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SECRETARY'S ANNUAL REPORT TO CONGRESS

January 1981

Volume III
Project Summaries

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PROJECT SUMMARIES

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SECRETARY OF ENERGY
U.S. DEPARTMENT OF ENERGY

JANUARY, 1981

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INTRODUCTION

This book covers representative projects in each program within the Department of Energy. The projects included were selected to provide an insight into the wide spectrum of projects authorized and ongoing in the Department. The projects described do not cover all projects authorized, they are merely representative.

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TABLE OF CONTENTS

Subject	Page
Conservation	
Advanced Automotive Heat Engine Systems Development Project	2
Electric and Hybrid Vehicle Development Program	4
Fossil Energy	
Solvent Refined Coal-I Demonstration Plant, Newman, Kentucky	8
Solvent Refined Coal-II Demonstration Plant, Morgantown, West Virginia	10
Ebullated Bed (H-Coal) Pilot Plant, Catlettsburg, Kentucky	12
High BTU Synthetic Pipeline Gas Demonstration Plants, Perry County, Illinois and Noble County, Ohio	14
Medium BTU Industrial Fuel Gas Demonstration Plant, Memphis, Tennessee	16
Pressurized Fluidized-Bed Combined Cycle Pilot Plant, New Jersey	18
Exxon Donor Solvent Pilot Plant, Baytown, Texas	20
Magnetohydrodynamics (MHD) Component Development and Integration Facility, Butte, Montana	22
Oil Shale Project (BX in Situ), Rio Blanco County, Colorado	24
Grimethorpe Pressurized Fluidized Bed Project, Grimethorpe, Eng.	26
4.8 MW Fuel Cell Demonstrator, New York City	28
Nuclear Energy	
New Waste Calcining Facility Project, Idaho National Engineering Laboratory, Idaho Falls, Idaho	32
Fuels and Materials Examination Facility, Richland, Washington	34
Advanced Isotope Separation (AIS) Development Module	36
Fast Flux Test Facility, Richland, Washington	38
Fifth Set of Calcined Solids Storage Bins, Idaho Chemical Processing Plant, Idaho	40
Renewable Energy Resources	
10 Megawatt Solar Thermal Pilot Plant, Barstow, California	44
Ocean Test Facility (OTEC-1), Hawaiian Islands	46
M-X Renewable Energy Systems (RES) Project	48
OTEC Pilot Plant Program	50
Model 2 Wind Turbine, Goldendale, Washington	52
Small Community Solar Thermal Power Experiment	54
Total Energy Experiment (Shenandoah), Shenandoah, Georgia	56
Active Solar Heating and Cooling Demonstrations, Huntsville, Alabama	58
Passive Solar Heating and Cooling Projects	60
Advanced Photovoltaic Power Experiments	62
Mirror Fusion Test Facility, Lawrence Livermore Laboratory, Livermore, California	64
Tokamak Fusion Test Reactor, Princeton, New Jersey	66
Fusion Materials Irradiation Test Facility, Richland, Washington	68
50 Megawatt (MWe) Geothermal (Binary) Demonstration Power Plant, Heber, California	70
Small Hydroelectric Demonstration Projects	72
Geothermal (Flash-Steam) Demonstration Power Plant, Sandoval County, New Mexico	74

TABLE OF CONTENTS—Continued

Subject	Page
Energy Production and Power Marketing	
Gas Centrifuge Enrichment Plant, Portsmouth, Ohio	78
Great Plains Gasification Associates Commercial High-BTU Gas Project, Mercer County, North Dakota	80
Centrifuge Plant Demonstration Facility, Oak Ridge, Tennessee	82
General Science	
ISABELLE, Brookhaven National Laboratory, New York	86
Energy Saver, National Laboratory, Batavia, Illinois	88
National Superconducting Cyclotron Laboratory, Michigan State University, Lansing, Michigan	90
Tevatron Phase I, National Laboratory, Batavia, Illinois	92
Tevatron Phase II, National Laboratory, Batavia, Illinois	94
National Synchrontron Light Source, Brookhaven National Laboratory, Upton, New York	96
Elmo-Bumpy Torus, Oak Ridge, Tennessee	98
Defense Programs	
NOVA (High Energy Laser Facility), Lawrence Livermore National Laboratory, Livermore, California	102
Fluorinel Dissolution Process and Fuel Receiving Improvements, Idaho Falls, Idaho	104
Antares (High Energy Gas Laser Facility), Los Alamos Scientific Laboratory, New Mexico	106
Restoration of Nuclear Weapons Complex Equipment and Utilities	108
Restoration of Materials Production Capabilities Project	110
New Plutonium Recovery and Waste Treatment Facility, Rocky Flats, Colorado	112
Particle Beam Fusion Accelerator—II, Sandia National Laboratories, Albuquerque, New Mexico	114
Contingency Planning	
Strategic Petroleum Reserve, Louisiana and Texas	118
Naval Petroleum Reserve No. 1 Development Facilities Projects, Elk Hills, California	120
Small Wind Energy Conversion System Pilot Plant, Washington	122
Management and Oversight	
In-House Energy Management Program	126

CONSERVATION

Advanced Automotive Heat Engine Systems Development Project

Description

In accordance with Public Law 95-238, Title 3, the Advanced Automotive Heat Engine Systems Development Project is designed to develop and demonstrate advanced heat engines for automobiles, trucks, and buses by 1984. The gas turbine and Stirling engines are the candidates DOE considers to offer the lowest pollution (exhaust emissions) levels, the potential for extremely high fuel economy, and the capability of burning any fuel. DOE plans to have these engines tested in automobiles by the Environmental Protection Agency for emissions levels and fuel economy. At that time, the advanced technologies will be available to the auto industry for them to further test, evaluate, and refine the engines. If they feel that these engines can be commercialized (profitably marketed), then the industry will carry out further demonstrations of the engines in small fleets and conduct market research to decide if these engines will be what the public will buy and what the industry needs to meet fuel economy and emissions standards of the future. DOE estimates that these

engines could be available in auto dealer showrooms around 1990. A few of the other efforts associated with this Project are developing and demonstrating high-temperature ceramic materials in heavy-duty trucks (18-wheelers), installing gas turbine engines in intercity (Greyhound) buses, and installing gas turbine engines in transit buses.

Both gas turbine and Stirling engines are different from present-day internal combustion engines. The gas turbine, similar to a jet engine, operates by means of a continuous flow of heated, compressed air and combustion products being directed at high velocities against a bladed rotor—called a turbine—which drives the transmission and, in turn, the vehicle wheels. The Stirling operates in a different manner: although it has cylinders and pistons like the conventional internal combustion engine, fuel burned outside the cylinder causes a sealed fluid to expand and contract. That action causes the pistons to move, and this motion is translated to the drive shaft, transmission, and wheels.

Mission

The gas turbine and Stirling engines are being developed by the Government for two reasons. One reason is to demonstrate with the auto industry the new technologies needed to decrease the transportation petroleum consumption projected for the increased number of vehicles on the road and the increased number of vehicle miles traveled during the 1990's. The Stirling engine and gas turbine projects aim to demonstrate at least 30 percent improvement in fuel economy over the 1984 version of the internal combustion engine (with potential for 50 percent) while meeting all emissions standards anticipated in the decade of the 1980's, and to demonstrate their multifuel potential. The other reason is to reduce the high element of risk involved in developing these advanced technologies for the automotive sector.

Baseline P-40 Stirling engine installed in a 1980 AMC Concord automobile.

Upgraded Chrysler gas turbine installed in a 1980 Dodge Mirada.

Program Status

In the Gas Turbine Project, two major contracts were signed early this year with the Detroit Diesel Allison Division of General Motors and Garrett/Ford Motor Company. Funding to a third turbine team, Chrysler/Williams, was provided in April of this year utilizing a current DOE contract. All three contracts are currently completing the first generation engine (MOD I) designs, and are preparing to test components to verify design requirements.

In the Stirling Engine Program, systems hardware development is underway with one industry team for the design, development, test, and demonstration of two successive generations of a preproduction engine which will have the potential to be economically feasible to both the producer and the consumer. The design of the first generation engine (MOD I) has been completed and seven engines will be delivered in FY81 for both engine dynamometer and vehicle test and evaluation. During FY80 a baseline P-40 Stirling Engine was installed in a 1980 AMC Concord to serve as a concept demonstration vehicle.

Contractors

Advanced Gas Turbine Team:
(1) Five divisions of General Motors—Detroit Diesel Allison, Pontiac, Delco, Harrison Radiator, and Hydra-Matic; (2) AiResearch Division of Garrett Corporation and Ford Motor Company; (3) Chrysler Corporation and Williams Research.

Stirling Engine Team: Mechanical Technology Inc., United Stirling of Sweden, and AM General.

Funding (\$ in millions)	Prior	FY 1982	To complete	Total
Research and development	150.0	56.4	155.8	362.2

Heavy duty gas turbine engine installed in a demonstration bus in active revenue service in Baltimore, Maryland.

Electric and Hybrid Vehicle Development Program

Goal

The goal of the program is to conduct R&D and undertake limited market development on vehicles that depend primarily on externally-generated electricity for propulsion energy in order to minimize the dependence on imported oil while maintaining continued flexibility in the transportation sector.

Description

The responsibility for implementing Public Law 94-413, the Electric and Hybrid Vehicle Research and Development and Demonstration Act, as amended in 1978, was assigned to the Electric and Hybrid Vehicle Program. The Government role in this program is to assist the electric and hybrid vehicle manufacturing and support industry identify suitable markets, stimulate a demand for electric and hybrid vehicles, improve the performance and lower the cost of vehicles, and demonstrate their practicality. The program has five major sub-programs to provide a focused

emphasis on the commercialization of electric and hybrid vehicles to better conduct the mandates of the Act. The five sub-programs are: market demonstration; vehicle evaluation and improvement; electric vehicle commercialization; hybrid vehicle commercialization and advanced vehicle development. Also, a Resource Manager position has been established for this program. The Resource Manager seeks to bring a market focus to the entire program through development and implementation of a commercialization strategy.

Full-size clay model of the hybrid vehicle being developed under contract with General Electric as part of the hybrid vehicle commercialization project. The vehicle body design and model is being done by Triad Services; engine and key power train components by Volkswagen; propulsion batteries by Globe Union; motor, generator and controls by General Electric.

Program Status

Public Law 94-413, as amended requires the demonstration of up to 10,000 electric and hybrid vehicles by 1986 in joint ventures with commercial firms, Federal Agencies and State and local governments. As of the end of FY 1980, cost sharing arrangements have been made to add 455 vehicles to the demonstrations to bring the total to 1,142. Ninety-seven sites in 30 states operated by 67 site operators are involved. The demonstration is designed to work through the marketplace by building the vehicle market and support infrastructure, providing cash flow to manufacturers and improving the products through market influence.

Advanced vehicle development is directed towards vehicles requiring no petroleum for operation that will be completely competitive with internal combustion engine vehicles. A high-speed, flywheel/battery-powered car with a body and chassis of composite material has been accepted and is undergoing testing. Tests by Garrett AiResearch Company have verified the high accelerations capability of the propulsion concept.

Funding (\$ in millions)
Resources

Prior
83.1

FY 1982
47.7

Contractors

Insofar as practicable, the implementation of the program has been decentralized. Major field offices and organizations supporting the program are Jet Propulsion Laboratory; NASA Lewis Research Center; Argonne National Laboratory, Department of Transportation, Department of the Army (MERADCOM); and Booze, Allen and Hamilton. In addition, over 100 industrial contractors participate in the program.

Electric Test Vehicle (ETV-2) developed, designed and built under contract with Garrett Corporation and is a part of the advanced vehicle development project. The body was developed by the Budd Company and batteries by Eagle Picher. The vehicle has been delivered and is under test.

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FOSSIL ENERGY

Solvent Refined Coal-I Demonstration Plant

Description

The Solvent Refined Coal-I (SRC-I) project currently underway is to design, construct and operate a full-size module of future commercial plants that would demonstrate the SRC process for converting coal into synthetic fuels. A joint venture of the Southern Company, Wheelabrator-Frye, and Air Products & Chemicals is concentrating on a variation of the SRC process that produces clean-burning solid and liquid fuels. The plant would be located near Newman, Kentucky.

SRC Demonstration Plant Parameters

Plant: Coal feed, 6,000 tons/day;
Fuel production, oil equivalent,
22,000 barrels/day.

Mission

The demonstration plant project will be a major step toward full commercial use of the SRC technology by the private sector. Future full-size plants will have the capacity of up to five of the demonstration modules. By building and operating the first of these modules, DOE intends to (1) provide a basis for determining investment and operating costs for commercial SRC plants; (2) prove the environmental acceptability of the fuel product for direct use in electric power generation; (3) assess the market potential of a range of fuels produced by the plants; (4) confirm that the fuels are acceptable to utilities and industries with minimum modifications to combustion equipment; (5) demonstrate the technical viability of the process steps and increase confidence in the materials of construction, design and fabrication technologies needed for commercial-scale applications.

SRC-I Demonstration Plant

Program Status

The contractor completed the first phase preliminary engineering, environmental and economic analyses of the demonstration plant in July, 1979. On September 13, 1979, DOE announced that contractor had been authorized to proceed with the detailed design leading to construction beginning in CY 1981 and operation in late 1984.

*Funding (\$ in millions)	Prior	FY 1982	To complete	Total
SRC-1				
Construction	255	496	481	1,232
Operating	25	11	220	256

*Funding requirements based on preliminary estimates of project costs. More detailed estimates are expected to be available in CY 1981.

Contractors

International Coal Refining Company; Joint Venture Air Products and Chemical Incorporated, Wheelabrator Clean-fuel Corp.; A-E R.M. Parsons, APCI, Catalytic Inc. Lummus and Rust Engineering; Marketing and Product Demo Southern Co. Services.

Solvent Refined Coal-II Demonstration Plant

Description

The Solvent Refined Coal-II (SRC-II) project currently underway is to design, construct and operate a full-size module of future commercial plants that would demonstrate the SRC process for converting coal into synthetic fuels. In a joint effort between DOE, a subsidiary of Gulf Oil Corporation, the Government of Japan, and the Federal Republic of Germany, a variation of the SRC process will be applied to produce primarily fuel oils. The SRC-II demonstration plant would be located near Morgantown, West Virginia.

SRC Demonstration Plant Parameters

Plant: Coal feed, 6,000 tons/day;
Fuel production, oil equivalent,
20,000 barrels/day.

Mission

The demonstration plant project will be a major step toward full commercial use of the SRC technology by the private sector. Future full-size plants will have the capacity of up to five of the demonstration modules. By building and operating the first of these modules, DOE intends to (1) provide a basis for determining investment and operating costs for commercial SRC plants; (2) prove the environmental acceptability of the fuel product for direct use in electric power generation; (3) assess the market potential of a range of fuels produced by the plants; (4) confirm that the fuels are acceptable to utilities and industries with minimum modifications to combustion equipment; (5) demonstrate the technical viability of the process steps and increase confidence in the materials of construction, design and fabrication technologies needed for commercial-scale applications.

SRC-II Demonstration Plant

Program Status

The contractor completed the first phase preliminary engineering, environmental and economic analyses of the demonstration plant in July, 1979. On September 13, 1979, DOE announced that the contractor had been authorized to proceed with the detailed design leading to construction beginning in CY 1981 and operation in late 1984.

Contractors

Pittsburgh and Midway Coal Mining Co.; A-E Stearns—Roger Inc.; Process Design Badger Energy Co.

*Funding (\$ in millions)	Prior	FY 1982	To complete	Total
SRC-II				
Construction	280	132	703	1,115
Operating	32	20	272	324

*Funding requirements based on preliminary estimates of project costs. More detailed estimates are expected to be available in CY 1981.

