item projects proposed in this plan will provide the means to implement this reduction.

Multiprogram General Purpose Facilities (MGPF)

The MGPF program at ORNL addresses those facilities-restoration projects that are beyond the scope of GPP. These projects focus primarily on badly needed utility system upgrades and obsolete building rehabilitation or replacement. Projects proposed for FY 1985 include the Primary Electrical Distribution System Restoration, which will improve the reliability, flexibility, and efficiency of the electrical system, particularly those portions of it which are deficient; the Central Chilled Water System Restoration; the Environmental Monitoring System Upgrade—Phase I, which will also provide efficient and reliable functioning of existing facilities; and the Fire Protection Upgrade at Y-12, which would replace obsolete systems and extend coverage into areas which still require protection.

Several projects are also proposed for FY 1986. The Utilities Restoration—Piping Systems Phase I for ORNL at Y-12 would replace key elements of various worn-out piping systems. The evaluation study of the Steam Distribution System noted significant deterioration of some parts of the current underground system. At the same time, another preliminary study indicated a significant potential energy savings from conversion to a hot water system for space heating. The two studies have determined that conversion to a district hot water system is more cost effective than the restoration of the steam system. A project for this conversion is therefore being proposed.

Other proposed projects for FY 1986 are the Central Administrative and Support Building, which will virtually eliminate the office overcrowding in the main research complex, and Phase II of the Environmental Monitoring System Upgrade, which will install added capabilities to enable the Laboratory to conform to current criteria. A summary of MGPF projects is provided in Table 15.

Table 15. MGPF project summary

Title	1983	1984	1985	1986	1987	1988	1989	TEC
<i>Multiprogram General Purpose Facilities (KG)</i>								
Funded projects								
Laboratory Emergency Response Center	2.0	2.2						4.2
Upgrade Electrical Service for Research Facilities (Y-12)	1.6	2.5	0.9					5.0
Total funded projects	3.6	4.7	0.9					
Budgeted projects								
Cooling Water Facilities Restoration (Y-12)		0.6	2.0	1.4				4.0
Improvements to Existing Sewage Treatment System		1.2						1.2
Total budgeted projects		1.8						
Proposed projects								
Environmental Monitoring System Upgrade, Phase I			1.0	2.5				3.5
Primary Electrical Distribution System Restoration			0.4	1.8				2.2
Central Chilled-Water System Restoration			1.1	3.6				4.7
Upgrade Fire Protection—ORNL facilities at Y-12			0.4	1.4				1.8
Utilities Restoration—Piping Systems, Phase I (Y-12)			1.1	3.6	3.6			8.3
Laboratory Hot-Water District Heating System (formerly Upgrade Steam Distribution System)				1.8	4.7			6.5
Central Administrative and Support Building				1.0	4.5			5.5
Environmental Monitoring Systems Upgrade, Phase II				1.0	4.0			5.0
Bioscience and Technology Facility					25.0			25.0
Utilities Restoration—Electrical Systems, Phase I (Y-12)					4.0			4.0
Electrical Distribution System Upgrade					1.5			1.5
Street System Rehabilitation and Additions						5.0		5.0
Existing Laboratories Upgrade						10.0		10.0
Utilities Restoration—Mechanical Systems, Phase I (Y-12)						4.0		4.0
Technical Support Facility						15.0		15.0
Support Facilities Upgrade							10.0	10.0
Utilities Restoration—Piping Systems, Phase II (Y-12)							4.0	4.0
Existing Laboratory/Office Upgrade							13.0	13.0
Total proposed projects			6.0	18.1	47.4	34.0	27.0	

General Plant Projects

The past lack of GPP funding, coupled with a lack of line-item funding, has resulted in the development of a significant backlog of facilities deficiencies. The updated MGPF inventory of deficiencies indicates that the Laboratory faces a backlog of deficiencies of approximately \$200 million. Not all of these deficiencies are, however, most logically corrected with GPP funds. It is estimated that at least \$150 million should receive line-item support, which means that the GPP backlog of general purpose facilities deficiencies is about \$50 million. The deficiencies identified by additional Facilities Evaluations now under way, while differing in some cases from the MGPF Inventory of Deficiencies, do produce proposed corrective measures with costs in the same general range as the previously developed proposed corrective measures. These more highly focused studies will continue to refine and prioritize essential needs as they are completed. The Laboratory believes, however, that these Facilities Evaluations will only confirm that there are significant needs in basic systems. For this reason, the Laboratory continues to project the need for substantial increases in GPP funding.

The \$9 million for FY 1985 indicated in the following table reflects immediate needs for pressing environmental concerns. The \$14 million shown in FY 1986 starts the ramp upward toward a peak of \$21 million in FY 1988. Based on the programmatic projections of each yearly total during the planning period, about \$6 million should be used to support program requirements. The remaining \$8 to 15 million would address the deficiencies identified in our evaluations.

	GPP							
(\$ in Millions—BA)	FY 1982	FY 1983	FY 1984	FY 1985	FY 1986	FY 1987	FY 1988	FY 1989
General Laboratory GPP (AT Program)	4.3	3.5	4.2	9.0	14.0	20.0	21.0	21.0
Waste Management (AR Program)	0.8	2.0	1.8	2.5	2.5	2.5	2.5	2.5
Energy Conservation (WB Program)	0.7	1.5	2.0	2.0	2.0	2.0	1.5	1.0
Total GPP funding	5.8	7.0	8.0	10.5	18.5	24.5	25.0	24.5

General Purpose Equipment

The funding for GPE has increased in recent years, but the increased levels have not been sufficient to meet new requirements as well as replacement of worn out equipment. Increased emphasis on accuracy and improved productivity and efficiency has made the acquisition of state-of-the-art equipment essential for supporting ongoing and new research activities. Because of the age of much of ORNL's capital equipment inventory, more than half of the GPE funding received annually must now be used to replace failed and worn-out equipment. An analysis of the current GPE inventory has revealed that of the \$40.4 million invested, \$16.7 million, or 41%, is older than design lifetimes by current accounting standards. The details of the analysis are shown in Table 16. Based on the U.S. Department of Labor's Producer Price Index for May 1983, the \$16.7 million of aged equipment would require about \$50 million for replacement based on 1983 dollars.

Table 16. Summary of aged GPE
(\$ in Thousands)

Asset class	Description	Average design lifetime (years)	Original purchase cost	Original cost of items exceeding design lifetime ^a	Percent equipment exceeding design lifetime
710	Heavy mobile equipment	12	\$1,785	\$785	44.0
715	Hospital and medical	12	105	33	31.4
720	Laboratory equipment	15	12,066	6,000	49.7
725	Motor vehicles	10	4,555	1,500	32.9
730	Office furniture and equipment	10	1,817	345	19.0
735	Process equipment	20	1,581	1,000	63.3
755	Shop equipment	20	6,089	3,750	61.6
770	Automated data processing and word processing equipment	7	11,180	3,000	26.8
770	Miscellaneous equipment	13	1,194	250	20.9
Total			\$40,372	\$16,663	41.3

^aReplacement cost is approximately three times original cost (\$50 million) in FY 1983 dollars.

In order to maintain an acceptable rate of new equipment additions and replacement of obsolete equipment, an annual base budget level of \$6 million should be maintained for the former while some additional funding of \$8M/yr over 12-13 years will be required for the latter. (Table 1 listing GPE for the years of the planning cycle, does not, however, reflect such necessary increases. Rather, only modest increases over the base budget are listed for the out years.)

The particular areas that will continue to require significant amounts of new GPE funds include small computers for budgeting and other purposes; fuel-conserving vehicles; instruments for analytical chemistry support services; satellite dishes for computer hook-ups; and computer-aided drafting and computer-aided manufacturing (CAD/CAM). Additionally, the impact of strict compliance with local, state, and national environmental regulations has not been fully assessed in terms of additional GPE, but it is expected to be significant as it is for GPP and MGPF.

PRIVATE SECTOR INTERACTIONS

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PRIVATE SECTOR INTERACTIONS

TECHNOLOGY TRANSFER PROGRAM

Overview of Existing Program

ORNL has had a Technology Transfer Program for 13 years. The Office of Research and Technology Applications (ORTA) now reports to the Executive Director and has one full-time professional staff member. Laboratory-wide activities are coordinated through 21 part-time Division and Program Technology Transfer officers (Fig. 8). Funding for the Program Office is from overhead; however, most technology transfer activities at the Laboratory are funded from the individual programs.

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Fig. 8. Organizational makeup and reporting level of ORNL's ORTA.

Major activities of the Technology Transfer Program include developing technology assessments, disseminating information, cooperating with broker organizations, and furnishing assistance to state and local government officials as required by the Stevenson-Wydler Technology Innovation Act. Since the office was established, 250 Technology Applications Bulletins have been published and some 14,000 requests for additional information have been received. An independent study indicated that 27% of these requestors used the information provided.

Proposed Expanded Activities: New Initiative on Industrial Technology

It is generally acknowledged that technical innovation is the key to the nation's economic future. For this reason, the links between generators and users of new knowledge must be strengthened. The focus of the Stevenson-Wydler Technology Innovation Act of 1980 was to help build the needed links between R&D performers and users. The Act was intended to provide a means of strengthening the relationships among government, industry, and academia so that each sector might contribute to the innovation process in a program of shared responsibilities. Major elements planned as means to accomplish the purposes of the Act include: (1) promoting technology development through the establishment of centers for Industrial Technology; (2) stimulating improved utilization of federally funded technology developments; and (3) encouraging the exchange of scientific and technical personnel among academia, industry, and the federal laboratories.

ORNL proposes a new initiative directed toward improving the Laboratory's effectiveness in contributing to the national goal of renewing the country's industrial base. The objectives of the new initiative are to (1) improve the rate of innovation at the Laboratory and (2) increase the frequency of effective transfer of technological innovations to the private sector. To accomplish these objectives, the scope and level of technology-transfer activities at ORNL will be substantially increased. No role model exists on which to base a successful technology transfer program. Thus, no grand concept is proposed at this time; experimentation with several relatively small, specific activities seems more appropriate. Nevertheless, at some future time, we would like to see the industrial technology activities expand to include a Center for Industrial Technology as envisioned in the Stevenson-Wydler Act. Among other activities, such a Center would provide the means for combining the ideas, talents, and industrial research capabilities of regional universities with the facilities of a national laboratory.

Specific activities proposed at this time are as follows:

1. *Strengthen Motivation for Technology Transfer.* The effectiveness of technology transfer activities at ORNL can be improved by increasing the incentives for the institution and for individual staff members. Specific ideas for improving the motivation for innovation and technology transfer have recently been discussed by ORO and ORNL. These ideas involve increased incentives for patent applications and easing of constraints on consulting by ORNL staff.
2. *Exchange Research Personnel With Industry.* People-to-people exchanges are the most effective means of technology transfer. A formal program that fosters the exchange of research personnel between ORNL and interested industrial firms will be established.

3. *Promote User Facilities.* Greater promotional effort to increase industrial utilization of user facilities will be made. Activities will include (1) identification of potential users for each facility, (2) "open-house" familiarization tours for potential industrial users, and (3) development of improved literature on facilities, including a summary document covering all user facilities at ORNL.
4. *Identify and Promote Promising Developments.* An improved program will be established to promote the transfer of promising technologies and techniques from ORNL to the private sector. The program will consist of two elements: (1) identifying ORNL developments that have the most promise for commercial applications and (2) funding of additional R&D or other activities necessary to bring the development to a state where industry can make an assessment of its true commercial potential. Examples of activities that may be supported are the preparation of materials samples for industry evaluation or the construction of prototypic instruments for industrial testing. Decisions about which developments to push will be made by the Director of ORNL based on advice from an Advisory Board on Industrial Technology. This board will consist mostly of people from industry but will also have representatives from DOE, academia, and ORNL. Members will be selected based on their degree of knowledge about the broad needs of industry and about the means by which new technologies are commercialized. Once a promising development has been identified, the further activities needed to make commercial judgements will be guided by advice from industry specialists. For the first year or so, the program will be a pilot-scale activity and will emphasize materials sciences.

Implementation of the proposed expanded activities will entail some additional costs. ORNL proposes that an additional \$500,000 annually be provided—one-half from ORNL overhead and one-half new funding from DOE. The following table (Table 17) of estimated staffing and expenditures reflects this expansion of ORTA funding.

Table 17. Estimated staffing and funding^a

	FY 1982	FY 1983	FY 1984	FY 1985	FY 1986	FY 1987	FY 1988	FY 1989
Staffing (FTEs)								
Professional Staff								
ORTA	2	2	2	2	2	2	2	2
Other (Estimate)	60	60	60	60	60	60	60	60
Total Staff	62	62	62	62	62	62	62	62
Support Staff	1	1	1	1	1	1	1	1
Funding (\$ in thousands)								
ORTA	67	74	580	626	626	626	62	62
Other	10,600	9,700	10,500	11,400	11,400	11,400	11,400	11,400
Total funding	10,700	9,800	11,080	12,026	12,026	12,026	12,026	12,026

^aAn 8.5% inflation factor has been used between FY 1983 and FY 1984 and between FY 1984 and FY 1985. FY 1986–FY 1989 amounts are in constant FY 1985 dollars.

LABORATORY COLLABORATIVE RESEARCH CENTERS

ORNL operates many large experimental facilities that are used extensively by both universities and industry. More than 100 universities and over 20 industrial firms have used these unique research resources. Use of the facilities by outside institutions is increasing, and major increases

among industrial users are expected as the capabilities of some of the newer facilities receive more publicity. Table 18 describes the extent to which each facility is used by ORNL and other institutions.

