U.S.
DEPARTMENT
OF ENERGY

MASTER

PROJECT
BOOK

SECRETARY OF ENERGY

JANUARY, 1980

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U.S. DEPARTMENT OF ENERGY

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SECRETARY OF ENERGY
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Authorizing Official

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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.

1. The first project is a study of the possibility of using the Department's resources to develop a new type of energy storage system. This project is being conducted by the Office of Energy Research and Development, Office of Advanced Research and Development, Office of Energy Storage Systems. The project is being conducted in cooperation with the Office of Energy Efficiency and Conservation, Office of Energy Conservation, Office of Energy Conservation Systems. The project is being conducted in cooperation with the Office of Energy Efficiency and Conservation, Office of Energy Conservation, Office of Energy Conservation Systems. The project is being conducted in cooperation with the Office of Energy Efficiency and Conservation, Office of Energy Conservation, Office of Energy Conservation Systems.

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ENERGY PROJECTS

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 reduce the high risk of failure of this technology. The other is to demonstrate with the auto industry the new technologies needed to decrease the transportation petroleum consumption figures projected for the increased number of vehicles on the road and the increased number of vehicle-miles traveled during the 1990's. The Stirling 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.

New, smaller, upgraded turbine engine has been designed for installation and testing

Program Status

Two contracts to develop an advanced gas turbine are expected to be signed by the end of CY 1979. One contract for Stirling engine development has been underway since March 1978. Development work on earlier versions of automotive gas turbine engines has been underway since 1976 under Federal funding.

Funding (\$ In millions)	Prior	FY1981	Total
Research and development	60.5	55.9	305

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) Crysler Corporation and Williams Research.

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

Stirling engine has been installed in a compact American car.

Gas turbine engine installed in a Demonstration Bus in Active Revenue Service.

Electric and Hybrid Vehicle Development Program

Goal

The goal of the program is to accelerate the expeditious introduction of electric and hybrid vehicles into the Nation's transportation fleet to reduce petroleum consumption and dependence on foreign petroleum sources.

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 four major elements: research and development; incentives; demonstration and product engineering. 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.

Intracity deliveries by public works department are perfect assignments for electric vehicles. The missions are short-range at moderate speeds, loads are generally light and the end-of-day destination is predictable so that batteries can be recharged at night.

Program Status

Demonstration: The Law requires demonstration of up to 10,000 vehicles by 1986 in the joint government/private sector venture. In FY 1978 with 200 vehicles, and in FY 1979 with 572 vehicles the DOE Demonstration effort established 11 private sector, 12 Federal, 10 state and local government and 12 university demonstration sites on a cost-sharing basis.

Incentives: Thirteen vehicle and/or component manufacturers, seeking guaranties for loans totaling \$21 million, have submitted project summaries. Six manufacturers have filed formal applications totaling \$13 million. Twenty-seven planning grants were awarded to small business firms to prepare research, development, and demonstration proposals.

Research and Development: Research and development is being conducted in the areas of total vehicle systems, subsystem technology, and in energy storage technology. The first two experimental electric test vehicles were completed and are undergoing track and dynamometer testing. Phase I of the hybrid vehicle project, consisting of mission analyses, design trade-off studies and development of preliminary designs has been completed by the four contractors. Proof of principle testing was completed on several improved propulsion subsystems and components.

Product Engineering: These activities are intended to accelerate the incorporation of new technology into practical use. Activities encompass product evaluation, state-of-the-art assessment, development of performance standards, vehicle testing and upgrading, and the commercialization of near-term technology. The overall emphasis in vehicle and battery work is on improvements which can reach the marketplace by the mid-80's.

Funding (\$ In millions)	Prior	FY1981
Resources	41.0	42.1

These four electric vehicle models have been selected for the 60 vehicle fleet being used by Long Island Lighting Company as part of the DOE Electric and Hybrid Vehicle Market Demonstration Project.

Contractors

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

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. 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 busbar 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.

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 will open in mid-1980.

Funding (\$ in millions)	Prior	FY1981	To complete	Total
Construction	108	10	0	118
Other project related costs	29.5	1.2	1.2	31.9
Operating	0	0	14.5	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.

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

Concept for 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 system 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 in-the-ocean development of equipment and components for economically competitive, inexhaustible, and renewable sources of substantial quantities of baseload electricity.

OTEC-1 Ocean Test Facility—diagram

Program Status

The tanker is presently undergoing conversion. The 1 megawatt heat exchanger has been delivered, and the facility will proceed to station and begin testing in July 1980.

Funding (\$ in millions)	Prior	FY1981	To complete	Total
Construction	33	0	0	33
Research and development	12.2	0	0	12.2
Operating	9.7	7.4	16.9	34
				<u>79.2</u>

Contractors

Global Marine Development Corporation, System integration and operations; ETEC Project Control, and Morris Guralnick Assoc., Marine System technical review. TRW is the heat exchanger development contractor.

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. knitware 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 is to be completed in early FY 1980. Construction is expected to begin in the Spring of 1980 with operation beginning in October, 1981.