Ebullated Bed (H-Coal) Pilot Plant

Description

One of four major processes to reach large-scale development in DOE's coal liquefaction program, the H-Coal process converts coal to synthetic liquids with the aid of a catalyst. Development of the process, which began in 1964, has progressed to the construction of large pilot plant at Catlettsburg, Kentucky. The plant will be capable of operating in two modes, producing either a synthetic crude oil product suitable for refining or a boiler fuel that could be used directly. The reactor design used for the H-Coal process has substantial scale-up background in commercial petroleum processing.

H-Coal Pilot Plant Parameters

Synthetic crude mode; Coal feed, 200 tons/day; Production (approx.), 600 barrels/day.

Boiler fuel mode: Coal feed, 600 tons/day; Production (approx.) 1,800 barrels/day.

Mission

The H-Coal pilot plant is of sufficient scale that combined with the construction experience and first-hand knowledge gained from the Solvent Refined Coal demonstration plants, the private sector should be able to move directly to commercial applications of the H-Coal technology in the late 1980s. Therefore, the H-Coal plant will provide the necessary data for further evaluation of the process and design of a pioneer commercial plant.

H-Coal Pilot Plant at Catlettsburg, Kentucky

Program Status

Construction of the plant was completed in April 1980, and was followed by plant shakedown activities and initial plant operations. In FY 1981, the plant will be operated in both syncrude and fuel oil modes of production. Funding data reflects a (5) five year plan for operational testing.

Funding (\$ in millions)	Prior	FY 1982	To complete	Total
DOE	253.2	65.0	265.2	583.4
Non-DOE	38.0	0	0	38.0

Contractors

Ashland Synthetic Fuels, Inc.,
Hydrocarbon Research Inc.,
Badger Inc.

H-Coal Liquefaction Pilot Plant, Cattleburg, KY

High BTU Synthetic Pipeline Gas Demonstration Plants

Description

As part of its program to develop a capability of converting a wide range of coals into pipeline quality, or "high-Btu" (British Thermal Unit), gas which could be fed into existing natural gas pipelines, DOE has ongoing projects with two firms to design and potentially construct a coal gasification demonstration plant. One firm, the CONOCO Coal Development Co., would use a process known as "slagging Lurgi" in a facility proposed for Noble County, Ohio. The other firm, a consortium of Illinois gas utilities called the Illinois Coal Gasification Group (ICGG) is designing a plant for a site in Perry County, Illinois. The ICGG design is based on the COGAS process, which includes pyrolysis, to produce a liquid product and a char which is then gasified.

High Btu Demonstration Plant Parameters

CONOCO: Coal usage, 1,250 tons/day; Production, 19 million cubic ft/day.

ICGG: Coal usage, 2,210 tons/day; Production, 23 million cubic ft/day pipeline gas; 1,500 barrels oil.

Mission

The facility will demonstrate the commercial feasibility of converting coal to high Btu pipeline gas for industrial and domestic uses. Particular attention is being paid to developing a capability of processing eastern coals, whose caking tendencies have proven troublesome for conventional gasifiers. The demonstration plant will be the final step prior to commercial application of the coal gasification technology.

CONOCO Coal's proposed facility for Noble County, Ohio

Program Status

Both contractors have moved into the process design phase of the project. Selection of one contractor to complete the design for construction is to be made in FY 1982. Construction of the selected project would begin in FY 1982.

Funding (\$ in millions)	Prior	FY 1982	Total*
DOE	199	0	TBD*
Non-DOE	0	0	TBD*

*Total project cost and cost-sharing between DOE and the industrial partners will be determined upon selection of the process.

Contractors

CONOCO Coal Development Co.; A-E Foster Wheeler Energy Corp., Process Design British Gas Lurgi. Illinois Coal Gasification Group; Joint Venture Northern Illinois Gas Co., Peoples Gas, Light and Coke Co., Central Illinois Public Service, North Shore Gas Co., Central Illinois Light Co.; A-E Dravo Corp.; Process Design Cogas Development Corp.

Medium BTU Industrial Fuel Gas Demonstration Plant

Description

The process being developed in the Medium BTU Industrial Fuel Gas Program is designed to produce a medium BTU gas which can be utilized as an industrial fuel. The process is an extension of the U-Gas reactor concept developed by the Institute of Gas Technology. The Demonstration Plant to be constructed in Memphis, Tennessee, is a major step in bringing the technology to commercial readiness by providing the data and experience required to demonstrate the economic and technical viability of the process.

Medium BTU Demonstration Plant Parameters

Coal feed: 3110 tons/day
Production: 154 million SCF/day.

Mission

The Medium BTU Demonstration Plant is a major step in developing the technology to enable commercial scale gasification of coal to produce a synthetic fuel for industrial use. The technology being developed has widespread potential for utilization of national coal resources to provide a substitute for diminishing natural gas and fuel oil supplies, thus enhancing the nation's available energy resources by converting coal to a clean synthetic fuel.

Industrial Fuel Gas Commercial Plant

Program Status

The plant is currently in final design, with the start of construction scheduled for April 1981.

Funding (\$ in millions)	Prior	FY 1982	To complete	Total
DOE	111.7	142.8	459.7	714.2
Non-DOE	1.0	1.0	98.0	100.0

Contractor

Memphis Light, Gas, and Water
Division, City of Memphis, Ten-
nessee.

Pressurized Fluidized-Bed Combined Cycle Pilot Plant

Description

This project includes the design, construction, and operation of a pressurized fluidized-bed (PFB) combustion facility on a site adjacent to an existing total Energy Power Generating Station owned and operated by Curtiss-Wright Corporation, and will utilize the in-place commercial gas turbine and waste heat boiler unit. The pilot plant is located on the Curtiss-Wright Corporation's Wood-Ridge, New Jersey facility. The pilot plant will address to a number of key technical issues associated with PFB development. Durability, maintenance and reliability of the PFB and gas turbine as well as environmental considerations will be evaluated.

PFB Pilot Plant Design Parameters

Coal Feed—5 tons/hour
Dolomite Feed—2.5 tons/hour
Rating—13 MWe
Combustor Pressure—8 atm
Combustor Temperature—1650°F.

Mission

The project objective is to confirm the technical feasibility of powering a combined cycle gas turbine with combustion gases from an air cooled pressurized fluidized-bed combustor that will burn high sulfur coal within established emission standards. The test program will identify and seek solutions for design or component deficiencies, establish operating characteristics under normal and off design conditions, and provide a firm engineering base for full-scale plant development decisions.

rogram Status

The Contractor completed the detail design of the pilot plant and the environmental analysis. Construction of the pilot plant was initiated in May 1980. Operation of the pilot plant is scheduled to begin in mid FY 1983.

Funding (\$ in millions)	Prior	FY 1982	To complete	Total
Department of Energy	42.1	14.0	29.7	85.8

PFB Combined Cycle Pilot Plant, Wood-Ridge, NJ

Exxon Donor Solvent Pilot Plant

Description

One of the coal-to-liquid processes to reach major development in DOE's program, the Exxon Donor Solvent (EDS) process supplies hydrogen to the coal both in gaseous form and by transfer from an internally generated coal liquid stream (called a "donor solvent") which is enriched with hydrogen in a separate catalytic reactor. Exploratory research on the EDS process began in 1966 and has led to the construction of a large pilot plant at Baytown, Texas.

EDS Pilot Plant Parameters

Coal feed, 250 tons/day; Production, 450 barrels/day.

Mission

The Exxon Donor Solvent pilot plant will be large enough that combined with experience gained from the construction and operation of the Solvent-Refined Coal demonstration modules, the process could be scaled directly to commercial applications. The pilot plant, therefore, will provide the needed information for design and development of a Donor Solvent process commercial-size plant.

Exxon Donor Solvent Pilot Plant

Program Status

Construction of the pilot plant was completed in April 1980, and was followed by the start of plant operations. In FY 1981, the plant will continue operations on both bituminous and sub-bituminous coals. Funding schedule reflects a five-year plan for operational testing.

Funding (\$ in millions)	Prior	FY 1982	To complete	Total
DOE	135.8	63.0	134.0	332.8
Non-DOE	146.6	35.9	23.4	205.9

Contractor

Exxon Research & Engineering Co.

Magnetohydrodynamics (MHD) Component Development and Integration Facility

Description

The Component Development and Integration Facility (CDIF) is one of two major coal fired test facilities in DOE's program to develop the magnetohydrodynamic (MHD) electrical generating system. Located at Butte, Montana, the CDIF will test individual components and subsystems at the 50 megawatt (thermal) level. MHD systems are potentially capable of producing 50 percent more electricity from a ton of coal than any other existing direct combustion power cycle and are compatible with both low and high sulfur coals.

MHD CDIF Parameters

Coal feed, 6.9 tons per hour; power rating, 50 thermal megawatts.

Mission

The MHD CDIF will provide a test facility where MHD components and subsystems can be tested in a continuous mode. Engineering data will be obtained to: (1) verify and improve components and subsystem design; and (2) obtain experience in the operation of large MHD power trains. This information will be used along with similar information to be generated at the 20 thermal megawatt level by the Coal-Fired-Flow-Facility in Tullahoma, Tennessee.

Component Development and Integration Facility

Program Status

By the end of FY 1980, physical construction of the CDIF was about 97% complete. Check-out of major systems was continuing and expected to be completed early in FY 1981.

Funding (\$ in millions)	Prior	FY 1982	To complete	Total
Construction of the CDIF	37.0	0	0	37.0
Operations costs thru FY 1985 (facility operations, test article installation and maintenance)	55.2	20.0	69.0	144.2

Contractors

Ralph M. Parsons Co. (design);
Henry J. Kaiser Co. (major construction);
Montana Energy & MHD
Research and Development Institute
(Operation).

Component Development and Integration Facility

Oil Shale Project (BX in Situ)

Description

One of three major projects in DOE's program to develop the "in situ" or underground processes for extracting oil from shale, the "BX" project is a cooperative project with the Equity Oil Company at the firm's field site in the Piceance Basin (Rio Blanco County) Colorado. In Equity's in situ process, superheated steam is injected in the "leached zone" of the oil shale formation at a depth of about 760 to 1360 feet below the ground level. The heat provided causes "retorting" to take place and oil is then recovered in adjacent production wells. This technique offers promise for extracting large quantities of oil that are present in the massive and extensive leached zone which is hundreds of square miles in areal extent. The process is "self-contained" and requires no external source of water for steam production. As of September, 1980 superheated steam injection had been achieved on a regular basis for only three months. Traces of oil are beginning to appear and larger production is anticipated.

BX Project Parameters

Depth 760 to 1360 feet, "leached zone"; Oil-in-place: about 1 million barrels/acre; Production: none as of September, 1980. Traces beginning to appear in observation wells.

Mission

The BX project is the first attempt by industry or Government to produce oil from the leached zone on any scale other than experimental by injection of superheated steam. The technique has the potential to recover billions of barrels of oil that would not be recoverable by conventional mining or any other in-situ technique. The technique has several potential environmental advantages since there is no solid waste disposal and retorting will be confined to the leached zone deep underground.

Steam injection well at the Equity BX field site

Program Status

No oil has been produced to date owing to the fact superheated steam has been injected only a few months as of September 1980. The small site is about one-acre in area and potential recovery could be 500,000 barrels, if 50% recovery is achieved. Several mechanical problems associated with surface equipment and downhole conditions have been overcome during the three-year start-up period.

Contractor

Equity Oil Company, Salt Lake City, Utah.

Funding (\$ in millions)	Prior	FY 1982	Total
DOE	8.6	1.2	9.8
Non-DOE	1.4	0.2	1.6
	<u>10.0</u>	<u>1.4</u>	<u>11.4</u>

Grimethorpe Pressurized Fluidized Bed Project

Description

The International Energy Agency (IEA) is an international agency in which the United States, United Kingdom, and the Federal Republic of Germany are participating equally in funding and program management of the Grimethorpe Pressurized Fluidized-Bed Combustion Test Facility. Program Management is exercised by an executive committee composed of one member from each country.

The PFB facility is located adjacent to the National Coal Board's Grimethorpe power station near Barnsley in Yorkshire, England.

Grimethorpe PFB Plant Parameters

Coal feed, 12 tons/hour; Thermal rating, 80 MW; Combustor pressure, 10 atm; Combustor temperature, 1500 to 1750°F.

Mission

The Grimethorpe PFB Plant is a flexible experimental facility which provides the means to conduct research to support other PFB development projects. The data thus provided will assist scaleup to larger commercial plants. The objectives of the program are:

- (1) To build the experimental facility to study combustion, heat transfer, hot gas cleanup, corrosion and energy recovery in a pressurized fluidized-bed combustion system,
- (2) To carry out tests over a wide range of operation conditions, and
- (3) To provide data for the analytical modeling of design data for larger commercial plant by empirical data extrapolation.

Grimethorpe Pressurized Fluidized-Bed Combustion Test Facility

Program Status

Construction of the facility will be completed in September 1980. Hot Commissioning of the unit will be initiated in September 1980, and completed in December 1980. Start-up of operations is scheduled to begin early in CY 1981.

Funding (\$ in millions)	Prior	FY 1982	To complete	Total
Department of Energy	26.2	11.5	6.6	44.3
Others*	55.1	20.6	12.9	88.6
Total	81.3	32.1	19.5	132.9

*United Kingdom and Federal Republic of Germany

Grimethorpe Pressurized Fluidized-Bed Combustion Test Facility

4.8 MW Fuel Cell Demonstrator

Description

The 4.8 MW phosphoric acid fuel cell demonstrator is being constructed and installed at a Consolidated Edison, New York City site in 1980. The powerplant will be started up and operated in 1981 to demonstrate and verify considerations for urban siting, system characteristics, and to demonstrate operational feasibility in the normal operating environment of an electric utility system.

4.8 MW Parameters

Power rating: 4.5 MW (net AC)
Life: design life of powerplant with scheduled overhaul and maintenance, 10,000 hours; Fuels: naptha or natural gas; Emissions of criteria pollutants: less than 0.020 lbs/10⁶ Btu input; Load response: min. power to rated—less than 15 seconds.

Mission

The 4.8 MW demonstrator is a prototype powerplant and the goal is to operate for 6,700 hours at 85 percent availability. Initial commercial service powerplants in the 5 to 10 MW power range will be available in the mid 1980 time period as a followup to the development and demonstration of the 4.8 MW demonstrator.

4.8-MW Demonstrator Site

Program Status

Final hardware modules are being fabricated and installed at the Consolidated Edison facility in late 1980. Process and control testing, which will precede actual power operation, is tentatively scheduled for February 1981. Power operation will commence in mid 1981.

Funding (\$ in millions)	Prior	FY 1981*	FY 1982	Total*
DOE	48.0	1.2	0	49.2
Non-DOE	23.0	2.8	0	25.8

*Estimated

Contractors

Consolidated Edison and United Technologies Corporation (hardware manufacturer).

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NUCLEAR ENERGY

New Waste Calcining Facility Project

Description

The New Waste Calcining Facility (NWCF) is being constructed at the Idaho National Engineering Laboratory (INEL). The NWCF will replace the existing Waste Calcining Facility (WCF), for processing liquid wastes which was constructed in the early 1960's, and will incorporate the latest available technology in the areas of fluidized bed calcination, off-gas cleanup, remote operation/maintenance, and decontamination. Anticipated fuel reprocessing rates combined with a limited capacity to store the resultant high-level radioactive liquid waste will require a greater waste processing rate than the WCF can provide. In addition, corroded equipment in the WCF prohibits sufficient decontamination to reduce existing radiation fields and allow the Idaho Chemical Processing Plant to meet long-

range goals concerning personnel radiation exposures.

