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FY 1989

Annual Report on In-house Energy Management

U.S. Department of Energy
Office of Administration and Human Resource Management
Associate Director for Administration, Information,
and Facilities Management
Office of Project and Facilities Management

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Washington, DC 20585

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CHAPTER I

OVERVIEW

CHAPTER I

Overview

A. Introduction

Each Federal Executive Agency is required by the Code of Federal Regulations to submit an "Annual Report on Energy Management." During FY 1989, the Department of Energy (DOE) completed its fourth year of operation under its Ten-Year In-house Energy Management Plan for FY 1986 - FY 1995. This Annual Report will address program activities during FY 1989, summarize total program achievements, as well as evaluate progress toward the achievement of DOE efficiency and energy reduction goals as outlined in the Ten-Year Plan.

1. Background

DOE provides the framework for a comprehensive and balanced National Energy Plan through the coordination and administration of the energy functions of the Federal Government. The Department's responsibilities include:

- Long-term, high-risk research, and development of energy technology;
- Marketing of Federal power;
- Energy conservation;
- Nuclear weapons program;
- Energy regulatory programs; and
- Management of a central energy data collection and analysis program.

DOE's organizational structure and the reporting relationship with the field sites used in carrying out its mission are shown in Figures I-1 and I-2. In carrying out its mission the Department is responsible for energy management at all its field sites. These field sites include such disparate facilities as power marketing administrations, national laboratories, weapons production facilities, and nuclear reactor facilities.

Figure I-1
The Department of Energy

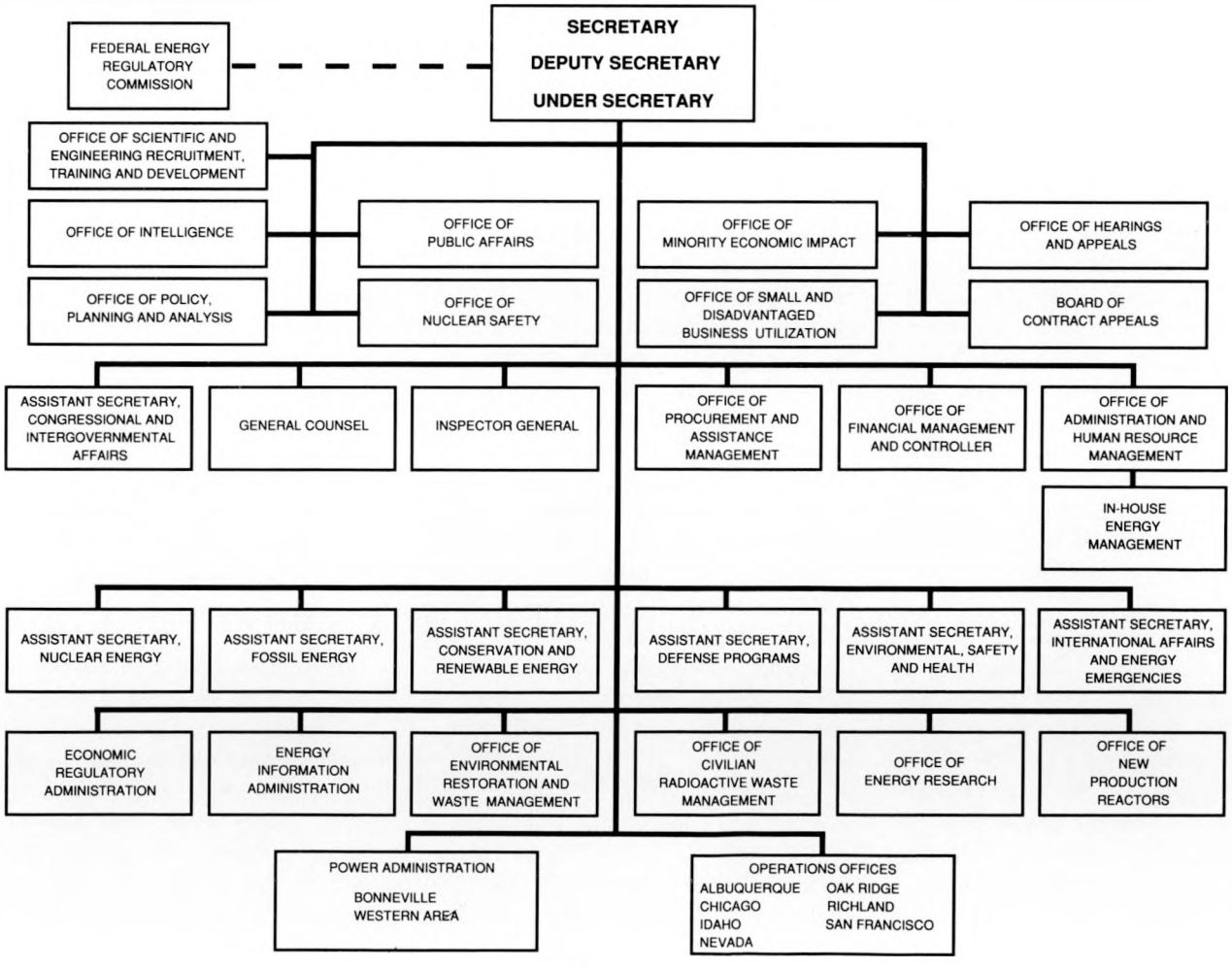
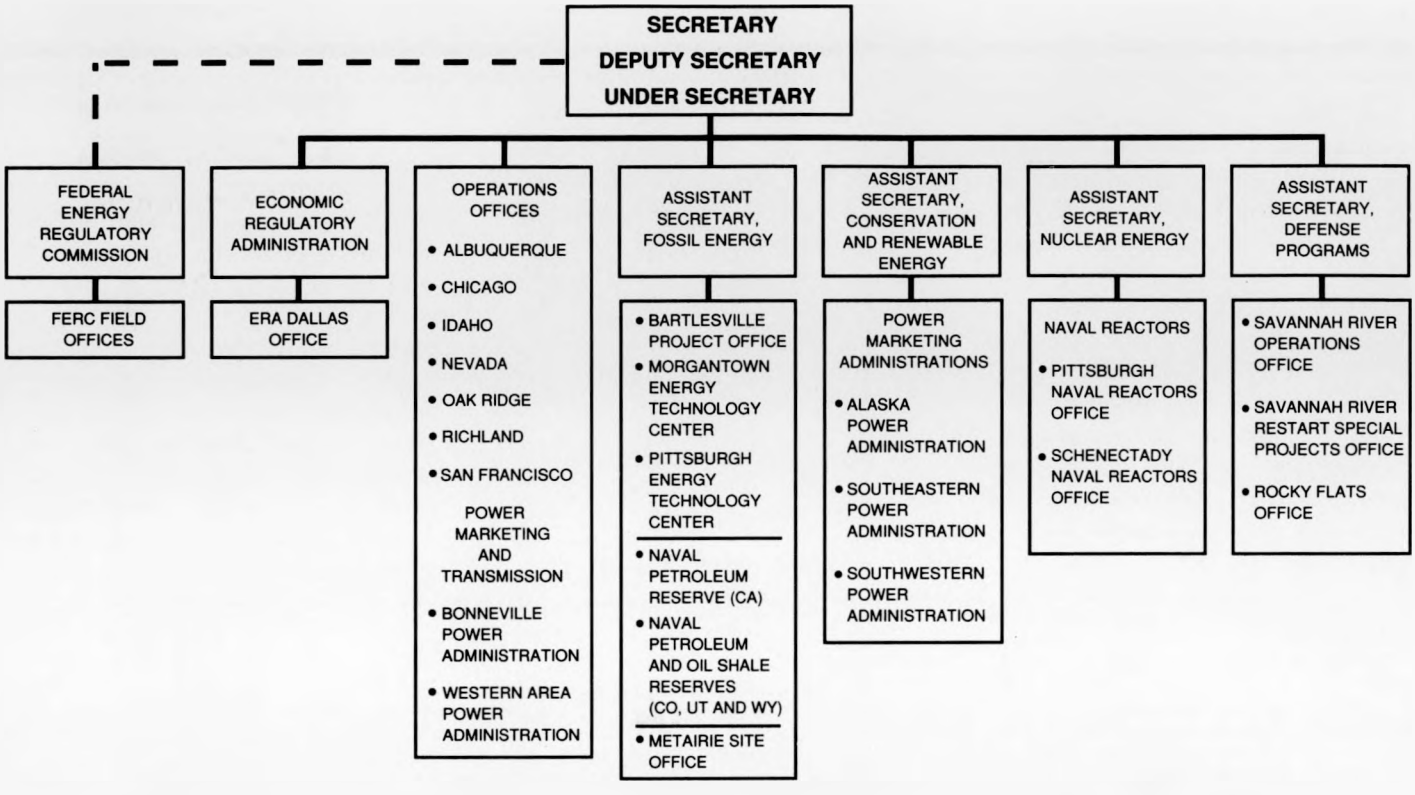


Figure I-2
Department of Energy
Field Relationships



The field comprises approximately 9,000 buildings with 93 million square feet of floor space, and 12,988 vehicles, including a fleet of 1,895 special purpose and off-road construction/maintenance vehicles and 5,817 General Services Administration assigned vehicles. The large inventory of equipment DOE operates includes forklifts, drilling rigs, mining machines, air compressors, and generators, which also must be managed in an energy efficient manner.

The Department manages, measures, and reports energy consumption in three categories. The two major categories are buildings energy and metered process energy. The third, smaller category is vehicles and equipment. The buildings category, energy consumed in DOE buildings, includes large amounts of process energy, which is not metered separately from the energy used in lighting, ventilation, and space conditioning. In fact, about 80 percent of the energy consumed in the buildings category is attributable to unmetered process energy. The metered process category is energy used in processes such as reactors, accelerators, lasers, large computers, and nuclear materials handling, which is separately metered and managed. The vehicles and equipment category includes energy used in operating DOE's fleet of vehicles and equipment. The majority of this energy is automobile gasoline and diesel fuel, but it also includes jet fuel, aviation gasoline, and propane. (Uranium enrichment activities are managed on a cost recovery basis; thus, they are excluded from this report.)

Total DOE consumption in FY 1989 was 89.8 trillion British Thermal Units at a cost of $315 million. Of this, 53.9 trillion British Thermal Units was consumed in the buildings category (60 percent), 33.3 trillion British Thermal Units in the metered process category (37 percent), and 2.7 trillion British Thermal Units in the vehicles and equipment category (3 percent). Figure I-3 shows DOE energy use in each of the three categories in the FY 1985 base-year and in FY 1989. Figure I-4 shows DOE consumption in these years by energy type.