Funding (\$ in millions)	Prior	FY1981	To complete	Total
Construction	5.9	5.8	0	11.7
Research and development and other costs	15.1	.6	.5	16.2
Operating	0	0	1 (2 yrs.)	<u>1</u>
				28.9

Contractors

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

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 4¢/kilowatt hour (including capital and operating and maintenance costs in 1977 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	FY1981	To complete	Total
Construction (total estimated cost)	27.2	0.1	0	27.3
Research and development	8.0	3.0	0.9	11.9
Operations & support	2.3	0.8	0.6	3.7
				42.9

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 prototype test unit of the 7 meter diameter parabolic receiver in Shenandoah, Georgia.) The field will consist of approximately 65 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 in December, 1979, to determine the smallest size that would meet program and project requirements. A competitive procurement for cost-shared construction will be issued to include, as a minimum, a community agency and the owner of the electric distribution system that serves that area. A visitor center will serve to explain the purpose and 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 operational 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.

Program Status

Systems definition studies were completed in May 1979. Preliminary design will be initiated in January 1980, and is scheduled to be completed in July 1980. A further decision on construction will be made after that date.

Funding (\$ in millions)	Prior	FY 1981	To complete	Total
Construction	3.8	3.8	TBD*	TBD
Research and development	.6	0	0	.6
Other project related costs	3.4	1.8	TBD	<u>TBD</u>
				TBD

*To be determined.

Contractors

Project Management by NASA Jet Propulsion Laboratory. System definition/conceptual design by McDonnell-Douglas, General Electric and Ford-Aerospace. Preliminary design by Ford-Aerospace.

Prototype Test Unit of 7 Meter Diameter
Parabolic Receiver, Shenandoah, Georgia

Refuse Conversion to Methane (RefCOM)

Description

RefCOM is a 50 to 100 tons per day (TPD) proof of concept facility located on a private landfill in Pompano Beach, FL. In normal operation the facility receives and landfills up to 2000 TPD of municipal waste. As part of the operation, the waste is reduced to a nominal 3 inch size and ferrous metals are removed by a magnet. A slipstream of shredded, ferrous free waste is provided to the Department of Energy facility. At this facility, the waste is further processed. Inorganics and fine particulates are removed and provision for particle size variation is provided for experimental pur-

poses. The cleaned waste is mixed with sewage sludge, water nutrients and steam in varying proportions and introduced into closed tanks. In the tanks, a complex of bacteria digest the waste to produce gas that is expected to be 60 to 70% methane and 30 to 40% carbon dioxide. The gas is useful as is or may be cleaned by various means to synthetic natural gas. The project is designed to experimentally determine the effects of temperature, particle size, hydraulic retentive time, and other parameters on the process as well as to correlate laboratory results to larger scale facilities.

Mission

RefCOM is a scale up step towards full scale commercial development of anaerobic digestion as a means to convert municipal waste to a premium fuel methane. Municipal waste is essentially inexhaustible and has the potential to produce up to 2% of our national energy needs.

Processing Building Platform for Rotary Screen in foreground Secondary Shredder on left backrow Bag House on right, Pompano Beach, Florida

Program Status

Design, construction and start up of the facility is complete. The project is in initial operational testing.

Funding (\$ In millions)	Prior	1981	To complete	Total
Design and construction	3.6	0	0	3.6
Operations	3.0	1.0	0	4.0
				<u>7.6</u>

Contractors

Waste Management Incorporated, operations; Jacobs Constructors, Inc., design and construction.

General view 2 Digesters and Process Building, Pompano Beach, Florida

Solar Heating and Cooling Demonstrations

Environmental Education Center, Basking Ridge, New Jersey

Description

This project incorporates an aesthetically and environmentally pleasing solar system into an Environmental Education Center in Basking Ridge, New Jersey, which opened January 3, 1977. Single glazed collectors are contained within the roof, covered by plastic panels. The collector array provides energy to heat the building directly and cool it through an absorption air conditioner. Hot water is stored in underground tanks to provide storage and retrieval capability for excess energy. A pond acts as a cooling sink for the 25-ton absorption air conditioner instead of a standard cooling tower. The system is fully instrumented to evaluate performance. An instrumentation console provides for data display and recording and a display panel graphically illustrates system operation. This equipment is part of an overall energy conservation display available to visitors to the Environmental Center as part of its educational program.

The project specifications are as follows: Owner/Builder, Somerset County Park Commission; Operation Date, October 1976; Building: Type, Auditorium/classrooms/office; Area, 18,000 sq. ft. (total); 18,000 sq. ft. (heat); 9,500 sq. ft. (cool); Location, Basking Ridge, New Jersey; Latitude, 40.8°N; Climatic Data: Degree Days, Heating—4,897, Cooling—1,021; Avg. Temp. (°F), Winter—51.6, Summer—72.5; Avg. Insol. (Ly/d), Winter—300, Summer—466.

The solar energy system specifications are as follows: Application, Heating 50-60%, Cooling 70-75%; Hot Water 100%; Collector: Type, Liquid flat-plate; Area (sq. ft.), 3,105; Manufacturer, General Electric Company; Storage: Type, Steel water tank (underground); Capacity, 6,000 gallons; Auxiliary System Type: Oil fired boiler, electric.

Mission

To demonstrate the feasibility of solar energy systems.

Program Status

Project is operational. All contractual obligations with the Department of Energy have been completed.

Funding (\$ in millions)	Prior	FY1981	To complete	Total
Design, fabrication and installation	.7	0	0	.7

Contractor

Somerset County Park Commission.