The NWCF is a concrete and steel structure approximately 250 feet long, 140 feet wide, and 75 feet high. The structure extends below grade with most of it supported on bedrock. The administrative and health physics offices, control room, decontamination and nonradioactive solution makeup area, and cell access and maintenance areas are located above grade. The calciner vessel and other process equipment are enclosed in individual cells located below grade. The cells are serviced by cubicles and corridors containing sample stations, valves, manipulators, and other support equipment and utilities. The hot cell, the elevator shaft, and an airlift pit extend several feet into bedrock. Net processing rate for NWCF is 3,000 gallons of liquid waste per day.

Mission

The Idaho Chemical Processing Plant is operated as part of the Defense Nuclear Materials Production Program. The Plant receives, stores, and chemically reprocesses a wide variety of highly enriched spent reactor fuels to recover the residual U-235. While the primary fuel load is from Navy propulsion reactors, fuels from research and test reactors are also processed. Recovered U-235 is used as fuel for Savannah River production reactors or as a feed for the Portsmouth Gaseous Diffusion Plant.

The reprocessing operation produces highly radioactive liquid waste which is stored temporarily in underground tanks. Calcining this liquid to a solid granular form reduces volume by about 8 to 1 and results in a more environmentally acceptable waste form.

The NWCF is a concrete and steel structure with all process cells located below grade. This picture, taken in October 1978, shows the size of the construction project.

gram Status

Construction is complete and pre-operational checkout and testing are underway. Hot start for the facility is scheduled for FY 1982.

Funding (\$ in millions)	Prior	FY 1982	Total
Design & Construction	90.0	0	90.0
Other Project Costs	9.8	2.5	12.3
	99.8	2.5	102.3

Contractors

Exxon Nuclear Idaho Company, operating contractor, design review; Fluor Corporation, architect-engineer; Jones-Boecon (a joint venture with J. A. Jones and Boeing Construction companies), constructor.

Using in-bed combustion, waste solution calcination takes place in the calciner vessel. The off-gas is processed through a sophisticated filtering and cleaning system and the solid waste is sent to underground storage bins.

Fuels and Materials Examination Facility

Description

The Fuels and Materials Examination Facility (FMEF) is being constructed on the Department of Energy Hanford Reservation near Richland, Washington. This project provides for construction of a facility with capabilities for post-irradiation examination of the fuels and materials tests irradiated in the Fast Flux Test Facility (FFTF) and for fuel process development, experimental test pin fabrication and supporting storage, assay and analytical chemistry functions. The project also provides building utilities and services, computer space, requisite radiological control for personnel and public safety, and necessary offices. The process building contains approximately 176,000 square feet of

floor space divided in six operating levels. Contiguous to the process building are two major single story wings having 23,000 square feet: the entry wing for personnel change rooms and security control, and the mechanical equipment wing to house building utility equipment. Internal and external security systems are provided to meet the requirements of The Department of Energy.

Mission

The mission of the FMEF is to provide for post irradiation examination of fuels and materials tests irradiated in the FFTF, and for fuel process fabrication development. With the FFTF becoming operational, the quantity, sizes, and geometrical configurations of the many types of irradiated assemblies that must be examined will exceed available postirradiation examination capability. To examine these larger assemblies and a statistically significant number of types of fuel and blanket pins irradiated under the wide variety of neutron flux and temperature conditions expected in the FFTF and future reactors, the FMEF is being designed as a highly mechanized examination facility. The FMEF will be the U.S. civilian nuclear power program's only hot cell facility capable of remote fabrication development and complete nondestructive and destructive examination with large enough cells to examine the full range of FFTF reference and proliferation resistant reactor fuels.

Fuels and Materials Examination Facility under construction

rogram Status

Title II engineering design for the FMEF is complete. Concrete placement for the subgrade level is continuing (now approximately 72 percent complete) and a contract was awarded in July 1980 for the above-grade civil general work. Bid packages have been prepared for the mechanical and electrical building internals and award of a contract for this work is scheduled for January 1981. The electrical substation for FMEF is complete and a contract was awarded in October 1980 for site utilities. Development, testing, and procurement of plant equipment is continuing. Facility construction will be complete and hot operations will begin in December 1983.

Funding (\$ in millions)	Prior	FY 1982	To complete	Total
Design and construction	135.2	26.8	8.0	170.0
Other project costs	35.8	13.8	25.6	75.2

Contractors

Hanford Engineering Development Laboratory, technical management and operating contractor; Norman Engineering Company, Architect-Engineer for building and site utilities; J. A. Jones Construction Services Company, construction support services contractor; Fixed Price Subcontractors, examination and special equipment, construction contracts.

Fuels and Materials Examination Facility

Advanced Isotope Separation (AIS) Development Module

Description

A Development Module (DM) will be constructed at Oak Ridge, Tennessee. The DM will be an integrated system with the capability to demonstrate appreciable uranium enrichment capacity for duty cycles which are long enough to verify process engineering and establish the upper cost of the AIS process in production. Physically the DM will require a building of about 50,000 square feet of high bay laboratory and office space.

Mission

The goal of the Advanced Isotope Separation program is to develop a technology which will reduce the cost of uranium enrichment services by 50 percent. The deployment of such a technology will also enhance the Nation's effective uranium supply by permitting the economic reduction of the tails assay of current and planned enrichment plants and the utilization of existing and future tails stockpiles. Deployment of an AIS technology, with its concomitant reduction of the tails assay, will provide uranium-235 fuel for an additional 20 to 25 percent light water reactors (LWR's) for any given amount of natural uranium ore (U_3O_8).

The DM will be the first major Advanced Isotope Separation test facility and will demonstrate the operation of near production-sized equipment of the selected AIS process. The DM will serve as the vehicle for technology transfer from the laboratory to industry for starting the certification of vendors for components production. The DM is a key step in the logistics of integrating AIS into the Nation's uranium enrichment enterprise.

Plasma Isotope Separation Process

rogram Status

The AIS program is pursuing three competing advanced technologies. During FY 1981, conceptual design studies are planned to be completed for the three processes. Title I design will begin in FY 1982 for the three processes and a single process will be selected by mid-FY 1982. After process selection Title I design will be completed for the selected process and initiation of Title II and long lead procurement will begin.

Funding (\$ in millions)	Prior	FY 1982	To complete
Design and construction (Approp.)	0	15.5	TBD

Contractors

Contractors for the AIS R&D program are: Lawrence Livermore Laboratory, Los Alamos Scientific Laboratory, TRW, Inc., and Union Carbide Corporation—Nuclear Division. Contractors for detailed design and construction have not yet been identified.

Molecular Laser Isotope Separation Process

Atomic Vapor Laser Isotope Separation Process

Fast Flux Test Facility

Description

The Fast Flux Test Facility (FFTF) in Richland, Washington, is a 400-thermal-megawatt sodium cooled fast neutron flux reactor specifically designed for irradiation testing of nuclear fuels and reactor materials. The reactor vessel and three primary heat transport loops are enclosed in a reactor containment building which extends 73 feet below ground level and 114 feet above and is 135 feet in diameter. Guard vessels are provided for the reactor vessel and each of the three primary groups and intermediate heat exchangers. Three secondary heat transport loops each containing four sodium-to-heat exchangers are used to dissipate the reactor heat. Reactor head mounted components provide the control, flow and temperature measurements for each fuel assembly, and in-vessel handling operations.

The FFTF core consists of 91 core and 108 radial reflector positions. Within the core region there are eight test positions which can be highly instrumented. Two of these eight positions can be used for fuels and materials experiments closed loop systems which permit flow, temperature, and sodium purity control independent of the main reactor system. The driver fuel is mixed uranium-plutonium oxide clad in 316 stainless steel. Each driver assemblies contains 217 pins in hexagonal duct 12 feet long with the fuel section 3 feet in length.

FFTF Characteristics

Reactor Power, 400 MwT (megawatts thermal); Reactor Core Outlet, 900°F to 1110°F; Reactor Flow, 7.9×10^5 pounds per hour of sodium; Test Positions, 8; Closed loop, 2 (capability for 2 additional); Open Loops, 6; Flux, $.7 \times 10^{16}$ neutrons per square centimeters; Fuel System, Uranium oxide/plutonium oxide elements with 316 stainless steel cladding.

Mission

FFTF will serve as an advanced fuels and materials irradiation facility for the Fast Breeder Reactor program and as a baseline for scaling up systems and components. It has the capability to serve as an advanced fast-flux test bed for alternative fuels and materials experiments needed to continue DOE advanced reactor development programs. Although FFTF, as a testing reactor, was not designed to breed or to produce electricity, it has provided and will continue to provide valuable information to follow-on Liquid Metal Fast Breeder Reactor projects and base-technology programs in the areas of (a) plant systems and components, (b) component fabrication, (c) prototype testing, and (d) site construction.

rogram Status

Initial criticality and completion of fuel loading were achieved in February 1980. Low power physics tests completed in March 1980 support the design goal of being able to operate the FFTF at 400 megawatts (thermal) for 100 days before partial refueling. One primary system pump was replaced due to excessive vibration demonstrating that major heat transport system equipment can be maintained and/or replaced. Insulation and Heating and Ventilating system modifications were successfully completed in June. The initial ascent to power and the power demonstration tests are projected for November and December 1980. Other activities scheduled for FY 1981 include: (a) completion of natural circulation testing, (b) completion of the core characterization testing, and (c) completion of final modifications in preparation for start of Cycle 1.

Funding (\$ in millions)	Prior	FY 1982	To complete	Total
Design and construction (approp.)	540	0	0	540
Other project costs	<u>100</u>	<u>0</u>	<u>7</u>	<u>107</u>
Total	640	0	7	647

Contractors

Hanford Engineering Development Laboratory (Westinghouse Hanford Company), Project Manager and Operator; Westinghouse Advanced Reactor Division, Reactor-Plant Designer (Completed); Bechtel Corporation, Architect-Engineer and Construction Management (Completed).

Fast flux test facility

Fast flux test facility

Fifth Set of Calcined Solids Storage Bins

Description

The fifth set of calcined solid storage bins is being built at the Idaho Chemical Processing Plant (ICPP) located at the Department of Energy's Idaho National Engineering Laboratory. The fifth set of bins will provide an additional 35,000 cubic feet of storage capacity for granular solid radioactive waste generated by nuclear fuel processing operations at the ICPP. This set of bins will consist of seven stainless steel cylindrical bins each approximately 12 feet in diameter and about 50 feet tall. The seven bins will be placed inside a reinforced concrete vault which provides secondary containment and radiation shielding. The vault rests on bedrock approximately 50 feet below grade.

The fifth set of bins will interface directly with the New Waste Calcining Facility (NWCF). The NWCF will convert liquid radioactive waste generated by the ICPP to a granular solid for storage. The granular solids will be pneumatically transported to the storage bins from the NWCF

and the transport air will be returned to the NWCF. Radioactive decay heat will be removed by air convection over the outside surface of the bins as well as as up through a four foot diameter open space through the center of each bin. This annular design allows for more efficient heat removal. The cooling air that passes through the vault will be monitored continuously for radioactivity.

The bins are designed to provide safe storage of the radioactive waste for at least 500 years. During this interval, the majority of the radioisotopes will have decayed so that only a fraction of the original radioactivity will remain. The bins are provided with retrieval nozzles for future removal of the solids, if necessary, for further treatment or removal to another location. The bins are designed to withstand natural disasters (flood, earthquake, etc.) without any significant damage or release of radioactive material to the environment.

Mission

The fifth set of bins is designed and constructed to provide safe and reliable storage for solidified high-level radioactive waste produced by the ICPP. The ICPP processes a wide variety of nuclear fuels from Naval propulsion reactors, and test and research reactors. The fuel processing operations produce liquid radioactive waste which is converted to a granular solid material in the NWCF.

Placement of forms and reinforcing steel for vault base

Program Status

The design for the fifth set of bins is complete and construction is approximately 60% complete. The bins will be completed by late FY 1981 and will be operational when the NWCF begins operations in FY 1982.

Funding (\$ in millions)	Prior	FY 1982	Total
Design & construction	\$10.5	\$7.5	\$18.0
Other project costs	\$ 0.4	\$0	\$ 0.4

Contractors

Exxon Nuclear Idaho Company—technical management and operating contractor;
EG&G Idaho—architect-engineer
Morrison and Knudsen—construction manager;
Mitchell Construction—fixed price construction contractor.

Placement of reinforced concrete for vault walls using slip-form technique

Fifth set of calcined solids storage bins, cutaway view

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RENEWABLE ENERGY RESOURCES

10 Megawatt Solar Thermal Pilot Plant

Description

The 10 Megawatt (MWe) Solar Thermal Pilot Plant project is a central receiver power plant connected to the electrical network of an adjacent fossil fueled plant near Barstow, California. Cost is being shared with Southern California Edison Power Company, the ultimate operator of the facility, as well as other participants. The pilot plant consists of a collector subsystem, receiver subsystem, thermal storage subsystem, electrical power generation subsystem, master control subsystem and plant support subsystem. It will operate with water/steam as the working fluid and be sized to generate 10 MWe net electrical power to the bus-bar at 12:00 noon solar time

on the winter solstice. The collector subsystem will consist of approximately 1,800 heliostats which will be controlled to continuously reflect sunlight onto an elevated receiver. The receiver subsystem will consist of an elevated receiver or boiler unit mounted about 300 feet above the ground on a steel tower. Superheated steam from the receiver will drive an electrical turbine generator or will be fed to thermal storage. An oil and rock storage facility will provide up to 28 MWe hours of power when demanded. Partners with DOE in the project are Southern California Edison, Los Angeles Department of Water and Power, and the State of California.

Mission

This first solar thermal central receiver power pilot plant is designed to test central receiver technology in a utility environment. This plant will establish engineering and environmental feasibility for central receiver technology, which may lead to subsequent construction of full scale solar thermal electric plants, with a near-term application to repowering currently existing fossil-fueled power plants.

Central Receiver Pilot Plant to be built near Barstow, CA.

Program Status

Construction began in 1979, to be completed in 1982. A visitor center at the Barstow site was opened in July 1980.

Funding (\$ in millions)	Prior	FY 1982	To complete	Total
Construction (DOE only)	118.0	0	0	118.0
Other projected related costs	30.7	1.2	0	31.9
Operating	0	14.5	0	14.5
				<u>164.4</u>

Contractors

Management by DOE Sandia Laboratories; Principal design and construction contractor is McDonnell Douglas Corporation; Project co-funded by Southern California Edison Power Co., Los Angeles Water and Power, and the State of California.

Concept for Central Solar Receiver Pilot Plant to be built near Barstow, CA.

Prototype of Heliostat to be used at the Central Solar Receiver Pilot Plant to be built near Barstow, CA.

Ocean Test Facility (OTEC-1)

Description

The Ocean Test Facility (OTEC-1) is a converted T-2 tanker which will be anchored 18 miles off Keahole Point, Hawaii. The facility takes cold water ($\Delta 40^\circ\text{F}$) from 2120 feet and extracts energy through a system of heat exchangers to a secondary liquid (ammonia) reservoir; the secondary liquid is recycled through an evaporator. The steam provides the means for assessment of heat exchanger technology to determine long-term biofouling and corrosion effects,

to determine performance data of power cycle operations and to establish baseline data on design, manufacture and deployment of a deep (2120 ft.) cold water pipe, ship shapes, station keeping and ancillary equipment. This will provide data that will be used to determine how the costs of ocean thermal energy conversion may be brought down to economically competitive levels.

Mission

The OTEC-1 is the first step in studying the feasibility of full scale development of in-the-ocean equipment and components for economically competitive, inexhaustible, and renewable sources of substantial quantities of baseload electricity.