2. In-house Energy Management Program

The purpose of the In-house Energy Management Program is to decrease the energy consumption (and, hence, energy costs) and increase energy efficiency in DOE facilities and operations. The program is managed by the In-house Energy Management Branch within the Office of Project and Facilities Management, under the Acting Associate Director for Ad-

Figure I-3
DOE Total Energy Consumption
FY 1985 & FY 1989

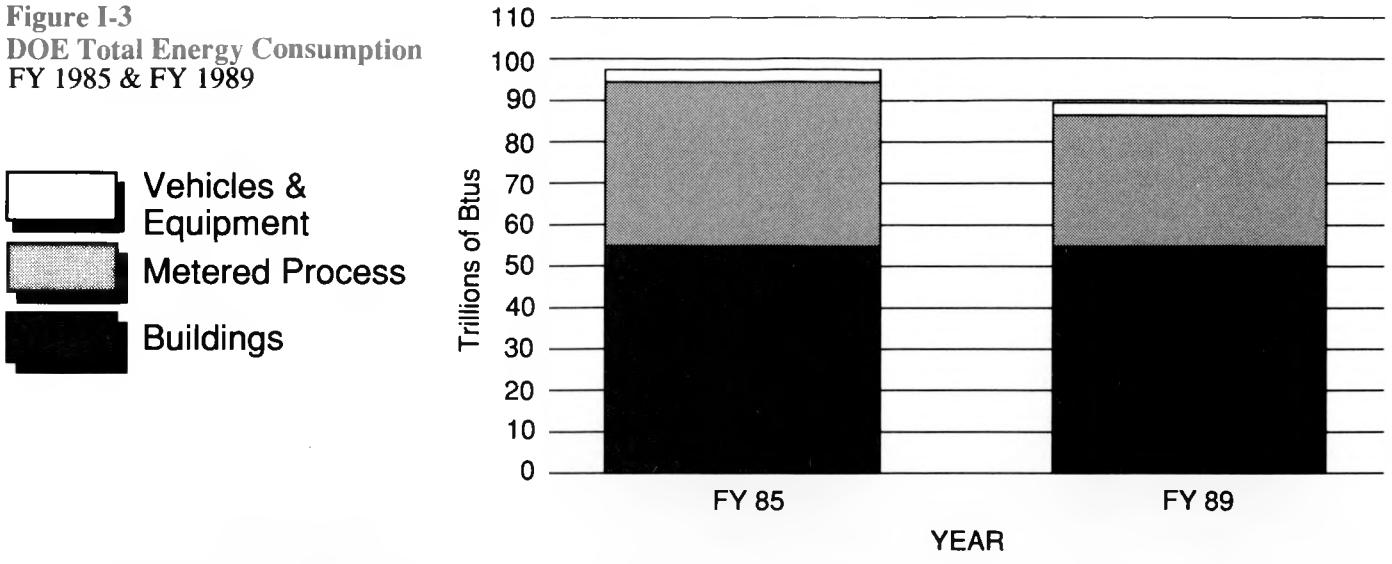
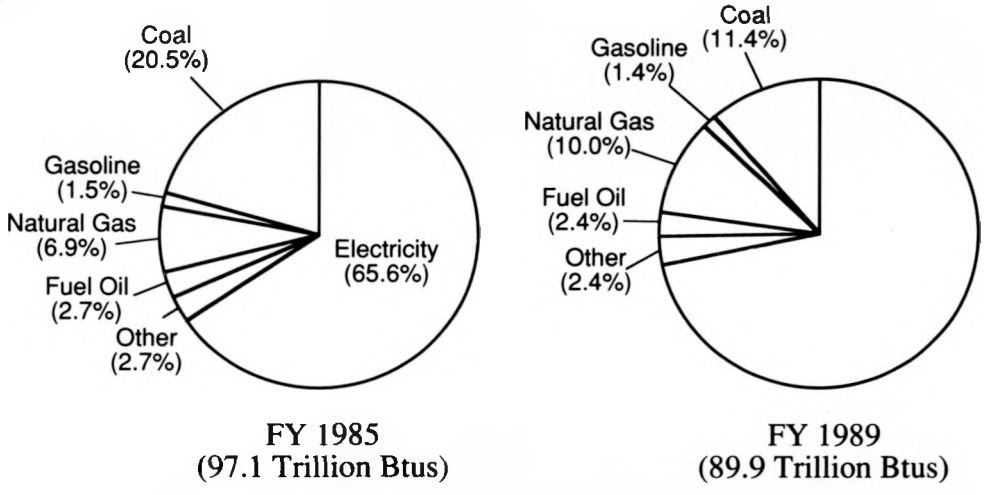


Figure I-4
DOE Total Energy Use by Type



ministration, Information and Facilities Management, and the Director of Administration and Human Resource Management.

The Department's In-house Energy Management Program is structured as program elements working in concert to achieve program goals. The program elements include:

- *Criteria Program* - The criteria program includes development, improvement, issuance and maintenance of criteria to ensure energy efficient planning, procurement, construction, operation, and maintenance of DOE facilities, and vehicles and equipment. These criteria include a DOE Order on In-house Energy Management, Energy Conservation Manuals, and a *Life-Cycle Cost Manual for the Federal Energy Management Program.*

- *Site Planning Program* - The site planning program includes activities such as: review of institutional plans and site master plans for energy management.

- *Energy Conservation Survey Program* - The energy conservation survey program includes all activities to survey and evaluate the energy efficiency of existing DOE buildings and processes, and evaluate the cost effectiveness of various actions to improve the energy efficiency of the existing facilities.

- *Retrofit Program* - The retrofit program includes all activities to retrofit existing DOE facilities to make them more energy efficient.

- *New Buildings Program* - The new buildings program includes all activities to develop and strengthen the energy efficiency of new buildings design criteria, as well as evaluate the results of new buildings design.

- *Central Plant Improvement Program* - The central plant improve-

ment program includes all activities to make existing and new central heating and cooling plants more energy efficient, including activities such as retrofit projects, boiler operator training, boiler tuneups, steam trap maintenance, Heating, Ventilating, and Air-conditioning training, and evaluation of solid waste and cogeneration of electricity alternatives.

- *Energy Conservation Awareness/Incentives Program* - The energy conservation awareness/incentives program includes activities such as employee awareness programs, beneficial suggestion programs, In-house Energy Management workshops, and evaluation of energy management in the determination of contract award fees.

- *Transportation Program* - The transportation program includes activities such as driver energy conservation awareness training, ridesharing program, alternate fuels use in vehicles and procurement of energy efficient vehicles.

- *Shared Energy Savings/Third-Party Financing Program* - The shared energy savings/third-party financing program includes activities to develop retrofits and new construction to improve the Department's energy efficiency via third-party financing contractual arrangements.

- *Utility Contract Improvement Program* - The utility contract improvement program includes review and improvement of utility contracts, interventions in utility rate cases, and innovative power procurement approaches.

- *Metering Program* - The metering program includes an effort to meter major DOE buildings and facilities in order to provide management information on major energy consumers.

- *Reporting and Program Assessment* - Includes such activities as quarterly energy consumption reporting, construction progress evaluations, contract award fee evaluations, site energy management evaluations, contract extend/compete evaluations, and the Annual Report on In-house Energy Management.

The In-house Energy Management Branch also cooperates with other programs within DOE and with other organizations in energy conservation and management efforts. For example, the branch reviews directives and *Federal Register* documents for impacts on energy efficiency; participates in the Federal-wide energy conservation efforts of the Assistant Secretary, Conservation and Renewable Energy; and participates in the Interagency Federal Energy Policy Committee.

B. Energy Conservation Goals and Objectives

The Ten-Year In-house Energy Management Plan, published in October 1985, contains the goals and objectives for FY 1986 - FY 1995, and describes the actions to achieve them. This is the second such plan; the first covered the period FY 1975 - FY 1985. The current Ten-Year Plan states as major goals:

- *Buildings Energy Consumption* - The Department's goal for buildings energy consumption is a 10 percent reduction per square foot by FY 1995, as compared to FY 1985 consumption. This is in compliance with statutory requirements of Title V, Part 3, of the National Energy Conservation Policy Act, as amended by the Federal Energy Management Improvement Act of 1988 (Public Law 100-615). Because the goal is expressed as a function of square feet, the addition of new facilities at sites should not adversely affect progress toward the goal, except when the facilities are more energy intensive than the existing physical plant.

- *Metered Process Energy Consumption* - The Department's goal for metered process energy consumption is a 10 percent reduction per square foot by FY 1995 as compared to FY 1985 consumption. Again, because the goal is expressed as a function of square feet, the addition of new facilities should not adversely affect progress toward the goal, except when the new facilities are more energy intensive than the existing plant.

- *Vehicles and Equipment* - The Department's goal for vehicles and equipment energy consumption is a 10 percent reduction by FY 1995 as compared to FY 1985 consumption.

Each DOE site has developed and implemented a comprehensive energy conservation program and a Ten-Year Plan to achieve these goals. These programs and plans closely follow those of the overall In-house Energy Management Program.

C. Accomplishments

The Department has made progress toward meeting the goals stated in the Ten-Year Plan at the end of FY 1989.

1. Energy Consumption

Under the first Ten-Year Plan FY 1976 - FY 1985 the Department reduced its energy consumption per square foot by 17.5 percent in buildings and by 5 percent in metered processes. These achievements were measured against a FY 1975 baseline. The current Ten-Year Plan, under which the In-house Energy Management Program operates, uses the FY 1985 consumption levels as the baseline against which to measure further progress.

The total energy use of DOE was 7.5 percent less in FY 1989 than in the base-year. A large portion of this reduction is attributable to shutdown of nuclear reactors at the Savannah River and Richland Operations Offices. The reduction in energy consumption was accomplished despite a 9 percent increase in total square footage. This means there was an increase in the energy efficiency of DOE facilities.

a. Buildings

DOE consumed 53.9 trillion British Thermal Units during FY 1989 in the buildings category. This is a 1.7 percent decrease over the baseline. The goal for the buildings category is measured in energy consumption per gross square foot to adjust for changes in facilities spaces. Measured against the goal, DOE reduced energy consumption per square foot in buildings by 10 percent in FY 1989. This is a significant improvement in energy efficiency.

b. Metered Processes

DOE consumed 33.2 trillion British Thermal Units in the metered process category in FY 1989. This is a decrease of 15.4 percent from the baseline. The goal for the metered process category is also measured in energy consumption per square foot to adjust for changes in facilities' spaces. Measured against the goal, DOE reduced its energy consumption per square foot in metered processes by 24 percent in FY 1989.

c. Vehicles and Equipment

DOE consumed the least energy in this category, 2.7 trillion British Thermal Units in FY 1989. This is a 7 percent decrease from the base-year. Included in this consumption is the fuel used by DOE's large inventory of specialized equipment, such as drilling rigs, and fuel used by aircraft for security surveillance and testing, as well as transportation. The reduction in the automobile gasoline alone in FY 1989 was 12.2 percent.

2. Retrofits, Surveys and Studies

In order to maximize the benefits of the retrofit and survey and studies programs, DOE manages them as central programs. Each field office submits proposed retrofits and surveys and studies. These are reviewed and prioritized by the In-house Energy Management Branch based on life-cycle-cost economic return.

Since the beginning of the retrofit program, in FY 1977 - FY 1989, 762 projects, costing $195.2 million were funded to save energy and funds in buildings and metered processes. The funded projects have a projected annual savings upon completion of 16 trillion British Thermal Units and $78.3 million. These savings represent a 2.9 year payback.

Surveys and studies are prioritized by the potential projects or other actions, which they will generate. Since the inception of the survey and study program in FY 1977, $27.9 million has been invested at all DOE sites. Some of the surveys and studies funded during FY 1989 were lighting efficiency studies, a gasoline extension and central utility plant study, and a process plant Heating, Ventilating, and Air-conditioning survey. A total of 51 studies and surveys were funded during FY 1989.

3. Employee Awareness and Ridesharing Efforts

Employee awareness is another aspect of the Department's energy management program. Efforts in this area include pertinent articles in newsletters and other employee publications, energy fairs, involvement with local schools, workshops, and employee suggestion programs. The goal of the awareness program is to sensitize employees to the energy consequences of their actions and to motivate them to use energy efficiently. The ridesharing program has two aspects. The first is the use of carpools, vanpools, and mass transit by employees for their commute to and from work; the second is their use during the workday for intrasite travel. DOE's ridesharing program incorporates both aspects, using buses and vans at sites for site-wide travel, and using zip code matching, notices in newsletters and bulletin boards for matching riders for commuting to and from work.

4. Utility Acquisition and Management

The Public Utilities Branch, Office of Project and Facilities Management, develops and administers policies and procedures for the acquisition and management of utility services for the Department's facilities and intervenes in utility regulatory proceedings representing the consumer interests of the Department. The program provides planning and management guidance for the acquisition and management of adequate, reliable, and economical utility services and provides support in rate case interventions, contract negotiations, and special technical studies. Guidance is provided in DOE Order 4540.1B, UTILITY ACQUISITION AND MANAGEMENT, and further explained in the manual *Utilities Planning and Management.*

In FY 1989, the Public Utilities Branch participated in 20 utility regulatory interventions on behalf of the Department, with an estimated impact of $16.9 million. Cost avoidance of $0.4 million was realized from 4 utility regulatory interventions closed during the year. Utility Procurement Plans and draft utility service contracts with a total value in excess of $560 million were reviewed and commented upon. Option Studies for natural gas and/or electric power with $11.7 million in annual procurement costs were also reviewed and commented upon.

The Public Utilities Branch accomplishments to provide reliable utility services economically complement the In-house Energy Manage-

ment Program accomplishments to use energy efficiently. Both programs work together to reduce the Department's utility energy costs.

5. Manuals, Guidelines, and Standards

The Department has been applying a consistent present value analysis life-cycle-cost costing methodology since 1976 as a part of the implementation of the In-house Energy Management Program. The Department currently uses the National Bureau of Standard's Handbook 135, "*Life-Cycle Cost Manual for the Federal Energy Management Program*" to provide life-cycle-cost analyses for evaluating energy conservation proposals for retrofit projects and for new building designs.