Environmental Education Center,
Basking Ridge, New Jersey

City of Albuquerque Animal Control Center

Description

This is a new building located on the grounds of the City of Albuquerque Animal Control Center. The building will provide office space and additional kennels for the Center. There are approximately 4,980 sq. ft. of office and nonkennel area and 1,540 sq. ft. of new kennel area. A passive heating system for the kennels and an active system (5:1 concentrating collectors with azimuth tracking and hydronic distribution system) for the nonkennel area are proposed. The selected construction site allows the building to take maximum advantage of a southern exposure, which is necessary for "sun-tempering" the kennels and correct orientation for the active solar collector banks.

The project specifications are as follows: Owner/Builder, City of Albuquerque (Animal Control Center); Operational Date, March, 1978; Total Estimated DOE Funds, \$39,250; Building: Type, Office/kennel; Area, 6,520 sq. ft.; Location, Albuquerque, New Mexico; Latitude, 35.05°N; Climatic Data: Degree Days, Heating—4350, Cooling—1300; Avg. Temp. (°F), Winter—47.5, Summer—89.5; Avg. Insol. (Ly/d), Winter—275, Summer—700.

The solar energy system specifications are as follows: Application, Heating 64%, Cooling 0%, Hot Water 95%; Collector: Type, Tracking, concentrating, parabolic (active/passive); Area (sq. ft.), 1,469 (active)/1,500 (passive); Manufacturer, Albuquerque Western Solar Industries, Inc.; Storage: Type, Insulated steel water tank (underground); Capacity, 2,000 gallons; Auxiliary System Type, Natural gas fired boiler.

Mission

To demonstrate the feasibility of solar energy systems.

Program Status

Project is operational and instrumentation equipment is currently being installed for data collection.

Funding (\$ in millions)	Prior	FY1981	To complete	Total
Design and installation	.04	0	0	.04

Contractor

Burns/Peters, Architects

Addition to the Albuquerque Animal Control Center
Albuquerque, New Mexico

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 500 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 shipping 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, 1979 seven of the nine design teams were under contract to install their system designs. Negotiations are continuing for remaining two design teams and contracts expected by end of CY 1979. Initial operating capability of these systems expected in the January-June, 1981 timeframe. The systems will be operated and evaluated, under DOE sponsorship, for a 2-year period.

Funding (\$ in millions)	Prior	FY1981	To complete	Total
Hardware installation	19.8	1.7	0	21.5
Design	8.4	0	0	8.4
Operating	0	2.3	3.0	5.3
				<u>35.2</u>

Contractors

Acurex Corp. (Kauai, HI Hospital); Arizona Public Service (Phoenix, AZ Airport); BDM Corp. (Albuquerque, MN 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

Solvent-Refined-Coal Demonstration Plant

Description

Two projects are currently underway to design, construct and operate full-size modules of future commercial plants that would demonstrate the Solvent-Refined-Coal (SRC) process for converting coal into synthetic fuels. In one effort, a joint venture of The Southern Company, Wheelabrator-Frye, and Air Products & Chemicals is concentrating on a variation of the SRC process (SRC-I) that produces clean-burning solid and potentially liquid fuels. The plant would be located near Newman, Kentucky. A concurrent effort is underway with a subsidiary of the Gulf Oil Corporation to design a plant based on an SRC variation (SRC-II) that produces primarily a liquid fuel. The Gulf plant would be located near Morgantown, West Virginia.

SRC Demonstration Plant Parameters

Each plant: Coal feed, 6,000 tons/day; Fuel production, oil equivalent, SRC-I, 22,000 barrels/day and SRC-II 20,000 barrels/day.

Mission

The demonstration plant projects 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 for each variation of the SRC process, 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.

Artist's Conception: SRC-II Demonstration Plant, Morgantown, WV

Program Status

Both contractors completed the first phase preliminary engineering, environmental and economic analyses of the demonstration plants in July, 1979. On September 13, 1979, DOE announced that both contractors had been authorized to proceed with the detailed designs leading to construction beginning in CY 1980 and operation in late 1984 or early 1985.

Funding (\$ in millions)	Prior	FY1981	Total
SRC-I			
Construction	80	175*	1,232
Operating	20	5*	184
SRC-II			
Construction	90	190	1,115
Operating	27	5	218

*Preliminary estimate. Cost sharing negotiations underway.

Artist's Conception: SRC-I, Newman, KY

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

H-Coal Pilot Plant under
Construction at Catlettsburg, KY

Program Status

By the end of FY 1979, construction was complete on two sections of the pilot plant (coal preparation, utilities), and overall the plant was over 90 percent complete. In FY 1980, construction will be completed and start-up will begin.

Funding (\$ in millions)	Prior	FY 1981	Total
DOE	193.9	57	258.1
Non-DOE	27.6	1.8	38.0

*Additional private funding is being solicited.

Contractors

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

H-Coal Liquefaction Pilot Plant
under Construction, Catlettsburg, KY

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, 695 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.

Artist's Conception: Exxon Donor Solvent Pilot Plant.

Program Status

Construction of the pilot plant was over 90 percent complete by the end of FY 1979. In FY 1980, construction will be completed and operations will begin.

Contractor

Exxon Research & Engineering Co.

Funding (\$ in millions)	Prior	FY1981	Total
DOE	103.8	32.0	151.0
Non-DOE	103.8	32.0	151.0

EXXON Donor Solvent Pilot Plant during Construction, Baytown, Texas

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, 2,220 tons/day; Production, 18 million cubic ft/day pipeline gas; 2,200 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 1980. Construction of the selected project would begin in FY 1981.