OTEC-1 Ocean Test Facility—diagram

gram Status

The converted navy T-2 tanker is now anchored 18 miles off Keahole Point in Hawaii. Final efforts for adding instruments to the cold water pipe are being completed, and other add on work due to higher than anticipated sub-surface currents. Deployment and commencement of testing is scheduled for October 1980.

Funding (\$ in millions)	Prior	FY 1982	To complete	Total
Construction	33	0	0	33.0
Research and development	12.2	0	0	12.2
Operating	17.1	11.5	11.4	<u>40.0</u>
				85.2

Contractors

Global Marine Development Corporation, system integration and construction; ETEC, project control and test director contractor; and Morris Guralnick Assoc., marine system technical review. TRW is the 1 MWe heat exchanger development contractor.

T-2 Tanker which was modified into the Ocean Test Facility

M-X Renewable Energy Systems (RES) Project

Description

The M-X Renewable Energy System (M-X/RES) Project is a joint effort of the Departments of Energy (DOE) and Defense (DOD) to determine the feasibility of RES applications to the M-X missile system. In late 1979, the Under Secretaries of each Department established a Coordinating Council to provide M-X/RES project policy and budgetary guidance. The project will be executed through the Joint DOE/DOD M-X/RES Project Office.

Significant advances have been made in the production of power using renewable energy resources. There are no current systems or designs, however, capable of meeting M-X power requirements without substantial technological and engineering development. The M-X/RES effort will accomplish engineering development required for RES applications to M-X. Requests for Proposal will be issued to develop RES which meet M-X energy, schedule, and reliability

requirements at three M-X power levels. These power levels are standalone missile shelters (14.5 KWe), clusters of shelters (3.5 MWe), and operating bases (37.1 MWe). Industry will be tasked to develop and produce RES as viable alternatives to fossil fuel energy systems. If RES systems are determined feasible for M-X application, a market of significant size will be created to accelerate national RES commercialization.

A number of RES technologies offer an opportunity for M-X application within the development time available. Dependent on the availability of renewable energy resources in the M-X deployment area, these technologies are:

- Geothermal
- Solar Energy Technology
- Wind Energy Technology
- Waste-to-Energy Technology

The preferred approach is to utilize an efficient and effective mix of all these technologies to satisfy the total M-X requirement.

Mission

The M-X/RES Project will develop renewable energy system alternatives capable of providing reliable operating power to the M-X missile system complex; and will accelerate the commercialization of renewable energy systems.

Program Status

The Joint DOE/DOD M-X/RES Project Office has been established and actions necessary to initiate procurement activities are underway. In FY 1981, resource assessments in the M-X deployment area and candidate M-X/RES system development will begin.

Funding (\$ in millions)	Prior	FY 1982	To complete	Total
Department of Energy	0.3	15.0	36.6	51.9
Department of Defense	<u>47.0</u>	<u>56.7</u>	<u>46.7</u>	<u>150.4</u>
Totals	47.3	71.7	83.3	202.3

Contractors

Procurement in Process for Contractor Selection in 1981.

● ELECTRICAL REQUIREMENTS

- SHELTER: 14.5 kW
 - CLUSTER: 3.54 MW*
 - BASE: 26.3 MW
- } 108.6 MW (AVERAGE)

● SCHEDULE: INITIAL OPERATING POWER IN 1986

OTEC Pilot Plant Program

Description

The OTEC Pilot Plant will use the closed cycle OTEC concept. The temperature difference between warm surface water and cold deep water will run a heat engine and generate electricity. The warm water vaporizes and the cold water condenses a working fluid to drive an electrical generator. Electrical energy produced will either be transmitted through an electrical cable or used in an energy intensive industrial process.

DOE sponsored design studies have been completed for a spar

buoy plant and a grazing ship plant. Artist concepts of possible configurations are shown in the sketches.

The Pilot Plant will be a test bed for a complete power system of the size and configuration of a modest sized commercial OTEC plant. Information provided by the Pilot Plant is expected to aid in the projection of economic benefits of OTEC with a confidence higher than present.

Mission

Congress, by means of The OTEC Research, Development and Demonstration Act of 1980, PL 96-310, has designated OTEC for accelerated development and commercialization. The mission of the OTEC Pilot Plant Program is demonstration of the technical and economic feasibility of OTEC electric power generation on a scale of an order of magnitude greater than that previously tested by DOE and within a reasonable scale of a commercial plant.

Program Status

The OTEC program has reached the stage of development where a pilot plant of intermediate electrical generating capacity is necessary. A pilot plant is needed to demonstrate the potential for commercial applications. DOE released a Program Opportunity Notice (PON) on September 22, 1980 inviting offerors to submit proposals for the design, construction, deployment, operation and evaluation of a closed cycle OTEC pilot plant with a minimum capacity of 40 megawatt electric power. The closing date for this PON is January 23, 1981.

Funding (\$ in millions)	Prior	FY 1982	To complete	Total
Construction	0	0	TBD	TBD
Research and development (thru 1980)	19.2	0	TBD	TBD
Operating	0	0	TBD	TBD

Construction

Contractors will be selected as a result of PON DE-PN01-80CS80000.

I-SUBMERSIBLE

OTEC Plant Ship

Model 2 Wind Turbine

Description

The Model 2 (Mod-2) Wind Turbine Project consists of three 2,500 kilowatt wind machines which will be built on a site overlooking the Columbia River near Goldendale, Washington, in cooperation with the Bonneville Power Administration. Designed for optimization in 14 mph winds,

the 2500 kilowatt machine is designed to develop full rated power in 27 mph winds. The wind turbine's blades are 300 feet in diameter. The Mod-2 machines are the second generation of large wind turbine development and incorporate substantial design improvements over earlier systems.

Mission

The Mod-2 Wind Turbine objectives are to establish the design and performance of a megawatt-size wind turbine that can achieve a cost-of-energy for the 100th unit in production of less than 5¢/kilowatt hour (including capital and operating and maintenance costs in 1980 dollars) when operating in a 25 machine cluster at a site with an annual mean wind speed of 14 mph.

Artist's Conception of Model 2 Wind Turbine to be located at Goldendale, Washington

Program Status

Site preparation is underway, and components are being assembled by Boeing in Seattle. The first and second machines should begin turning in late 1980, with the third following closely thereafter.

Funding (\$ in millions)	Prior	FY 1982	Total
Construction (total estimated cost)	27.3	0	27.3
Research and development	11.0	0.9	11.9
Operations and support	3.1	0.6	3.7
			<u>42.9</u>

Contractors

The Department of Energy's large wind turbine development program is managed by the National Aeronautics and Space Administration's Lewis Research Center, Cleveland, Ohio; Boeing Engineering and Construction Company, Seattle, is contracted for analysis, design, fabrication, site preparation, installation and check out. Bonneville Power Administration is to operate machines and integrate power into grid.

Model 2 Wind Turbine Commercial Park (artist's conception)

Small Community Solar Thermal Power Experiment

Description

As presently planned, the project will consist of a field of parabolic dish reflectors, each with a cavity receiver, steam Rankine cycle heat engine and electric generator at the focal point. (See illustration of the Low Cost Concentration to be used for this experiment. The field will consist of approximately 52 collectors delivering about 1 megawatt electric to the power distribution system of a small community. In addition to the collector field, a power conversion system, a building housing an office, controls, and ancillary equipment will be

provided. The exact size and power output of the project were reviewed, to determine the smallest size that would meet program and project requirements. A competitive procurement for cost-shared site participation was issued to include, as a minimum, a community agency and the owner of the electric distribution system that serves that area. Six candidate sites were selected from a total of forty-four (44) proposals evaluated. A visitor center will serve to explain the purpose and the function of this visible operation.

Mission

Solar Thermal Electric systems of this type are capable of supplying a portion of the nation's electric power needs. This experiment seeks to validate system design and assist in ultimate commercialization of the technology. The experiment will be designed to: establish technical readiness of small point-focusing, display distributed receivers and distributed generation technology in a small community/utility environment; determine economic, performance, and operation aspects of this type system in a user environment; stimulate the creation of an industrial base for small community power systems; advance acceptance of this type of system by the user sector, and identify institutional barriers.

Low-Cost 12-meter diameter Parabolic Dish Concentration for Small Community Solar Thermal Power Experiment

rogram Status

Systems definition studies were completed in May 1979. Preliminary design was completed in July 1980. A further decision on construction will be made after that date.

Funding (\$ in millions)	Prior	FY 1982	To complete	Total
Construction	7.6	5.0	22.4	35.0
Research and Development	.9	1.4	3.2	5.5
Other Project related costs	5.2	1.3	10.0	16.5
Total				57.0

Contractors

Project Management by NASA Jet Propulsion Laboratory. Preliminary design by Ford-Aerospace and Communications Corporation.

Artist conception of small community solar thermal power experiment

Total Energy Experiment (Shenandoah)

Description

The Total Energy Experiment will utilize on site distributed solar collectors to provide both electrical and thermal energy for an industrial plant. Through a cooperative agreement with the Georgia Power Company, the experiment is being installed in Shenandoah, Georgia, at a knitwear manufacturing facility operated by Bleyle America Inc. The design incorporates a field of seven meter diameter, 2 axis tracking parabolic dish collectors. These collectors heat a silicone transfer fluid to approximately 750°F. This fluid is then transported to energy storage tanks. A total thermal storage capacity of 60 million BTUs

(British Thermal Units) is provided to permit evening and inclement weather operations. A power conversion system will be employed to supply electrical power and to process steam and hot water for heating and absorption air conditioning for the plant. Between 100 and 400 kilowatts of electrical power will be delivered by a steam driven turbine with reject heat directed to the space heating and/or cooling units. The experiment will be designed to supply 50% of the total electrical and thermal requirements of the 24,000 square ft. knitwear plant from solar energy.

Mission

The project will demonstrate the potential benefits that solar energy offers for total energy systems. A total energy system is a system which supplies both electrical and thermal energy by utilizing the residual thermal energy from electrical generation. The project will provide visibility for encouragement of private industry to become participants in solar industry both as manufacturers and users, and will provide operational data on the performance of parabolic dish energy systems.

Solar Total Energy Large scale Experiment, Shenandoah, Georgia

Program Status

The research and development preliminary design phases have been completed. Final design was completed in early FY 1980. Construction began in the Spring of 1980 with operation commencing in October, 1981.

Contractors

General Electric Space Division,
Valley Forge, Pa.; Georgia Power
Company.

Funding (\$ in millions)	Prior	FY 1982	To complete	Total
Construction	11.7	0	0	11.7
Research and development and other costs	15.7	.5	0	16.2
Operating	0	1.0	0	<u>1.0</u> 28.9

Shenandoah Parabolic Dish Collector and Receiver under test at the mid temperature solar systems test facility at Albuquerque, New Mexico

Active Solar Heating and Cooling Demonstrations

Description

The renovation of this Center included the design and installation of a mechanical system that would easily accept the solar system. The Center is located in the heart of downtown Huntsville. The site is level, well graded, landscaped, and tastefully planned. A stone-rimmed lagoon of clear spring water is situated immediately north of the building. The basic construction is brick and concrete block-bearing walls with a steel bar joist roof frame and exposed cement fiber insulating roof deck with built-up bituminous

roofing. Floors are standard concrete slab-on-grade construction. The solar system is designed to provide space heating and domestic water heating using the existing conventional system as backup. The system includes 1,945 square feet of self-supporting solar collectors mounted on the southeast side of the building with a 30° cant to face the collectors almost due south. The absorber plate is covered with a dual pane, low iron, tempered glass. A dual wall heat exchanger provides direct heating of domestic water.

Mission

To demonstrate the feasibility of solar energy systems.

Solar Energy System:

Annual Energy Requirements (10^6 Btu)

Application	Total Load	Solar Contribution	% Solar
Heating	162	138	85
Hot Water	198	168	85
Cooling	—	—	—

Collector

Type:	Liquid flat plate
Area (sq ft):	1,945
Manufacturer:	Solar Unlimited

Storage

Type:	Steel water tank
Capacity:	3,000 gallons

Auxiliary System: Gas-fired boiler

Huntsville Senior Citizens Center Huntsville, Alabama

Program Status

Project is fully operational.

Contractors

City of Huntsville.

Funding (\$ in millions)	Prior	FY 1982	To complete	Total
	.01	0	0	.01

Passive Solar Heating and Cooling Projects

Description

The Residential Solar Heating and Cooling Demonstration Program, managed by the Department of Housing and Urban Development as one element of the DOE National Solar Heating and Cooling for Buildings Program, included a limited number of passive solar projects in each of the early demonstration cycles, beginning 1976.

The major emphasis on passive solar residential designs began in 1978 with the Passive Residential

Design Competition and Demonstration. From over 500 applicants, 162 passive solar home designs were selected as worthy of design awards and in some cases construction assistance. Most of the awards went to architect designed homes, such as shown in Figure A.

In order to encourage homebuilders to adopt passive solar concepts, the fifth cycle of demonstration awards solicited applications from homebuilders. In excess of 550 applications were received; 114 were selected for design assistance grants, and of those 91 were selected for construction assistance. One of these homes is shown on the opposite page.

Mission

Demonstrate the feasibility and practicality of passive solar building design.

Architect designed passive solar home, Devonshire, CA

Program Status

Experience from these passive solar demonstration projects is being used to formulate regulations for the new Solar Energy and Energy Conservation Bank, which will provide financial incentives to builders and homebuyers to use passive solar designs.

Funding (\$ in millions)	Prior	FY 1982	Total
Resources	3.2	0	3.2

Contractors

A total of 276 awards to individuals and firms.

Homebuilders designed passive solar home, Tucson, AZ

Advanced Photovoltaic Power Experiments

Description

A three-phased program was initiated in 1978 to design, install, operate and evaluate a number of different photovoltaic application experiments using both flat panel and concentrating array technologies. The system sizes were to be between 20 and 225 kilowatts peak. Included in the system design phase were 29 different commercial, industrial, and university design teams. The designs were completed in early 1979. Nine designs were selected to enter the system installation phase. Each of these systems will subsequently progress to the third phase, system operation and evaluation. The

nine selected systems and locations are:

225 kilowatts for an airport in Phoenix, AZ; 110 kilowatts for an amusement park in Orlando, FL; 60 kilowatts for a hospital in Kauai, HI; 150 kilowatts for a high school in Beverly, MA; 50 kilowatts for an office building in Albuquerque, NM; 150 kilowatts for a shopping center in Lovington, NM; 150 kilowatts for a museum in Oklahoma City, OK; 27 kilowatts for an airport in Dallas-Ft. Worth, TX; 20 kilowatts for a power station computer in El Paso, TX.

Mission

These photovoltaic applications experiments are part of a series of system evaluation experiments to develop information about the suitability and acceptability of photovoltaic power systems for intermediate-sized applications.

Sea World, Orlando Florida 110 kW electric plus 300 kW thermal energy

Program Status

As of October 1, 1980 all of the nine design teams were under contract to install their system designs. Initial operating capability of these systems is expected in the January-September, 1981 timeframe. The systems will be operated and evaluated, under DOE sponsorship, for a 2-year period.

Funding (\$ in millions)	Prior	FY 1982	Total
Hardware installation	21.5	0	21.5
Design	8.4	0	8.4
Operating	2.3	3.0	<u>5.3</u>
			35.2

Contractors

Acurex Corp. (Kauai, HI Hospital); Arizona Public Service (Phoenix, AZ Airport); BDM Corp. (Albuquerque, NM Office Building); E-Systems, Inc. (Dallas-Ft. Worth, TX Airport); General Electric (Orlando, FL Amusement Park); Lea County Electric Coop (Lovington, NM Shopping Ctr.); NMSU (El Paso, TX Power Station Computer); Science Applications, Inc. (Oklahoma City, OK Museum); Solar Power Corp. (Beverly, MA High School).