Table 18. ORNL user facility participation

	FY 1978	FY 1979	FY 1980	FY 1981	FY 1982	FY 1983
EN-Tandem Van de Graaff Accelerator						
Experimenter personnel						
University	20	20	20	20	20	16
ORNL	1.5	1.5	1.5	1.5	1.6	1.6
Use ratio, %						
University	25	25	25	25	25	25
ORNL	75	75	75	75	75	75
Total operating cost, millions of dollars	0.14	0.15	0.16	0.18	0.20	0.22
Oak Ridge Electron Linear Accelerator						
Experimenter personnel						
University	8	8	8	8	10	10
Industry	5	5	5	5	5	3
ORNL	14	14	14	14	14	12
Other national laboratories	3	3	3	3	3	2
Others	2	2	2	2	2	5
Use ratio, %						
University	9	9	9	9	9	11
Industry	5	5	5	5	5	3
ORNL	85	85	85	85	85	85
Other national laboratories	1	1	1	1	1	1
Total operating cost, millions of dollars	1.0	1.1	1.2	1.3	1.4	1.5
University Isotope Separator (UNISOR)*						
Experimenter personnel						
University	19	21	16	20	17	20
ORNL	1	3	2	2	2	1
Other national laboratories	2	3	1	3	0	2
Others	4	3	4	5	5	5
Use ratio, %						
University	78	73	75	82	68	70
ORNL	5	17	8	3	19	9
Other national laboratories	14	4	0	5	0	3
Others	3	6	17	10	13	18
Total operating cost, millions of dollars	0.20	0.21	0.27	0.36	0.40	0.40
Shared Research Equipment						
Experimenter personnel						
University	20	20	20	40	20	
Industry		3	6	6	6	
ORNL	3	6	7	7	10	
Other national laboratories			1	1		
Others			1	1		
Use ratio, %						
University	15	20	23	23	23	
Industry		3	5	5	5	
ORNL	85	77	72	72	72	
Other national laboratories						
Others						
Total operating cost, millions of dollars		0.40	0.45	0.50	0.50	0.50

Table 18 (continued)

	FY 1978	FY 1979	FY 1980	FY 1981	FY 1982	FY 1983
Oak Ridge National Environmental Research Park						
Experimenter personnel						
University		1	0	2	1	
ORNL	10		12	15	15	
Others	4		13	11	7	
Use ratio, %						
University		0.5	0	2	1	
ORNL	90.5		89	96	96.5	
Others	9		11	2	2.5	
Total operating cost, millions of dollars		0.141	0.123	0.123	0.120	
National Center for Small-Angle Scattering Research						
Experimenter personnel						
University		80	100	72		
Industry		15	20	15		
ORNL		0.7	3.2	20		
Other national laboratories		6	6	0		
Others		4	4	9		
Use ratio, %						
University		85	85	85		
Industry		10	10	8		
ORNL		5	5	7		
Other national Laboratories		<5	<5	<5		
Total operating cost, millions of dollars		0.15	0.58	0.62		
Holifield Heavy Ion Research Facility						
Experimenter personnel						
University		60	65	87		
Industry		1	0	3		
ORNL		22	22	45		
Other national laboratories		10	12	21		
Others		20	20	0		
Use ratio, %						
University		36	36	44		
Industry		<1		<1		
ORNL		60	60	50		
Other national laboratories		4	4	6		
Others		<1	<1	<1		
Total operating cost, millions of dollars		2.5	2.8	3.4		
Surface Modification Laboratory						
Experimenter personnel						
University		10	12	15		
Industry		8	10	11		
ORNL		7	9	28		
Others		3	3	11		
Use ratio, %						
University		15	15	16		
Industry		20	20	12		
ORNL		65	65	60		
Others		~1	~1	12		
Total operating cost, millions of dollars		0.8	0.9	1.2		

Table 18 (continued)

	FY 1978	FY 1979	FY 1980	FY 1981	FY 1982	FY 1983
Neutron Scattering Facilities						
Experimenter personnel						
University	3	8	13	19	20	
Industry	0	0	0	0	1	
ORNL	12	16	13	14	15	
Other national laboratories	4	8	8	7	6	
Others	5	7	6	6	17	
Use ratio, %						
University	7	10	17	23	21	
Industry	0	0	0	0	1	
ORNL	75	71	65	61	55	
Other national laboratories	8	10	10	9	6	
Others	10	9	8	7	17	
Total operating cost, millions of dollars	1.30	1.46	1.58	1.93	2.28	
Health Physics Research Reactor						
Experimenter personnel						
University					58	
Industry					54	
ORNL					15	
Other national laboratories					10	
Others					22	
Use ratio, %						
University					36	
Industry					34	
ORNL					9	
Other national laboratories					6	
Others					14	
Total operating cost, millions of dollars					0.545	

^aAdministered by Oak Ridge Associated Universities (ORAU).

SUBCONTRACTING

Subcontracting and procurement are two of the major types of expenditures incurred in interactions with outside institutions. Figure 9 shows that R&D subcontracting expenditures reached a peak in FY 1980 but have declined recently like the Laboratory's funding as a whole. Despite these necessary reductions, subcontracting expenditures will remain an important part of our operations. Table 19 gives the estimated value of procurements, subcontracts, and transfers for the years of the current planning cycle.

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Fig. 9. Subcontracts and procurements, over time

Table 19. Procurements, subcontracts, and transfers
(\$ in Millions—BA)

	FY 1982	FY 1983	FY 1984	FY 1985	FY 1986	FY 1987	FY 1988	FY 1989
Transfers	1.9	1.9	2.0	1.9	1.9	1.9	1.9	1.9
University subcontracts	7.9	7.5	8.5	7.8	7.7	7.5	7.5	7.5
All other subcontracts ^a	54.8	53.1	60.1	55.1	54.7	53.4	53.4	53.4
Total	64.6	62.5	70.6	64.8	64.3	62.8	62.8	62.8

^aIncludes Interagency Agreements, DOE-directed contracts, and ORAU. In the past three years, interagency agreements and DOE-directed contracts made up approximately 3% of the subcontract cost, and ORAU has made up approximately 2% of the subcontract cost.

UNIVERSITY PROGRAMS

Interactions between the Laboratory and the university community continue to provide a two-way flow of technical information through formal programs and informal association. Table 20 summarizes participation in energy R&D under the direction of the Laboratory's technical staff. The participation at ORNL during FY 1982 is summarized by type of program and by academic level of people temporarily assigned to programs.

Table 20. Summary of ORNL-University programs for FY 1982

Program	Under-grads	Grads	Faculty	Post-doctoral	Total people	Total No. of universities
DOE University-Laboratory Cooperative Programs						
ORNL funded						
Environmental Sciences Cooperative Curriculum	8				8	4
Great Lakes Colleges Association/Associated Colleges of the Midwest—Oak Ridge Science Semester	33		3		36	25
Southern College University Union—Oak Ridge Science Semester	12		1		13	8
MIT Oak Ridge School of Chemical Engineering Practice ^a		36	1		37	1
Reactor Training Cooperative Experiments		38			38	3
ORAU funded						
Faculty Research Participants			10		10	<i>b</i>
Student Research Participants	43				43	<i>b</i>
Laboratory Graduate Participation		12			12	<i>b</i>
Postgraduate Research Training				5	5	<i>b</i>
ORNL programs (operating funds)						
Faculty Research Participants			7		7	7
Summer Research Internships		15			15	15
Special Summer AA ^c Program	1				1	1
Forestry Program	0				0	0
Pre-co-ops (AA)	7				7	7
Co-ops	35				35	21
Oak Ridge Graduate School of Biomedical Sciences		48	7	35	90	1
Wigner Fellows				5	5	5
ORNL guests (other sponsorship)	41	106	179	2	328	<i>b</i>
ORNL consultants			98		98	62
Total	180	255	306	47	788	160

^aDiscontinued after FY 1982.^bInformation not available.^cAffirmative action.

The sources of funding for these programs are the DOE University-Laboratory Cooperative Program; ORNL's operating funds; and guest sponsorship funds from educational institutions, agencies, or fellowships.

A total of 788 people from the academic community participated in research programs at the Laboratory in FY 1982. Many of the 180 undergraduates received academic credit from their respective universities as a result of their assignment at the Laboratory, and most of the 255 graduate students were engaged in master's or doctoral research. Of the 306 faculty included in the table, more than 30 are Laboratory employees on a part-time, year-round basis as adjunct research participants. Of the 47 postdoctoral fellows, five were recipients of the Laboratory's prestigious Eugene P. Wigner fellowship. At least 160 different universities sponsored the representatives from academia.

The Oak Ridge Associated Universities (ORAU) Traveling Lecture Program is also funded by DOE, and in the 1982-1983 academic year, the program listed 75 staff members from ORNL; lectures were presented at 24 universities.

For a number of years, minorities from the historically black colleges and other educational institutions have participated in the Laboratory's university relations programs and have been employed in craft, administrative and technical support, and professional positions.

A special summer program for undergraduates in science and engineering, for which students from minority institutions have been especially encouraged to apply, was established several years ago. Nine students were supported in the summer of 1983.

ORNL has also participated for ten years in the UCC-ND Pre-co-op Scholarship Program for minority students in engineering. Employment is provided each summer for pre-co-op students who are high school graduates and who are enrolled, beginning the following fall, in one of the participating colleges and universities. After satisfactory completion of two semesters or three quarters of college, the students enter the UCC-ND Cooperative Education Program. Each year from three to five pre-co-ops are accepted into this program.

New efforts to enhance ORNL's relationship with black colleges and universities in the Southeast are continually explored. In December 1982, the Office of Fusion Energy asked ORNL to propose a program of interaction with historically black colleges and universities (HBCUs) in the area of fusion research. During the following several months, ORNL submitted a proposal for a pilot program, established criteria for selecting one or two HBCUs with whom ORNL could interact, and made four site visits. Atlanta University was identified as the HBCU with which ORNL would initiate the first such arrangement to assist a University in fusion research. This effort should result in broadening the University's role in mainstream science and remedy minority underrepresentation in those scientific fields that are within the purview of DOE's Office of Fusion Energy. This program was formalized by the signing of a Letter of Intent by the President of Atlanta University and the Director of ORNL on May 26, 1983. A Memorandum of Understanding to include other scientific and technical fields of endeavor is in process of formal endorsement. Information on planned expenditures on behalf of historically black colleges may be found in Supplementary Data.

SUPPLEMENTARY DATA

89/90

Table SD.1. Resources by subprogram
(Millions of dollars)

ORNL

	FY 1983		FY 1984 ^a		FY 1985 ^a		FY 1986 ^a		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Assistant Secretary for Fossil Energy														
AA05 Control Technology & Coal Prep														
Internal Operating		0.1		0.1		0.1		0.2		0.2		0.2		0.2
Procurement		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.0	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Direct Personnel		0.4		0.8		1.2		1.6		1.6		1.6		1.6
AA15 Advanced Research & Technology Dev														
Internal Operating		3.5		2.8		3.6		3.7		3.7		3.7		3.7
Procurement		3.3		3.5		4.1		4.1		4.1		4.1		4.1
Total Operating	5.7	6.8	6.0	6.3	7.8	7.6	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8
Capital Equipment	0.1		0.3		0.2		0.3		0.3		0.3		0.3	
Total Activity	5.9		6.3		8.0		8.0		8.0		8.0		8.0	
Direct Personnel		26.1		21.0		24.0		25.0		25.0		25.0		25.0
AA25 Liquefaction														
Internal Operating		1.8		2.6		4.6		5.2		5.2		5.2		5.2
Procurement		0.0		0.4		1.1		1.5		1.5		1.5		1.5
Total Operating	2.0	1.9	2.9	3.0	6.6	5.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6
Capital Equipment	0.0		0.2		0.3		0.4		0.4		0.4		0.4	
Total Activity	2.0		3.1		6.9		7.0		7.0		7.0		7.0	
Direct Personnel		17.5		19.5		30.0		34.0		34.0		34.0		34.0

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Table SD.1 (continued)

	FY 1983		FY 1984 ^a		FY 1985 ^a		FY 1986 ^a		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
AA35 Combustion Systems														
Internal Operating		0.1		0.0		0.0		0.0		0.0		0.0		0.0
Procurement		0.1		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Direct Personnel		0.9		0.0		0.0		0.0		0.0		0.0		0.0
AA55 Heat Engines and Heat Recovery														
Internal Operating		0.0		0.1		0.0		0.0		0.0		0.0		0.0
Procurement		0.1		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Direct Personnel		0.4		0.8		0.0		0.0		0.0		0.0		0.0
AA85 Surface Coal Gasification														
Internal Operating		0.8		0.4		0.8		0.8		0.8		0.8		0.8
Procurement		0.3		0.5		0.6		0.5		0.5		0.5		0.5
Total Operating	1.1	1.1	0.6	0.9	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Capital Equipment	0.0		0.0		0.0		0.1		0.1		0.1		0.1	
Total Activity	1.1		0.6		1.3		1.3		1.3		1.3		1.3	
Direct Personnel		5.7		3.6		5.6		5.6		5.6		5.6		5.6

Table SD.1 (continued)

	FY 1983		FY 1984 ^a		FY 1985 ^a		FY 1986 ^a		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
AA COAL														
Internal Operating		6.4		6.0		9.0		9.8		9.8		9.8		9.8
Procurement		3.7		4.4		5.7		6.1		6.0		6.0		6.0
Total Operating	8.9	10.1	9.6	10.4	15.9	14.7	15.9	15.9	15.9	15.9	15.9	15.9	15.9	15.9
Capital Equipment	0.1		0.5		0.6		0.7		0.7		0.7		0.7	
Total Program	9.0		10.1		16.4		16.5		16.6		16.5		16.5	
Direct Personnel		51.0		45.7		60.8		66.2		66.2		66.2		66.2
AB05 Enhanced Gas Recovery : AB GAS														
Internal Operating		0.0		0.1		0.0		0.0		0.0		0.0		0.0
Procurement		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Direct Personnel		0.0		0.9		0.0		0.0		0.0		0.0		0.0
AC15 Enhanced Oil Recovery : AC PETROLEUM														
Internal Operating		0.03		0.0		0.0		0.0		0.0		0.0		0.0
Procurement		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.005	0.03	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Direct Personnel		0.2		0.0		0.0		0.0		0.0		0.0		0.0
CH02 Project Devel Feasibility Studies : CH ALTERNATE FUELS PRODUCTION														
Internal Operating		0.1		0.2		0.4		0.7		0.7		0.7		0.7
Procurement		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.1	0.1	0.1	0.2	0.6	0.4	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Direct Personnel		0.2		0.7		1.8		3.4		3.4		3.4		3.4

Table SD.1 (continued)