Funding (\$ in millions)	Prior	FY 1981	Total*
Construction	95	55	TBD**
Operating	48	1	TBD**

*Cost-sharing between DOE and industrial partner to be determined.

**To be determined.

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 component subsystem design; (2) provide the necessary design data base for the next generation of test facilities; and (3) obtain experience in the operation of large MHD power plants. 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.

Artist's conception of MHD Facility, Butte, Montana

Program Status

By the end of FY 1979, physical construction of the CDIF was about 75 percent complete, and both the initial combustor and channel had been delivered to the Butte, Montana site. Initial combustor testing will begin in the 4th Quarter of FY 1980.

Funding (\$ in millions)	Prior	FY1981	Total
Total Construction of the CDIF (thru 1985)			37
Total project costs thru FY 1985 (design, construction, operating expenses, component development)	69.8	17.2	300

Contractors

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

MHD Facility Rear View, Butte, Montana

Occidental Oil Shale Project

Description

One of three major projects in DOE's program to develop the "in situ", or underground, process for extracting oil from shale, the Occidental Oil Shale project is underway at the firm's Logan Wash site in Garfield County, Colorado. In Occidental's modified in situ process, about 20 percent of the shale is mined to form an underground chamber. Surrounding shale is broken up and expanded by explosives to create a zone of rubble shale. Combustion is begun at the top of the zone and the heat converts the organic matter in shale to oil. This technique is believed to offer promise for early development and is especially attractive for deeper and very thick deposits of oil shale. Occidental Oil is proceeding to install a commercial size in-situ facility on a Federally leased track in Colorado.

Occidental Project Parameters

Retort #6 dimensions, 160' x 160' x 270' deep; Production 47,000 barrels.

Mission

The Occidental project is a step towards full commercial application of the modified in situ technology. The technique being developed holds potential for extracting large quantities of oil from the shales of Colorado, Wyoming and Utah in a way that reduces environmental disruption caused by large-scale mining operations and disposal of large amounts of spent shale.

Occidental Oil Shale Facility under Construction in Garfield County, Colorado

Program Status

Some 47,000 barrels of oil have been produced from retort #6, the most successful of the initial phase of Occidental's project. Approximate recovery rate is estimated to be 40 percent of the oil in place. This compares to a calculated production of 21 percent and to the recovery of about 10 percent of the oil in place from retort #5. DOE and Occidental are now moving into Phase II of the project which will involve a two-retort test of the process.

Funding (\$ in millions)	Prior	FY1981	Total
DOE	29.8	7.0*	45.0
Non-DOE	17.1	*	30.0

*The project funding is part of the Oil Shale program budget under negotiation with OMB

Contractor

Occidental Oil Shale, Inc.

Occidental Oil Shale Process Retort Operation

Georgetown University Atmospheric Fluidized Bed

Description

The atmospheric (pressure) fluidized bed steam plant, on the campus of Georgetown University, Washington, D.C., is one of the most advanced systems for burning coal cleanly to be used in actual commercial applications in the U.S. The system removes sulfur from coal in the boiler by bringing it into contact with limestone during the combustion process. This eliminates the need for expensive "scrubbers" or for tall stacks. The unit also burns at sufficiently low temperatures to minimize production of nitrogen oxides, another major pollutant. The Georgetown University system, the largest and first to operate of several industrial fluidized bed projects begun by the Federal government in 1975, will produce steam to heat and cool campus buildings.

Georgetown AFB Parameters

Coal feed, 5 tons/hour; Steam production, 100,000 pounds/hour.

Mission

The Georgetown University fluidized bed steam plant will provide information on performance, cost and reliability by private industry before the technology can be commercialized in the early 1980s for medium size industrial units and in the late 1980s for large size industrial and utility units.

Atmospheric Fluidized Bed Boiler,
Washington, D.C.

Program Status

Following the signing of a contract with Georgetown University on June 30, 1976, site work began in October, 1977. The boiler was first lit on July 9, 1979. The unit was officially dedicated on November 15, 1979, at which time it had accumulated over 600 hours of operating time. Preliminary information has indicated the system will meet both local and Federal environmental regulations on sulfur, nitrogen oxides and particulate emissions.

Contractors

Georgetown University (prime contractor); Pope, Evans & Robbins (system design, construction management); Foster-Wheeler Energy Corp. (boiler fabrication and installation).

Funding (\$ in millions)	Prior	FY1981	Total
DOE	11.0	0.5	11.5
Non DOE	5.0	0	5.0

Georgetown Atmospheric Fluidized Bed Facility, Washington, D.C.

Mirror Fusion Test Facility

Description

The Mirror Fusion Test Facility (MFTF) is being constructed at the Lawrence Livermore Laboratory in Livermore, California. This project provides for construction of a magnetic fusion facility, including a magnetic mirror research device, power supplies, cooling systems and requisite office and experimental areas. The research device will consist of the following main components: fusion chamber, magnetic mirror, 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

Center field, 2 Tesla; Mirror length, 3.6 meters; Fusion chamber length, 18 meters; Fusion chamber diameter, 10.5 meters; Sustaining neutral beams: power injected, 60 megawatts; energy, 80 thousand electron volts; pulse length, 0.5 seconds.

Mission

MFTF will be the largest experimental facility in the world capable of investigating the mirror fusion concept. Its principal objectives are: (1) To reach plasma confinement conditions near those predicted by classical theory; (2) to explore plasma confinement scaling in a plasma having confinement values an order 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.