The Department has issued and continues to update the General Design Criteria for energy conservation in the design of new buildings and for modifications to existing buildings. The general design criteria were updated in FY 1977, FY 1980, FY 1981, and FY 1984. Revised general design criteria were issued in February 1988.

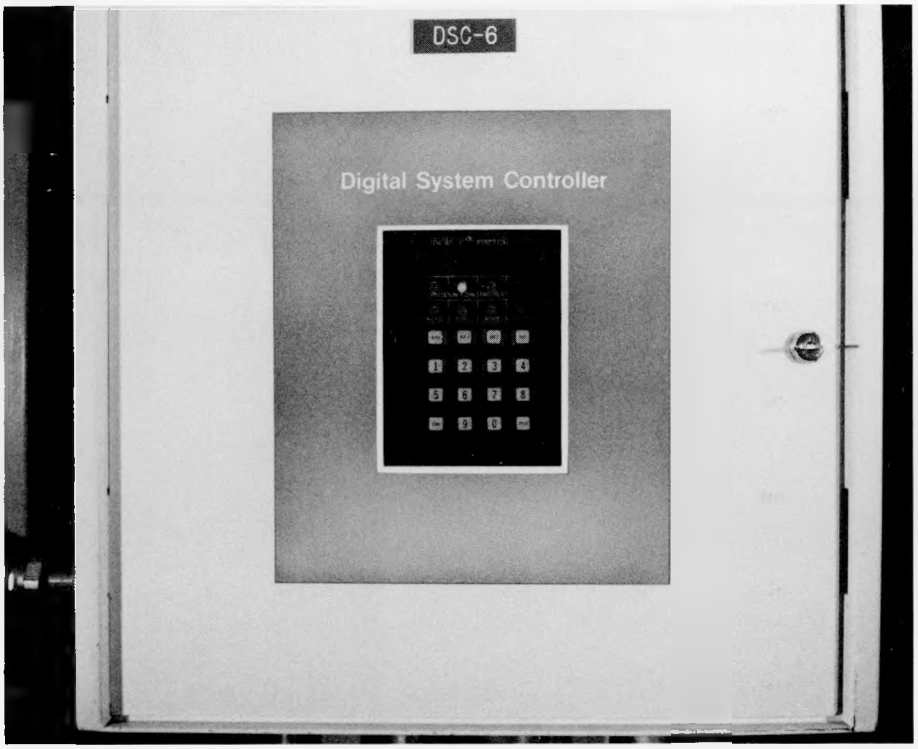
The Department developed a comprehensive site planning handbook "*Site Development Planning for Energy Management.*" This handbook discusses many diverse aspects of energy management, which should be addressed during site planning, such as human factors, landscaping, buildings, utilities, and circulation. DOE also has in force the DOE Order 4330.2C, IN-HOUSE ENERGY MANAGEMENT. This Order provides overall guidance for energy management and fuel selection/conversion for DOE facilities.

D. Reporting Systems and Information Analysis

DOE has a quarterly energy reporting system to measure the progress of the In-house Energy Management Program toward its established goals. The Quarterly Energy Conservation Performance Report measures net energy savings resulting from all program activities. The system allows managers to measure progress against the base-year at various organizational levels.

Quarterly reports on energy consumption are reviewed by managers to identify variations from previous data. The cost of energy is also collected and is used in validating field proposals for retrofit projects. The Department's energy reporting system feeds data each quarter into the Federal-wide data collection system managed by the staff of the Assistant Secretary, Conservation and Renewable Energy.

CHAPTER II
BUILDINGS PROGRAM



Shown is a Digital System Controller, for the Heating, Ventilating, and Air-conditioning System on the Administration and Engineering Building, at the Nevada Test Site. This controller will reduce the electrical consumption 388,000 kilowatthours and produce an annual cost savings of $21,384.

CHAPTER II

BUILDINGS PROGRAM

A. Introduction

Energy consumption in buildings accounts for 60 percent of the Department's annual energy usage. DOE's structures are diverse, including trailers, machine shops, and warehouses as well as highly sophisticated research facilities, weapons fabrications facilities, and nuclear reactor facilities. The age of the facilities ranges from new to over 40 years old. The average age of all DOE facilities is 28 years.

Included in the buildings' energy is all energy consumed within the structures. This means that large amounts of unmetered process energy, which cannot be separately metered is included in buildings energy. Process energy, energy used to operate large mission related production, and experimental processes, which is metered, is addressed in the Operations Program, Chapter III.

During FY 1989, DOE buildings (and the unmetered processes they house) used 53.9 trillion British Thermal Units of energy at a cost of $179.5 million. Figure II-1 presents building energy consumption and cost by fuel type during FY 1989. There are 7,717 buildings whose energy consumption is included in these figures.

Energy savings in buildings is mainly achieved through a program of retrofitting existing buildings to be more energy efficient. A smaller portion of energy savings can be attributed to changes in the operations and maintenance of buildings, conservation awareness programs, and the energy efficient design of new buildings.

B. Program Objectives

The objective of the buildings energy conservation program is to reduce energy consumption in DOE buildings by 10 percent per gross square foot by FY 1995 as compared to FY 1985. The FY 1985 baseline energy consumption was 54.6 trillion British Thermal Units in 70.5 million gross square feet of space. This equates to a baseline usage of 777,133 British Thermal Units/gross square foot. This baseline can be broken-down by various levels in the field organization to permit managers at each level to measure the progress of their organization.

Energy conservation through the Buildings Program is a significant part of DOE's overall energy management program in terms of energy saving opportunities. A summary of DOE buildings and their energy consumption is presented in Figure II-2.

C. Program Elements

Reduction in energy usage for DOE buildings includes improved operation and maintenance procedures, the identification and implementation of energy reducing retrofit projects in existing buildings based on the results of energy surveys and studies, stringent building energy design criteria to maximize efficiency of new DOE structures, and a reduction in critical fuels for central heating plants by substituting alternative energy resources.

1. Operations and Maintenance

Operations and maintenance improvements accounted for most of the energy reduction in DOE's buildings and facilities during the early years of the In-house Energy Management Program. Currently, they account for a smaller percentage of energy savings than when they were first instituted. Conservation efforts in operations and maintenance continue to focus on:

- Efficient operation of buildings
- Improved preventive maintenance
- Improved maintenance techniques for maximum energy efficiency
- Improved energy training for personnel.

Measures to improve operations and maintenance procedures have been implemented primarily through the publication and use of energy conservation guidelines, how-to manuals, training programs for operating and administrative personnel, and employee awareness programs. Efforts such as steam trap maintenance programs, energy-conscious thermostat settings, and delamping and relamping of lighting fixtures have continued to produce energy savings. Also, the installation of a number of Energy Monitoring and Control Systems at major DOE complexes have improved building operations. These systems automatically

Table II-1
DOE BUILDINGS INVENTORY

	FY 1985	FY 1989
Number of Buildings	7,419	7,717
Buildings Square Feet	68,304,800	77,161,800

Note: Does not include metered process buildings or square footage.

Figure II-1
DOE Building Energy Cost & Use
FY 1989

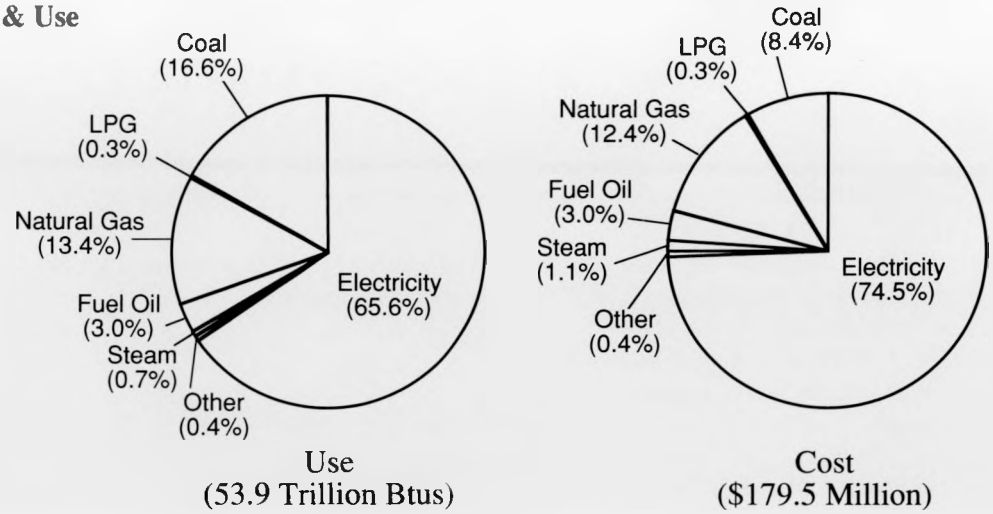
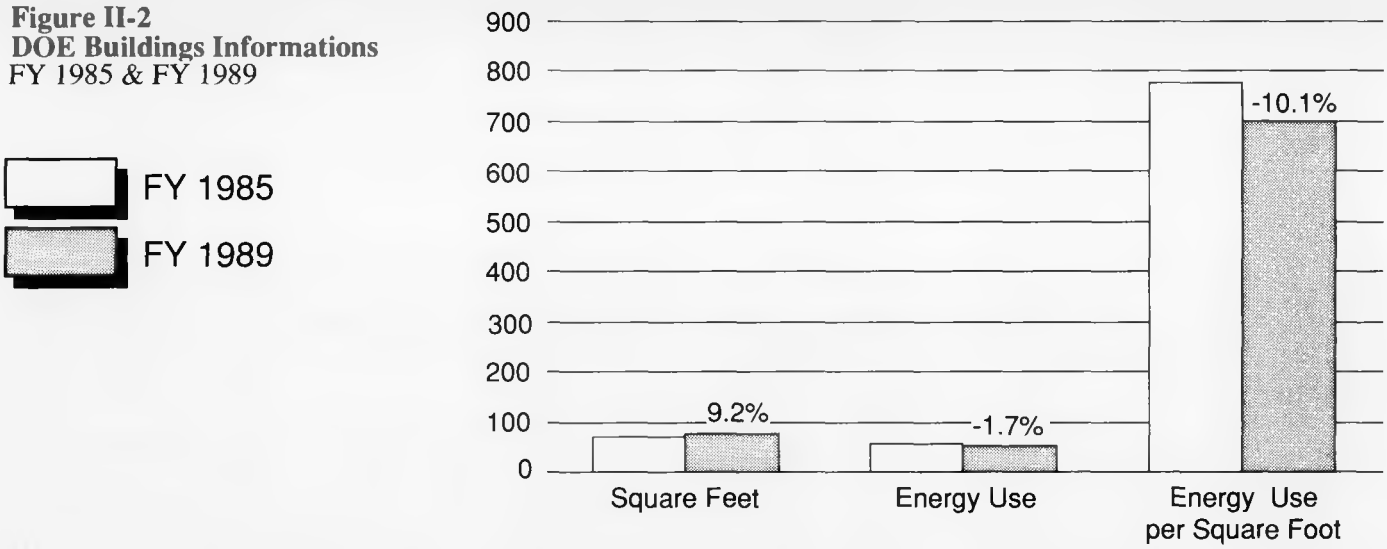


Figure II-2
DOE Buildings Informations
FY 1985 & FY 1989



monitor and control building energy use patterns.