Photovoltaic installation at Phoenix Airport

Mirror Fusion Test Facility

Description

The Mirror Fusion Test Facility (MFTF) is being constructed at the Lawrence Livermore Laboratory in Livermore, California. In FY 1981 this project was upgraded from a single mirror device to tandem mirrors joined by a solenoid. This project provides for construction of a magnetic fusion facility, including a tandem magnetic mirror research device, power supplies, cooling systems and requisite office and experimental areas. The research device will consist of the following main components: two fusion chambers, two magnetic mirrors, joining solenoid, vacuum pumping equipment, plasma injectors, and neutral beam systems. This configuration will be augmented by auxiliary systems, electric power systems, and instrumentation and control systems.

MFTF Machine

Parameters

Mirror center field, 2 Tesla; mirror length, 3.6 meters; fusion chamber length, 18 meters; fusion chamber diameter, 10.5 meters; solenoid chamber length, 25 meters; sustaining neutral beams: power injected, 60 megawatts; energy, 80 thousand electron volts; pulse length, 30 seconds.

Mission

MFTF will be the largest experimental facility in the world capable of investigating the tandem mirror fusion concept. Its principle objectives are: (1) To reach plasma confinement conditions near those predicted for a fusion reactor; (2) to explore plasma confinement scaling in a plasma having confinement values almost three orders of magnitude beyond those of present experiments; (3) to provide significant technological advances in the areas of high energy steady-state vacuum pumping, large superconducting magnets, and operation and control of a large plasma facility.

MFTF-B Facility

Program Status

The engineering design for MFTF has been completed and contracts for conventional and high technology hardware have been placed for the original single mirror configuration. New contracts for the tandem configuration will be placed in FY 1981. Fabrication of this hardware will proceed through 1984. Assembly and installation will be completed by the end of FY 1985, at which time the project will be completed.

Funding (\$ in millions)	Prior	FY 1982	To complete	Total
Design and construction	107	38	81	226
Other project costs	31	14	46	<u>91</u>
				317

Contractors

Lawrence Livermore Laboratory operating contractor; CVI Corporation fusion chamber system; Aydin Energy Division Neutral Beam Power supplies.

Vacuum vessel for an MFTF-B mirror end plug

Tokamak Fusion Test Reactor

Description

The Tokamak Fusion Test Reactor (TFTR) is being constructed at the Princeton Plasma Physics Laboratory in Princeton, New Jersey. This project provides for construction of a reactor facility, including a tokamak research device, related power supply and cooling systems, and requisite office, laboratory and experimental areas. The research device will consist of the following main components: toroidal vacuum vessel, torus shielding, toroidal field coils, ohmic field coils, equilibrium field coils, device substructure and magnet supports. This configuration will be augmented by auxiliary systems, neutral beam systems, electric power systems and instrumentation and control systems.

TFTR Machine Parameters

Major radius of vacuum vessel (R), 2.65 meters; minor radius of vacuum vessel (a), 1.1 meters; maximum toroidal field in coils, 9.5 Tesla; toroidal field coil flat top time, 3 seconds; pulse repetition time, 5 minutes; neutral beam line: Injection power, 24 megawatts; maximum deuterium energy, 120 thousand electron volts; pulse duration, 0.5 seconds.

Mission

The TFTR is a major milestone in an extensive program plan which identifies the major steps leading to the operation of a demonstration fusion power reactor early in the next century. Its principal objectives are: (1) To demonstrate fusion energy production from the burning of DT (deuterium and tritium) in a tokamak; (2) to study the physics of burning plasmas; (3) to demonstrate engineering features of large fusion systems. TFTR is expected to achieve, for the first time in a fusion device, scientific energy breakeven in which the fusion energy produced is equal to the energy supplied to the plasma.

Model of vacuum chamber magnetic field coils shielding a neutral beam for portions of the TFTR

Program Status

The engineering design for TFTR has been completed and contracts for conventional construction and state-of-the-art components have been placed. Major fabrication of the tokamak, neutral beams and power supplies will proceed through FY 1981. The tokamak assembly and installation is scheduled to be finished in CY 1981. The final neutral beam installation effort will then be made to meet a June 1982 project completion schedule.

Funding (\$ in millions)	Prior	FY 1982	To complete	Total
Design and construction (approp.)	274	10	0	284
Other project costs	134	60	0	<u>194</u> 478

Contractors

Princeton Plasma Physics Laboratory, operating contractor; Ebasco Services Incorporated, special facility design, procurement and installation; Giffels Associates, conventional facility design; Terminal Construction Corporation, conventional construction.

Aerial view of "C" site at Princeton Plasma Physics Laboratory, Princeton, New Jersey

Fusion Materials Irradiation Test Facility

Description

The Fusion Materials Irradiation Test Facility is being constructed at the Hanford Engineering Development Laboratory (HEDL) in Richland, Washington. This project provides for the construction of a new irradiation facility that will produce high energy neutrons representative of fusion reactor conditions. The

FMIT is an integrated complex consisting of an accelerator building, housing a linear accelerator to generate a beam of 35 MeV deuterons, and a test building which provides two shielded irradiation test cells (one unequipped) containing a liquid lithium target which strips the deuterons to produce neutrons.

Mission

Successful design and operation of commercial fusion power plants will require materials property data at operating conditions significantly beyond that currently experienced. FMIT will play a crucial role in both the mid-term and long-term phases of the fusion program by providing the basis for materials selection and materials confirmation through accelerated end-of-life testing.

Artist's conception of the accelerator and target layout for the Fusion Materials Irradiation Test Facility at Richland, Washington

Program Status

Preliminary design has been essentially completed. The accelerated design was subjected to a major peer design review at the end of November 1979, which established its technical baseline. Title II design of the conventional facilities has been initiated; construction was started in early CY 1980. Project completion is scheduled for April 1985.

Funding (\$ in millions)	Prior	FY 1982	To complete	Total
Design and construction	48	32	32	112
Other project costs	32	14	23	69
				<u>181</u>

Contractors

Hanford Engineering Development Labs, operation contractor; Los Alamos Scientific Laboratory, accelerator design; Ralph M. Parsons, Architect Engineer, design for conventional facility; J.A. Jones, construction support.

Schematic representation of physical process for producing neutrons in the Fusion Materials Irradiation Test Facility at Richland, Washington

50 Megawatt (MWe) Geothermal (Binary) Demonstration Power Plant

Description

The project provides for the design, construction, and operation of a commercial-scale geothermal electric power plant which utilizes a liquid-dominated hydrothermal reservoir and a binary conversion cycle. The project consists of a geothermal well field development, power plant and transmission construction, and operation of a 50 megawatt electric (MWe) generating facility. The demonstration plant will be located at Heber in the Imperial Valley of California. The well field and plant sites are approximately 7.5 miles southwest of El Centro and 4.8 miles northwest of Calexico.

The power plant will use the highly efficient binary-cycle energy conversion process. Hot geothermal fluid is pumped up

from the reservoir through production wells, to a heat exchanger, and then back down into the reservoir through injection wells. As the brine passes through the heat exchanger, it yields its heat to a secondary working fluid which then expands to a vapor. This vapor drives a turbine-generator to produce electricity. Cooling water condenses the working fluid before it is returned to the heat-exchanger. The power plant consists of a turbine generator, cooling tower, heat exchangers, piping systems, and an electric switchyard. Electricity will be transmitted from the plant by a 34.5 thousand volt (kV) transmission line which will connect the plant site to the commercial grid near El Centro.

Mission

The main purpose of this project is to design, build, and operate a commercial-scale geothermal binary power plant utilizing a liquid-dominated, moderate temperature (150-200°C), hydrothermal reservoir in the United States to achieve the Federal geothermal program goal of speeding commercial development of geothermal energy in an environmentally sound manner. The plant is scheduled to be operational in 1984.

Power Plant Site

Demonstration Plant

rogram Status

A cooperative agreement was executed between DOE and San Diego Gas and Electric Company (SDG&E). Total project costs are estimated at \$132 million. DOE share is estimated at \$70 million. A final Federal Environmental Assessment was prepared and plant design will commence early in fiscal year 1981.

Funding (\$ in millions)	Prior	FY 1982	To complete	Total
Design and construction	10.2	19.9	12.0	42.1
Research and development related to construction	0	0	0	0
Facility operations	0	0	19.3	19.3
Direct project support costs	1.8	1.1	5.7	8.6
Total DOE funds	12.0	21.0	37.0	70.0

Contractor

The project team consists of SDG&E as the project manager and representative of the owners and participants, Flour-Pioneer as the engineer/constructor, Chevron Resources Company as the geothermal fluid supplier, and the Imperial Irrigation District as the purchaser of power and supplier of cooling water. Heber reservoir development is being undertaken by the three geothermal lease holders, Chevron, Union and NARCO (a subsidiary of SDG&E), with Chevron as Unit Operator.

Power Plant Site

Small Hydroelectric Demonstration Projects

Description

Small-scale hydroelectric power demonstration projects were under way at 21 sites throughout the U.S. as part of the DOE small-scale hydropower demonstration program by the end of fiscal year 1980. Additional power capacity at presently generating power plants, rehabilitation of old abandoned power plants, and the addi-

tion of power generating capacity to existing dams where no power has previously been generated on rivers, lakes and irrigation canals are all scenarios which can be found among the current projects. All projects are cost shared with DOE paying 25% or less of the total project costs.

Mission

To stimulate and accelerate the development of small-scale (30 megawatt or less) hydroelectric projects by demonstrating their technical and economic viability.

Site Parameters

Owner	Location	Power (Kilowatts)	No. of Units	Hydraulic Head (Feet)
City of Idaho Falls	Snake River/Idaho Falls, ID	24,000	3	20
Turlock Irrigation Dist.	Turlock Main Canal/Modesto, CA	3,260	3	29
Brown-New Hampshire), Inc.	Androscooggin River/Berlin, NH	2,800	5	17
Riegel Textile Corp.	New River/Fries, Va.	2,163	1	39
Salt River Ag. Imp. & Power Dist.	South Canal/Mesa, AZ	1,400		35
Antrim County, MI	Elk River/Elk Rapids, MI	1,050	3	10
F.H.E. Stapenhorst, Inc.	Susquehanna River/Milford, NY	1,325	2	32
Green Mountain Power Corp.	Winooski River/Waterbury, VT	6,500	1	45
Central Maine Power	Shammut Dam/Augusta, ME	3,440	2	21
Public Ser. Co. of NH	Garvine Falls/Concord, NH	5,900	2	30
Boott Mills	Pawtucket Dam/Lowell, MA	15,000	2	35
NY State Electric & Gas Co.	Dam 43/Mechanicville, NY	15,000	5	20
City of Paterson, NJ	S.U.M. Dam/Paterson, NJ	7,500	4	70
PA Hydroelectric Dev. Corp.	Flat Rock Dam/Phil., PA	3,531	2	20
Broad River Electric Corp.	Cherokee Falls Dam/Gaffney, SC	3,900	2	20
City of Tallahassee, FL	Jackson Bluff Dam/Tallahassee, FL	8,800	3	33
City of Columbus, OH	O'Shaughnessy Dam/Col., OH	5,100	*	65
City of Carlyle, IL	Carlyle Dam/Carlyle, IL	8,750	2	24
City of Gonzales, TX	Gonzales Dam/Gonzales, TX	1,140	*	15
Shoshone Irrigation Dist.	Garland Canal/Powell, NY	2,400	1	52
City of Spokane, WA	Upriver Dam/Spokane, WA	9,000	2	33
	Totals	131,959		665
	Average	6,284		32

Sawmill Dam Middle Section

Sawmill Dam East Section

ogram Status

Two of the demonstration projects, Turlock Irrigation District, California, and F.W.E. Stapenhorst, Inc., at Goodyear Lakes Power Station in New York, were completed and went on-line during the last quarter of FY 1980. In an earlier phase of the program, initiated in 1979, DOE shared the cost of studies to determine the feasibility of undertaking small hydroelectric power projects at 54 existing dams. Currently, DOE is also making loans for feasibility studies and licensing costs as authorized by Title IV of the Public Utility Regulatory Policies Act. In addition, DOE coordinates assistance for such projects by various agencies under the President's Rural Energy Initiative.

Funding (\$ in millions)	Prior	FY 1982	To complete	Total
DOE	25	2.4	0	27.4
Owner	100	40	29	169

Contractors

Each site owner is responsible for getting his own contractors for all aspects, including design, construction and equipment manufacture. Contractors already selected include: Tudor Engineering; General Electric; James Leffel & Company; Hardison & Komatsu; Kleinschmidt & Duting; J.E. Sirrine; Stone and Webster; Ayre, Lewis, Norris & May; F.W.E. Stapenhorst; Gilbert/ Commonwealth; International Engineering Company; Voest-Alpine; Neyrpic; Hitachi; H K Contractors; Ossberger; and Allis-Chalmers.

Low Head Hydro Power Demo Small Hydro Demo Projects Idaho Falls, Idaho

Geothermal (Flash-Steam) Demonstration Power Plant

Description

The project provides for the design, construction, and operation of a commercial-scale geothermal electric power plant which utilizes a liquid dominated hydrothermal reservoir. The project consists of a geothermal well field development, power plant and transmission construction, and operation of a 50 megawatt (MWe) electrical generating facility. The demonstration plant will be located within the Valles Caldera at Baca Location #1 in north-central Sandoval County, NM. The well field and plant sites are approximately 60 miles north of Albuquerque and 19 miles west of Los Alamos.

The power plant is a single-flash steam unit, generating 50

MWe gross from 103 pounds per square inch atmosphere steam, and from the standpoint of power cycle design will be similar to the closed-condenser system now being designed and constructed at The Geysers in northern California, where only steam reaches the turbine from the wells. The power plant consists of a turbine generator building, cooling tower, hydrogen sulfide abatement system, and an electrical switchyard. Electricity will be transmitted from the plant by a 115 thousand volt (kV) transmission line which will connect the plant site to the commercial grid near Los Alamos.

Mission

The main purpose of this project is to design, build, and operate a commercial-scale geothermal flash-steam power plant utilizing a liquid-dominated hydrothermal reservoir in the United States to achieve the Federal geothermal program goal of speeding commercial development of geothermal energy in an environmentally sound manner. The plant is scheduled to be operational in 1982.

Index Map of the Valles Caldera

ogram Status

A cooperative agreement was signed by DOE and Public Service Company of New Mexico and Union Geothermal of New Mexico on August 6, 1979. Total project costs are estimated at \$143 million. DOE share is estimated at \$70 million. A final Federal Environmental Impact Statement was issued and plant design is continuing and well drilling has begun.

Funding (\$ in millions)	Prior	FY 1982	To complete	Total
Design and construction	50.3	3.9	0	54.2
Research and Development	0	0	0	0
Related to Construction	0	.8	6.0	6.8
Facility Operations	1.7	1.3	5.9	9.0
Direct Project Support Costs				
Total DOE Funds	52.0	6.0	11.9	70.0

Contractors

The industrial participants are Public Service Company of New Mexico and Union Geothermal of New Mexico who will own and operate the plant; Bechtel Corporation is the A&E and construction contractor; General Electric will supply the turbine/generator; Westec Service, Inc., is responsible for data analysis and dissemination.

Geothermal Demonstration Power Plant, Sandoval County, New Mexico

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ENERGY PRODUCTION AND POWER MARKETING

Gas Centrifuge Enrichment Plant

Description

The gas centrifuge enrichment plant (GCEP) will provide 8.8 million separative work units (SWU) per year of additional uranium enrichment capacity to fuel nuclear power plants. The plant site is located on Department of Energy property at Piketon, Ohio adjacent to the existing Portsmouth gaseous diffusion plant. This plant will be operated in an integrated mode with the three existing DOE gaseous diffusion plants. Initial production of enriched uranium will begin in 1988 with 2.2 million SWU/year capacity completed by 1989. Additional production capacity will be added as demand for enrichment services indicate the need. For planning purposes, full production is scheduled for 1994. The plant facilities will consist of eight centrifuge process buildings with a total floor area of 2.3 million square feet. In addition, there will be a recycle/assembly building, a feed and withdrawal building, warehouses, administration buildings and support, test and service facilities. Electric power consumption for the GCEP will be about 135 MW, about 5% of the requirements for a similar capacity gaseous diffusion plant.