Mirror Fusion Test Facility and Associated Systems, Lawrence Livermore Laboratory, Livermore, California

Program Status

The engineering design for MFTF has been completed and contracts for conventional and high technology hardware have been placed. Fabrication of this hardware will proceed through FY 1980 and FY 1981. Assembly and installation will be completed by the end of FY 1981, at which time the project will be completed.

Funding (\$ In millions)	Prior	FY1981	Total
Design and construction	82	7	94
Other project costs	26	22	48

Contractors

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

Experimental Shielded Area being rearranged to House Mirror Fusion Test Facility.

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 inside 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 1980 and 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	FY1981	To complete	Total
Design and construction (approp.) •	244*	30	10	284
Other project costs	101	27	30	158
				<u>442</u>

*Includes \$5 million reprogramming request in FY 1980.

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 accelerator 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 is scheduled to start in early CY 1980.

Funding (\$ in millions)	Prior	FY1981	To complete	Total
Design and construction	25	23	57	105
Other project costs	22	8	33	63
				<u>168</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.

THE FMIT WILL USE A LINEAR ACCELERATOR TO PRODUCE A BEAM OF DEUTERIUM IONS WHICH WILL IMPINGE ON A FLOWING LITHIUM TARGET LOCATED IN THE IRRADIATION TEST CELL. THE DEUTERON-LITHIUM STRIPPING REACTION WILL PRODUCE NEUTRONS FOR IRRADIATING MATERIAL TEST SPECIMENS.

HEDL 7808-019.23

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

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 postirradiation 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 167,000 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 Department of Energy manuals.

Mission

The mission of the FMEF is to provide for postirradiation 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 fuel.

Fuels and Materials Examination Facility (FMEF) Construction Site as of 10/25/79

Program Status

Title II engineering design for the FMEF is 90% complete. The scheduled completion date for engineering design is March 1980. Site preparation and excavation have been completed. Concrete placement for the subgrade level is under contract and was begun in September 1979. Long lead procurement of electrical equipment for the substation is complete and major equipment is on site. The contract for embedments and liners for the subgrade levels was awarded in May 1979. Contract placements for construction and equipment will continue through FY 1983. Construction will be completed in December 1983.

Funding (\$ In millions)	Prior	FY1981	To complete	Total
Design and construction	83.2	52.0	34.8	170.0
Other project costs	36.7	10.9	27.6	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 (FMEF) Cutaway View

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-air 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 inclosed 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 Loops, 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 system and component design, (b) component fabrication, (c) prototype testing, and (d) site construction.

View of Inside of Reactors Containment Building Showing Fuel and Closed Loop Handling Machine, Richland, Washington.

Program Status

Construction activities and preoperational checkout and testing are essentially completed. Initial fuel loading started in late November 1979, with initial criticality projected for late January or early February 1980. Other activities scheduled for FY 1980 include: (a) completion of the acceptance testing, (b) power demonstration, (c) initiation of the fuels and materials irradiation program including hardware procurement, test article assembly and engineering and safety analysis, and (d) procurement of cores 3 and 4 and essential spare parts.

Funding (\$ In millions)	Prior	FY1981	To complete	Total
Design and construction (approp.)	540	0	0	540
Other project costs	100	0	7	107
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,
Richland, Washington

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 electric power plants. The plant site and gas centrifuge process were selected by President Carter, and are 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 1987 with 2.2 million SWU/year capacity completed by 1988. Additional production capacity will be added as demand for enrichment services indicate the need. For planning purposes, full production is scheduled for 1993. 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 Carter Administration 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—element of the Carter Administration policy. 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 Plant,
Portsmouth, Ohio

Program Status

The new gas centrifuge enrichment plant project is progressing on schedule, with nine (9) architect engineering firms working. Four (4) construction contracts have been completed and eleven (11) others are underway including the site rough grading which is 40% complete. Eighteen (18) off site test and demonstration facilities are being designed or constructed. 2,500 people are employed in design and construction of the plant.

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

Funding (\$ In millions)	Prior	FY1981	To complete	Total
Design and construction	803	319	4,678	5,800
Other project costs	22	1	1,120	1,143
				<u>6,943</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; KZF, Incorporated; Dalton, Dalton, and Newport, Incorporated; Howard Needles, Tammer and Berghoff.

Gas Centrifuge Enrichment Process

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 FY 1982.

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

Centrifuge Plant, Demonstration Facility
at Oak Ridge, Tennessee.

Program Status

The centrifuge plant demonstration facility is under construction and is approximately 30% complete. The building shell is complete and utilities and services are being installed. A letter contract has been signed with three manufacturers to provide the centrifuge machines, with the first delivery expected in FY 1981.

Funding (\$ in millions)	Prior	FY1981	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.

Interior of Centrifuge Plant
Demonstration Facility under construc-
tion at Oak Ridge, Tennessee.

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 produc-

tion from the development drilling program. The projects include 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.

Contractors

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

Funding (\$ in millions)	Prior	FY1981	To complete	Total
Design and construction (approp.)	282	6	43	331

This is one of the gas processing plants used to separate the natural gas that is pumped from the oil well into component gases (i.e., propane, butane) for sale and reinjection into the underground oil reserve to maintain reserve pressure.

50 Megawatt (MWe) Geothermal 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 electric (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.

Geothermal Demonstration Power Plant,
Sandoval County, New Mexico

Program 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 is being prepared and plant design has begun.