	FY 1983		FY 1984 ^a		FY 1985 ^a		FY 1986 ^a		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Assistant Secretary for Fossil Energy														
Internal Operating		6.4		6.3		9.4		10.5		10.5		10.5		10.5
Procurement		3.7		4.4		5.7		6.1		6.0		6.0		6.0
Total Operating	9.0	10.2	9.8	10.7	16.5	15.1	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6
Capital Equipment	0.1		0.5		0.6		0.7		0.7		0.7		0.7	
Total Asst Secretary	9.2		10.3		17.1		17.2		17.3		17.2		17.3	
Direct Personnel		51.4		47.3		62.6		69.6		69.6		69.6		69.6
Assistant Secretary for Nuclear Energy														
AE20 Space and Terrestrial Applications : AE ADVANCED NUCLEAR SYSTEMS														
Internal Operating		2.6		2.1		2.7		4.0		4.0		4.0		4.0
Procurement		0.5		0.5		0.6		0.0		0.0		0.0		0.0
Total Operating	2.7	3.1	2.7	2.6	3.2	3.2	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Capital Equipment	0.1		0.6		0.1		0.1		0.1		0.1		0.1	
Total Activity	2.7		3.3		3.4		4.1		4.1		4.1		4.1	
Direct Personnel		22.0		17.8		21.7		32.0		32.0		32.0		32.0
AF15 Liquid Metal Fast Breeder Reactor : AF BREEDER REACTOR SYSTEMS														
Internal Operating		9.5		9.1		9.1		9.1		9.1		9.1		9.1
Procurement		3.4		0.9		0.9		0.9		0.9		0.9		0.9
Total Operating	10.9	12.9	9.4	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Capital Equipment	0.1		0.6		0.3		0.3		0.3		0.3		0.3	
Total Activity	10.9		9.9		10.3		10.3		10.3		10.3		10.3	
Direct Personnel		83.0		72.8		72.8		72.8		72.8		72.8		72.8

Table SD.1 (continued)

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	FY 1983		FY 1984 ^a		FY 1985 ^a		FY 1986 ^a		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
AG25 High Temperature Reactor Technology														
Internal Operating		3.7		4.3		4.6		4.9		4.9		4.9		4.9
Procurement		0.9		0.1		0.2		0.3		0.3		0.3		0.3
Total Operating	4.4	4.6	4.5	4.4	5.0	4.8	5.5	5.2	5.2	5.2	5.2	5.2	5.2	5.2
Capital Equipment	1.3		2.3		1.8		1.8		2.0		1.8		2.0	
Total Activity	5.7		6.8		6.8		7.3		7.2		7.0		7.2	
Direct Personnel	28.6		30.0		30.0		33.0		33.0		33.0		33.0	
AG30 Three Mile Island Activities														
Internal Operating		0.2		0.3		0.3		0.3		0.3		0.3		0.3
Procurement		0.1		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Direct Personnel	1.7		1.8		2.0		2.0		2.0		2.0		2.0	
AG36 Light Water Reactor Systems														
Internal Operating		0.5		0.7		0.8		0.8		0.8		0.8		0.8
Procurement		0.7		1.1		1.7		1.6		1.6		1.6		1.6
Total Operating	1.1	1.2	2.5	1.8	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Direct Personnel	4.4		6.3		6.3		6.3		6.3		6.3		6.3	
AG CONVERTER REACTOR SYSTEMS														
Internal Operating		4.4		5.2		5.7		6.0		6.0		5.9		5.9
Procurement		1.7		1.3		1.8		1.9		1.9		1.9		1.9
Total Operating	5.8	6.1	7.4	6.5	7.7	7.5	8.2	7.9	7.9	7.9	7.9	7.9	7.9	7.9
Capital Equipment	1.3		2.3		1.8		1.8		2.0		1.8		2.0	
Total Program	7.1		9.7		9.5		10.0		9.9		9.7		9.9	
Direct Personnel	34.7		38.1		38.3		41.3		41.3		41.3		41.3	

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Table SD.1 (continued)

	FY 1983		FY 1984 ^a		FY 1985 ^a		FY 1986 ^a		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
AH10 Remedial Actions : AH REMEDIAL ACTION PROGRAMS														
Internal Operating		1.0		3.4		3.5		3.6		3.6		4.1		4.7
Procurement		0.1		0.1		0.1		0.1		0.1		0.2		0.2
Total Operating	1.5	1.1	3.9	3.4	3.6	3.6	3.6	3.6	3.6	3.6	4.5	4.3	5.1	4.9
Capital Equipment	0.0		0.0		0.0		0.1		0.1		0.0		0.0	
Total Activity	1.5		3.9		3.6		3.7		3.7		4.5		5.1	
Direct Personnel		6.2		18.5		18.5		18.5		18.5		21.5		25.0
AP05 Commercial Waste Management : AP COMMERCIAL NUCLEAR WASTE MANAGEMENT														
Internal Operating		0.0		0.1		0.1		0.1		0.1		0.1		0.1
Procurement		0.1		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Direct Personnel		0.0		0.6		0.6		0.6		0.6		0.6		0.6
AS05 Spent Fuel Technology														
Internal Operating		0.0		0.1		0.1		0.1		0.1		0.1		0.1
Procurement		0.1		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Direct Personnel		0.0		0.4		0.4		0.4		0.4		0.4		0.4

Table SD.1 (continued)

	FY 1983		FY 1984 ^a		FY 1985 ^a		FY 1986 ^a		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
AS15 Fuel Cycle R&D														
Internal Operating		10.6		13.0		15.2		14.9		14.9		14.9		14.9
Procurement		9.5		11.5		8.5		8.0		8.0		8.0		8.0
Total Operating	20.0	20.1	24.5	24.5	23.7	23.7	22.9	22.9	22.9	22.9	22.9	22.9	22.9	22.9
Capital Equipment	3.6		3.0		10.0		3.0		3.0		3.0		3.0	
Total Activity	23.6		27.5		33.7		25.9		25.9		25.9		25.9	
Direct Personnel		112.1		124.8		132.0		130.0		130.0		130.0		130.0
AS25 Waste Treatment R&D														
Internal Operating		0.3		0.8		1.5		2.3		3.3		3.3		3.5
Procurement		0.6		0.0		0.0		0.1		0.1		0.1		0.1
Total Operating	0.6	0.9	1.0	0.8	1.8	1.5	2.7	2.4	3.4	3.4	3.4	3.4	3.6	3.6
Direct Personnel		3.2		5.0		10.0		15.0		22.0		22.0		23.0
AS NUCLEAR FUEL CYCLE														
Internal Operating		10.9		13.8		16.8		17.3		18.3		18.3		18.4
Procurement		10.2		11.5		8.5		8.1		8.1		8.1		8.1
Total Operating	20.7	21.1	25.6	25.3	25.6	25.3	25.7	25.4	26.4	26.4	26.4	26.4	26.5	26.5
Capital Equipment	3.6		3.0		10.0		3.0		3.0		3.0		3.0	
Total Program	24.3		28.6		35.6		28.7		29.4		29.4		29.5	
Direct Personnel		115.3		130.2		142.4		145.4		152.4		152.4		153.4

Table SD.1 (continued)

	FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
CD10 Uranium Enrichment Activities														
Internal Operating		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Procurement		0.3		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Direct Personnel		0.6		0.0		0.0		0.0		0.0		0.0		0.0
CD20 Uranium Resource Assessment														
Internal Operating		0.0		0.1		0.1		0.0		0.0		0.0		0.0
Procurement		0.1		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Direct Personnel		0.2		0.3		0.4		0.0		0.0		0.0		0.0
CD30 Advanced Isotope Separation Technol														
Internal Operating		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Procurement		0.1		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Direct Personnel		0.0		0.0		0.0		0.0		0.0		0.0		0.0
CD URANIUM ENRICHMENT														
Internal Operating		0.1		0.1		0.1		0.0		0.0		0.0		0.0
Procurement		0.4		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.4	0.5	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Direct Personnel		0.8		0.3		0.4		0.0		0.0		0.0		0.0

Table SD.1 (continued)

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	FY 1983		FY 1984 ^a		FY 1985 ^a		FY 1986 ^a		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
DA30 Repositories : DA NUCLEAR WASTE DISPOSAL ACTIVITIES														
Internal Operating		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Procurement		0.1		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Direct Personnel		0.0		0.0		0.0		0.0		0.0		0.0		0.0
DB30 Nuclear Waste Fund Repositories														
Internal Operating		0.3		1.1		2.0		2.7		4.5		4.7		4.7
Procurement		0.1		0.4		0.4		0.4		0.7		0.8		0.8
Total Operating	0.5	0.4	1.8	1.5	2.9	2.4	3.3	3.1	5.8	5.2	5.4	5.4	5.4	5.4
Direct Personnel		3.4		8.5		15.0		20.5		34.5		35.7		35.7
DB60 Program Management & Tech Support														
Internal Operating		0.1		0.4		0.4		0.4		0.2		0.2		0.2
Procurement		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.2	0.1	0.5	0.4	0.4	0.4	0.4	0.4	0.2	0.2	0.2	0.2	0.2	0.2
Direct Personnel		1.0		2.5		2.5		2.5		1.0		1.0		1.0
DB NUCLEAR WASTE FUND														
Internal Operating		0.4		1.5		2.4		3.1		4.7		4.9		4.9
Procurement		0.1		0.4		0.4		0.4		0.7		0.8		0.8
Total Operating	0.7	0.5	2.3	1.9	3.3	2.8	3.7	3.5	6.0	5.4	5.6	5.6	5.6	5.6
Direct Personnel		4.4		11.0		17.5		23.0		35.5		36.7		36.7

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Table SD.1 (continued)

	FY 1983		FY 1984 ^a		FY 1985 ^a		FY 1986 ^a		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Assistant Secretary for Nuclear Energy														
Internal Operating		28.9		35.3		40.4		43.2		45.7		46.4		47.2
Procurement		16.6		14.5		12.2		11.3		11.6		11.9		11.8
Total Operating	42.8	45.5	51.4	49.9	53.6	52.6	55.3	54.5	58.0	57.4	58.5	58.3	59.2	59.0
Capital Equipment	5.1		6.5		12.3		5.4		5.5		5.2		5.4	
Total Asst Secretary	47.9		57.9		65.9		60.6		63.5		63.7		64.6	
Direct Personnel		266.4		289.3		312.2		333.6		353.1		357.3		361.8
AS for Conservation and Renewable Energy														
AK04 Electric Field Effects														
Internal Operating		0.0		0.3		0.4		0.3		0.3		0.3		0.3
Procurement		0.0		0.2		0.2		0.2		0.2		0.2		0.2
Total Operating	0.0	0.0	0.5	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Direct Personnel		0.0		2.2		2.7		2.7		2.7		2.7		2.7
AK05 Power Delivery														
Internal Operating		1.3		1.2		1.3		1.4		1.4		1.4		1.4
Procurement		1.0		1.0		1.1		1.1		1.1		1.1		1.1
Total Operating	1.7	2.3	2.3	2.2	2.5	2.4	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Capital Equipment	1.4		0.0		0.0		0.0		0.0		0.0		0.0	
Total Activity	3.1		2.3		2.5		2.5		2.5		2.5		2.5	
Direct Personnel		8.4		8.5		8.6		8.5		8.5		8.5		8.5

Table SD.1 (continued)

	FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
AK10 Systems Architecture & Integration														
Internal Operating		1.0		1.5		1.2		1.0		2.0		2.0		2.0
Procurement		2.0		3.3		1.1		1.0		0.0		0.0		0.0
Total Operating	1.5	3.0	1.8	4.8	1.8	2.4	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Direct Personnel		6.0		8.0		7.0		6.0		6.0		6.0		6.0
AK ELECTRIC ENERGY SYSTEMS														
Internal Operating		2.4		3.0		2.9		2.7		3.7		3.7		3.7
Procurement		3.0		4.5		2.4		2.3		1.3		1.3		1.3
Total Operating	3.2	5.3	4.5	7.5	4.8	5.3	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Capital Equipment	1.4		0.0		0.0		0.0		0.0		0.0		0.0	
Total Program	4.6		4.5		4.8		5.0		5.0		5.0		5.0	
Direct Personnel		14.4		18.7		18.3		17.2		17.2		17.2		17.2
AL05 Battery Storage														
Internal Operating		0.04		0.0		0.0		0.0		0.0		0.0		0.0
Procurement		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.04	0.04	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Direct Personnel		0.0		0.0		0.0		0.0		0.0		0.0		0.0
AL10 Physical and Chemical Storage														
Internal Operating		1.2		0.6		0.7		0.7		0.7		0.7		0.7
Procurement		1.1		0.8		0.9		0.9		0.9		0.9		0.9
Total Operating	1.6	2.3	1.2	1.4	1.4	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Capital Equipment	0.0		0.1		0.0		0.0		0.0		0.0		0.0	
Total Activity	1.6		1.3		1.4		1.6		1.6		1.6		1.6	
Direct Personnel		7.4		4.2		5.2		5.0		5.0		5.0		5.0

Table SD.1 (continued)

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	FY 1983		FY 1984 ^a		FY 1985 ^a		FY 1986 ^a		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
AM GEOTHERMAL														
Internal Operating		0.2		0.6		0.6		0.6		0.6		0.6		0.6
Procurement		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.0	0.2	0.6	0.6	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Direct Personnel		1.9		3.7		3.7		3.7		3.7		3.7		3.7
CE10 Small Scale Hydropower : CE HYDROPOWER														
Internal Operating		0.5		0.3		0.0		0.0		0.0		0.0		0.0
Procurement		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.6	0.5	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Direct Personnel		4.5		2.5		0.0		0.0		0.0		0.0		0.0
EB01 Solar Applications for Buildings														
Internal Operating		0.2		0.2		0.0		0.0		0.0		0.0		0.0
Procurement		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.0	0.2	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Direct Personnel		1.1		1.4		0.0		0.0		0.0		0.0		0.0
EB02 Solar Applications for Industry														
Internal Operating		0.9		0.9		1.0		1.0		1.0		1.0		1.0
Procurement		2.8		3.4		4.0		4.0		4.0		4.0		4.0
Total Operating	3.6	3.7	5.0	4.3	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Capital Equipment	0.0		0.1		0.1		0.1		0.1		0.1		0.1	
Total Activity	3.6		5.1		5.1		5.1		5.1		5.1		5.1	
Direct Personnel		6.9		6.0		5.5		5.5		5.5		5.5		5.5

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Table SD.1 (continued)