Plant Data

Capacity, 8.8 million SWU/year; Product, Nominal 3.0% uranium 235 (U235) tails, Nominal 0.25% U235; Number of process buildings, 8; Site Area, 250 acres; Electrical Power Consumption, 135 MW.

Mission

The goals for the gas centrifuge enrichment plant are as follows: Allow U.S. to reopen order book which had been closed since 1974. Maintain U.S. position as a reliable supplier and minimum cost produced based on world's most extensive enrichment experience. Minimize world-wide proliferation risks. Conserve energy, using only 5% of the electric power required by the diffusion process. Conserve natural resources by allowing our plants to operate at a lower tails assay no greater than 0.25% U235.

Gas Centrifuge Enrichment Process

Program Status

The new gas centrifuge enrichment plant project is progressing on schedule, with four (4) architect engineering firms working; five (5) others having completed their designs. Sixteen (16) construction contracts have been completed and twenty-one (21) others are underway. Site rough grading is now complete. Nine (9) off site test and demonstration facilities have been designed and are being constructed with five (5) others completed. 3,000 people are now employed in design and construction of the plant.

In addition major procurement contracts have been placed for centrifuge machine, process building structural steel, power transformers and all of the raw materials.

Funding (\$ in millions)	Prior	FY 1982	To complete	Total
Design and construction	952	669	4,179	5,800
Other project costs	23	0	1,177	1,200
				<u>7,000</u>

Contractors

Construction, Stone and Webster Engineering Corp.; Many fixed price contractors. Centrifuge Manufacturers, The Garrett Corporation; Boeing Engineering and Construction Co.; Goodyear Aerospace Corporation. Operating Contractors, Union Carbide Corporation; Goodyear Atomic Corporation; AiResearch Manufacturing Company. Systems Engineering & Support, Systems Development Corporation, Daniel, Mann, Johnson and Mendenhall. Architect Engineers, Catalytic, Inc.; Fluor Engineers & Constructors, Inc.; Bechtel National Incorporated; Commonwealth Associates, Incorporated.

Gas centrifuge enrichment plant, Portsmouth, Ohio

Great Plains Gasification Associates Commercial High-BTU Gas Project

Description

Great Plains Gasification Associates, a consortium of five interstate pipeline companies, is planning to construct and operate the nation's first commercial synthetic fuels project in Mercer County, North Dakota. The project will employ the Lurgi pressurized, fixed bed gasification process with Lurgi methanation to convert North Dakota lignite into pipeline quality or "high-BTU" (British Thermal Unit) gas which can be mixed with natural gas in existing pipelines.

Project Parameters

The plant will use 14,000 tons/day of sized lignite to produce 137.5 million cu. ft./day of pipeline quality gas, 93 tons/day of ammonia, and 85 tons/day of sulfur. Tars, tar oils and phenols will also be produced, but will be used as fuel for the gasification plant. Approximately 6,000 acre/ft. of water will be used yearly.

Mission

The facility will be the nation's first commercial synthetic fuels project and will demonstrate the technical, economic and environmental acceptability of the Lurgi process on western United States coal. The timely construction and operation of this plant is vital in the nation's efforts to achieve significant synthetic fuels production and reduce dependence on imported oil.

Great Plains Gasification Associates Commercial High-BTU Gas Project

Project Status

To date, about \$60 million has been spent on the project which has resulted in a complete process design, the start of detailed engineering and a control cost estimate suitable to initiate construction. The Department of Energy is supporting the project through a repayable \$25 million Cooperative Agreement covering detailed design and preconstruction activities and a \$1.5 billion conditional loan guarantee commitment covering the debt portion of construction costs. Total project costs are expected to be approximately \$2.0 billion, depending upon final financing arrangements. Site preparation work was initiated in August 1980. The project is expected to begin operation in 1985.

Contractor

ANG Coal Gasification Company (a subsidiary of the American Natural Resource Company) will construct and operate the project on behalf of the partnership. The architect and engineering team consists of The C.E. Lummus Company and Kaiser Engineers.

Centrifuge Plant Demonstration Facility

Description

The centrifuge plant demonstration facility is a single multi-height building, complete with services and all equipment necessary to demonstrate a full cascade of gas centrifuge machines. This facility is being constructed at the existing gaseous diffusion plant site at Oak Ridge, Tennessee. The enrichment cascade is a close duplication of configuration and conditions planned for the full-scale gas centrifuge enrichment

plant under construction at the Portsmouth, Ohio site. Design started in FY 1977, and the facility is scheduled for completion in 1982.

Building, 75,000 square feet; Centrifuges, Model Plc (baseline machine—full scale plant); Number of operating personnel, 60; Capacity of plant, 23,000 (SWU) separative work units/year.

Mission

The centrifuge plant demonstration facility will provide the following information for the full-scale centrifuge plant: (1) industrial development of a vendor base; (2) Fabrication of plant components; (3) Cascade start-up, operation and maintenance; (4) Proof of plant design and operating criteria; (5) Operator training.

Interior of Centrifuge Plant Demonstration Facility under construction at Oak Ridge, Tennessee.

ogram Status

The centrifuge plant demonstration facility is under construction and is approximately 85% complete. The building shell is complete and utilities and services are being installed. A contract has been signed with three manufacturers to provide the centrifuge machines, with the first delivery expected in FY 1981.

Funding (\$ in millions)	Prior	FY 1982	To complete	Total
Design and construction	60	0	0	60

Contractors

Project Management, Department of Energy, Oak Ridge, Tennessee; Construction, Rust Engineering Company; Architect Engineers, Catalytic, Incorporated; H.K. Ferguson Company; Operations, Union Carbide Corporation/Nuclear Division; Centrifuge Machine Manufacturers, The Garrett Corporation; Boeing Engineering and Construction Company; Goodyear Aerospace Corporation.

Centrifuge Plant, Demonstration Facility at Oak Ridge, Tennessee.

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GENERAL SCIENCE

ISABELLE

Description

ISABELLE (Intersecting Storage Accelerator) is a 400 GeV x 400 GeV* high luminosity proton-proton colliding beam facility being constructed at Brookhaven National Laboratory (BNL) in Upton, Long Island. The project provides for construction of two rings of superconducting magnets located in an underground circular tunnel (3.8 kilometers in circumference) adjacent to the existing Alternating Gradient Synchrotron (AGS) ac-

celerator at BNL. Proton beams will be injected from the AGS at 30 GeV into ISABELLE; the beams will be accelerated to energies up to 400 GeV in the ISABELLE rings; the beams will then be made to collide at 6 points around the ring; each of these intersecting points will be enclosed in an experimental hall in which experimental apparatus will be located to study the results of the collisions.

*1 GeV = 1 billion electron volts

Mission

The purpose of ISABELLE is to extend our knowledge of the fundamental structure of matter and energy and the nature and interrelationships of the four fundamental forces in nature. With an energy range from 60 GeV up to 800 GeV available for reactions, compared to the 60 GeV now available at the European Organization for Nuclear Research's Intersecting Storage Ring, ISABELLE represents a giant step forward in research capability. The knowledge gained from experiments at ISABELLE is expected to be incisive in clarifying the nature of the weak interaction. At ISABELLE it should be possible to produce and examine in detail the full family of heavy intermediate vector bosons predicted by the Nobel prize winning theory which describes the weak and electromagnetic interactions in a unified framework. Research at ISABELLE will also substantially extend our knowledge of the strong nuclear interactions and the properties of the basic constituents of nuclear matter (called quarks). There is also the expectation that probing into this new energy regime will reveal exciting and totally unexpected physical phenomena.

Schematic diagram of ISABELLE Facility at BNL

Program Status

Conventional construction began in January 1979 and is approximately half completed. R&D and engineering design of the superconducting magnets are in progress. The current schedule calls for first circulating beams in early FY 1986.

Funding (\$ in millions)	Prior	FY 1982	To Complete	Total
Design and construction	120	41	116	277
Other project costs	33	19	117	169
				<u>446</u>

Contractors

Associated Universities Inc., BNL, Operating Contractor; Amman and Whitney (Architect-engineering and design services); Amman and Whitney/Safeguards (Construction Management); A.D. Herman Construction Company, Inc., Lasker-Goldman, Inc., J.F. O'Healy (Conventional Construction).

ISABELLE Facility, Brookhaven National Laboratory (June 1980)

Energy Saver

Description

The Energy Saver is under construction at Fermi National Accelerator Laboratory (FNAL) in Batavia, Illinois. The project will provide an additional ring of superconducting magnets within the existing accelerator tunnel and the ancillary systems required for the ring to operate as a rapid-cycling fixed target proton accelerator, capable of delivering 500 GeV (billion electron-volt)

primary protons to three external experimental areas and protons at about 800 GeV to an internal target. The existing conventional accelerator will serve as a 150 GeV injector for the Energy Saver. When operating for fixed target external beam experiments the accelerator will be capable of a repetition rate of one pulse every 24 seconds with an 8 second flat top.

Mission

The present accelerator is limited to 400 GeV operation because of the cost of electric power. The Energy Saver, equipped with superconducting magnets, will operate at reduced electric power consumption and at higher energy than the present accelerator. The annual energy saving from the superconducting technology will be \$5 million or more; fluxes of secondary beams will be substantially increased because of the higher primary energy.

Energy Saver superconducting magnets in accelerator ring under normal magnets

Program Status

Formal approval to begin design and construction of the project was given to FNAL by DOE in July 1979. The first sixth of the superconducting ring is being built with research and development funds. Several accelerator quality superconducting dipoles were built last year and full production will get underway early in FY 1981 with production complete in FY 1982. Refrigeration and other technical components are on schedule. Major procurements under the construction project are proceeding to meet first quarter FY 1982 project completion date.

Contractor

University Research Associates,
operating contractor.

Funding (\$ in millions)	Prior	FY 1982	Total
Design and construction	44	3	47
Other project costs	57	9	66
			<u>113</u>

Magnet Assembly Facility for construction of superconducting magnets

National Superconducting Cyclotron Laboratory

Description

A major research facility for the study of nuclear reactions between "heavy ions" is being constructed at Michigan State University in Lansing, Michigan. The facility is based on a new kind of nuclear particle accelerator, a superconducting cyclotron. The use of ultra-cold, superconducting technology for the power coils has resulted in a compact cyclotron with a uniquely high energy gain.

The Laboratory will be constructed as an extension of an existing facility and will provide a second-stage superconducting cyclotron to boost the energy of ion beams from a previously constructed first-stage superconducting cyclotron, with appropriate additional beam transport systems, additional experimental areas, additional radiation shielding, additional major experimental

apparatus, and additional support areas.

The new superconducting cyclotron will be arranged to provide a second stage of acceleration for beams from the first-stage superconducting cyclotron, which has an energy constant of 500 millions electron volts (MeV). A stripping foil at the injection point of the second cyclotron will increase the ion charge by a factor of 2 to 4 depending on the ion and this in combination with the larger energy constant of the second cyclotron will give a total energy increase of approximately 20 fold. The coupled cyclotron system will then produce energies of 200 MeV per nucleon for projectiles lighter than calcium and a decreasing energy per nucleon for heavier projectiles, to a value of about 20 MeV per nucleon for uranium.

Mission

The purpose of the National Superconducting Cyclotron Laboratory is to study collisions of heavy ions, and the nuclides produced in these collisions, in a new region of energy and intensity.

This Laboratory will give the United States a world leadership position in this forefront area of nuclear science, the study of nuclear reactions between "heavy ions."

In the new energy region available, the projectile begins to compress the nuclear matter of the target significantly and new phenomena and new aspects of nuclear behavior are likely to occur. Experimental programs will examine the effects of the central nuclear field in heavy-ion collisions, whether shock waves are produced and the related question of whether there is a fluid-like flow of nuclear matter.

Cross sectional schematic magnetic coils and vacuum chamber of the National Superconducting Cyclotron Laboratory, Lansing, Michigan.

Program Status

The architect and engineer contractor has been selected. Procurement of long lead-time items is proceeding. The major conventional facilities contract was let in early FY 1981 and the project is scheduled to be completed early in FY 1984.

Funding (\$ in millions)	Prior	FY 1982	To complete	Total
Design and construction*	11.9	9.1	9.0	30

*All DOE costs for this facility are included in this plant authorization. For example, \$4,200,000 associated Research and Development will be funded from this authorization.

Contractor

Michigan State University, design, construction and operation of cyclotron; Commonwealth Associates, architecture and engineering.

National Superconducting Cyclotron Laboratory, Lansing, Michigan

Tevatron Phase I

Description

The Tevatron Phase I is under construction at Fermi National Accelerator Laboratory (FNAL) in Batavia, Illinois. The project will provide (1) the construction of two experimental halls to house the detector systems for proton-antiproton colliding beam experiments; (2) the construction of an antiproton source, which includes a production target system capable of withstanding high power deposition and a 4 GeV (billion electron-volt) storage ring

to collect the antiprotons from the target and compress them to a usable size; and (3) upgrading the Energy Saver to allow the storage of 1000 GeV protons and antiprotons simultaneously. The 1000 GeV energy is 1 TeV, one tera (trillion) electron volts, thus the name Tevatron. The system will produce collisions of protons and antiprotons of sufficient intensity to perform rare event experiments at energies of 2000 GeV in the center of mass.

Mission

The frontier of research in high energy physics lies principally at the highest reaction (center of mass) energies. When beams are extracted and bombarded onto a fixed target, much of the incoming energy goes into kinetic energy of the outgoing particles, thus reducing significantly the interaction energy available for producing new particles. The Tevatron I project will have protons and antiprotons simultaneously counter-rotating in the superconducting Energy Saver ring. Their collisions take place in the center of mass and thus essentially all the energy released in the interaction is available for the production of new phenomena. By providing up to about 2000 GeV in the center of mass, Tevatron I will open up a new area of important research opportunities at the highest center of mass energies ever made available to laboratory physics experimentation.

Program Status

Formal approval to begin design and construction of the project was given to FNAL by DOE in October 1980. The first year will see the initiation of construction of the first experimental hall. Construction of the antiproton source and the saver upgrade will begin in FY 1982.

Contractor

University Research Associates,
operating contractor.

Funding (\$ in millions)	Prior	FY 1982	To complete	Total
Design and construction	2	18	20	40
Other project costs	12	5	8	25
				<u>65</u>

Tevatron Phase II

Description

The Tevatron Phase II project will begin construction in FY 1982 at Fermi National Accelerator Laboratory (FNAL) in Batavia, Illinois. The project will provide the necessary facilities for a 1000 GeV fixed target experimental program in existing areas to fully exploit the higher energy of the superconducting accelerator, the TEVATRON. It calls for the con-

struction of an extraction system, hardening and upgrade of the external beam switchyard and targets to allow operation at 1000 GeV, and construction of new secondary beams and support facilities in each existing experimental area in order to fully exploit the fixed target physics opportunities of the TEVATRON.