Funding (\$ in millions)	Prior	FY1981	To complete	Total
Design and construction	39.43	10.91	3.88	54.22
Research and development related to construction	0	0	0	0
Facility operations	0	0	6.81	6.81
Direct project support costs	.57	1.14	7.26	8.97
Total DOE funds	40.00	12.05	17.95	70.00

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.

Index Map of the Valles Caldera

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 DOE 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.

Program Status

Five sites and one marine terminal under development have a combined underground storage capacity of 244 million barrels. These sites are:

Storage site	Location	Storage capacity (million barrels)
Bryan Mound	Brazoria County, Texas	60
West Hackberry	Cameron Parish, La.	51
Bayou Choctaw	Iberville Parish, La.	36
Weeks Island	Iberia Parish, La.	75
Sulphur Mines	Calcasieu Parish, La.	22
		<u>244</u>
Tanks and Pipelines		4
	Total	<u>248</u>

The marine terminal in St. James Parish, Louisiana, consists of 2 million barrels of above-ground storage and two tanker docks for dishcarging and loading of crude oil. There are plans to expand three of the existing sites for 290 million barrels. Development plans for the remaining storage capacity are not final.

Funding for 750 Million Barrel Reserve (Dollars in Millions)

General Fund (725.7 million barrels in underground storage facilities)	Prior	FY1981	To complete	Total
Program direction	31	10	57	98
Planning	48	10	30	88
Facilities	1,396	83	1,236	2,715
Oil acquisition	5,478	0	23,109	28,587
Total general fund	6,953	103	24,432	31,488
Energy security trust fund (24.3 million barrels in regional storage facilities)*	9	13	344	366
Total general fund and energy security trust fund	6,962	116	24,776	31,854

*Contingent upon enactment of the Windfall Profits Tax.

Unloading dock under construction at St. James Terminal, LA

Contractors

Parsons-Gilbane, Construction Manager; Dravo Utility Constructions, Inc., Operations and Maintenance; The Aerospace Corporation, Systems Engineering; OAO Corporation, Support Services.

West Hackberry—Sunoco Pipeline 42 inch diameter pipeline

5 Megawatt (MWe) Raft River Pilot Plant

Description

The 5 megawatt (MWe) Raft River Pilot Plant project, near the town of Maita in Cassia County, Idaho, will consist of the designing, building, testing and operating a geothermal binary power plant to convert the heat content of moderate temperature hydrothermal geothermal reservoirs into electric power. The project will also include associated reservoir testing and development. The plant will collect

statistically reliable engineering and cost data on reservoir performance and plant construction, operation and maintenance for 3 years to determine and demonstrate predictable, technical, economic, and environmental performance with acceptable risk on a pilot scale.

Mission

Pilot Plant Operation is a key phase in the commercialization of the technology to exploit known geothermal resources. The plan for commercialization is based on the premise that developers, utilities, and the financial community will not make large-scale commitments to unfamiliar technologies until confidence is gained from development of these technologies. The principal goal of this project is to determine and demonstrate the economic, environmental, and technical feasibility of the production of electric power from a moderate temperature (approx. 300°F) hydrothermal resource.

Raft River Geothermal Loop Experimental
Facility, Idaho Falls, ID

Program Status

Construction began in the fourth quarter of FY 1978 and is scheduled for completion in the third quarter FY 1980 (June 1980). Qualification testing is scheduled for completion in the first quarter of FY 1981 (October 1980). The fluid supply system development and testing are scheduled for completion in the third quarter of FY 1980 (June 1980). Facility operation is scheduled for the first quarter of FY 1981 (October 1980). Operation will be completed by the end of FY 1983 (September 1983).

Funding (\$ In millions)	Prior	FY1981	To complete	Total
Design and construction	23.63	.04	0	23.67
R&D related to construction	.91	.05	0	0.96
Facility operations	3.04	1.56	3.13	7.73
Direct project support costs	3.05	.81	1.20	5.06
Total Operating Funds	30.63	2.46	4.33	37.42
Capital Equipment Funds	.55	0	0	.55
Total				37.97

Contractors

EG&G, Inc., a prime contractor to DOE/Idaho, will provide all administrative and technical management for the construction contract assigned to them by DOE/Idaho, as well as for EG&G subcontracts for project-related procurements and construction. Mitchell Construction Company is under contract for the facility construction. Elliott Company is supplying the turbine.

Raft River Fluid Supply and Injection System

Small Hydroelectric Demonstration Projects

Description

Small-scale hydroelectric power demonstration projects were under way at eight sites throughout the U.S. as part of the DOE small-scale hydropower demonstration program by the end of fiscal year 1979. In the first quarter of fiscal year 1980, 15 more projects were selected for grants. Additional power capacity at presently generating power plants,

rehabilitation of old abandoned power plants, and the addition 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 (25 Megawatt or less) hydroelectric energy sites 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.	Androscoggin 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	1	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/Caffney, 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/Colum., 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
United Water Conservation District	Santa Felicia Dam/Lake Piru, CA	3,575	*	166
City of Spokane, WA	Upriver Dam/Spokane, WA	9,000	2	33
City of Petersburg, Alaska	City Reservoir/Petersburg, Alaska	700	1	323
TOTALS		136,234		1,154
AVERAGE		5,923		50

*Number of units not identified.

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

Program Status

The eight projects underway at the beginning of fiscal year 1980 are in various stages of development from completion of final design to well along in the construction process.