	FY 1983		FY 1984 ^a		FY 1985 ^a		FY 1986 ^a		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
EB03 Solar Applications for Power														
Internal Operating		0.0		0.1		0.1		0.1		0.1		0.1		0.1
Procurement		0.0		0.1		0.1		0.1		0.1		0.1		0.1
Total Operating	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Direct Personnel	0.1		0.4		0.5		0.5		0.5		0.5		0.5	
EB11 Alcohol Financial Assistance														
Internal Operating		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Procurement		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Direct Personnel	0.2		0.1		0.0		0.0		0.0		0.0		0.0	
EB SOLAR ENERGY														
Internal Operating	1.1		1.2		1.1		1.1		1.1		1.1		1.1	
Procurement	2.9		3.5		4.1		4.1		4.1		4.1		4.1	
Total Operating	3.8	3.9	5.2	4.7	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
Capital Equipment	0.0		0.1		0.1		0.1		0.1		0.1		0.1	
Total Program	3.8		5.2		5.3		5.3		5.3		5.3		5.3	
Direct Personnel	8.3		7.9		6.0		6.0		6.0		6.0		6.0	
EC01 Buildings Systems														
Internal Operating	1.2		1.3		1.3		1.8		1.8		1.8		1.8	
Procurement	1.1		1.2		1.2		1.2		1.2		1.2		1.2	
Total Operating	3.3	2.2	2.5	2.5	2.5	2.5	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Capital Equipment	0.0		0.6		0.3		0.0		0.0		0.0		0.0	
Total Activity	3.3		3.1		2.8		3.0		3.0		3.0		3.0	
Direct Personnel	4.5		12.0		12.7		0.0		0.0		0.0		0.0	

Table SD.1 (continued)

	FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
EC04 Urban Waste														
Internal Operating		0.1		0.0		0.0		0.0		0.0		0.0		0.0
Procurement		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Direct Personnel		1.1		0.0		0.0		0.0		0.0		0.0		0.0
EC05 Technology and Consumer Products														
Internal Operating		3.3		2.6		2.6		2.7		2.7		2.7		2.7
Procurement		3.6		3.4		3.4		3.4		3.4		3.4		3.4
Total Operating	6.3	6.9	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Capital Equipment	0.0		0.3		0.1		0.1		0.1		0.1		0.1	
Total Activity	6.3		6.3		6.1		6.1		6.1		6.1		6.1	
Direct Personnel		26.2		21.0		21.0		21.0		21.0		21.0		21.0
EC06 Analysis and Technology Transfer														
Internal Operating		0.02		0.0		0.0		0.0		0.0		0.0		0.0
Procurement		0.02		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.0	0.04	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Direct Personnel		0.0		0.0		0.0		0.0		0.0		0.0		0.0
EC07 Residential Conservation Service														
Internal Operating		1.4		1.6		0.4		0.3		0.0		0.0		0.0
Procurement		0.1		0.1		0.0		0.0		0.0		0.0		0.0
Total Operating	0.9	1.4	1.0	1.6	0.3	0.4	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0
Direct Personnel		11.2		12.4		2.8		2.0		0.0		0.0		0.0

Table SD.1 (continued)

	FY 1983		FY 1984 ^a		FY 1985 ^a		FY 1986 ^a		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
EC BUILDINGS AND COMMUNITY SYSTEMS														
Internal Operating		5.9		5.5		4.3		4.7		4.5		4.5		4.5
Procurement		4.8		4.6		4.6		4.6		4.6		4.6		4.6
Total Operating	10.5	10.8	9.5	10.1	8.8	8.9	9.0	9.3	9.0	9.0	9.0	9.0	9.0	9.0
Capital Equipment	0.0		0.9		0.5		0.1		0.1		0.1		0.1	
Total Program	10.5		10.4		9.3		9.1		9.1		9.1		9.1	
Direct Personnel		43.0		45.4		36.5		23.0		21.0		21.0		21.0
ED01 Waste Energy Reduction														
Internal Operating		1.1		0.9		0.6		0.6		0.6		0.6		0.6
Procurement		0.2		0.9		1.8		1.8		1.8		1.8		1.8
Total Operating	0.6	1.2	1.8	1.8	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Capital Equipment	0.0		0.1		0.1		0.1		0.1		0.1		0.1	
Total Activity	0.6		1.9		2.5		2.5		2.5		2.5		2.5	
Direct Personnel		7.8		10.0		10.0		10.0		10.0		10.0		10.0
ED02 Industrial Process Efficiency														
Internal Operating		0.1		0.2		0.0		0.0		0.0		0.0		0.0
Procurement		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.0	0.1	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Direct Personnel		1.2		1.5		0.0		0.0		0.0		0.0		0.0

Table SD.1 (continued)

	FY 1983		FY 1984 ^a		FY 1985 ^a		FY 1986 ^a		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
ED INDUSTRIAL														
Internal Operating		1.2		1.0		0.6		0.6		0.6		0.6		0.6
Procurement		0.2		0.9		1.8		1.8		1.8		1.8		1.8
Total Operating	0.6	1.4	1.8	2.0	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Capital Equipment	0.0		0.1		0.1		0.1		0.1		0.1		0.1	
Total Program	0.6		1.9		2.5		2.5		2.5		2.5		2.5	
Direct Personnel		9.0		11.5		10.0		10.0		10.0		10.0		10.0
EE01 Vehicle Propulsion Research & Dev														
Internal Operating		1.0		1.8		2.1		2.9		2.9		2.9		2.9
Procurement		0.0		2.1		4.3		5.1		5.1		5.1		5.1
Total Operating	1.3	1.0	5.5	3.9	6.5	6.3	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Capital Equipment	0.0		0.2		0.2		0.2		0.2		0.2		0.2	
Construction	0.0		9.0		9.0		2.6		0.0		0.0		0.0	
Total Activity	1.3		14.7		15.7		10.8		8.2		8.2		8.2	
Direct Personnel		7.0		14.2		15.1		18.0		18.0		18.0		18.0
EE03 Electric/Hybrid Vehicle Program														
Internal Operating		0.03		0.0		0.0		0.0		0.0		0.0		0.0
Procurement		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.2	0.03	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Direct Personnel		0.4		0.0		0.0		0.0		0.0		0.0		0.0

Table SD.1 (continued)

	FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
EE04 Advanced Materials Development														
Internal Operating		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Procurement		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Direct Personnel		0.0		0.0		0.0		0.0		0.0		0.0		0.0
EE05 Transportation Utilization Program														
Internal Operating		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Procurement		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Direct Personnel		0.1		0.0		0.0		0.0		0.0		0.0		0.0
EE TRANSPORTATION														
Internal Operating		1.1		1.8		2.1		2.9		2.9		2.9		2.9
Procurement		0.0		2.1		4.3		5.1		5.1		5.1		5.1
Total Operating	2.7	1.1	5.5	3.9	6.5	6.3	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Capital Equipment	0.0		0.2		0.2		0.2		0.2		0.2		0.2	
Construction	0.0		9.0		9.0		2.6		0.0		0.0		0.0	
Total Program	2.7		14.7		15.7		10.8		8.2		8.2		8.2	
Direct Personnel		11.1		14.2		15.1		18.0		18.0		18.0		18.0

Table SD.1 (continued)

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	FY 1983		FY 1984 ^a		FY 1985 ^a		FY 1986 ^a		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
EF01 Schools and Hospitals														
Internal Operating		0.0		0.1		0.1		0.0		0.0		0.0		0.0
Procurement		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Direct Personnel		0.3		0.8		0.5		0.0		0.0		0.0		0.0
EF03 Weatherization														
Internal Operating		0.1		0.3		0.3		0.2		0.2		0.2		0.2
Procurement		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.2	0.1	0.3	0.3	0.4	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Direct Personnel		0.7		2.4		2.5		2.0		2.0		2.0		2.0
EF04 Energy Policy & Conservation Grants														
Internal Operating		0.2		0.2		0.1		0.1		0.1		0.1		0.1
Procurement		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Direct Personnel		2.6		1.5		0.5		0.5		0.5		0.5		0.5

Table SD.1 (continued)

	FY 1983		FY 1984 ^a		FY 1985 ^a		FY 1986 ^a		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
EF05 Energy Conserv. Production Grants														
Internal Operating		0.1		0.1		0.1		0.1		0.1		0.1		0.1
Procurement		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.1	0.1	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Direct Personnel		0.7		1.3		0.5		0.5		0.5		0.5		0.5
EF STATE/LOCAL PROGRAMS														
Internal Operating		0.4		0.7		0.4		0.3		0.3		0.3		0.3
Procurement		0.1		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.6	0.5	0.9	0.8	0.5	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Direct Personnel		4.3		6.0		4.0		3.0		3.0		3.0		3.0
EG03 Energy Extension Service														
Internal Operating		0.1		0.2		0.0		0.0		0.0		0.0		0.0
Procurement		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.4	0.1	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Direct Personnel		0.6		2.1		0.0		0.0		0.0		0.0		0.0

Table SD.1 (continued)

	FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
EG05 Energy Conversion Technology														
Internal Operating		0.8		1.2		1.4		1.4		1.4		1.4		1.4
Procurement		0.7		1.2		1.3		1.3		1.3		1.3		1.3
Total Operating	2.9	1.6	2.7	2.4	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
Capital Equipment	0.0		0.3		0.6		0.0		0.0		0.0		0.0	
Total Activity	2.9		3.0		3.3		2.7		2.7		2.7		2.7	
Direct Personnel		7.6		9.1		10.0		10.0		10.0		10.0		10.0
EG06 Inventors Program														
Internal Operating		0.1		0.2		0.0		0.0		0.0		0.0		0.0
Procurement		0.1		0.1		0.0		0.0		0.0		0.0		0.0
Total Operating	0.2	0.3	0.2	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Direct Personnel		0.9		1.3		0.4		0.0		0.0		0.0		0.0
EG MULTI-SECTOR														
Internal Operating		1.1		1.6		1.4		1.4		1.4		1.4		1.4
Procurement		0.9		1.3		1.3		1.3		1.3		1.3		1.3
Total Operating	3.5	2.0	2.9	2.9	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
Capital Equipment	0.0		0.3		0.6		0.0		0.0		0.0		0.0	
Total Program	3.5		3.2		3.3		2.7		2.7		2.7		2.7	
Direct Personnel		9.1		12.5		10.4		10.0		10.0		10.0		10.0

Table SD.1 (continued)

	FY 1983		FY 1984 ^a		FY 1985 ^a		FY 1986 ^a		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
AS for Conservation and Renewable Energy														
Internal Operating		15.0		16.2		14.1		15.1		15.8		15.8		15.8
Procurement		13.0		17.9		19.4		20.0		19.0		19.0		19.0
Total Operating	27.1	28.0	32.0	34.1	33.0	33.5	34.8	35.1	34.8	34.8	34.8	34.8	34.8	34.8
Capital Equipment	1.4		1.6		1.4		0.4		0.4		0.4		0.4	
Construction	0.0		9.0		9.0		2.6		0.0		0.0		0.0	
Total Asst Secretary	28.5		42.6		43.4		37.9		35.3		35.3		35.3	
Direct Personnel		113.0		126.6		109.2		95.9		93.9		93.9		93.9
Office of Policy, Planning & Analysis														
PE01 Policy, Planning and Analysis : PE POLICY ANALYSIS & SYSTEMS STUDIES														
Internal Operating		0.0		0.1		0.1		0.1		0.1		0.1		0.1
Procurement		0.0		0.1		0.1		0.1		0.1		0.1		0.1
Total Operating	0.0	0.1	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Direct Personnel		0.2		0.5		0.8		1.0		1.0		1.0		1.0
Office of Policy, Planning & Analysis														
Internal Operating		0.0		0.1		0.1		0.1		0.1		0.1		0.1
Procurement		0.0		0.1		0.1		0.1		0.1		0.1		0.1
Total Operating	0.0	0.1	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Direct Personnel		0.2		0.5		0.8		1.0		1.0		1.0		1.0

Table SD.1 (continued)

	FY 1983		FY 1984 ^a		FY 1985 ^a		FY 1986 ^a		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Office of Energy Research														
AT05 Applied Plasma Physics														
Internal Operating		4.6		4.7		5.4		5.6		5.6		5.6		5.6
Procurement		0.4		0.4		0.5		0.3		0.3		0.3		0.3
Total Operating	5.3	5.0	5.3	5.2	7.0	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9
Capital Equipment	0.1		0.2		1.2		0.2		0.2		0.2		0.2	
Total Activity	5.4		5.5		8.2		6.1		6.1		6.1		6.1	
Direct Personnel	32.0		31.0		31.0		31.0		31.0		31.0		31.0	
AT10 Confinement Systems														
Internal Operating		16.7		21.5		21.8		22.4		22.4		22.4		22.4
Procurement		3.9		7.7		8.5		7.8		7.8		7.8		7.8
Total Operating	30.0	20.6	24.5	29.2	32.4	30.2	30.2	30.2	30.2	30.2	30.2	30.2	30.2	30.2
Capital Equipment	2.9		1.2		3.6		3.5		3.5		3.5		3.5	
Total Activity	32.9		25.7		36.0		33.7		33.7		33.7		33.7	
Direct Personnel	71.2		69.3		69.3		69.3		69.3		69.3		69.3	
AT15 Development and Technology														
Internal Operating		19.2		12.4		18.8		18.8		18.8		18.8		18.8
Procurement		13.8		16.7		13.3		13.3		13.3		13.3		13.3
Total Operating	32.6	32.9	29.2	29.1	40.7	32.1	32.1	32.1	32.1	32.1	32.1	32.1	32.1	32.1
Capital Equipment	5.2		3.8		3.2		3.0		3.0		3.0		3.0	
Total Activity	37.7		33.0		43.9		35.1		35.1		35.1		35.1	
Direct Personnel	83.8		74.7		74.7		74.7		74.7		74.7		74.7	

Table SD.1 (continued)