Mission

The Tevatron Phase II project is the final phase of an upgrade of Fermilab's accelerator and experimental facilities, preceded by the Energy Saver and then Tevatron Phase I. It will provide a unique opportunity for producing secondary particle beams at higher energies and intensities than anywhere else in the world. The TEVATRON fixed target program will give Fermilab international leadership for many years, allowing scientists to study many new phenomena involved in the fundamental interactions of matter. Study of these phenomena are at the heart of our understanding of the most basic processes of inanimate matter.

ogram Status

Approval by DOE to begin design and construction of the project is planned for early FY 1982. It is planned to complete the extraction system early in the year so as to begin limited 1000 GeV experiments by the end of FY 1982. This is possible because the project is being preceded by intensive R&D efforts required to develop the sophisticated controls needed for the new superconducting beam lines. Some beams lines will, therefore, be capable of accepting 1000 GeV beams as soon as the extraction equipment is in place and functioning.

Contractor

University Research Associates,
operating contractor.

Funding (\$ in millions)	Prior	FY 1982	To complete	Total
Design and construction	0	6	40	46
Other project cost	3	4	11	18
				<u>64</u>

National Synchrotron Light Source

Description

NSLS, the National Synchrotron Light Source is a complex of two electron storage rings for the production of intense X-rays and ultra-violet light which are to be utilized for advanced experimental research. The facility, being constructed at Brookhaven National Laboratory (BNL) in Upton, Long Island, will permit the simultaneous operation of the two rings in a pulsed mode. The X-ray ring will be about 170 meters in circumference, with

about 28 photon ports, and will operate at flexible energies up to 2.5 GeV with a circulating current of 1 ampere. The ultra-violet ring, with a circumference of about 44 meters, will contain approximately 16 ports for experimental stations, and will operate at 700 MeV with circulating current of 1 ampere. The project also provides for a Booster linac at 50 MeV, an injector at 650 MeV, and a building to house these experimental facilities.

Mission

The purpose of NSLS is to serve as a national, user-oriented, dedicated facility for advanced multidisciplinary research with synchrotron radiation. This radiation will be utilized as a powerful investigative tool which will be of major importance for the materials, chemical, and life sciences. The range of scientific and technical fields the facility is designed to serve include the following: solid state, atomic and chemical spectroscopy, photo and radiation chemistry, life sciences, crystal structure, defects in solids, physics and chemistry of surfaces and thin films, X-ray microscopy, optics and holography, lithography of microelectronics, and processes related to solar and fossil energy applications. Although designed specifically for X-ray and ultra-violet ray production additional important studies will be made utilizing the intense infra-red rays which will also be present. The facility is expected to be utilized by teams of university, laboratory, and industrial scientists in varying combinations which are best suited to the investigations at hand.

Aerial view of NSLS building facility

Program Status

The project was started in October, 1977 (FY 1978) and is scheduled for completion in October 1981. Full power operation, however, will probably not be achieved until the middle of 1982. Conventional construction is nearly complete and research at the ultra-violet ring is expected to begin about July 1, 1981, and at the X-ray ring about October 1, 1981.

Funding (\$ in millions)	Prior	FY 1982	Total
Design and construction	24	—	24
Other project costs	6	7	13
			<hr/> 37

Contractors

Associated Universities Inc.;
BNL, Operating Contractor;
BNL, major technical oversight;
Max Urbahn Associates—Seelye,
Stevenson, Value, and Knecht,
Inc. (Joint architect-engineer and
design services); Conventional
construction contractor, J.S.
O'Healy.

View of vacuum ultra violet ring

Elmo Bumpy Torus

Description

The Elmo Bumpy Torus Proof-of-Principle Experiment (EBT-P), a magnetic fusion confinement device, is being constructed at the Oak Ridge Valley Industrial Park in Oak Ridge, Tennessee, a privately owned site adjacent to the Oak Ridge National Laboratory (ORNL) Y-12 plant. While ORNL has overall management responsibility for the project, the principal contractor, McDonnell Douglas Astronautics Co., will construct the device and facility in addition to participating significantly in the operation of EBT-P. This project provides for construction of a magnetic fusion facility, including a research device, power supplies, cooling systems, and requisite office and experimental areas. The research device will consist of the following main components: fusion chamber, superconducting magnets, cryogenic system, vacuum pumping equipment, and microwave systems. This configuration will be augmented by auxiliary systems, electric power systems, and instrumentation and control systems.

EBT-P Machine Parameters

Steady-state operation, major radius of 4.5 meters, plasma radius of 17 centimeters, microwave power 1.6 megawatts, ion cyclotron resonance heating power 1.0 megawatts.

Mission

EBT-P is the vehicle through which the bumpy torus concept will be accelerated to such a level that it can be meaningfully considered with tokamaks and tandem mirrors in important program decisions which must be made in the mid-late 80's. Specifically, EBT-P will substantially improve the plasma parameters obtained in the present EBT-Scale experiment and provide a significant benchmark in developing EBT scaling laws. The fusion program in general will benefit from the advances in superconducting magnet and gyrotron technology required for EBT-P.

EBT-P

Program Status

McDonnell Douglas was recently selected to construct EBT-P and to participate with ORNL in the required research and development and in the operation. During FY 1981 design studies, magnet and microwave research and development, engineering, and a limited amount of long-lead procurement will be done. Construction will commence in FY 1982 and is scheduled for completion in FY 1986.

Funding (\$ in millions)	Prior	FY 1982	To complete	Total
Design and construction	7	13	67	87
Other project costs	4	5	40	<u>49</u>
				136

Contractors

McDonnell Douglas is the principal contractor. Its primary sub-contractors are General Dynamics, magnets; Gilbert/Commonwealth, architect/engineer; Helix Technology, cryogenic systems; Jaycor, physics support; and Continental Electronics, power supply design.

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DEFENSE PROGRAMS

NOVA (High Energy Laser Facility)

Description

The NOVA Neodymium Glass Laser and Target Irradiation Facility is being constructed at the Lawrence Livermore National Laboratory in Livermore, California. Included in this facility are new laboratory and office buildings, laser and target chamber systems, and control and support systems. Ten laser chains will produce intense pulses of light for thermonuclear target irradiation experiments. A second phase of NOVA, to increase the primary laser output by over a factor of two is under consideration.

NOVA Laser Parameters

Number of beams, 10; Primary wavelength, 1.053 nanometers; Pulse length, 0.1 to 3 nanoseconds; Pulse energy, 80-120 kilojoules; Pulse power, 80-120 terawatts; Beam diameter aperture, 46 centimeters; Diameter of final focusing lenses, 74 centimeters.

Mission

NOVA is a major, advanced experimental facility for use in developing inertial confinement fusion (ICF) technology for national security and national energy programs. Specifically, NOVA will: (1) provide a major weapons physics research facility; and (2) increase the energy on target obtainable from existing lasers in order to demonstrate significant thermonuclear burn in high density fuel as a key feasibility demonstration for ICF.

NOVA Laser Fusion Facility

Program Status

Phase I of NOVA will be built at a cost of \$137 million. Conventional facilities, including the laser building, are currently under construction and design of the laser system is nearing completion. The laser building is scheduled for completion in late summer 1981 and NOVA will begin operation at 80-120 kilojoules in mid-1983.

Funding (\$ in millions)	Prior	FY 1982	Total
Design and construction	104	33	137

Contractors

University of California, Lawrence Livermore National Laboratory, Overall project management; special facilities design, procurement and installation; and operation; Albert C. Martin and Associates, Conventional facilities design; Kaiser Engineers Incorporated, Conventional facilities construction management.

NOVA Construction

Fluorinel Dissolution Process and Fuel Receiving Improvements

Description

The Idaho Fuels Processing Facility (IFPF) at the Idaho National Engineering Laboratory, Idaho Falls, Idaho, was established for the purpose of recovering uranium from spent reactor fuel and for developing improved fuel processing methods. The Fluorinel Dissolution Process and Fuel Receiving Improvements project (Fluorinel) provides for construction of a new facility at the IFPF for receipt, handling, storage, and dissolution of spent reactor fuel for which no

other capability exists. The new Fluorinel facility will occupy approximately 150,000 square feet and will include areas for truck receiving, fuel cask receiving and decontamination, fuel unloading and storage, fuel cutting, fuel transfer, water treatment, chemical makeup, fuel dissolution, process storage and process support services. The dissolved solution will be transferred to existing facilities at the IFPF for recovery of contained uranium.

Mission

A wide variety of spent fuels, including Naval, test, and research fuels, are scheduled to be received at the Idaho Fuels Processing Facility for fuel processing and uranium recovery. The Fluorinel facility will process, through 1992 a projected 9460 kilograms of uranium with a 1980 value of approximately \$350 million. The recovered material will increase the amount of uranium resource available to the U.S. and thereby reduce the demand from other sources and the cost of mining, processing, and enriching natural uranium.

Fluorinel construction site, summer 1980.

Program Status

The engineering design for the Fluorinel facility has been completed, and construction was initiated in February 1979. As of November 1, 1980, construction was approximately 17% complete. Construction is scheduled to be completed in the first quarter of FY 1984, with commencement of operations in July 1984 for fuel storage and March 1985 for fuel dissolution.

Funding (\$ in millions)	Prior	FY 1982	To complete	Total
Design and construction (approp.)	150	40	10	200
Other project costs	16	11	18	45
				<u>245</u>

Contractors

Exxon Nuclear Idaho, Inc., facility operating contractor; Ralph M. Parsons Company, architect-engineer; Catalytic, Inc., construction contractor; Idaho Operations Office, DOE field management. Boecon Construction, subcontractor; S. P. Wallace, Independent Cost Estimator; Decision Planning Co., Management Systems consultant.

Fluorinel Dissolution Process and Metal-Clad Fuels Storage Facility under construction at the Idaho Fuels Processing Facility near Idaho Falls, Idaho.

Antares (High Energy Gas Laser Facility)

Description

The Antares High Energy Gas Laser Facility is being constructed at the Los Alamos National Scientific Laboratory in Los Alamos, New Mexico. The project provides for construction of a carbon dioxide gas laser facility including the Antares multi-beam laser fusion system and requisite office, laboratory and experimental areas. The laser system consists of a short pulse generator and preamplifiers which feed two large annular laser power amplifier modules. Each power amplifier contains a central electron beam gun surrounded by twelve lasing amplifiers and optical sectors. Each of the twelve laser beams from each power amplifier is transmitted through evacuated tubes and guided by a series of mirrors to the target chamber, in a separate shielded building, where they are all focused on the fusion targets. Supporting systems consist of high voltage pulsed power supplies, cryogenic vacuum systems, instrumentation and control systems, and an experimental/diagnostics area.

Antares Parameters

Energy, 40 kilojoules; Pulse duration, 0.5 to 1 nanoseconds; Power 40 to 80 terawatts; Laser gas, 80% CO₂, 20% N₂; Wavelength, 10.6 micrometers; Pumping methods, Electron beam controlled discharge; Discharge voltage, 550 kilovolts; Energy storage, 7.2 megajoules; Focalspot, 400 micrometers.

Mission

Antares represents an important step in the development of inertial confinement fusion (ICF) technology and the demonstration of its feasibility for the solution of both national security and national energy problems. Before commitments are made to begin the costly development of engineering-oriented or prototype test facilities, it is essential that ICF concepts be verified using powerful laser or other beam sources. The carbon dioxide gas laser has the potential benefits of high energy, and high repetition rates required for useful applications, coupled with a well developed technology base. The objective of the Antares project is nearly an order of magnitude extension in laser energy to verify target design predictive capability and scaling in the establishment of the energy requirements for thermonuclear ignition.

Antares Power Amplifier Module

Program Status

The building construction is complete and installation of the first power amplifier module and the target vacuum chamber system is nearly finished. The engineering design of the entire system is near completion and major components for the first power amplifier have been fabricated, delivered, and are being assembled. Major fabrication of components will proceed through FY 1982. Assembly and installation will continue into FY 1983, with the final system checkout and completion scheduled for July 1984.

Funding (\$ in millions)	Prior	FY 1982	To Complete	Total
Design and construction	52.7	9.8	—	62.5

Contractors

University of California, Los Alamos National Scientific Laboratory, Overall project management; Norman Engineering Co., Conventional facility design; Allen M. Campbell Co., Conventional construction; Pittsburgh Des Moines Steel Co., Target chamber and vacuum system.

Antares Facility

Restoration of Nuclear Weapons Complex Equipment and Utilities

Description

This project provides for the replacement or restoration of utilities and equipment that, in progressing at their normal life cycle, have deteriorated to the point that their physical condition is poor or is no longer technologically satisfactory. It is expected that approximately 35,000 items of equipment will be replaced/restored as will hundreds of important building services and

utility systems. This program will involve all seven sites of the nuclear weapons production complex, the three weapons research and development laboratories, and the Nevada Test Site. The cost of this restoration effort is estimated at approximately \$850 million in FY 1982 dollars and funding is planned over a six-year period beginning in FY 1980.

R&D Activities

Mission

The Department of Energy is responsible for: (1) sustaining international leadership in new ideas and technologies essential to maintain modern nuclear forces capable of responding to threats against the United States national security; (2) design, development, and certification of nuclear weapons approved by the President for the Department of Defense delivery systems; and (3) production and lifetime surveillance of safe and reliable nuclear weapons in support of United States national security. Concern has developed within the Department of Energy that the nuclear weapons production, development, and testing facilities were deteriorating to such a condition that planned workloads and schedules for the 1980's may not be met. The extent of deterioration has been identified in a series of appraisals conducted throughout the complex beginning in 1977. As a result of these appraisals, items of equipment and utility systems in need of restoration/replacement have been identified for correction by this project.

Production Mission

Program Status

Engineering design, procurements, and construction by the operating contractors, as well as private sector A-E and construction firms, are well under way on the first phase (FY 1980) of this multiyear program. Activities related to the second phase (FY 1981) are now being initiated.

Funding (\$ in millions)	Prior	FY 1982	To complete	Total
Design and construction	133	176	538	847

Contractors

Bendix Corporation, E.I. duPont de Nemours and Company, General Electric Corporation, Rockwell International, Monsanto Research Corporation, Union Carbide Corporation, Mason and Hanger-Silas Mason, University of California, Western Electric Company, Reynolds Electric Company, EG&G, and numerous other A-E firms, vendors, and construction contractors.

WEAPONS COMPLEX ACTIVITIES TESTING MISSION

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Restoration of Materials Production Capabilities Project

Description

The Production Facilities Restoration Project consists of over 400 separate construction or repair activities to correct physical deterioration that has accumulated as a result of the aging of DOE's defense nuclear materials production facilities. Production complexes at Savannah River, South Carolina; Hanford, Washington; Oak Ridge, Tennessee; Fernald, Ohio; and Idaho Falls, Idaho are included in the restoration. The work will cover a wide spectrum of facilities and equipment including: reactors, nuclear fuel processing plants, heavy water production plants, radioactive waste processing and storage facilities, research and development laboratories, and plant utility systems. Representative examples of the activities to be undertaken are described below:

- Retubing of the N-Reactor steam generators at Hanford.

- Safety modifications and additions to the existing Savannah River facilities for handling irradiated reactor fuel and target assemblies.
- Replacement of obsolete Savannah River process lines for production of plutonium-238 oxide.
- Replacement of reactor cooling water heat exchangers at Savannah River that have reached the end of their service life.
- Renovation of coal handling equipment and boiler combustion controls at Savannah River.
- Restoration of uranium chemical processing equipment in Buildings 9206 and 9212 at the Oak Ridge Y-12 Plant.

Mission

The Restoration Project is tied directly to DOE's assigned mission of providing nuclear materials for national defense needs. The facilities involved are the prime source of weapons-grade materials within the United States. It is therefore necessary that excessive breakdowns be avoided and that production needs be met in a safe, effective and efficient manner.

Restoration activities at the N Reactor, Hanford, Washington, will include control system upgrading, instrumentation replacement, and retubing of the steam generators.