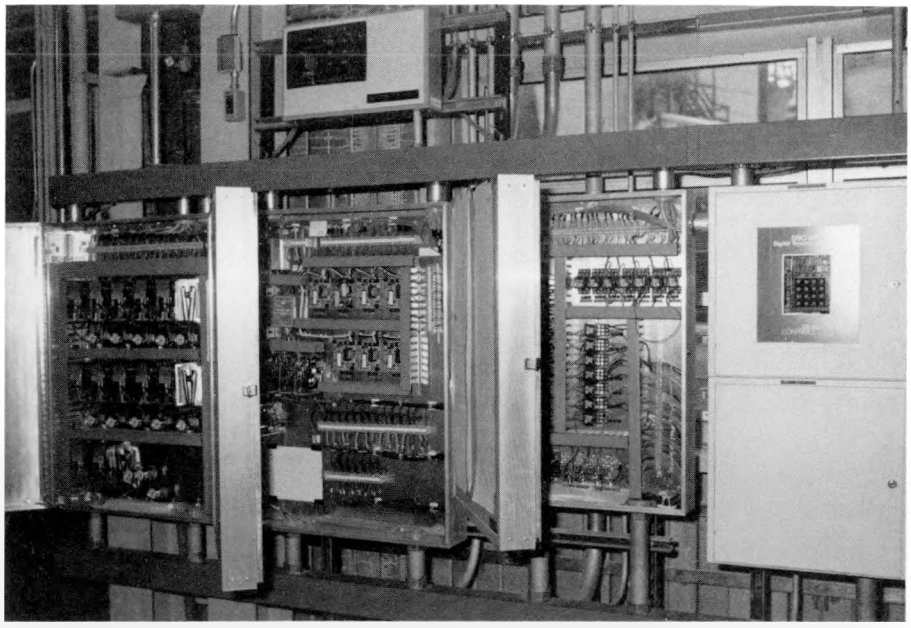
There have been various actions to improve the operations and maintenance of DOE facilities during FY 1989. These included:

Direct Digital Controls were installed in one production building at the Mound Facility. Design of a major renovation of the plant's Operational Support Facility (OS Building) was completed and construction started in late FY 1989. This project converts the building Heating, Ventilating, and Air-conditioning System to a variable air volume system and installs direct digital controls throughout the facility. Together, these projects will save $55,000 per year in energy costs.

Argonne National Laboratory-East began operating a 3,200 ton central chilled water system, which currently supplies chilled water to four major buildings (Buildings 202, 205, 212, and 223), in lieu of individual (local) chillers and cooling towers, which are over 20 years old. The implementation of the central system will reduce maintenance costs and energy consumption.

Brookhaven National Laboratory completed Phase III of the Energy Monitoring and Control System Expansion. This project proposes to install the Energy Monitoring and Control System in four buildings. As presently envisioned, the proposed Energy Monitoring and Control System will be a distributed system, using direct digital controls. A "smart" microprocessor based panel will be installed in each building. This panel will contain all required algorithms and will be capable of stand-alone operation and communication with smaller equipment room panels, which are also capable of stand-alone operation. The building panels for the four buildings will be connected via phone lines in a data highway to a "head-end" mini-computer with color graphics capability. The "head-end" computer will be the operator interface and will

Pictured is the variable frequency drive and one of the chilled water distribution pumps at the Argonne National Laboratory-East's central chilled water plant. The drive saves pumping energy as chilled water flow to the buildings is reduced with a reduction in the building cooling loads.



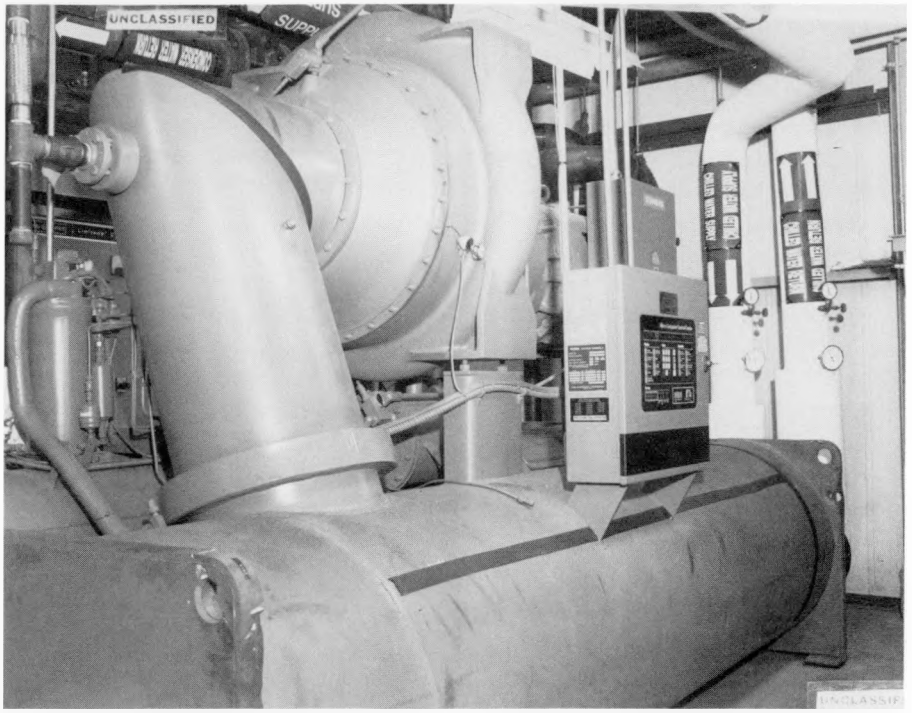
Shown is the control panel at the Argonne National Laboratory-East's central chilled water plant, containing Direct Digital Controls for optimizing the chilled water plant operation.

perform the required alarm and logging functions.

At Knolls Atomic Power Laboratory Site, Schenectady Naval Reactors, installation was completed on a new, 450 ton chiller and closed circuit cooling tower. This chiller is equipped with oversized condensers and evaporators to provide significant energy savings over conventional chillers with smaller heat exchange surfaces. The chiller replaces old, less efficient reciprocating chillers used as backups during maintenance on the "main" 425 ton chiller.

The Nevada Test Site replaced Mercury vapor lights with more energy-efficient halide lamps on twenty floodlight sets. The site also replaced seven 750 watt fixtures with 90 watt low pressure sodium fixtures and replaced six 750 watt fixtures with 55 watt low sodium fixtures.

The Portsmouth Gaseous Diffusion Plant Performance Improvement Project Team identified energy savings at the transformer, capacitor, and switchgear cooling fans. The savings would be realized when cooling fans are de-energized for certain unloaded transformers and switchgear. Maximum savings could be realized when the plant production level is below 1200 megawatts. The equivalent annual savings would be 5,138 megawatt hours. At times production increases have pushed plant production levels past the 1,200 megawatts total. Annual savings at these increased production levels would be 1,621 megawatthours.



Pictured is the new 450 ton "York" chiller unit installed in FY 1989 at Knolls Atomic Power Laboratory. This unit replaces older, less efficient reciprocating chillers which serve the Knolls Atomic Power Laboratory computer complex.

The 337 Office Building Heating, Ventilating, and Air-conditioning retrofit project at the Westinghouse Hanford Company was developed to reduce operating expenses and to conserve energy. The project consists of converting the Heating, Ventilating, and Air-conditioning System to a variable air volume system with provisions for automatic night-time temperature setback and off shift fan shutdown. Benefits include the reduction of the electrical and steam energy used to heat, air-condition, and ventilate the 337 Office Building and enhanced comfort of the building occupants during normal day shift-hours. The project is completed except for the substitution of an electrical speed controller for the mechanical speed controller that failed during testing.

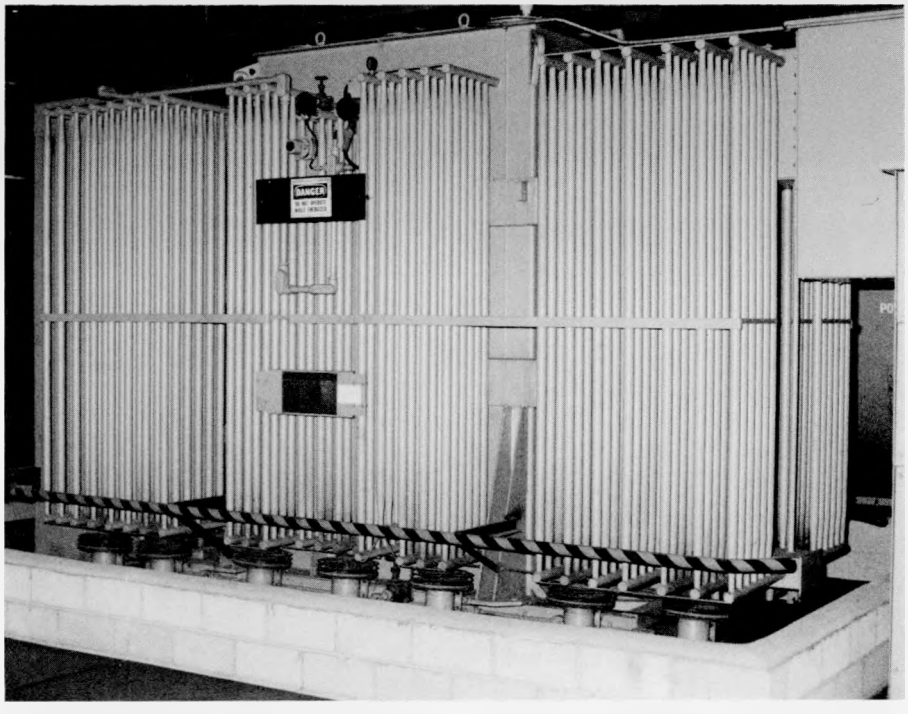
Knolls Atomic Power Laboratory identifies faulty steam traps through the use of ultrasonic detectors and replaces them as soon as possible consistent with personal safety and system operational necessities. Faulty traps are initially identified in buildings through the observation of steam emitting from building vents or from condensate receivers. The sonic detectors are then utilized to determine the exact location of the faulty traps. The locations are marked and the traps are replaced within a reasonable time span. In FY 1989 over 140 steam traps were replaced.

2. Energy Surveys

In 1977, DOE instituted a program of technical surveys to identify life-cycle-cost-effective energy conservation retrofit opportunities. Initially, preliminary energy audits were performed to determine energy consumption patterns and the potential for energy management in individual buildings. These preliminary audits were followed by indepth technical surveys to identify, analyze, and develop retrofit projects and to improve operating procedures. At first, these surveys were primarily directed at reducing buildings' energy consumption through analysis of energy saving modifications to building envelopes, lighting systems, and the Heating, Ventilating, and Air-conditioning System. Currently, survey and study efforts focus on saving energy in metered process areas as well as continuing to improve the energy efficiency of buildings. Funding of surveys at all DOE sites through FY 1989 was $27.8 million.

Some of the studies and surveys funded or completed in FY 1989 are:

- Argonne National Laboratory-East completed the central plant cogeneration feasibility study. The study determined that cogeneration is technically and environmentally feasible. The most attractive cogeneration system was determined to be a com-



Pictured are transformer, capacitor, and switchgear cooling fans at Portsmouth Gaseous Diffusion Plant. Annual savings of 5,138 megawatthours can be saved when the plant production level is below 1,200 megawatts.

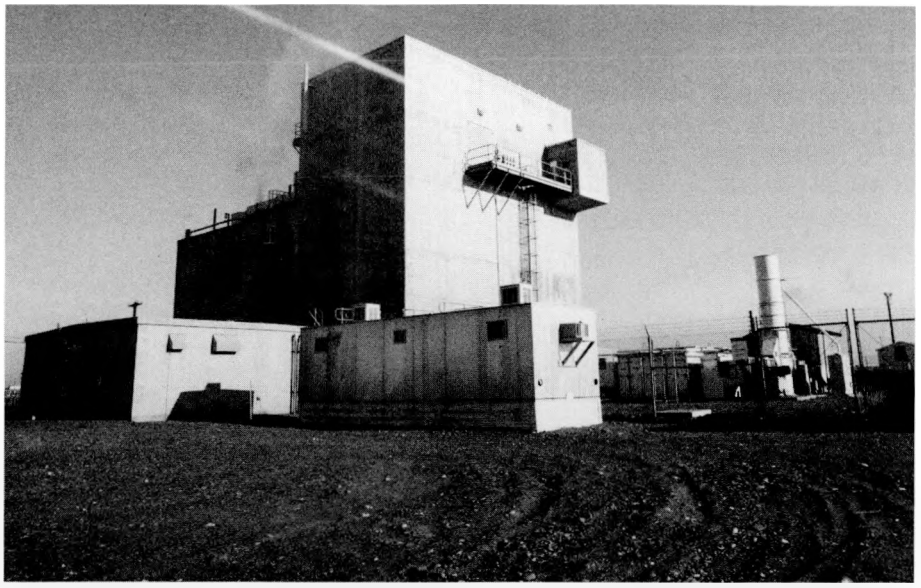
The Heating, Ventilating, and Air-conditioning Fans in the 337 Building at the Richland, Hanford Site, have been converted to a variable air volume system with provisions for automatic night-time temperature setback and off shift fan shutdown. The project, which is near completion, permits the reduction of the electrical and steam energy used to heat, air-condition, and ventilate the building.

bined cycle using a gas combustion turbine-generator as prime mover, rated at 21,800 gross kilowatt, and a condensing/extraction steam turbine-generator rated at 8,000 kilowatt, for a total capacity of 29,800 kilowatt for the combined cycle cogeneration plant. The project would be a promising candidate for line-item funding or a shared energy savings arrangement. The project was nominated for a DOE pilot test of shared energy savings.