	FY 1983		FY 1984 ^a		FY 1985 ^a		FY 1986 ^a		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
AT MAGNETIC FUSION														
Internal Operating		40.4		38.6		46.0		46.8		46.8		46.8		46.8
Procurement		18.0		24.9		22.2		21.4		21.4		21.4		21.4
Total Operating	67.9	58.5	59.0	63.5	80.1	68.2	68.2	68.2	68.2	68.2	68.2	68.2	68.2	68.2
Capital Equipment	8.1		5.2		8.0		6.7		6.7		6.7		6.7	
Total Program	76.0		64.2		88.1		74.9		74.9		74.9		74.9	
Direct Personnel	187.0		175.0		175.0		175.0		175.0		175.0		175.0	
HA02 Biological & Environmental Research : HA ENVIRONMENTAL RES & DEVELOPMENT														
Internal Operating		24.1		26.8		26.9		26.9		26.9		26.9		26.9
Procurement		2.8		2.5		2.6		2.6		2.6		2.6		2.6
Total Operating	24.1	27.0	26.8	29.3	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5
Capital Equipment	1.8		1.5		1.6		1.6		1.6		1.6		1.6	
Total Activity	25.9		28.3		31.1		31.1		31.1		31.1		31.1	
Proposed Construction	0.0		1.8		6.0		8.8		28.2		1.5		0.0	
Direct Personnel	198.0		200.0		200.0		200.0		200.0		200.0		200.0	
KA01 Physics Research : KA HIGH ENERGY PHYSICS														
Internal Operating		0.6		0.6		0.7		0.7		0.7		0.7		0.7
Procurement		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.6	0.6	0.6	0.6	0.9	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Capital Equipment	0.1		0.0		0.1		0.1		0.1		0.1		0.1	
Total Activity	0.6		0.6		1.0		0.8		0.8		0.8		0.8	
Direct Personnel	4.5		5.3		5.3		5.3		5.3		5.3		5.3	
Direct Personnel	4.5		5.3		5.3		5.3		5.3		5.3		5.3	

Table SD.1 (continued)

	FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
KB02 Heavy Ion Physics														
Internal Operating		7.0		7.4		8.5		8.8		9.1		9.4		9.6
Procurement		0.5		0.5		0.6		0.6		0.6		0.7		0.8
Total Operating	7.2	7.5	8.0	8.0	10.9	9.2	9.6	9.5	9.9	9.8	10.2	10.1	10.5	10.4
Capital Equipment	0.9		1.2		1.3		1.3		1.4		1.4		1.5	
Total Activity	8.1		9.2		12.1		10.9		11.2		11.6		11.9	
Proposed Construction	0.0		0.0		0.0		0.5		0.0		0.0		0.0	
Direct Personnel	63.8		66.5		69.4		72.5		75.5		78.5		82.0	
KB03 Nuclear Theory														
Internal Operating		0.6		0.7		0.8		0.8		0.8		0.9		0.9
Procurement		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.7	0.7	0.7	0.7	1.0	0.8	0.8	0.8	0.9	0.9	0.9	0.9	0.9	0.9
Direct Personnel	4.4		5.5		5.5		5.5		5.7		5.8		6.0	
KB04 Low Energy Physics														
Internal Operating		0.7		0.8		0.9		1.0		1.0		1.0		1.1
Procurement		0.1		0.1		0.1		0.0		0.0		0.0		0.0
Total Operating	0.8	0.8	0.9	0.9	1.3	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.1	1.1
Capital Equipment	0.1		0.1		0.1		0.1		0.1		0.1		0.1	
Total Activity	0.9		1.0		1.3		1.1		1.1		1.1		1.1	
Direct Personnel	5.6		7.3		7.4		7.6		7.7		7.8		8.0	

Table SD.1 (continued)

	FY 1983		^a FY 1984		^a FY 1985		^a FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
KB NUCLEAR PHYSICS														
Internal Operating		8.3		8.9		10.2		10.6		11.0		11.2		11.5
Procurement		0.6		0.6		0.8		0.7		0.7		0.7		0.8
Total Operating	8.7	9.0	9.6	9.6	13.1	11.0	11.4	11.3	11.7	11.6	12.0	11.9	12.4	12.3
Capital Equipment	1.0		1.3		1.4		1.4		1.4		1.5		1.5	
Total Program	9.7		10.8		14.4		12.8		13.2		13.5		14.0	
Proposed Construction	0.0		0.0		0.0		0.5		0.0		0.0		0.0	
Direct Personnel	73.8		79.3		82.3		85.6		88.9		92.1		96.0	
KC01 Nuclear Sciences														
Internal Operating		16.2		16.0		17.4		17.7		17.7		17.7		17.7
Procurement		0.3		0.8		0.8		0.8		0.8		0.8		0.8
Total Operating	15.7	16.5	16.7	16.7	22.2	18.1	18.6	18.5	18.5	18.5	18.5	18.5	18.5	18.5
Capital Equipment	0.6		1.0		1.2		1.0		1.0		1.0		1.0	
Construction	0.0		0.3		0.0		0.0		0.0		0.0		0.0	
Total Activity	16.3		17.9		23.5		19.6		19.5		19.5		19.5	
Proposed Construction	0.0		0.0		0.6		0.6		0.0		0.0		0.0	
Direct Personnel	151.2		150.0		146.9		147.0		147.0		147.0		147.0	
KC02 Materials Sciences														
Internal Operating		18.4		19.8		23.2		23.9		24.7		25.5		26.3
Procurement		1.2		1.1		1.3		1.4		1.5		1.5		1.6
Total Operating	19.6	19.6	21.0	21.0	29.5	24.5	25.5	25.3	26.3	26.1	27.3	27.0	28.1	27.9
Capital Equipment	2.1		2.6		3.0		2.6		2.6		2.6		2.6	
Total Activity	21.7		23.6		32.5		28.1		28.9		29.9		30.7	
Direct Personnel	168.5		167.1		180.0		186.0		192.0		198.0		204.0	

Table SD.1 (continued)

	FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
KC03 Chemical Sciences														
Internal Operating		7.2		7.4		8.4		8.4		8.4		8.4		8.4
Procurement		0.3		0.3		0.4		0.4		0.4		0.4		0.4
Total Operating	7.7	7.6	7.8	7.8	9.9	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7
Capital Equipment	0.6		0.7		0.9		0.9		0.9		0.9		0.9	
Construction	0.0		0.3		0.0		0.0		0.0		0.0		0.0	
Total Activity	8.3		8.8		10.8		9.7		9.7		9.7		9.7	
Proposed Construction	0.0		0.0		0.0		2.8		0.0		0.0		0.0	
Direct Personnel	66.4		70.0		72.5		72.5		72.5		72.5		72.5	
KC04 Engineering, Math, and Geosciences														
Internal Operating		1.3		1.3		2.8		3.2		3.3		3.4		3.5
Procurement		0.1		0.3		0.5		0.7		0.7		0.8		0.8
Total Operating	1.4	1.4	1.7	1.7	3.9	3.3	4.0	3.8	4.1	4.0	4.2	4.1	4.3	4.2
Capital Equipment	0.1		0.2		0.3		0.6		0.5		0.4		0.4	
Total Activity	1.5		1.9		4.3		4.5		4.6		4.6		4.7	
Direct Personnel	5.8		10.0		12.7		17.0		19.0		21.0		22.0	
KC06 Biological Energy Research														
Internal Operating		0.2		0.2		0.2		0.4		0.5		0.5		0.5
Procurement		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.2	0.2	0.2	0.2	0.3	0.2	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5
Direct Personnel	1.6		2.0		2.0		3.5		5.0		5.0		5.0	

Table SD.1 (continued)

	FY 1983		FY 1984 ^a		FY 1985 ^a		FY 1986 ^a		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BC	BA	BO	BA	BO	BA	BO	BA	BO
KC BASIC ENERGY SCIENCES														
Internal Operating		43.3		44.8		51.9		53.5		54.5		55.5		56.4
Procurement		1.9		2.6		2.9		3.2		3.3		3.4		3.4
Total Operating	44.6	45.2	47.3	47.4	65.9	54.9	57.2	56.7	58.2	57.9	59.2	58.9	60.1	59.8
Capital Equipment	3.4		4.4		5.5		5.1		5.0		5.0		5.0	
Construction	0.0		0.6		0.0		0.0		0.0		0.0		0.0	
Total Program	48.1		52.3		71.3		62.4		63.2		64.1		65.1	
Proposed Construction	0.0		0.0		0.6		3.4		0.0		0.0		0.0	
Direct Personnel	393.5		399.1		414.1		426.0		435.5		443.5		450.5	
KD01 Assessment Projects														
Internal Operating		0.7		0.7		0.7		0.7		0.7		0.7		0.7
Procurement		0.2		0.4		0.3		0.3		0.3		0.3		0.3
Total Operating	1.3	0.9	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Direct Personnel	4.6		6.0		6.0		6.0		6.0		6.0		6.0	
KD04 Advanced Technology Projects														
Internal Operating		0.1		0.0		0.0		0.0		0.0		0.0		0.0
Procurement		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Direct Personnel	0.6		0.0		0.0		0.0		0.0		0.0		0.0	

Table SD.1 (continued)

	FY 1983		FY 1984 ^a		FY 1985 ^a		FY 1986 ^a		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
KD ENERGY RESEARCH AND ANALYSIS														
Internal Operating		0.8		0.7		0.7		0.7		0.7		0.7		0.7
Procurement		0.2		0.4		0.3		0.3		0.3		0.3		0.3
Total Operating	1.3	1.0	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Direct Personnel		5.2		6.0		6.0		6.0		6.0		6.0		6.0
KE01 University Research Support : KE UNIVERSITY RESEARCH SUPPORT														
Internal Operating		0.1		0.1		0.1		0.1		0.1		0.1		0.1
Procurement		0.0		0.1		0.1		0.1		0.1		0.1		0.1
Total Operating	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Direct Personnel		0.5		2.5		2.5		2.5		2.5		2.5		2.5
Office of Energy Research														
Internal Operating		117.7		120.5		136.6		139.4		140.7		141.9		143.1
Procurement		23.7		31.0		28.9		28.2		28.4		28.5		28.7
Total Operating	147.3	141.4	144.5	151.5	190.7	165.4	168.2	167.6	169.5	169.1	170.8	170.4	172.1	171.8
Capital Equipment		14.4		12.4		16.5		14.9		14.9		14.9		14.9
Construction		0.0		0.6		0.0		0.0		0.0		0.0		0.0
Total Asst Secretary	161.8		157.5		207.2		183.2		184.4		185.7		187.1	
Proposed Construction		0.0		1.8		6.6		12.7		28.2		1.5		0.0
Direct Personnel		862.5		867.2		885.2		900.4		913.2		924.4		935.3

Table SD.1 (continued)

	FY 1983		FY 1984 ^a		FY 1985 ^a		FY 1986 ^a		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Assistant Secretary for Defense														
AR05 Defense Waste Management Programs : AR DEFENSE WASTE MANAGEMENT														
Internal Operating		14.9		16.5		18.5		18.0		17.9		17.8		17.4
Procurement		3.4		3.0		4.2		3.6		3.3		2.8		2.8
Total Operating	18.5	18.3	19.3	19.6	23.5	22.7	21.5	21.6	21.0	21.2	20.5	20.6	20.2	20.2
Capital Equipment	1.3		1.4		1.6		1.2		1.0		0.9		0.9	
Construction	5.0		4.0		0.0		0.0		0.0		0.0		0.0	
Total Activity	24.8		24.7		25.1		22.7		22.0		21.4		21.1	
Waste Management GPP and Proposed Construction	2.0		1.8		2.5		3.5		6.0		5.5		2.5	
Direct Personnel	126.5		128.0		132.0		129.0		128.0		127.0		124.0	
GC01 Verification and Control Technology : GC VERIFICATION & CONTROL TECHNOLOGY														
Internal Operating		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Procurement		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Direct Personnel		0.4		0.1		0.1		0.1		0.1		0.1		0.1
GD02 Nuclear Matls Security & Safeguards : GD NUCLEAR MATERIALS SECURITY & SAFEGUARDS														
Internal Operating		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Procurement		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Direct Personnel		0.5		0.0		0.0		0.0		0.0		0.0		0.0

Table SD.1 (continued)

	FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
GE02 Processing of Nuclear Materials														
Internal Operating		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Procurement		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Capital Equipment	0.0		0.1		0.1		0.1		0.1		0.1		0.1	
Total Activity	0.0		0.1		0.1		0.1		0.1		0.1		0.1	
Direct Personnel		0.0		0.0		0.0		0.0		0.0		0.0		0.0
GE03 Supporting Services														
Internal Operating		1.9		4.1		4.7		4.1		3.0		2.4		2.4
Procurement		3.3		5.3		5.4		2.9		0.1		0.0		0.0
Total Operating	5.6	5.2	9.1	9.4	10.7	10.1	6.6	7.0	3.0	3.1	2.4	2.4	2.4	2.4
Capital Equipment	0.0		0.1		0.1		0.1		0.1		0.1		0.1	
Total Activity	5.6		9.1		10.8		6.7		3.1		2.5		2.5	
Direct Personnel		32.5		34.5		36.7		31.5		23.0		18.5		18.5
GE MATERIALS PRODUCTION														
Internal Operating		1.9		4.1		4.7		4.1		3.0		2.4		2.4
Procurement		3.3		5.3		5.4		2.9		0.1		0.0		0.0
Total Operating	5.6	5.2	9.1	9.4	10.7	10.1	6.6	7.0	3.0	3.1	2.4	2.4	2.4	2.4
Capital Equipment	0.0		0.1		0.1		0.2		0.2		0.2		0.2	
Total Program	5.6		9.2		10.9		6.8		3.1		2.6		2.6	
Direct Personnel		32.5		34.5		36.7		31.5		23.0		18.5		18.5

Table SD.1 (continued)

	FY 1983		FY 1984		FY 1985		FY 1986		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Assistant Secretary for Defense														
Internal Operating		16.9		20.7		23.2		22.2		20.9		20.2		19.8
Procurement		6.7		8.3		9.6		6.5		3.4		2.8		2.8
Total Operating	24.2	23.6	28.4	29.0	34.2	32.8	28.1	28.7	24.0	24.4	22.9	23.0	22.6	22.6
Capital Equipment	1.3		1.5		1.8		1.4		1.1		1.1		1.1	
Construction	5.0		4.0		0.0		0.0		0.0		0.0		0.0	
Total Asst Secretary	30.5		34.0		36.0		29.5		25.1		24.0		23.7	
Waste Management GPP and Proposed Construction	2.0		1.8		2.5		3.5		6.0		5.5		2.5	
Direct Personnel	159.9		162.6		168.8		160.6		151.1		145.6		142.6	
AS for Env. Protection, Safety & Emerg. Prep														
HA01 Environment, Safety and Health : HA ENVIRONMENTAL RES & DEVELOPMENT														
Internal Operating		2.7		1.5		2.0		2.0		2.0		2.0		2.0
Procurement		1.0		0.5		0.5		0.5		0.5		0.5		0.5
Total Operating	3.5	3.8	2.0	2.0	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Capital Equipment	0.1		0.1		0.1		0.1		0.1		0.1		0.1	
Total Activity	3.6		2.1		2.6		2.6		2.6		2.6		2.6	
Direct Personnel	24.3		10.0		12.0		12.0		12.0		12.0		12.0	
UB02 Power Supply and Reliability : UB UTILITY PROG & REGULATORY INTERVEN														
Internal Operating		0.0		0.4		0.3		0.3		0.3		0.3		0.3
Procurement		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.0	0.0	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Direct Personnel	0.0		0.3		0.2		0.2		0.2		0.2		0.2	