Program Status

Due to the size and diverse nature of the project, it has been subdivided into six separate phases. Phase I was authorized in FY 1981 and includes eight subprojects having a total estimated cost of \$51.9 million. Phase II, which is being requested in FY 1982, funds nine additional subprojects. The total scope of work still to be performed is reappraised annually and priorities established for the next phase. An overall project schedule and cost will not be established until Phase IV, however, it currently appears that the restoration will require approximately \$350 million in FY 1981 dollars funded over a six-year period.

Funding (\$ in millions)	Prior	FY 1982
Design and construction	25.5	62.3
Other project costs	<u>1.8</u>	<u>20.1</u>
Totals	27.3	82.4

Contractors

The individual subprojects will be managed through the existing operating contractors for the sites. These are: DuPont at Savannah River, Exxon Nuclear at Idaho, Rockwell International and UNC Nuclear at Hanford, Union Carbide at Oak Ridge, and National Lead at Fernald. Phase I design and construction will also be performed by DuPont.

Twenty-two year old reactor heat exchangers at the Savannah River plant will be replaced as part of the Restoration project. Each heat exchanger contains approximately 9,000 stainless steel tubes and is approximately 30 ft long.

New Plutonium Recovery and Waste Treatment Facility

Description

This project provided for the design and construction of a new facility that includes a plutonium recovery section, a process waste treatment section, and support facilities of approximately 303,000 gross square feet. The facility consists of a single new building, partially above and partially below ground level. Critical areas are hardened to resist tornadoes and dynamic earthquake loadings. The hardened section of the building includes plutonium recovery, plutonium storage, incineration and waste drum storage, filter plenums, and building utilities. The non-hardened section of the building contains the process waste treat-

ment section and support facilities, including offices, change rooms, and cafeteria space. All utilities have been extended from existing systems on the plant site. Also included is a new steam boiler and a 3,000 square foot addition to the existing steam plant to provide the necessary steam capacity. New service roads, parking and security fencing have been provided for the area. This project also included interim upgrading of the existing plutonium recovery operations in Building 771, and decontamination and removal of potentially unsafe equipment and gloveboxes after the new facilities are fully operational.

Mission

This project will replace existing plutonium recovery operations and treatment of contaminated wastes being conducted in existing facilities to enhance further fire protection, safety, and operating conditions at the Department of Energy's (DOE's) Rocky Flats Plant. The plutonium recovery using chemical and metallurgical operations, is performed on scrap containing plutonium to recover as much of the plutonium as feasible. The waste treatment will remove contaminants from the plants process liquid wastes (new facility and from existing facilities). The low-level waste (in a dry form) will be appropriately packaged for disposal. The liquid effluent will be collected at a central location and recycled for plant use (boilers, cooling towers, etc.). The new facility will support the production of plutonium parts required for development and production of nuclear weapons by the DOE for the Department of Defense (DOD).

New Plutonium Recovery and Waste Treatment Facility

Program Status

The new facilities were completed in June 1980. After the operations' startup has been completed, the existing production plutonium operations and the new facility will be operated for one year. At that time, decontamination of the existing production recovery facilities located in a portion of Building 771 will start (scheduled April 1982), and is scheduled for completion in April 1985.

Funding (\$ in millions)	Prior	FY 1982	To complete	Total
Design and construction	215	0	0	215
Other project costs	15	0	0	<u>15</u>
				230

Contractors

Engineering Design, C. F. Braun and Company; Construction, Swinerton and Walberg Company; Operating, Rockwell International, Al. Building Internals, Lummins Co.; substructure and plutonium recovery, Frank Briscoe Co.; Waste Treatment Superstructure, Centric Corp.; support facility, Cyrus G. Delano. Co.; utilities outside, Meyer-Wheedle Co.

New Plutonium Recovery and Waste Treatment Facility

Particle Beam Fusion Accelerator—II

Description

The Particle Beam Fusion Accelerator-II (PBFA-II), including the necessary laboratory and office space, is being constructed at the Sandia National Laboratories, Albuquerque, New Mexico. A high-bay heavy laboratory building of approximately 35,000 square feet and a 13,000 square foot office building will be provided. The PBFA-II facilities will require distribution systems for deionized water and sulfur hexafluoride (SF_6), and a cooling tower will be provided to dissipate heat from the experiments. PBFA-II will be a major upgrade to PBFA-I; PBFA-II will use the same basic mechanical structure as PBFA-I. There is enough volume in the present accelerator tankage to allow greater than a twofold increase in energy storage. The upgraded energy storage unit will be arranged into 36 pie-shaped sections.

Included in the total estimated cost of \$39,300,000 is laboratory space for a high repetition rate facility aimed at the demonstration of high average power key components necessary for reactor power applications.

PBFA-II Parameters

Particle of Choice, light ions;
Energy, 3.5 megajoules; Ion
Energy, 4 megavolts; Power,
100 terawatts; Pulse Duration,
35 nanoseconds.

Mission

The long term application and primary motivation for the large national commitment to fusion research is for an inexhaustible source of energy from fusion power. A shorter term application for which inertial confinement research is particularly well suited is weapons research. Sandia's work with PBFA-II will allow target testing at the multi-terawatt level at relatively low cost.

PBFA-I (Sandia)

Program Status

Design for PBFA-II began in FY 1979 under plant engineering and design (PE&D) funding. It was completed in FY 1980 under additional PE&D funding. Construction will begin in FY 1981 and is scheduled to be completed by the end of FY 1984.

Funding (\$ in millions)	Prior	FY 1982	To complete	Total
Design and construction	7.5	20.0	11.8	39.3

Contractors

Sandia Corporation, Sandia National Laboratories, overall project management; W. J. Kruger & Associates, Architect/Engineer.

PBFA-II (Sandia)

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CONTINGENCY PLANNING

Strategic Petroleum Reserve

Description

The purpose of the Strategic Petroleum Reserve (SPR) is to reduce the vulnerability of the United States to a severe shortage of petroleum supply. In developing the SPR system, the Department of Energy has located storage sites in areas where they would be most accessible to tankers and major pipelines. Thus, during an interruption, the oil could be rapidly withdrawn and entered into the normal crude oil distribution system of the country. The vast majority of all crude oil entering the United States enters through the Gulf of Mexico and is transferred inland via three major pipelines: the Seaway, the Texoma, and the Capline pipelines. Thus, the most

desirable locations are along the Gulf Coast. This area already receives the majority of crude oil imports and provides the necessary access to the primary crude oil distribution system of the country. Storage sites in this area can feed the major market areas dependent upon oil imports that are likely to be interrupted; the interior of the country, the Gulf Coast refinery complexes, the East Coast, and the Caribbean refineries. Each of the complexes being developed for the SPR will be connected to one of the three major pipelines referred to above. The complexes have been grouped according to the associated major pipelines.

Mission

The Energy Policy and Conservation Act (EPCA) of 1975 authorized the storage of up to one billion barrels of petroleum products for the purpose of reducing the impact of disruptions in petroleum supplies or to carry out obligations of the United States under the International Energy Program.

Bryan Mound, Texas—overview of site

St. James Terminal and Docks, Louisiana—overview of completed docks and storage tanks

Program Status

Five sites have a combined existing underground storage capacity of 244 million barrels. Three of the five sites are being expanded for an additional 290 million barrels for a total of 538 million barrels. These sites are:

Storage Site	Location	Storage Capacity (million barrels)
Bryan Mound	Brazoria County, Texas	180
West Hackberry	Cameron Parish, LA	211
Bayou Choctaw	Iberville Parish, LA	46
Weeks Island	Iberia Parish, LA	75
Sulphur Mines	Calcasieu Parish, LA	<u>22</u>
		534
Tanks and Pipelines		<u>4</u>
Total		538

Contractors

Parsons-Gilbane, Construction Manager; Dravo Utility Construction, Inc., Operations and Maintenance; the Aerospace Corporation, Systems Engineering; OAO Corporation, Support Services; Thacker-Construction Co., modification, equipment upgrading and enhancement.

The marine terminal in St. James Parish, Louisiana, consists of 2 million barrels of above-ground storage and two tanker docks for discharging and loading of crude oil. There are plans to expand two of the existing sites for 70 million barrels and develop a new site for 140 million barrels to create a 750 million barrel capacity. Development plans for the remaining storage capacity are not final.

Funding for 750 Million Barrel Reserve (Dollars in Millions)

General Fund (750 million barrels)	Prior	FY 1982	To complete	Total
Program direction	41	13	54	108
Planning	58	9	32	99
Facilities	1,479	193	1,261	2,933
Oil acquisition	<u>4,860</u>	<u>3,436*</u>	<u>28,044</u>	<u>36,340</u>
Total general fund	6,438	3,651	29,391	39,480

*Does not include entitlement proceeds

Naval Petroleum Reserve No. 1 Development Facilities Projects

Description

The Development Facilities Projects at Naval Petroleum Reserve No. 1 (NPR-1), located in Elk Hills, California, consists of 25 projects established to support production from the development drilling program. The projects in-

clude gas processing plants, gas compression facilities, oil and gas collection lines and shipping stations, and waterflood facilities, as well as production and support related facilities.

Mission

The Naval Petroleum Reserves Production Act of 1976 (Public Law 94-258) provides that the Naval Petroleum Reserves be produced at the Maximum Efficient Rate (MER) consistent with sound engineering practices. The Development Facilities Projects are an integral element in producing NPR-1 at MER.

The oil flow diagram depicts the processes required for pumping oil from wells, processing oil and natural gases, reinjecting natural gases into the underground oil reserves and selling the processed crude oil.

Program Status

All of the major development projects are either under design or under construction at this time and should be completed by the end of FY 1982. There will always be a certain amount of development work, (although minor in relation to the current program) in future years.

Funding (\$ in millions)	Prior	FY 1982	To complete	Total
Design and construction (approp.)	295.8	58.2	12.2	366.2

Contractors

Construction Manager, Naval Facilities Engineering Command; Operating Contractor, William Brothers Engineering Company.

Naval Petroleum Reserve #1 Elk Hills, Tupman, CA

Naval Petroleum Reserve #1 Elk Hills Tupman, CA

Small Wind Energy Conversion System Pilot Plant

Description

The Small Wind Energy Conversion System Pilot Project (SWECS) consists of installing up to 12 commercially available windmills of varying designs at homes and farms in a relatively small area of the Klickitat County Public Utility District in South-central Washington State, near the Columbia River Gorge. Bonneville Power Administration and the

PUD are managing the project. Though generation potential of this pilot project is difficult to assess because output is very site specific, machines rated at 2 kilowatts should supply about 6,000 kWh per year with average annual wind speed of 12 mph; units rated at 7 kW would supply about 20,000 kWh per year with average 12 mph winds.

Mission

The pilot project is designed to test the effects of windmills on local utility operations, generation potential, and economics of end-use small windmills in the Pacific Northwest. Other purposes include determining the extent SWECS can displace the need for utility supplied energy and the amount of surplus energy SWECS can feed back into the power grid. Data will be collected for 5 years measuring wind speeds, power production and consumption from the windmills and power taken from and contributed to the PUD.

Small Wind Energy Conversion System Pilot Plant

rogram Status

Two a.c. generating windmills, rated at 2 kW, were installed in March 1980. News of these installations resulted in 93 applications for participation in the project. 20 preliminary test sites have been chosen for up to ten additional installations. The remaining machines will include d.c. generators using synchronous inverters to change the power to a.c., and units of up to 10 kW capacity. Installations should be completed by mid-1981.

Funding (\$ in thousands)	Prior	FY 1982	To complete	Total
Construction	204.6	0	0	204.6
Research and Development	33.5	0	0	33.5
Operations and Maintenance	34.0	15.9	47.7	<u>97.6</u> 335.7

Contractors

The Bonneville Power Administration conducts this pilot project with the assistance of the Klickitat County Public Utility District. Windmills are purchased on competitive bids. The first two units were supplied by Enertech Corp., Vermont, and installed by Clean Energy Products, Seattle, Washington, and Andrews Fuel Savers, LaGrande, Oregon. Research is conducted by Oregon State University.

Small Wind Energy Conversion System Pilot Project

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MANAGEMENT AND OVERSIGHT

In-House Energy Management Program

Description

The In-House Energy Management Program embodies the Department of Energy's efforts to conserve energy in its own offices, plants, laboratories, and other facilities. As the second largest energy consumer in the Federal Government, the Department used approximately 15 million barrels equivalent in FY 1979, exclusive of energy required for uranium enrichment. Goals for the reduction of energy consumption in the Department's buildings have been established by law and agency-established goals for process operations are being developed. Major elements of the In-House Energy Management Program include a retrofit program to improve the energy efficiency of existing facilities, a fuel conversion program for major DOE central plants burning critical fuels, and a program for the design of energy efficient new facilities for the Department. Energy conservation surveys are underway to identify energy saving "retrofit" projects for both DOE buildings and processes. These projects include modifica-

tions to heating, ventilating and air conditioning systems, replacement of inefficient lighting systems, improvements to building shells, such as insulation and double glazing, solar projects, and heat recovery projects for DOE processes. Candidate retrofit projects are selected for funding on the basis of economic return. Central plant studies are also being made to develop central plant conversions (e.g. from fuel oil or natural gas to coal) which are aimed at reducing dependency on critical fuels as well as improving overall site energy efficiency by cogeneration of electricity. Other aspects of the In-House Energy Management Program include an Energy Conservation Employee Awareness Program and a Vanpooling Program. The Driver Energy Conservation Awareness Training (DECAT) Program developed by the Department is providing training for drivers of DOE vehicles as well as drivers of Federal, State and local governments, including law enforcement agencies.

Installation of capacitors throughout the electrical system at DOE's Los Alamos site has resulted in reduction of transmission line losses. The capacitor banks are incrementally switched by remote supervisory control as the load requirements change. Energy savings for this project is estimated at 108 billion BTU annually.

DOE's Mound Facility at Miamisburg, Ohio, has replaced 77 single speed ventilation fan motors with two-speed motors with control timers. The new motors reduce ventilation rates during unoccupied periods. Annual energy savings is estimated to be 5.3 million kilowatt hours of electricity, 15 million cubic feet of natural gas and 13,000 gallons of fuel oil. This represents a total of 78.7 billion BTU in annual savings.

Mission

The mission of the In-House Energy Management Program is to maximize the Department's energy efficiency to meet energy conservation goals established by the President and the Congress, and, as the Nation's energy agency, to set the example for other Federal agencies. Specific in-house goals for the Department are:

- 20% reduction by FY 1985 in energy use in existing buildings, as compared with FY 1975.
- 45% reduction in energy needs of new buildings (completed after November 1979) as compared with similar buildings in FY 1975.
- 30% reduction in petroleum consumption by 1985.
- Eliminate use of fuel oil and natural gas in major fuel burning installations by 1990.
- Retrofit existing buildings by 1990 to minimize life cycle costs.

Goals for general operations (research, production processes, vehicles) are being established.

Program Status

The Department, since 1973, has been able to reduce its consumption of fuel oil by 51 percent and its total energy consumption per square foot by 15 percent. These reductions have been achieved in a time when the Department's research, development, and production programs have increased significantly. In-house Energy Management is an ongoing program focused primarily on 1985 and 1990 goals established by the President and Congress.

Funding (\$ in millions)	Prior	1982
Survey and Studies	13.1	6.9
Retrofit projects	90.1	50.0
Fuel Conversion Projects	<u>18.9</u>	<u>28.0</u>
	122.1	84.9

Contractors

The majority of the Department's facilities are government owned and contractor operated. Thus all of the contractors operating DOE sites are active participants in the In-House Energy Management Program.

One of the seven photoelectrically powered railroad crossing installations at DOE's Hanford Reservation, at Richland, Washington. Costly conventional electrical services to the remote locations were avoided.

The Grand Junction Office installed this solar system on the cafeteria building, which was built in 1977. The system has exceeded design estimates by supplying approximately 90 million BTU per year, or more than 60 percent of the cafeteria's hot water and space heating.