The 8 projects underway, plus 15 projects selected for negotiation, are in the second phase of a two phase demonstration program. Under the first phase in 1979, DOE shared the cost of 54 studies to determine the feasibility of undertaking a small hydroelectric power project at existing dams. In the future DOE will implement a loan program for such feasibility studies and licensing costs authorized by Title IV of the Public Utility Regulatory Policies Act. It is anticipated that applications for loans will be submitted in increasing numbers. The sites which prove feasible when developed will provide a further supply of power.

Funding (\$ in millions)	Prior	FY1981	To complete	Total
DOE	16	7	5	28
Owner	44	78	38	160

Contractors

Each site owner is responsible for getting his own contractors for all aspects, including design, construction and equipment manufacture. Contractor selection for work costing over \$500,000 is subject to DOE approval. Contractors already selected include: Tubor Engineering; General Electric; James Leffel & Company; Hardison & Komatsu; Kleinschmidt & Dutting; J. E. Sirrine; Stone & Webster; Ayres, Lewis, Norris & May; F.W.E. Stapenhorst; Gilbert/Commonwealth; International Engineering Company; Voest-Alpine; Neyrpic; Hitachi; H-K Contractors; Osberger; and Allis-Chalmers.

The Turlock Irrigation District's \$2.3 million Hickman Powerhouse is one of the first small hydro projects to go online in recent years in the United States. Located on the District's Main Canal, the two generator plant will serve the needs of nearly 1,000 homes each irrigation season. Modesto, California.

SCIENCE PROJECTS

Isabelle

Description

ISABELLE (Intersecting Storage Accelerator) is a 400 GeV (billion electron-volts) x 400 GeV (billion electron-volts) 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) adja-

cent to the existing Alternating Gradient Synchrotron (AGS) accelerator 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 intersective points will be enclosed in an experimental hall in which experimental apparatus will be located to study the results of the collision.

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 a peak energy of 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 Weinberg-Salam theory which attempts to describe 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

The engineering design for conventional construction is nearing completion and construction for a portion of the tunnel began Jan. 1979. R&D and engineering design of technical components are still in progress. Magnet production is expected to begin late in FY 1980. The current schedule calls for first circulating beams early in FY 1986.

Funding (\$ In millions)	Prior	FY1981	To complete	Total
Design and construction	75	45	157	277
Other project costs	19	9	141	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. (Conventional Construction).

Artist's Conception of ISABELLE Facility.

Positron Electron Project

Description

The Positron Electron Project (PEP) was completed in 1979 at the Stanford Linear Acceleration Center (SLAC), Stanford, California. It is an underground storage ring (vacuum chamber in a magnetic guide field) of 0.44 miles diameter in which beams of positrons and electrons, at energies between 4 and 18 GeV (billion electron-volts) each, will circulate in opposite directions and interact with each other at six beam crossing points. The construction project includes the underground tunnel, four large experimental halls, the technical components needed to control the storage and inter-

actions of the particles, and a number of surface buildings to house a control room, power supplies, radio frequency klystrons, etc. The technical components include dipole and quadrupole magnets to bend and focus the beams, radio frequency accelerating cavities, an evacuated beam enclosure in which very high vacuum can be maintained, and an instrumentation and control system. The storage ring will be filled with positrons and electrons by the existing two mile long Stanford Linear Accelerator Center's linear accelerator.

Mission

The study of the basic nature of matter and energy, and the transformations between them, will be significantly advanced by the major new PEP research facility. The positron is the anti-particle to the more familiar electron, and when these two collide they often mutually annihilate into a state of pure energy, which then transforms itself into yet other fundamental particles of matter. By determining the relative frequencies with which various types of fundamental particles are created in these controlled matter-antimatter annihilations, the microstructure and basic characteristics of pure energy states and the fundamental particles of nature can be examined.

Schematic Drawing of PEP Superimposed an Aerial View of SLAC Site Switchyard Area

Program Status

The conventional construction and technical components of PEP are complete. Installation and checkout will be finished by February 1980 and the facility is expected to become fully operational a few months later, at which time a strong and highly diversified high energy physics research program will begin.

Funding (\$ in millions)	Prior	FY1981	Total
Design and construction	78	0	78
Other project cost	59	23	82
			<u>160</u>

Contractors

Lawrence Berkeley Laboratory (University of California) and Stanford Linear Accelerator Center (Stanford University); Architect Engineer and Construction Manager, Parsons, Brinkerhoff, Quade and Douglas/Kaiser Engineers; Conventional Facilities, Fred J. Early, Jr. Co. and Continental-Heller Corporation.

View of Beam Transport Components
Installed in the South Injection Tunnel
of PEP

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 Magnet (R) in Accelerator Ring Next to Normal Magnets, Batavia, Illinois

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 and the superconducting dipoles which had been under intensive development last fiscal year are now in production. Refrigeration and other technical components are on schedule. Major procurements under the construction project are proceeding.

Contractor

University Research Associates,
operating contractor.

Funding (\$ In millions)	Prior	FY 1981	Total
Design and construction	27	20	47
Other project cost	46	3	49
			96

Single Energy Saver Superconducting
Magnet

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 the existing 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 present superconducting cyclotron, which has an energy constant of 500 million 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 the 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.

Program Status

The architect and engineering contractor has been selected. Procurement of long lead-time items is proceeding.

Contractor

Commonwealth Associates,
architecture and engineering.