Table SD.1 (continued)

ORNL

	FY 1983		FY 1984 ^a		FY 1985 ^a		FY 1986 ^a		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
AS for Env Protection, Safety & Emerg Prep														
Internal Operating		2.7		1.9		2.3		2.3		2.3		2.3		2.3
Procurement		1.0		0.5		0.5		0.5		0.5		0.5		0.5
Total Operating	3.5	3.8	2.4	2.4	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Capital Equipment	0.1		0.1		0.1		0.1		0.1		0.1		0.1	
Total Asst Secretary	3.6		2.5		2.8		2.9		2.9		2.9		2.9	
Direct Personnel		24.3		10.3		12.2		12.2		12.2		12.2		12.2

Federal Energy Regulatory Commission

VP00 Other Expenses : VP OTHER EXPENSES

Internal Operating		0.3		0.5		0.6		0.7		0.7		0.7		0.7
Procurement		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.3	0.3	0.7	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Direct Personnel		2.4		3.6		3.5		3.5		3.5		3.5		3.5

Federal Energy Regulatory Commission

Internal Operating		0.3		0.5		0.6		0.7		0.7		0.7		0.7
Procurement		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.3	0.3	0.7	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Direct Personnel		2.4		3.6		3.5		3.5		3.5		3.5		3.5

Table SD.1 (continued)

	FY 1983		FY 1984 ^a		FY 1985 ^a		FY 1986 ^a		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Energy Information Administration														
TA01 Program Support : TA COLLECTION, PRODUCTION AND ANALYSIS														
Internal Operating		1.2		1.0		1.1		1.2		1.3		1.4		1.5
Procurement		2.9		0.8		0.7		0.6		0.5		0.4		0.3
Total Operating	0.5	4.2	1.0	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
Direct Personnel		13.7		8.0		8.0		8.0		8.0		8.0		8.0
TB01 Program Services Support : TB PROGRAM SERVICES														
Internal Operating		0.5		0.1		0.1		0.1		0.1		0.1		0.1
Procurement		0.3		0.3		0.3		0.3		0.3		0.3		0.3
Total Operating	0.0	0.7	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Direct Personnel		0.8		1.0		1.0		1.0		1.0		1.0		1.0
Energy Information Administration														
Internal Operating		1.7		1.1		1.2		1.3		1.4		1.5		1.6
Procurement		3.2		1.1		1.0		0.9		0.8		0.7		0.6
Total Operating	0.5	4.9	1.4	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
Direct Personnel		14.5		9.0		9.0		9.0		9.0		9.0		9.0

Table SD.1 (continued)

OFM

	FY 1983		FY 1984 ^a		FY 1985 ^a		FY 1986 ^a		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Asst. Sec. for Management & Administration														
LA01 Technical Information Center : LA TECHNICAL INFORMATION SERVICES														
Internal Operating		0.8		1.0		1.2		1.2		1.3		1.3		1.4
Procurement		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.9	0.8	1.1	1.0	1.2	1.2	1.3	1.2	1.3	1.3	1.4	1.3	1.4	1.4
Capital Equipment	0.1		0.1		0.1		0.0		0.0		0.0		0.0	
Total Activity	1.0		1.2		1.3		1.3		1.3		1.4		1.4	
Direct Personnel		0.0		0.0		0.0		0.0		0.0		0.0		0.0
WB00 In-House Energy Management : WB IN-HOUSE ENERGY MANAGEMENT														
Internal Operating		0.1		0.0		0.0		0.0		0.0		0.0		0.0
Procurement		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy Conservation GPP	1.5		2.0		2.0		2.0		2.0		1.5		1.0	
Direct Personnel		0.4		0.0		0.0		0.0		0.0		0.0		0.0
Asst. Sec. for Management & Administration														
Internal Operating		0.9		1.0		1.2		1.2		1.3		1.3		1.4
Procurement		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.9	0.9	1.1	1.0	1.2	1.2	1.3	1.2	1.3	1.3	1.4	1.3	1.4	1.4
Capital Equipment	0.1		0.1		0.1		0.0		0.0		0.0		0.0	
Total Asst Secretary	1.0		1.2		1.3		1.3		1.3		1.4		1.4	
Energy Conservation GPP	1.5		2.0		2.0		2.0		2.0		1.5		1.0	
Direct Personnel		0.4		0.0		0.0		0.0		0.0		0.0		0.0

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Table SD.1 (continued)

	FY 1983		FY 1984 ^a		FY 1985 ^a		FY 1986 ^a		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
DOE CONTRACTORS & OPERATIONS OFFICE														
DOE CONTRACTORS & OPERATIONS OFFICE														
Internal Operating		10.5		6.5		5.5		5.6		5.6		5.6		5.6
Procurement		0.7		0.8		1.2		0.3		0.3		0.3		0.3
Total Operating	12.8	11.3	6.9	7.3	6.4	6.8	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9
Capital Equipment	0.1		0.1		0.1		0.1		0.1		0.1		0.1	
Total Program	12.9		7.0		6.5		6.0		6.0		6.0		6.0	
Direct Personnel	83.9		46.3		36.6		36.7		36.7		36.7		36.7	
Work for Others														
NRC/Nuclear Reactor Regulation														
Internal Operating		2.3		2.2		1.8		1.8		1.8		1.8		1.8
Procurement		0.1		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	2.6	2.5	2.4	2.2	1.7	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
Direct Personnel	19.2		13.0		9.7		19.0		17.6		15.5		14.0	
NRC/Administration														
Internal Operating		0.3		0.4		0.4		0.4		0.4		0.4		0.4
Procurement		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.4	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Direct Personnel		4.3		4.6		4.5		4.7		4.7		4.7		4.7

Table SD.1 (continued)

	FY 1983		FY 1984 ^a		FY 1985 ^a		FY 1986 ^a		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
NRC/Nuc Mat Safety & Safeguards														
Internal Operating		2.5		2.3		2.5		3.1		3.2		3.2		3.2
Procurement		0.2		0.4		0.4		0.4		0.4		0.4		0.4
Total Operating	2.6	2.7	2.7	2.7	2.6	2.9	3.6	3.5	3.6	3.6	3.6	3.6	3.6	3.6
Direct Personnel		16.6		20.2		23.0		24.0		24.7		24.7		24.7
NRC/Nuclear Regulatory Research														
Internal Operating		18.3		19.1		16.7		17.7		17.7		17.7		17.7
Procurement		5.3		4.4		3.8		3.8		3.8		3.8		3.8
Total Operating	21.0	23.7	21.3	23.5	22.8	20.4	22.1	21.4	21.9	21.4	21.4	21.4	20.8	21.4
Capital Equipment		1.0		0.0		0.0		0.0		0.0		0.0		0.0
Total Activity	22.1		21.3		22.8		22.1		21.9		21.4		20.8	
Direct Personnel		128.0		125.7		110.4		109.0		108.0		107.0		106.0
NRC/Analysis & Eval of Oper Data														
Internal Operating		1.3		1.8		1.7		2.0		2.0		2.0		2.0
Procurement		0.3		0.1		0.1		0.1		0.1		0.1		0.1
Total Operating	1.5	1.5	1.8	1.9	2.2	1.8	2.0	2.1	2.0	2.1	2.0	2.1	2.0	2.1
Direct Personnel		9.4		10.4		9.8		9.7		9.5		9.3		9.1

Table SD.1 (continued)

	FY 1983		FY 1984 ^a		FY 1985 ^a		FY 1986 ^a		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
NRC/Other Offices														
Internal Operating		0.4		1.0		1.6		1.6		1.6		1.6		1.6
Procurement		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.7	0.4	1.0	1.0	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Direct Personnel		1.5		6.3		9.2		9.2		9.2		9.2		9.2
NUCLEAR REGULATORY COMMISSION														
Internal Operating		25.2		26.8		24.7		26.6		26.6		26.6		26.6
Procurement		5.9		4.9		4.3		4.2		4.2		4.2		4.2
Total Operating	28.9	31.1	29.6	31.7	31.4	28.9	31.5	30.8	31.3	30.9	30.8	30.9	30.2	30.9
Capital Equipment	1.1		0.0		0.0		0.0		0.0		0.0		0.0	
Total Program	30.0		29.6		31.4		31.5		31.3		30.8		30.2	
Direct Personnel		179.0		180.2		166.6		175.6		173.7		170.4		167.7
DEPARTMENT OF DEFENSE														
Internal Operating		5.4		8.7		11.1		11.4		12.1		13.1		13.1
Procurement		2.3		6.8		10.2		12.7		13.5		13.5		13.5
Total Operating	7.7	7.7	20.8	15.5	25.6	21.3	26.0	24.0	26.5	25.5	26.5	26.5	26.5	26.5
Capital Equipment	0.1		1.9		2.5		1.6		1.5		1.5		1.5	
Total Program	7.7		22.7		28.1		27.6		28.0		28.0		28.0	
Direct Personnel		42.6		81.1		97.3		99.0		96.0		96.0		96.0

Table SD.1 (continued)

	FY 1983		FY 1984 ^a		FY 1985 ^a		FY 1986 ^a		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
DEPARTMENT OF INTERIOR														
Internal Operating		0.7		2.5		2.6		2.6		2.6		2.6		2.6
Procurement		0.5		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	1.2	1.2	2.5	2.5	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Direct Personnel		5.3		8.0		8.0		8.0		8.0		8.0		8.0
DEPT OF HEALTH & HUMAN SERVICES														
Internal Operating		4.8		5.0		5.5		5.5		5.5		5.5		5.5
Procurement		0.2		0.4		0.4		0.4		0.4		0.4		0.4
Total Operating	5.0	5.0	5.4	5.4	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9
Direct Personnel		48.4		41.0		41.0		41.0		41.0		41.0		41.0
ENVIRONMENTAL PROTECTION AGENCY														
Internal Operating		4.2		4.7		5.1		5.1		5.1		5.1		5.1
Procurement		0.5		0.5		0.5		0.5		0.5		0.5		0.5
Total Operating	4.7	4.7	5.2	5.2	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7
Direct Personnel		43.9		50.0		50.0		50.0		50.0		50.0		50.0

Table SD.1 (continued)

	FY 1983		FY 1984 ^a		FY 1985 ^a		FY 1986 ^a		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
NATIONAL SCIENCE FOUNDATION														
Internal Operating		1.7		2.3		2.7		2.7		2.7		2.7		2.7
Procurement		0.2		0.1		0.1		0.1		0.1		0.1		0.1
Total Operating	2.0	2.0	2.4	2.4	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Direct Personnel		12.6		15.0		17.0		17.0		17.0		17.0		17.0
TENNESSEE VALLEY AUTHORITY														
Internal Operating		0.3		0.7		0.7		0.7		0.7		0.7		0.7
Procurement		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.4	0.4	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Direct Personnel		2.5		5.7		5.5		5.5		5.5		5.5		5.5
SYNTHETIC FUELS CORPORATION														
Internal Operating		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Procurement		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Total Operating	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Direct Personnel		0.3		0.0		0.0		0.0		0.0		0.0		0.0

Table SD.1 (continued)

	FY 1983		FY 1984 ^a		FY 1985 ^a		FY 1986 ^a		FY 1987		FY 1988		FY 1989	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
OTHER FEDERAL AGENCIES														
Internal Operating		3.0		5.9		6.0		6.0		6.0		6.0		5.8
Procurement		0.4		0.7		0.3		0.1		0.1		0.1		0.1
Total Operating	3.5	3.5	6.6	6.6	6.3	6.3	6.1	6.1	6.1	6.1	6.1	6.1	5.9	5.9
Direct Personnel		24.3		37.3		35.9		36.9		36.9		36.9		35.6
ELECTRIC POWER RESEARCH INSTITUTE														
Internal Operating		1.8		2.2		2.2		2.7		2.7		2.7		2.7
Procurement		0.4		0.3		0.3		0.3		0.3		0.3		0.3
Total Operating	2.2	2.2	2.5	2.5	2.5	2.5	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Direct Personnel		13.0		17.6		17.0		17.0		17.0		17.0		17.0
OTHER NONFEDERAL AGENCIES														
Internal Operating		0.8		3.3		1.5		1.4		1.4		1.4		1.4
Procurement		0.2		0.5		0.1		0.0		0.0		0.0		0.0
Total Operating	1.0	1.0	3.8	3.8	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Direct Personnel		6.7		20.0		13.5		12.9		12.9		12.9		12.9

^a

Escalation factors from FY 1983 to FY 1984 and from FY 1984 to FY 1985 are both 8.5%. Figures for FY 1986 through FY 1989 are in constant FY 1985 dollars.