- An important element of the FY 1989 Energy Management Program at the Fermi National Accelerator Laboratory was the completion of the engineering feasibility study for the extension of an underground natural gas pipeline and the conversion of five industrial buildings, totalling 106,700 square feet, from electric to a natural gas Heating, Ventilating, and Air-conditioning system. The study generated a FY 1991 DOE $1.1 million funding request for completion of the project.

- A lighting efficiency study was completed at the Rocky Flats Plant. The study investigated relamping the plant with more efficient forms of lighting. It was found that replacing Mercury vapor lamps with high pressure sodium lamps would payback in about 4 years. Additionally, the use of infrared motion detectors for switching lights in offices would payback at the same rate. Engineering scope and estimates for these projects are envisioned for FY 1990.

- The Idaho National Engineering Laboratory Flue Gas Heat Recovery Study investigated nineteen boilers to determine the feasibility of retrofitting them with stack gas economizers. The study considered physical condition of the boilers, availability of the appropriate economizer, boiler efficiency, steam loading, and type of energy to be saved. Economizer recommendations were then based on life-cycle-cost analysis.



A study was performed to determine the feasibility of reducing the airflow rates in the 242-S Evaporator Building at the Richland, Hanford Site. This study indicated that a savings of $27,000 per year could be achieved by reducing lighting in the zones, turning off the domestic water heaters, and turning off the steam to the turbine on the backup exhaust fan.

At the Naval Reactors Facility Site (Idaho Falls, ID), Building 631 was retrofitted with insulation. Fiberglass batting and foil faced foam board were applied to the interior of the roof and walls, with metal ribbed siding protecting the wall insulation, as shown in this picture. The insulation was installed to reduce the heat loss and is estimated to save 2.48 billion British Thermal Units annually.

- The Westinghouse Hanford Company conducted a process plant Heating, Ventilating, and Air-conditioning survey. This study examined the ventilation systems within several processes to identify both operational and retrofit activities that could reduce and/or eliminate the need for continuous-

ly processing large volumes of air. The cost of energy for moving and heating or cooling large volumes of air is significant and its reduction could generate substantial costs savings. During FY 1989, this study identified two potential retrofit projects. One of those projects could save-up to $27 thousand per year through air flow reduction to the 242-S Evaporator Building.

- At Lawrence Berkeley Laboratory, work continued in FY 1989, on the survey of building lighting, the study of process energy use at the Bevatron, the instrumented survey of five buildings, and the survey of the compressed air system. The building lighting survey was completed resulting in $3.5 million in retrofit projects with potential annual savings of over $600 thousand.

- Rockwell International, the management and operations contractor of Energy Technology Engineering Center, adopted a non-smoker occupancy policy in office areas as of March 1989. Heating, Ventilating, and Air-conditioning outside air requirements of Energy Technology Engineering Center buildings at the present time is estimated to be well in excess of 60 cubic foot per minute in its office buildings. With the adoption of ASHRAE Std 62, which calls for 15 cubic foot per minute in non-smoker office buildings, a substantial energy savings (30 to 40 percent) can be realized by resetting Heating, Ventilating, and Air-conditioning Systems and rebalancing air flow under the new ASHRAE criteria.

3. Building Retrofit Projects

The most significant aspect of DOE energy management program is the development and implementation of life-cycle-cost-effective retrofit projects. Implementation of quick payback retrofit projects not only reduces energy consumption, but also provides substantial savings in operating cost to the Department.

The majority of the retrofit projects at DOE facilities have fallen into five general energy saving categories:

- Energy monitoring and control system installations
- Heating, Ventilating, and Air-conditioning System modifications
- Mechanical equipment and boiler modifications
- Electric light and power improvements
- Building insulation and storm-window improvements.

Since the beginning of the retrofit program in FY 1977, DOE has funded a total of 762 projects for $195.2 million. Of this total, 77 projects at a cost of $17.4 million were funded in FY 1989. These projects benefit both buildings and metered processes. The annual savings from the FY 1989 program in the buildings category, upon projects completion, will be 675 billion British Thermal Units and $2.9 million. The annual savings in the buildings category from projects funded from FY 1977 - FY 1989 are 12.1 trillion British Thermal Units and $58.5 million.

Examples of retrofit projects benefiting buildings, which were underway or completed in FY 1989 are:

The Kansas City Plant replaced two 800 horsepower condenser water pumps and cooling tower fan controls at the West Boilerhouse. The old pumps were replaced with three 400 horsepower variable frequency variable speed pumps and one 400 horsepower constant speed backup pump. Direct Digital Controls were added for the pumps and cooling tower fan operation. Water filtration was also added to improve chiller operation. The existing tower basin was modified to allow use of an adjacent 500,000 gallon basin to increase cooling efficiency.

Brookhaven National Laboratory began a project that provides for the removal and disposal of existing pipe insulation and replacement with new insulation. The existing insulation is inefficient, of minimal thickness, and contains asbestos. Much of this in-

Shown is the Kansas City Plant restored condensing water system. The restored system increases cooling efficiency at the plant.

sulation is deteriorated or missing. This ineffective insulation will be replaced by insulation meeting current DOE design criteria in economical thicknesses.

The Nevada Test Site completed the condenser water chiller project in CP-1. The cost was $31,000. This project resulted in an annual energy savings of 3,132 Million British Thermal Units and annual energy cost savings of $13,121.

Table II-2 summarizes energy conservation activities in the Retrofit and Survey and Study Programs.

4. Central Plant Programs

The Department's central plant program includes criteria for fuel selection in the design, construction, and conversion of combustors; and boiler operator training, tuneup, steam trap, and boiler feedwater treatment programs to improve the operational efficiency of the plants. Through these efforts, the Department ensures that the most life-cycle-cost-effective fuels are used at its sites and that both fuel usage and operating costs are minimized through efficient plant operation and maintenance.

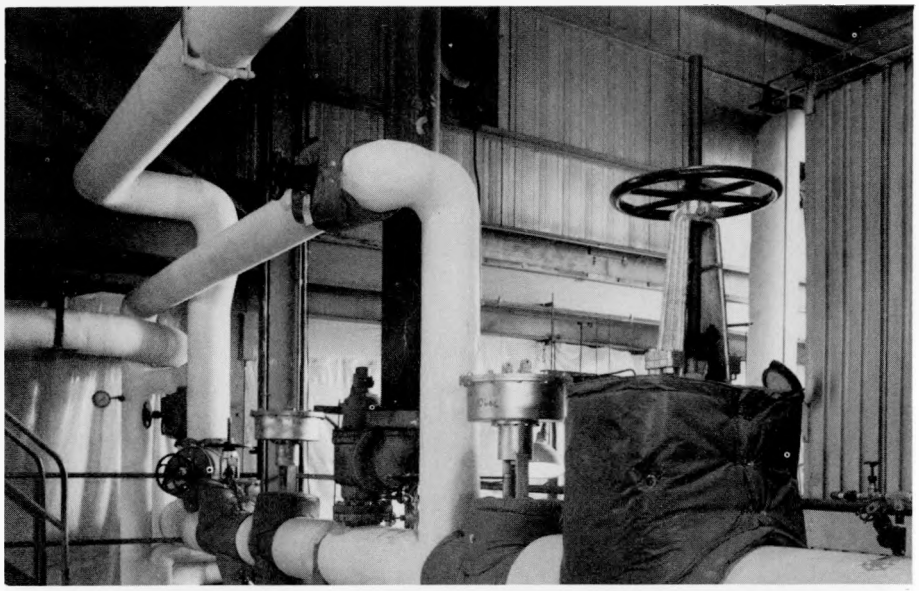
Representative central plant improvements accomplished in FY 1989 were:

The major improvement in the West Valley Demonstration Project was the replacement of the 24 year old oil-less reciprocating compressor with a state of the industry centrifugal compressor. In addition, a vastly oversized air compressor in the Supernatant Treatment System is being replaced with a much smaller, more efficient air compressor. The savings from this project alone were projected at $209,500 over 3 years in capital investment savings, and maintenance costs.

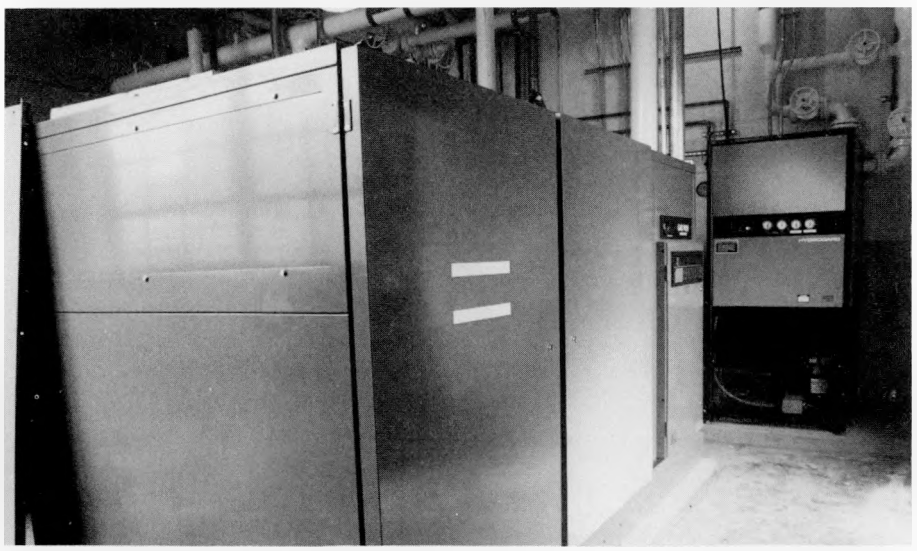
The Pinellas Plant replaced three natural gas-fired boilers with electrically driven heat pumps, which

Table II-2
BUILDINGS ENERGY CONSERVATION ACTIVITIES SUMMARY THROUGH FY 1989

Activity		FY 1977-88	FY 1989	FY 1977-89
Retrofit Projects	Number Conducted	685	77	762
	Est. Cost ($000)	177,780	17,400	195,200
Surveys and Studies	Est. Cost ($000)	FY 1978-88 25,995	FY 1989 2,000	FY 1978-89 27,995



This photo is representative of insulation upgrades completed on piping in numerous buildings throughout the Brookhaven National Laboratory Site.



Shown is one of the two, new central plant air compressors installed at the Bettis Site (West Mifflin, PA). The new, replacement units, provide primary and backup capability and are estimated to save about 500 million British Thermal Units annually as compared with the older, less efficient air compressors.

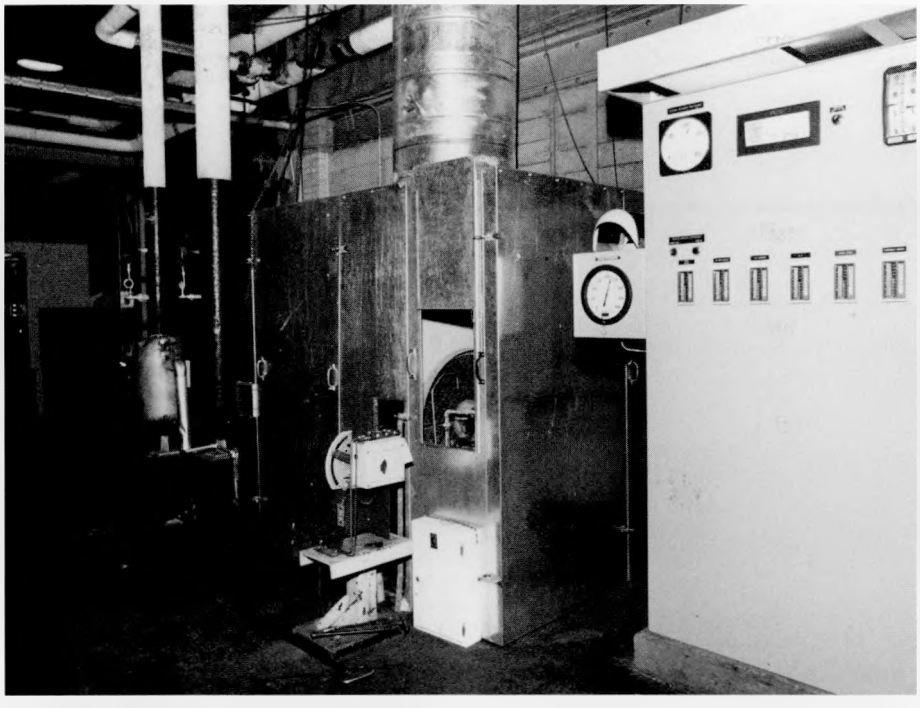
reclaim waste heat from six 900-ton chillers to augment the hot water system, and at the same time relieve the cooling towers of part of their load. Concurrent with the installation, the Pinellas Plant has sent three boiler operators to the manufacturer's heat pump training program. The gas boilers and electric heat pumps are controlled and operated at optimum levels using the new computerized Utility Management System.