Funding (\$ in millions)	Prior	FY1981	To complete	Total
Design and Construction*	6	9	15	30

**Cross Sectional Schematic
Magnetic Coils and Vacuum Chamber of
the National Superconducting Cyclotron
Laboratory, Lansing, Michigan**

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

DEFENSE PROJECTS

NOVA High Energy Laser Facility

Description

The NOVA Neodymium Glass Laser and Target Irradiation Facility is being constructed at the Lawrence Livermore 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.

NOVA Laser Parameters

Number of beams, 10;
Wavelength, 1.053 nanometers;
Pulse length, 0.1 to 3 nano-seconds;
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—Phase I. Livermore, California

Program Status

NOVA will be built at a cost of \$136 million. Conventional facilities, including the laser building, are currently under construction and design of the laser system is nearing completion. NOVA operation will begin by the mid 1980's.

Funding (\$ In millions)	Prior	FY1981	To complete	Total
Design and construction	80	0	50	130
Other project funding	4	1	1	6
				<u>136</u>

Contractors

University of California, Lawrence Livermore 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.

Fluorinel Dissolution Process and Fuel Receiving Improvements

Description

The Idaho Chemical Processing Plant (ICPP) 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 ICPP

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 ICPP 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 Chemical Processing Plant for fuel processing and uranium recovery. The Fluorinel facility will process, through 1994, a projected 8320 kilograms of uranium with a 1979 value of approximately \$377 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 Dissolution Process and Metal-Clad Fuels Storage Facility Under Construction at the Idaho Chemical Processing Plant near Idaho Falls, Idaho.

Program Status

The engineering design for the Fluorinel facility has been completed, and construction was initiated in February 1979. As of November 1, 1979, construction was approximately 5% complete. Construction is scheduled to be completed in the first quarter of FY 1983, with commencement of operations in July 1983 for fuel storage and December 1983 for fuel dissolution.

Funding (\$ In millions)	Prior	FY1981	To complete	Total
Design and construction (approp.)	116	34	0	150
Other project costs	14	4	22	40
				190

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. T. Wallace, Independent Cost Estimator; Decision Planning Co. is the Management Systems consultant.

New Plutonium Recovery and Waste Treatment Facility, Rocky Flats, Colorado

Description

This project provides for the design and construction of a new facility that will include a plutonium recovery section, a process waste treatment section, and support facilities of approximately 303,000 gross square feet. The facility will consist of a single new building, partially above and partially below ground level. Critical areas will be hardened to resist tornadoes and dynamic earthquake loadings. The hardened section of the building will include plutonium recovery, plutonium storage, incineration and waste drum storage, filter plenums, and building utilities. The nonhardened section of the building will contain the process waste treatment section and sup-

port facilities, including offices, change rooms, and cafeteria space. All utilities will be 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 will be provided for the area. This project also includes interim upgrading of the existing plutonium recovery operations in Building 771, and decontamination and removal of potentially unsafe equipment and gloveboxes after completion of the new facilities.

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 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 pelletized 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 Department of Energy for the Department of Defense.

Aerial View of New Plutonium Recovery and Waste Treatment Facility, Rocky Flats, Colorado

Program Status

Engineering design and major procurements by the government and the construction contractor have been completed. As of October 1, 1979, the construction of the new facilities was 96 percent complete with a scheduled completion date of March 1980. After the new facilities and the operations start up have been completed, the existing plutonium operations and the new facility will be operated for one year. At that time, decontamination of the existing facilities in Building 771 will start (scheduled April 1982), and is scheduled for completion in April 1985.

Funding (\$ In millions)	Prior	FY1981	To complete	Total
Design and Construction	215	0	0	215
Other Project Costs	15	0	0	15

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.

Plutonium Process Enclosure Used to Isolate the Operators from Radioactive Materials, Rocky Flats, Colorado.

Process Cell, Fuel Loading into Dissolver

Antares (High Energy Gas Laser Facility)

Description

The Antares High Energy Gas Laser Facility is being constructed at the Los Alamos 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 six 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, 100 kilojoules; Pulse duration, 0.5 to 1 nanoseconds; Power, 100 to 200 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 efficiency, scalability to high energy, and high repetition rates required for useful applications, coupled with a well developed technology base. The objective of the Antares project is 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 Target Chamber and Vacuum System

Program Status

The building construction is essentially complete and installation of the first power amplifier module and the target vacuum chamber system is under way. The engineering design of the entire system is near completion and major components for the first power amplifier have been fabricated and delivered. Major fabrication of components will proceed through FY 1982. Assembly and installation, now beginning, will continue into FY 1983, with the final system checkout and completion scheduled for January 1984.

Funding (\$ in millions)	Prior	FY1981	To complete	Total
Design and construction	38.7	14.0	9.8	62.5*
Other project costs	8.2	4.3	9.7	22.2

*Current authorization is 54.5.

Contractors

University of California, Los Alamos 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 Power Amplifier

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 Laboratories, Albuquerque, New Mexico. A high-bay heavy laboratory building of approximately 35,000 square feet and a 13,000 square feet 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 & II

Program Status

Design for PBFA-II began in FY 1979 under plant engineering and design (PE&D) funding. It will be 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	FY1981	To complete	Total
Design and construction	2.5	5.0	31.8	39.3
Other project costs	.1	1.0	1.6	2.7

Contractors

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

PBFA-I

Sandia Laboratories

PBFA-I