Table SD.2. WPAS cross reference^a

B&R code	WPAS No.	WPAS title
Assistant Secretary for Fossil Energy		
AA0515000	00211	FE Solid Waste Extractions
	00241	Pgm Plan Fos En Solid Wastes
	00270	Metals from Fly Ash-Process Eval
AA0520000	00253	Coal Beneficiation: Novel Flotation
	00279	System Analysis of Coal Prep
	99999	Unassigned Uncosted Bal 9/30/82
AA1505000	00157	Ceramic HX for FF Comb
AA1510100	00028	AR&TD Fossil Energy Mtls Program
AA1515050	00231	FFFB Bioreactors for Coal Wastewater
	00268	Control of Reverse Osmosis
	00269	Solids and Sludge Disposal
	99999	Unassigned Uncosted Bal 9/30/82
AA1515100	00084	Process Research Digest
	00208	Process Factors Affecting SCT Prodn
	00209	Slurry Reactor Development
	00302	New Liquefaction Techniques
AA1520150	00305	Physical Properties of Coal Liquids
	A0208	Process Factors Affecting SCT Prodn
	00205	GEMS/Liquid-Gaseous Fuel Supplies
	00213	Liquefaction ECT Assessments
	00223	Regulatory/Update (Newsletter)
	00227	Liq Econ & Tech Assmts
	00228	FE Envir Safety & Health
	00265	Pseudo Comp Prop for ASPEN
	00311	IEA - EA Service
	00316	Systems Analysis Support - DLTAS
AA2515150	00324	Performance Assurance & Stand
	00262	Matls for Coal Liqu P-Vessels
	00263	Coal Liqu Matls Test & Fail
	00272	Coating Studies for Coal Conversion
AA2530100	00280	CVD Coating Studies
	00216	Eff of Hydrotreat & Mitig Processes
	00220	On-Line Monitor-ESR
	00222	Liq Plant Studies - Components
	00239	LIQUEFACTION COMPONENTS STUDIES
AA3505400	00255	Fluid Props. for Coal Conversion
	00258	SCT Process Liquids Properties
	00017	Coal Combustor for Cogenerat
AA3505500	00273	Mag Benef of FBC Streams
AA3520100	00274	Combustion Kinetics of AFB Fuels
	00275	Coupled FBC Pyrolysis Pwr Sys
	00276	High Performance PFBC Dev
	00277	Risk Assessment of PFBC
	00278	PFBC Deposition Experiment
AA3525050	00326	Systems assessment of PFBC
AA5505050	00159	Dist Heating - Fossil Energy
AA5515150	00011	Low-Temperature Heat Utilization
AA8540000	00210	IEA Tech Rep
	00259	Purification of SNG
AA8545050	00232	Slurry Pump Development
	00233	Hot Dirty Gas Heat Exchangers

Table SD.2 (continued)

B&R code	WPAS No.	WPAS title
	00234	Hot Dirty Gas Compressors/Expanders
	00235	Hot Dirty Gas Valves
	00236	Plant Component Support
	00238	Critical Component Tech. Assmt.
	00281	NDT Needs for Gasification
	A0218	Adv Pres Vessel Matl Technology
	A0219	Plant Matls Surveillance Tests
	B0218	Electroslag Component Casting
	E0218	Nondestructive Test Ultrasonic
	E0219	Plant Materials Support
	M0218	Mgmt Surface Gasif Matls Prog
AA8550050	00237	Gasifiers in Industry, EH&S
AC1510100	00087	Amphiphiles in EOR
CH0203000	00203	METC Modeling Support

Assistant Secretary for Nuclear Energy

AE2005100	99999	Unassigned Uncosted Balance 9/30/82
AE2005150	SNR01	Space Nuclear Reactor Studies
	SR005	Alternative Heat Pipe Development
	SR006	Heat Pipe Heater Development
	SR007	Heat Pipe Alloy Development
AE2010050	01322	Space Flight Systems Hardware
AE2015050	99999	Unassigned Uncosted Balance 9/30/82
AE2015100	01311	Small Reactor Evaluation
AE2081050	00000	Other Spec Matls-Iridium Change
AF1015000	99999	Unassigned Uncosted Balance 9/30/82
AF1025000	99999	Unassigned Uncosted Balance 9/30/82
AF1520000	01311D	Small Reactor Eval-Program Plan
	01312A	Elec Utility Industry-Region Study
	01447K	Technical Support
	01448A	Energy Economic Data Base
AF1540101	OH016	Measurements & Controls Technology
AF1540102	OH037	Clad/Duct Development
AF1540103	OR1.1	High-Temp Structural Design Tech
	OR1.10	MSTMC Development
	OR1.2	Seismic Design Tech
	OR1.3	Mech Props Design Data
	OR1.4	Fabrication Technology
	OR1.5	NDT Technology
	OR1.7	Advanced Alloy Development
	OR1.7.3	Advanced Alloy Design Methods
	OR1.8.2	Documentation
	OR1.8.3	Nuclear Systems Materials Handbook
AF1540104	OH004	Fast Shielding Experimental Prog
	OH013	Cross Sections for Reactor Mtls
	OH015	Radiation Shielding Info Center
	OH054	Assess of Reactor Parameter Uncert
	OH057	Shielding Analysis
	OH153	US/UK Actinide Irradiations
AF1540105	OH020	R&D Integration
	OH044	LOA-2 THORS
	OH136	LOA-4 Environment

Table SD.2 (continued)

B&R code	WPAS No.	WPAS title
AF1540303	01311E	Small Reactor Eval-Program Support
	01312E	Electric Utility Indust-Region Stu
	01447J	Age Profile of Power Plants
	01501	Breeder Strategy Studies Support
	99999	Unassigned Uncosted Balance 9/30/82
	ONLWI06	Integrated Data Base Program
AF1540352	OH022	Nuclear Standards Management Center
AF1540836	00000	Breeder Reactor-TSF Fuel Change
AG2520000	01329	HTGR Chemistry Studies
	01330	Fueled Graphite Development
	01331	Structural Component Testing
	01332	HTR Materials Studies
	01333	HTGR Graphite Studies
	01334	HTR Shielding
	01335	HTR Physics
	01336	HTR Assessments
	01338	HTR CFTL Studies
AG3005000	ORTMI01	TMI Technical Support'
AG3010000	99999	Unassigned Uncosted Balance 9/30/82
AG3610000	99999	Unassigned Uncosted Balance 9/30/82
AG3620000	01311A	Small Reactor Eval-Base Program
	01312	Utility Deregulation Study
	01447L	Technical Support for NE Plans and
	01448	Energy Economic Data Base
	ONLWF02	FUSRAP Support
AH1005000	ONLWI07	Integrated Data Base Program
	01312F	Electric Utility Industry-Regional
AH1010000	01312B	Electric Utility Industry-Regional
AH1020000	ONLWD09	Commercial Surplus Fac Surveil
	ONLWD14	Disposition Planning
	ONLWD15	Molten Salt Reac Decomm
	ONLWI08	Integrated Data Base Program
	00000	All Other Inventories-Hafnium Chang
AJ0581030	ONLWI05	ORIGEN2 Work
AP0515150	ONLWR02	Commercial Waste Transport Studies
AP0515250	01312C	Electric Utility Industry-Regional
AP0520150	99999	Unassigned Uncosted Balance 9/30/82
	ONLWL48	Maxey Flats Project
	ONLWI09	Integrated Data Base Program
AS0500000	01311B	Small Reactor Eval-Utility
AS1505000	01312G	Electric Utility Industry-Region St
	01447G	Technical Support for NE Plans and
	01448B	Energy Economic Data Base
	CFR1	Breeder Reprocessing
	CFR2	Thorium Fuel Cycle Reprocessing
AS1525100	99999	Unassigned Uncosted Balance 9/30/82
AS2505000	99999	Unassigned Uncosted Balance 9/30/82
AS2510000	01448C	Energy Economic Data Base
AS2515000	99999	Unassigned Uncosted Balance 9/30/82
	01311C	Small Reactor Eval-Multi-Unit
CD1001228	01311F	Small Reactor Eval-Utility Contact
CD1001232	01312D	Electric Utility Industry -Region S
	01447I	Tech Support for NE Plans and Eval

Table SD.2 (continued)

B&R code	WPAS No.	WPAS title
	01448D	Energy Economic Data Base
CD2001010	ORN101	GJOIS
	ORN102	Recovery of Uranium from Phos Acid
CD3001023	00001	AISP Gyrotron Development
DA3030015	ONW2895	Sensitivity Analysis
DA303003A	OCR1303	Reg Env Charac Studies
	OCR7630	Blue Ridge Reconnaissance Study

Assistant Secretary for Conservation and Renewable Energy

AK0400000	00004	Power Systems Technology
AK0505000	00004	Power Systems Technology
AK0510000	00004	Power Systems Technology
AK0525000	00004	Power Systems Technology
AK1005000	00004	Power Systems Technology
AK1010000	00004	Power Systems Technology
AL1005050	00001	Thermal Energy Storage Program
AL1010050	00002	MES Program
AM0520000	00005	Env Anal of Geoth Engy - Geopressur
AM1005100	00003	Waste Heat Rejection-Geotherm
AM1505000	00004	Env Anal of Geoth Energy - Hydroth.
CE1003000	00002	Envir. Research for Small Hydro.
EB0102000	00401	Passive Cooling
EB0103000	00017	Eff of Wea & Atm Contam on PV
	00021	Tech Assist PV Demo Projects
EB0202000	00001	Short Rotation Woody Crops
EB0301000	00004	Power Systems Technology
EB0405100	99999	Unassigned Uncosted Bal 9/30/82
EB1101000	00005	Alcohol Fuels Environmental Project
EC0100000	00015	Adv Tech for Building Controls
	A1014	Administration/Technical Support
	A2014	BTESIM: A2 Research Utilization
	B0014	BTESIM B Matl's
	C0014	BTESIM C - Systems
	D0014	BTESIM Task D-Diagnostics
EC0400000	00006	ANFLOW - Municipal
EC0500000	00001	Building Equipment Research
	D0014	BTESIM Task D - Diagnostics
EC0600000	00020	RCS-Tax Credit Analysis
	00050	Engineering Economic Models
EC0700000	A0020	Management of RCS Program
	B0020	Evaluation of RCS
	C0020	Research for RCS Program
ED0101000	00007	Chemical Heat Pump
	00009	Materials - Waste Heat Utilization
ED0201000	00004	Power Systems Technology
EE0101020	00002	Toughened Cer for Adv Heat Engines
EE0103030	00004	Ceramic Technology - Engines
EE0104000	00001	Ana of Trans Data Rel to En Use
	00003	Tech Dev Plan for Hvy Duty Trans
EF0104000	00025	Int Assmt Bldg Energy Conserv
EF0400000	00045	Eval of DOE State En Conserv Prog
EF0500000	00045	Eval of the State Ener Conserv Prog
EG0300000	00045	Eval of the State Ener Conserv

Table SD.2 (continued)

B&R code	WPAS No.	WPAS title
EG0500000	00001	ECUT Materials Project
	00003	ECUT Tribology Project
EG0600000	00002	ERIP Evaluation
Office of Policy, Planning & Analysis		
PE0100000	00005	Energy Demand Modeling & Analysis
	00034	Cartel Models
Office of Energy Research		
AT0520210	00046	Toroidal Confinement Theory
AT0520250	00115	EBT Confinement Theory
AT0520260	00047	Theoretical Atomic Phy for Fusion
AT0530320	00048	Controlled Fusion Atomic Data Ctr
	00049	Diagnostics of High Temp Plasmas
	00050	Atom Molec Nuc Physics in CTR
	00051	Diagnostics Center
AT0540420	00052	User Service Center Operations
AT101011G	00002	Tokamak Operations
AT101011Z	00151	TFTR Pellet Injection
	00152	Neut Exper & Anal Prog at TFTR
	00154	Pellet Fueling-Confinement
AT101012M	00166	Advanced Toroidal Facility - 1
	00167	ATF-1 Support
	00168	ATF Reactor Studies
AT102021C	00008	EBT-S Base
	00009	EBT Reactor Studies
	00127	EBT-P Related Operations
AT1510131	00011	LCP Coil Subcontract
AT1510132	00013	LCTF Coil Components
AT1510133	00122	LCP R&D Activities
AT1510134	00012	LCP ORNL Management
AT1510135	00014	LCTF Operations
AT1510141	00056	Advanced Conductor Development
AT1510142	00010	12 Tesla Coil Program
AT1520212	00017	Adv Positive Ion Source Dev
AT1520214	00054	Neutral Beam Test Facility Ops
AT1520221	00165	RF Technology Plan Pro
AT1520222	00021	Gyrotron Development
	00171	ECH TECHNOLOGY DEVELOPMENT
AT1520250	00023	Pellet Fueling
	00172	Tritium Pellet Injector
AT1530310	00025	Alloy Development for Irrad Perf
AT1530320	00027	Plasma Materials Interactions
AT1530330	00032	Magnet Insulators and Stabilizers
AT1530340	00033	Damage Analysis & Dosimetry
AT1530352	00034	Radiation Facilities Operation
AT1530354	00036	ORNL/JAERI COLLAB IN HFIR & ORR
AT1540410	00169	Study of Remote Handling for Fusion
AT1540420	00164	EBT Reactor Studies - D&T
AT1540433	00039	RSIC
	00041	Blanket & Shield Int Exp
	00160	Data Eval & Process Fusion Neutroni

Table SD.2 (continued)

B&R code	WPAS No.	WPAS title
AT1540450	00044	Plasma Systems Analysis (Tokamak)
AT1550510	00043	Magnetic Fusion Env Assess Prog
AT1581011	00000	Fuels Fabrication-ORR Change
AT1581020	00000	Common Use Stores-Change
AT1581030	00000	OSM-Precious Metals-Change
AT1581040	00000	Chg in Collat Funds & Other Dep
AT1590000	00035	FEDC
	00170	Fusion Remote Handling Demonstratio
HA0201010	000801	Dosimetry for Human Exposures
HA0202010	000143	Fission Neutrons & Gamma Rays
	000190	Radiation Immunology
	003441	H-Coal Bioassay
	003551	Interpretation of Cancer Tests
	003552	Radn Carc-Time Dose Relation
	003955	Dose Response Relation in Chem Carc
	003957	Carcinogen Activity in Human Cells
	003958	Solid State RIA in Cocarcinogenesis
	003959	Chem Carcinogens & UV Radiation
	NOEW80	Interferon
HA0202020	000173	Mammalian Biochem Genetics
	000174	Mammalian Genetics
	000181	Mammalian Cytogenetics
	001569	Comparative Mutagenesis
	001570	Mammalian Chem Mutagenesis
	002527	Genetic Effect of Plutonium
	003555	Freezing Mouse Mutants
	003968	Mammalian Cell Genetic Toxicology
	003969	Medical & Molecular Genetics
	003970	Mechs of Mamm Mutagenesis
	003971	Genetic Basis of Mutagenesis
HA0202030	000183	Mammalian Gametogenesis
	002362	Chemical Toxicology
	003980	Biostatistics & Biomathematics
HA0203010	000608	Transport, Fate, & Effs of Ener Eff
	000681	Envir Effs of Uran Enrich Facils
	000690	Radionuclides in the Environment
	002528	Radionuclide in the Coastal Zone
	003356	Comparative Environmental Chemistry
	009029	Hydrologic Transport of Trace Elem
HA0203020	000609	Ecological Processes in SE Systems
	001693	Envir Fate and Effs of Org Mixtures
	003546	H Coal Environmental Project
	003944	Terrestrial Effects of Energy Dev.
	003945	Effs on Vegetation of Gas Pollutant
HA0203050	000929	National Environmental Research Par
	002936	Dev of Guidelines for Montr
HA0204010	001710	Char and Repository of SynFuels
	001722	Chem Related to the Toxicol Props
	003469	Coal Liquefaction: Pollutant Char.
HA0204020	001624	Atmosphere-Canopy Interactions
	NOEW42	Dry Deposition Calibration
	NOEW66	Control of Trit Exposure in Reacs
HA0204030	000714	Health Physics Research Reactor
	000717	Medical Physics & Internal Dos