Forty-five boilerhouse and three maintenance personnel received 231 hours of training on Heating, Ventilating, and Air-conditioning direct digital controls at Kansas City Plant.

The Argonne National Laboratory-East Preventative Maintenance Program covering steam and condensate systems includes periodic checkout of 2,700 steam traps on-site. Maintenance work orders are issued upon detection of faulty traps. A study is currently being conducted to evaluate the feasibility of replacing conventional drip traps with constant orifice traps.

Brookhaven National Laboratory is conducting an Automatic Brush Cleaning System project that will install automatic condenser tube cleaning systems on four chillers in the Central Chilled Water Facility. These systems will automatically clean internal condenser tube surfaces to assure minimum fouling and maximum chiller efficiency. By reducing condenser tube fouling factors, greater heat transfer is achieved resulting in decreased energy consumption. Normally chiller condenser tubes are manually cleaned on an annual basis. Installation of these systems will allow condenser tubes to be automatically cleaned according to condenser water quality and chiller run-time, resulting in significant energy savings and eliminating the need for costly manual cleaning.

The Westinghouse Hanford Company conducted a boiler efficiency improvement project at the 200 Area. This project will install ductwork to return warm air (boiler heat losses) from the top of the steam plants to the boiler inlet fans. During FY 1989, two tests were performed on a model plenum to evaluate the effects of enclosing the fan and allow plant operations the ability to make comments on its configuration. Results showed that fan bearing vibration was reduced and air flow was also reduced with the speed of the fan. Results from tests aided in the write-up of the design specifications. Design of the system is underway; when completed, the retrofit is expected to save $65 thousand annually.



The Boiler Efficiency Improvement Mockup Plenum was developed at the Hanford Site to determine the final design of the plenum, which would permit full maintenance and maintenance checks to be performed. The 200-E Boiler Efficiency Improvement Project is to provide ductwork to be installed in the steam plant to route hot air from the plant ceiling region to the inlet side of the forced draft fans that supply air into the boilers.

5. New Construction Program

The energy conservation design criteria, which were revised in FY 1985, impose specific requirements such as: computer-aided dynamic analyses of alternative design concepts for energy consumption evaluation; a formal Energy Conservation Report, which must include a list of the major energy conservation features incorporated and the expected building performance in British Thermal Units per square foot per year; and an analysis of solar and other renewable energy systems considered for use in the building. New construction projects are reviewed in the design phase to assure that energy conservation features are provided for in the proposed construction.

To augment the design of energy efficient buildings at its facilities, DOE uses building analysis computer programs for analyzing alternate energy conserving features in new building design. A Facilities Solar Design Handbook was developed by DOE and distributed to engineering personnel and operating contractors at the field installations.

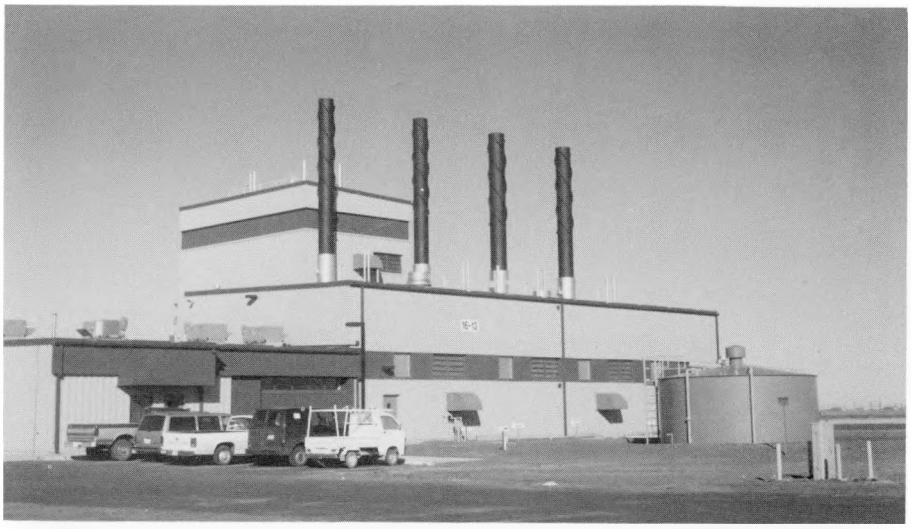
Since FY 1980, the Department has designed 272 new buildings for DOE sites. Construction has been completed for many of these buildings. Energy Conservation Reports were prepared for these buildings to determine the Department's progress toward the goal of a 45 percent reduc-

tion in average energy use per gross square foot of floor area as compared with FY 1975.

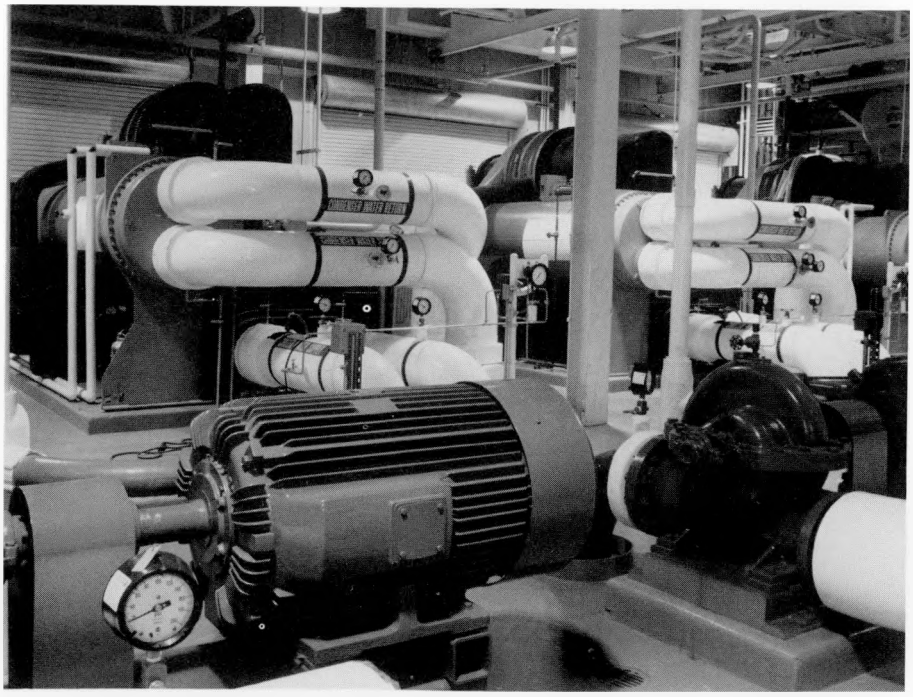
The building designs reviewed represent a total of 5,542,200 gross square foot and a combined total projected average energy use of 2,238,000 million British Thermal Units per year, which is equivalent to 403,800 British Thermal Units per gross square foot per year. When compared to the Department's average building energy use in FY 1975 of 997,749 British Thermal Units/gross square foot, the new Federal buildings represent a 59 percent reduction in average buildings energy use. When compared to the Department's average building energy use in FY 1985, the new Federal buildings represent a 49 percent reduction in average buildings energy use.

It should be noted that the 272 new Federal building designs do not necessarily represent a typical cross section of building types in the FY 1975 database, with which these comparisons are being made. Also, these comparisons use a mixture of design data and actual consumption data for new Federal buildings (since actual consumption data is not always available), and only actual consumption data for the Department's FY 1975 building inventory.

Therefore, these comparisons are quantitative rather than qualitative in nature, but do indicate progress. The Department is gathering actual consumption data for these new Federal buildings to verify the progress that is being made in new building designs.



Pictured is the new more energy efficient Boiler Facility at the Pantex Plant.



This photo is part of the energy conservation features of the recently completed Central Chilled Water Facility at the Brookhaven National Laboratory, 250 horsepower variable speed chilled water pumps (foreground) and high efficiency 1,250 ton electric centrifugal chillers (background).

The new site Central Chilled Water Facility was completed during FY 1989 at Brookhaven National Laboratory. This facility contains three 1,250 ton high efficiency electrical centrifugal chillers and one 1,250 ton steam absorption chiller. This facility will reduce site energy consumption by supplying chilled water to six major site buildings from a highly efficient central source. All of the systems contained in this new central chiller plant are designed for high efficiency and include features such as variable speed drive pumping, multi-speed cooling tower fans, optimize (low pressure drop) piping, insulation, and an Energy Management control System. This facility is expected to operate during the 1990 cooling season.

D. Achievements for FY 1989

The achievements of the buildings program are measured in energy consumption and cost avoidance. Cost avoidance is the savings associated with the amount of energy resources not used because of conservation actions. It allows for changes in cost per unit of energy.

DOE's building conservation efforts through FY 1985 resulted in a cost avoidance of $168 million, based on

FY 1975 energy consumption levels. Cost avoidance in FY 1989, measured from the new baseline year of FY 1985, was $24.5 million, and cost avoidance from FY 1986 - FY 1989 was $45.9 million.

The Department has decreased its energy use per square foot in buildings by 10 percent in FY 1989. This is significant progress toward the goal of a 10 percent reduction by FY 1995. This achievement is the net result of energy management actions under all the program elements described in this chapter such as:

- Improved system and equipment operations and maintenance
- Energy efficient building system retrofits including Heating, Ventilating, and Air-conditioning and building envelope
- Energy efficient lighting including reduced lighting levels
- Energy management control systems.

CHAPTER III

GENERAL OPERATIONS PROGRAM

CHAPTER III

GENERAL OPERATIONS PROGRAM

A. Introduction

The General Operations Program includes energy used in both the metered process and vehicles and equipment categories. Due to the nature of its mission, DOE operates extensive experimental and production processes, many of which are energy intensive. DOE also uses a large number of vehicles due to the large areas covered by many of its sites. For example, the Savannah River Plant encompasses over 192 thousand acres and the Idaho National Engineering Laboratory, over 569 thousand acres.

Process energy includes energy consumed in production nuclear reactors, industrial type operations for weapons and nuclear fuel production, and research and development facilities such as experimental nuclear reactors and linear accelerators. Vehicles and equipment energy includes energy consumed in general vehicle transportation, aircraft, and special-purpose vehicles including off-road construction equipment. Operations energy is differentiated from buildings energy, which was described in the previous chapter in that operations energy is separately metered and is more reflective of programmatic increases and decreases.

During FY 1989, experimental and production metered processes used 33.2 trillion British Thermal Units of energy at a cost of $120 million. Figure III-1 presents metered process energy consumption and cost by fuel type during FY 1989. There are 1,052 buildings housing the metered processes included in these figures. Table III-1 compares FY 1989 metered process costs and consumption with that of the base-year, FY 1985. Figure III-2 depicts process energy consumption in FY 1988 compared with FY 1985, and Figure III-3 depicts vehicles and equipment consumption for the same 2 years.

B. Program Objectives

The objectives of the general operations energy management program are to reduce energy consumption in energy intensive metered processes by 10 percent per gross square foot by FY 1995 as compared to FY 1985, and to reduce energy consumption in DOE vehicles and equipment by 10 percent during the same time period. The usage during the base-year was 39.3 trillion British Thermal Units consumed in 14.6 million gross square feet of space for metered processes, and 2.9 trillion British Thermal Units consumed by vehicles and equipment.

C. Program Elements

Reduction in energy usage for DOE general operations includes energy conservation in the areas of experimental and production metered processes, and vehicles and equipment. DOE continues to save energy by implementing conservation procedures for the following program elements:

1. Survey and Retrofit of Experimental and Production Metered Processes

Process energy surveys address life-cycle-cost-effective retrofit projects for both industrial and laboratory processes. Production processes at DOE sites include such energy intensive operations as nuclear fuel production and nuclear weapons production. Experimental processes include such research and development operations as reactor research, operation of several kinds of experimental and test reactors, and the operation of linear accelerators, synchrotrons, cyclotrons and other highly sophisticated, energy intensive research equipment used in a variety of physics experiments.

At Fermi National Accelerator Laboratory, two retrofit projects involving the extension of underground natural gas pipelines and the replacement of electric boilers with natural gas fired boilers in two experimental buildings were underway. These boiler replacements are anticipated to reduce heating costs for the two buildings by 75 percent with a related energy cost savings of $88,000/year.

Table III-1
FY 1989 ENERGY COST AND USAGE
EXPERIMENTAL AND PRODUCTION METERED PROCESSES

	Energy Cost Thousands of Dollars			Energy Usage Billions of Btu's		
Energy Type	FY 85	FY 89	% Change	FY 85	FY 89	% Change
Electricity	120,604	109,521	-9.2	31,614	29,675	- 6.1
Natural Gas	3,208	6,141	+91.4	778	1,697	+118.0
Fuel Oil	5,934	1,807	-69.5	1,126	548	-51.3
Coal	11,225	2,641	-76.5	5,777	1,308	-77.3
LPG	103	42	-58.5	20	9.9	-49.7
Purchased Steam	25	28	+12.8	10	9.4	- 2.9
Total	141,099	120,195	-14.8	39,325	33,250	-15.4

Figure III-1
DOE Metered Process Energy Cost & Use FY 1989

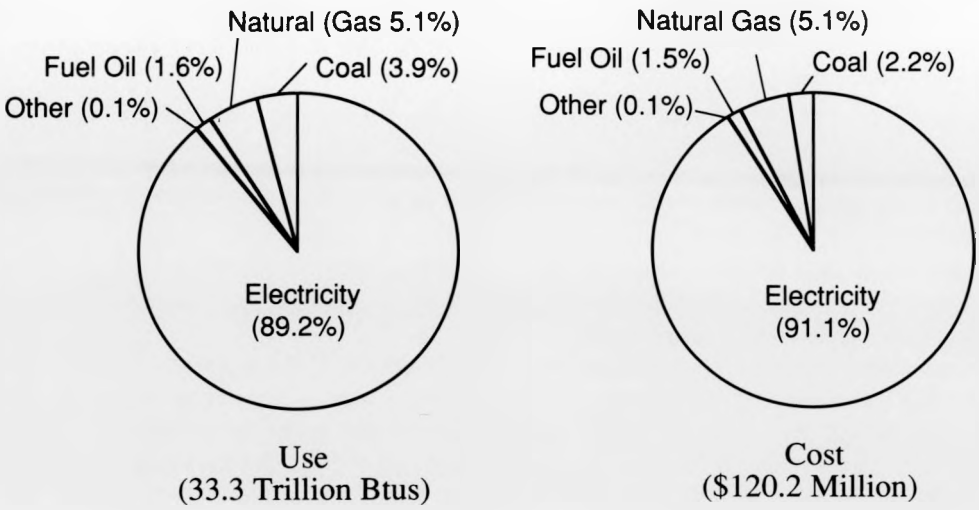


Figure III-2
DOE Metered Process
Energy Use FY 1985 & FY 1989

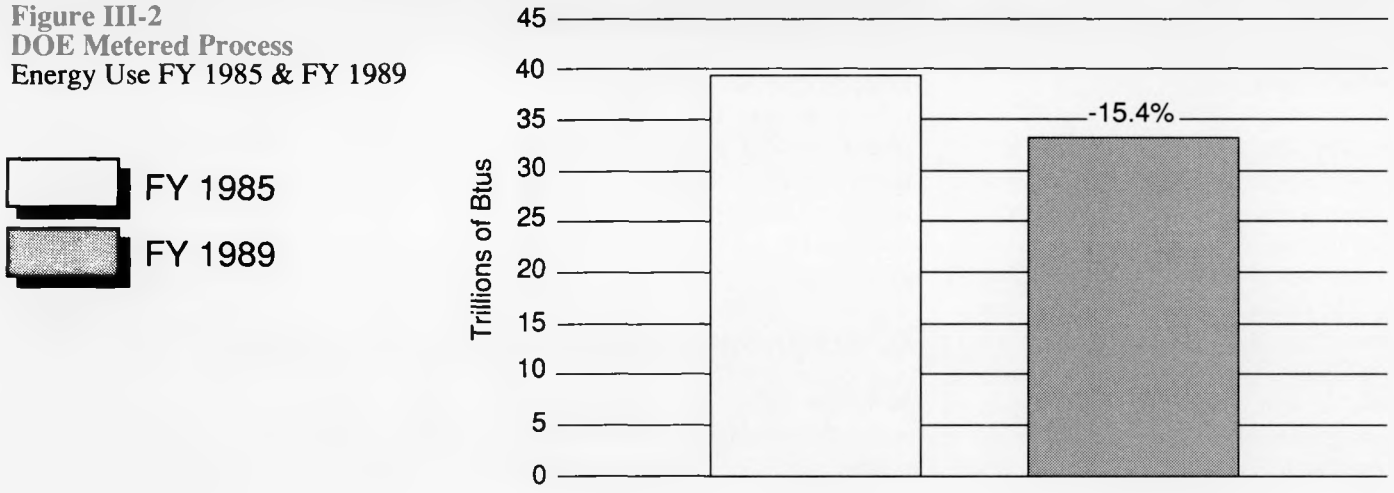
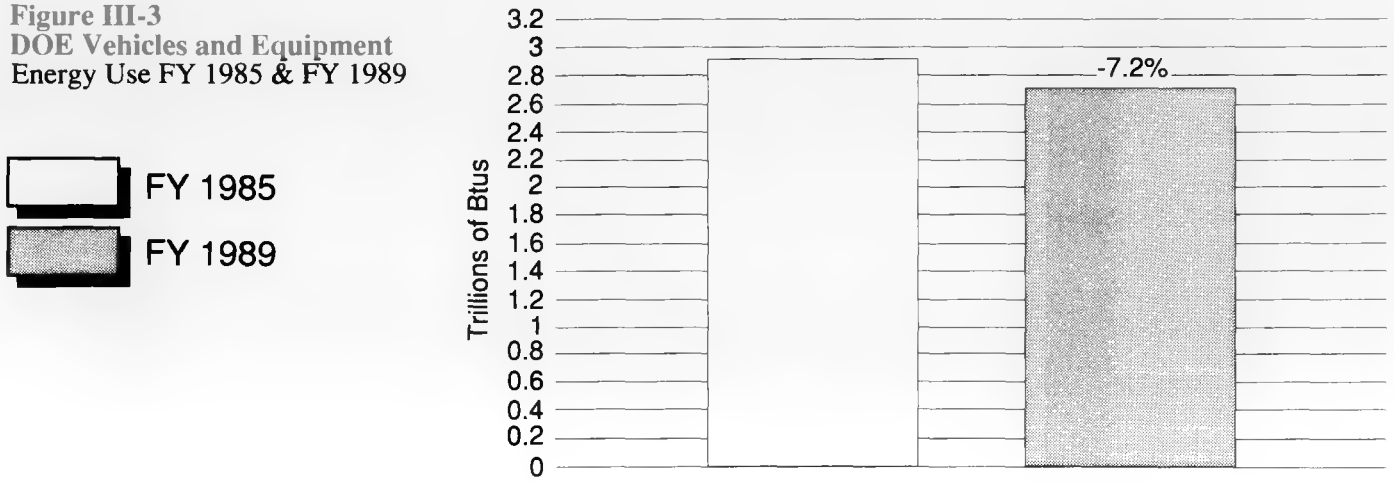


Figure III-3
DOE Vehicles and Equipment
Energy Use FY 1985 & FY 1989



In addition, the DOE Mobile Energy Laboratory at Fermi National Accelerator Laboratory is equipped with state-of-the-art energy monitoring instrumentation and computers for data reduction. The Mobile Energy Laboratory was used extensively throughout FY 1989 in conducting energy consumption audits on various buildings and in conducting wintertime base-load studies on the experimental beam lines. These studies generated several additional retrofit funding requests.

Experimental Operations has always been one of the most difficult areas in which to effect energy conservation at the Princeton Plasma Physics Laboratory. Comparing FY 1989 to the FY 1985 base-year, Tokamak Fusion Test Reaction, Princeton Beta Experiment, Current Drive Experiment, and other Princeton Plasma Physics Laboratory experimental devices were able to maintain successful research programs while reducing electrical usage by one-tenth of 1 percent. In FY 1989, Tokamak Fusion Test Reaction reduced its Motor Generator Operations hours by 17.8 percent. During the same period, there was a reduction of 14.5 percent in experimental heating Btu energy usage (fuel oil and natural gas).

The In-house Energy Management Program funded project to increase the efficiency of the Par Pond Pumphouse at the Savannah River Site was active in FY 1989. This project will replace the existing two stage pump impellers with a more efficient design. In support of reactor operations, the site utilizes a 2600 acre cooling water reservoir known as Par Pond to supply cooling water to P-Area Reactor. It was determined that upgrading the ten existing pumps at Par Pond would result in improved operations with implications for energy savings and cost reductions. The energy savings were estimated to be 350 Billion British Thermal Units/year with corresponding cost savings of $1.2 million per year.

Through FY 1989, DOE has funded process retrofit projects at an investment cost of $40.3 million. These projects are expected to yield an annual energy savings of 3.9 trillion British Thermal Units and $19.7 million.

2. Transportation Program

To meet the transportation energy conservation objectives for vehicles and equipment, DOE is continuing to focus on acquiring more energy efficient vehicles and, where feasible, using alternative fuels. Driver energy conservation awareness training, another aspect of the program, improves the energy efficiency of Government and operating contractor driving.

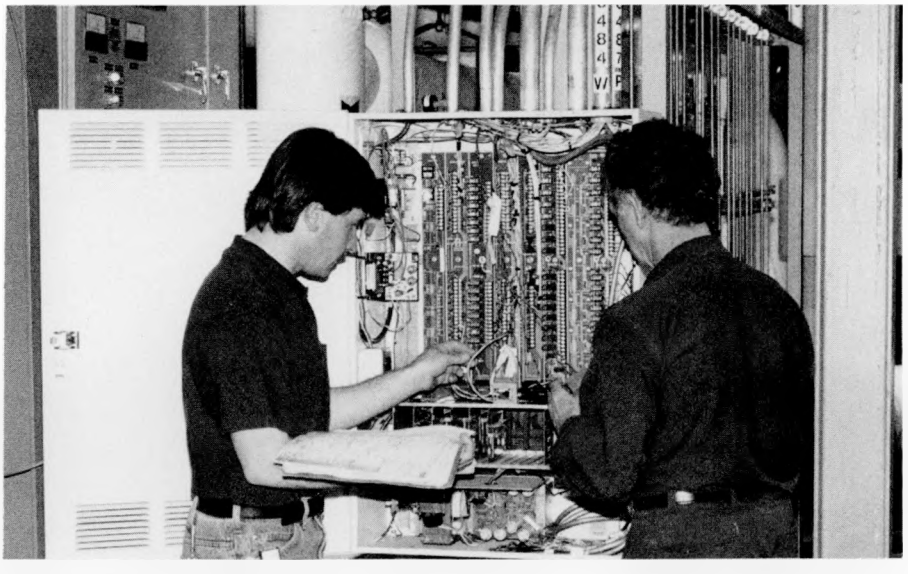
DOE is continuing to emphasize the purchase of fuel efficient vehicles for its fleet. The fuel efficiency goals are stated in 41 Code of Federal Regulations 101 and are shown in Table III-2 along with DOE performance. In FY 1989, the Department exceeded the established Federal mileage goals as it has in each of the previous years. Tables III-3 and III-4 display the makeup of the FY 1989 DOE fleet of vehicles and equipment.

D. Achievements in Operations Energy Conservation

The Department, during FY 1989, used 15 percent less metered process energy than it did in FY 1985, the base-year. This equates to a 23.9 percent reduction in energy use per square foot in this category.

In addition to the types of actions to reduce metered process consumption discussed in previous sections of this chapter, various other site initiatives contribute to increasing energy efficiency. Examples of site initiatives follow.