Table SD.2 (continued)

B&R code	WPAS No.	WPAS title
HA0204060	001608	Resonance Ionization Spectroscopy
	001707	Dosimetry for New Energy Sys Poll
	004169	Environ. & Personnel Monitoring
	004170	Anal Chem of Isomers and Intractabl
	004273	Hiroshima/Nagasaki Reevaluation Stu
	000722	Atomic & Molecular Physics
	001706	Microdosim & Biol Modeling
	004165	Studies-Phys Param-Health Protectn
	004166	Chemistry in the Atmosphere
	004167	Poll Ion Formation and Atmos Clust
HA0205000	004168	Surf Inter & Ion Part Accretion
	001669	Global Carbon Cycle & Climate
	003160	Bioclimatology of Energy Impacts
	003457	Elevated CO2 Effects on Terrest
	003547	Soil Carbon in the Global Carbon Cy
	003781	Sensitivity Analysis of CO-2
	003939	Carbon Dioxide Info Center
	004181	Carbon Cycle Prog. Mgmt.
	003462	Hlth and Env Impacts of Coal Liquef
	003932	Water Chlorination Conference
HA0206000	004182	LMFBR Health Risk Assessment
	004262	Risk Barriers Survey
	00000	Fuel Fabrication-HPRR Change
HA0281000	000158	Growth & Regeneration
HB0100000	000162	Mechanism of Radiation Lethal
	000165	Nucleic Acids in Pathogenesis
	000167	Theoretical & Applied Cryobiol
	000169	Enzyme Regulation
	000177	Drosophila Cytology & Genetics
	000179	Microbial Mutagenesis & Cell
	000184	Effs and Uses of Chromosome Aberrat
	000283	Environmental Insults to DNA
	000284	Chromosome Chemistry
	000607	Systs Processes in Landscape Ecolog
	000718	Transport & Surface Physics
	000719	Chemical Physics Studies
	000720	Liquid & Submicron Physics
	000721	Physics of Solids & Macromolecules
	001472	Protein Chemistry
	001476	Molecular Aspects of Radiation
	001603	Physicochem Props of Chem Polluts
	001610	Energy pathways in Irrad Gases
	001699	Gene Expression in Carcinogenesis
	001701	Carcinogen-Cell Genome Interact
	002360	Studies-Tumor Cell Immunology
	002368	Reg of Membrane Transport System
	003236	Mechanisms of Damage & Repair
	003763	Dev Tunable VUV Spectroscopic Techs
	003947	Nucleic Acid Biochemistry
	004277	Electronic Autofluorography
	NOEW98	DNA-Carcinogen Interactions
HB0201000	000982	86-In Cyclotron Tech Support
	001161	Nuc Medicine & Biomed Technology
	003765	Radisotope Prod Tech Dev
HB0281011	00000	Radioactive Isotopes-Change

Table SD.2 (continued)

B&R code	WPAS No.	WPAS title
HB0281012	00000	Non-EM Stable Isotopes-Change
	003264	Isotope Enrichment--Biomedical
KA0101000	00001	High Energy Physics
	00002	High Energy Accel Shield Studies
KB0101000	99999	Unassigned Uncosted Bal 9/30/82
KB0201000	00012	Heavy Ion Nuclear Research
KB0202000	00016	HHIRF - Operations
	00017	HHIRF User Support
	00018	Heavy Ion Laboratory Development
KB0300000	00020	Theoretical Nuclear Physics
KB0401000	00022	Light Ion Nuclear Physics Research
	00025	Neutron Capture
KC0101020	00003	Imp in Med-En Trans Code
	00004	Spectra of Fission Neutrons
	00005	Operations - ORELA
	00006	Nucl Data-Fusion & Fission React
	00008	Neutron Reactions
KC0101030	00002	Nuclear Data Project
KC0102010	00013	Electromag Isotope Separation
KC0102020	00014	High Flux Isotope Reactor
	00015	Transuranium Element Processing
KC0102030	00012	Chem of Transuranium El & Comp
KC0201010	00018	Theoretical Studies of Metals and A
	00019	X-ray Research Using Synchro Source
	00020	Anal & High Voltage Electron Micros
KC0201020	00021	Deform & Fract of Metals & Alloys
	00026	Mech Prop of Ceramics
KC0201030	00022	Solid State Reacts & Phys Props
KC0201040	00023	Radiation Effects
KC0201050	00024	Fundamentals of Welding & Joining
	00025	High-Temp Alloy Design
	00124	Research in Ceramics Processing
KC0202010	00027	Interatomic Interact in Cond Syst
	00028	Prop-Defects, Supercond, Hydrides
	00029	Support for Neutron Users' Program
	00030	Assist to Sol St Phys & Matls Chem
KC0202020	00031	Phys Prop of Superconductors
	00032	Phytophys Proc-Solar Energy Conv
	00033	Fund Aspects of Metal Fracture
	00038	Scatter of Synchrotron Radiation
	00134	High Temp Ceramic Materials
	00136	Prep & Char of Res Matls
	00137	Small-Angle X-Ray Scattering
KC0202030	00039	Theory of Condensed Matter
KC0202040	00040	X-Ray Diffraction & Electron Micros
	00044	Gases in Metals
KC0202050	00017	R&D - Isotope Research Matls Prep
	00042	Surface Physics & Catalysis
	00142	Surf Mod & Char Fac & Collab Res Ct
	00143	Ion Beam Analysis & Ion Implant
	00144	Radioactive Waste Storage
KC0203010	00045	Chem Structure of Energy Rel Mat
KC0203020	00046	Thermodyn & Sens Ana of En Rel Sys

Table SD.2 (continued)

B&R code	WPAS No.	WPAS title
	00047	Chem Eng Res (Matls Science)
	00048	Hi Temp Chem & Thermo Str Mat
KC0203030	00051	Local Corr & Str Cr Ph Rel En Te
KC0281024	00000	Fuel Fabrication-BSR Change
KC0281025	00000	Fuel Fabrication-HFIR Change
KC0281030	00000	OSM Pa-231 & Thorium-Changes
KC0301020	00056	Photo, Pyro & React Int by El Spin
	00059	Molecular Res El Spectroscopy
KC0301030	00060	Collision of Low-Energy Multicharge
	00061	Accelerator Atomic Physics
	00063	Theoretical Atomic Physics
	00064	En-Tandem Operations
KC0302010	00069	Kinetics of Enzyme Catalyzed Proc
	00072	Basic Aq Chem to Hi Temp & Press
	00073	Het Catal Related to Energy Systems
	00074	Org Chem & Chem Fossil Fuels
	00075	Molten Salt Cat Clean Fuel Synthesi
KC0302020	00068	Chemistry of Actinides & Fiss Prod
	00076	Chem & Phys Principles in Multiph S
	00077	Chemical Separations for Tritium
	00078	Chem Sepr by Complexation Phenom
	00080	Chem Sepr for Low Grade Sources
	00082	Fund of Separations Chemistry
	00085	Molten Salt Proc High Lev Rad Waste
	00087	RD&D Adv Chem Meas Tech
	00088	Mass Spec R&D for Inorg Anal
	00089	Res & Dev in Second Ion Mass Spect
	00090	Mass Spec R&D Org Analysis
	00091	Adv Spec Meth for Chem Anal
KC0302040	00189	Sorption Pumping & Transfer Oper
KC0401030	00100	Engineering Science Center
KC0402010	00105	Computational Mathematics
	00106	Applied Analysis
KC0402020	00107	Statistical Methods
KC0402040	00110	Special Projects
KC0403020	00111	Geochem of Crust Proc to Hi Temp &
KC0600000	00114	Energy & Nutrient Utilization
KD0100000	00001	Tech & Anal Support for OER
	00002	Technical Support for ERAB
	00003	Environmental Analyses
KD0400000	00112	Tech Development of Ordered Alloys
KE0103000	00007	University Lab Cooperative Program

Assistant Secretary for Defense Programs

AR051005K	ONLWI01	Integrated Data Base
	ONLWN01	Liquid & Gaseous Waste Syst Oper
	ONLWN02	ORNL Site Specific Low Level
	ONLWN03	Gunite Tank Sludge Removal
	ONLWN04	Solid Waste Storage Management
	ONLWN05	Hydrofracture Mix Development
	ONLWN06	Operational Planning & Development
	ONLWN07	Volume Reduction Operations
	ONLWN08	Traffic Managers Program

Table SD.2 (continued)

B&R code	WPAS No.	WPAS title
AR0510100	ONLWN10	Mgmt Metal Waste ORO Sites
	ONLWN13	Development of LLW Disposal Fac.
	ONLWD05	FPDL Decommissioning
	ONLWD08	Defense Surplus Fac Surveil
	ONLWD12	Metal Recovery Bldg Decommissioning
AR0515050	ONLWD13	ILW Transfer Line Decom
	ONLWD16	Disposition Surplus ORNL Facilities
	ONLWA05	Carbon-14 Immobilization
	ONLWA08	FTF Quality Assurance
AR0515100	99999	Unassigned Uncosted Balance 9/30/82
AR0515150	ONLWL01	LL Waste Program Management
	ONLWL09	Corrective Measures Technology
	ONLWL14	Shallow Land Burial Technology
	ONLWL32	Shallow Land Burial Handbook
AR0515200	ONLWL33	Corrective Measures Handbook
	ONLWT10	Instrumentation Support
	ONLWT16	RH Tru Waste Certification
	ONLWT22	Inventory Work off Plan
AR0515250	ONLWB01	Krypton-85 Light Development
AR0525000	ONLWR01	Defense Waste Trans Studies
GB0103010	99999	Unassigned Uncosted Balance 9/30/82
GB0381042	00000	Spec React Matls-Boron-10 Change
GC0102050	OR00002	Sensitive Tech -- Proliferation
GC0102070	OR00001	Nuclear Fuel Cycle Workshop
	ORGC2	Isotopes Separation Tech
GD0201010	OR00002	NLO CASE STUDY
GD0203000	OR04011	Micro-Sampling Resin Bead Mass Spec
GE0221010	ON5419B	Inventory--Heavy Element Production
GE0348040	ON5419A	233U Dispensing Facility
	ON5519A	Con-Ed Conversion
GE0348060	00001	Management DOE-DP UOR System
	99999	Unassigned Uncosted Balance 9/30/82
GE0381044	00000	Sp Reac Matls-Hvy Water Change
GE0381054	00000	OSM Am-241,Np-237,U-234-Inv Changes
Assistant Secretary for Env. Protection, Safety & Emerg. Prep		
EF0700000	99999	Unassigned Uncosted Bal 9/30/82
HA0101010	003474	Envir Tech Assist and Guidelines
HA0101020	002975	OEA - Envir. Policy & Analysis
	003921	Equipment Support to Spain
HA0108061	ES010	Computation Performance Assessment
HA0108062	600097	Emergency Technology
HA0108081	003740	Tech Assist for Spain
HA0108082	800477	Radiological Surveys
HA0108084	ES090	Tech. Support Hazardous Waste Manag
SA0101000	99999	Unassigned Uncosted Bal 9/30/82
UB0201000	99999	Unassigned Uncosted Bal 9/30/82
UE0401000	99999	Unassigned Uncosted Bal 9/30/82
Federal Energy Regulatory Commission		
VI0104010	00002	Wheeling
VP0000000	00001	FERC Support
	00002	Susitna Hydro Project Need for Powe

Table SD.2 (continued)

B&R code	WPAS No.	WPAS title
Economic Regulatory Administration		
UC0101000	00020	Regulatory Anal of Oil Refineries
UD0100000	99999	Unassigned Uncosted Bal 9/30/82
UE0301000	99999	Unassigned Uncosted Bal 9/30/82
Energy Information Administration		
TA0100000	00001	Ana in Supp of Info Valid Prog
TB0100000	00001	Anal in Support of Infor Valid Prog
Assistant Secretary for Management & Administration		
LA0101000	00012	Energy Data Base
	00013	Special Support Project
LA0102000	00010	RECON Operations
	00011	RECON Development
	00014	Information Interchange Stds
	00015	RECON Revenue
	00016	RECON Users
WB0000000	00017	Text Management System
	00002	Energy Mgmt Thru Site Planning

^aORNL's base budget submittal, April 1983.

Table SD.3. Expenditures on behalf of historically black colleges
(\$ in Thousands)

	FY 1983	FY 1984	FY 1985	FY 1986	FY 1987	FY 1988	FY 1989
Total estimated expenditures	22	347	200	200	200	200	200

Table SD.4. Phases of R & D analysis
(\$ in Millions—total BO)

	FY 1983	FY 1984	FY 1984
Research	198.6	222.9	243.6
Exploratory Development	33.1	37.4	38.7
Advanced Development	56.3	56.8	58.5
Engineering Development	40.6	48.1	50.5

OAK RIDGE NATIONAL LABORATORY

*DUAL CAPACITY
... UCCND STAFF
... UNIVERSITY OF TENNESSEE STAFF
*REPORTS TO C. R. RICHMOND FOR INFORMATION CENTER COMPLEX PROGRAMMATIC WORK

OAK RIDGE NATIONAL LABORATORY
ORGANIZATION CHART

CONTRACTOR: UNION CARBIDE CORPORATION
NUCLEAR DIVISION
CONTRACT NO. W-7405-ENG-26

APPROVED: *[Signature]* DATE: 9/1/83