Major ongoing site funded energy management actions at the Mound Facility include operation of the centralized control systems tied to major building air handlers and other heating, ventilating, and air-conditioning equipment, the continued operation of the heating, ventilating, and air-conditioning Preventive Maintenance and System Tune-up team, support for plant energy reporting/meter readings, and the steam trap preventive maintenance program. In addition, operating funds have been used to convert additional units to Direct Digital Con-



Electrical Technicians at Princeton Plasma Physics Laboratory are completing wiring to the in-field Remote Computer Unit which receives its commands from the main Computer Unit, the Energy Management Control System.

trols, eliminate condensate problems to enable more condensate return to the powerhouse, and eliminate oversized heating, ventilating, and air-conditioning units by serving multiple spaces from the same unit. During FY 1989, one system was converted to Direct Digital Controls using site operating funds.

At DOE Radiation Laboratory on the Campus of the University of Notre Dame infrared sensor switches have been installed in the Xerox room, two offices, and one laboratory. Old three lamp two ballast fluorescent fixtures have been replaced by new, two-lamp, single ballast energy efficient types, in the Data Center Complex, Computer Room, and several offices. A total of approximately 50 fixtures were replaced by in-house personnel.

Princeton Plasma Physics Laboratory went into contract renewal in FY 1988 with Public Service Electric and Gas Company for Interruptible Electric Service for FY 1989. This 3 year contract will be adjusted annually on the basis of the previous summer's kilowatt demand peak average; a saving of over $847 thousand in electricity costs was realized in FY 1989 because of this contract.

A Lawrence Berkeley Laboratory, In-House Energy Management staff member monitors flow rates for open lines, and leaky valves at Lawrence Berkeley Laboratory's Compressed Air Facility. The automated control system reduced compressed air consumption by one-third, saving about $20,000 a year in energy costs.

Test Area North at the Idaho National Engineering Laboratory has purchased two 500 horsepower replacement boilers having improved operating efficiencies. Also the boilers will be equipped with stack gas economizers and stack gas analyzers. The boilers will be installed at the end of the FY 1990 heating season.

The Nevada Test Site installed twenty-four new energy efficient heat pumps on two EG&G Buildings. Reynolds Electrical and Engineering Co., Inc. will receive a $10,000 rebate from the Nevada Power Company for acquiring these cost-efficient units. Annual energy savings are 722 Million British Thermal Units at an annual energy cost saving of $9,540.

The Westinghouse Hanford Company assesses a 1 percent energy tax on all coal, electricity, and fuel oil consumed by Westinghouse Hanford Company. This tax is used to generate funds for investment into energy saving activities that yield cost saving dividends. Typically the tax assessment generates $175 thousand to $200 thousand in expense funds each fiscal year. Expense type projects are selected for implementation with these funds using the same economic analysis methods that the DOE In-house Energy Management Program uses for selecting capital construction projects.

The Pacific Northwest Laboratory conducted a project for replacement of Steam System and Preheat Coils at the 326 Building. This system included a Direct Digital Controls System capable of communicating to the 300 Area Johnson Controls Energy Monitoring and Controls System. The operators now have the capability of seeing, on a computer screen, the complete operation of the heating system

for the building. This allows them to set zone conditions and see preheat and reheat damper positions. With this new insight, the Operations personnel can now keep systems from heating and cooling at the same time and still maintain comfort levels in the facility.

In FY 1989, 54 percent of Lawrence Berkeley Laboratory's electricity was purchased through an interruptible power source saving over $1.27 million dollars. Interruptible power was purchased from the local utility, Pacific Gas and Electric as well as the Western Area Power Administration. Manual scheduling and coordination of the various unrelated energy intensive processes were utilized to minimize the demand charges.

E. Emergency Conservation Plan

Title 10 of the Code of Federal Regulations, Part 436.105, requires all Federal agencies to develop an Emergency Conservation Plan to lessen the impact of a sudden disruption in the supply of oil-based fuels, natural gas, electricity and coal. These plans are intended to preserve public health and safety, and to ensure the national defense in the event of an emergency. The code calls for a gradual 10, 15, and 20 percent curtailment of electricity, natural gas, gasoline, oil, and coal use.

DOE sites were requested to report what actions they would take, and the impacts and fuel savings for each fuel type. Emergency actions and impacts were summarized for each fuel type, including the number of sites proposing each action or impact. These site-specific responses were summarized in order to establish an agency-wide Emergency Conservation Plan for DOE.

Table III-2

TRANSPORTATION: VEHICLE GASOLINE MILEAGE

	Passenger Vehicles		4 x 2 Light Trucks		4 x 4 Light Trucks	
Fiscal Year	GSA MPG Goal	DOE New Vehicle MPG	GSA MPG Goal	DOE New Vehicle MPG	GSA MPG Goal	DOE New Vehicle MPG
1978	20.0	21.0				
1979	22.0	23.3	17.2	19.4	15.8	18.0
1980	24.0	24.5	16.0	22.1	14.0	15.2
1981	26.0	26.1	16.7	18.9	15.0	15.2
1982	24.0	29.4	18.0	28.2	16.0	16.1
1983	26.0	28.4	19.5	20.3	17.5	17.0
1984	26.0	28.4	20.3	20.4	18.3	17.0
1985	26.0	28.3	20.5	20.7	18.8	19.8
1986	26.0	28.0	20.5	20.7	19.5	19.8
1987	26.0	26.9	21.0	21.2	19.5	20.6
1988	26.0	27.1	21.0	21.2	19.5	20.6
1989	27.5	27.7	20.5	20.0	19.0	19.0

Table III-3

DOE MOTOR VEHICLE FLEET DATA
(FY 1975 - FY 1989)

Years	Passenger Vehicles	Trucks	Special Purpose*
1975	2,265	7,133	—
1976	2,265	7,447	—
1977	2,264	8,251	—
1978	2,379	9,061	—
1979	2,329	9,096	—
1980	2,374	9,182	1,549
1981	2,366	9,223	1,710
1982	2,273	9,499	1,683
1983	2,326	9,717	1,794
1984	2,351	10,395	2,127
1985	2,291	10,761	2,162
1986	2,297	10,742	2,188
1987	2,230	9,240	1,931
1988	2,195	9,221	1,901
1989	2,200	8,893	1,895

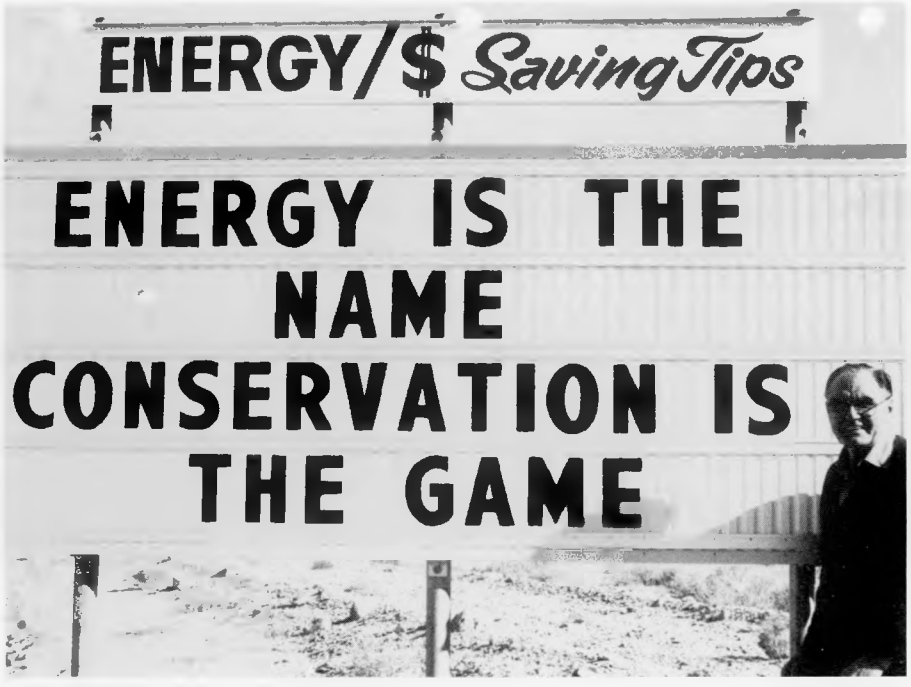
*Special purpose includes: Fire trucks, construction equipment, drilling rigs, dump trucks, and forklifts.

Table III-4

DOE FLEET OPERATIONS
FY 1989

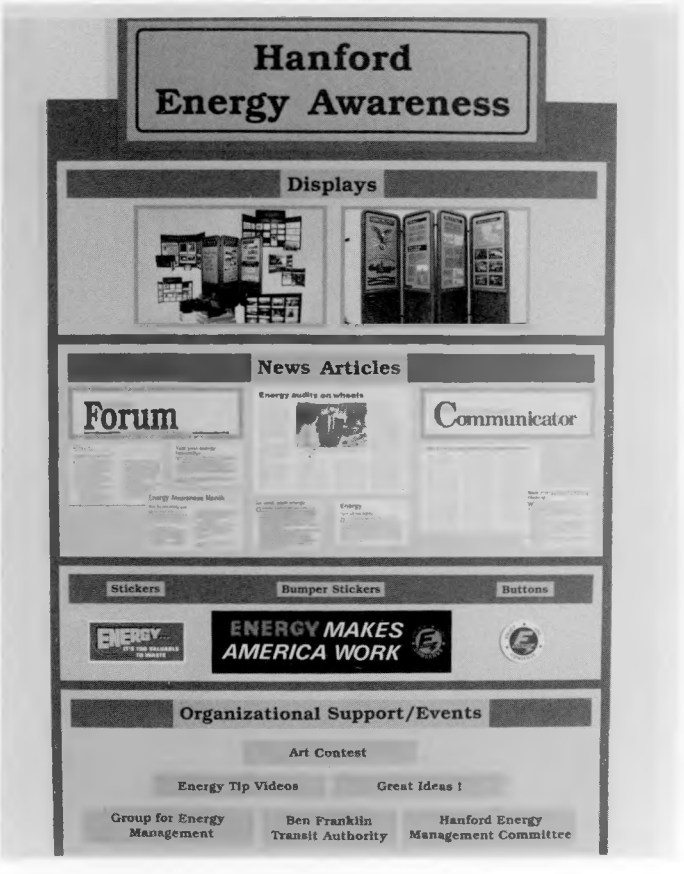
Vehicles on Hand	
Sedans	1,817
Station Wagons	132
Ambulances	47
Buses	204
Trucks	8,893
Special Purpose	1,895

CHAPTER IV
RELATED PROGRAMS



Energy Slogan Contest Winner Walter J. Matthews stands next to the sign with his slogan, located just outside Gate 100 at the Nevada Test Site.

Pictured is the Mound Facility FY 1989 winning Poster selected during Energy Awareness Month. The winner was Shannon Frizzell (12) daughter of Mound Employee Judy Frizzell.



This Energy Awareness Poster depicts the various energy related activities that are happening on the Richland, Hanford Site. Shown on the poster are the energy awareness displays which have been prepared, the news articles which have appeared in the local publications, the bumper stickers that are available for the employees as well as the listing of current energy related activities.

CHAPTER IV

RELATED PROGRAMS

A. Introduction

In addition to elements directed only toward either the Buildings or the General Operations Energy Management Programs, DOE is also involved in several energy conservation related programs designed to promote conservation and encourage more efficient use of available energy. These include a boiler operator training and tuneup program, a steam trap program, and a metering program, among others, which will save energy at DOE sites in both buildings and metered processes.

B. Activities Included in Related Programs

In order for energy conservation to be a totally effective program, it must reach beyond the buildings and operations energy conservation activities and become an integral part of the activities of DOE employees both at work and at home. This chapter highlights DOE's commitment to and involvement in related energy conservation programs.

1. Employee Awareness Programs

As part of the In-house Energy Management Program, DOE established a Department-wide Energy Conservation Employee Awareness Program to promote energy conservation for its civil service and operating contractor employees. A variety of promotional techniques, such as newsletters, posters, films, lectures, seminars, stickers, and decals have been used to disseminate information on energy conservation throughout DOE. Table IV-1 summarizes field participation in the awareness program during FY 1989.

The following are representative examples of field office and site programs to promote energy awareness and conservation efforts among civil service, contractor employees, and their communities:

At Nevada Test Site, Reynolds Electric and Engineering Company, conducted an Energy Slogan Contest with cash prizes of $100, $75, and $50. The winning slogan was "Energy is the Name—Conservation is the Game." An energy slogan was maintained alongside the Mercury Highway leading into the Nevada Test Site.

FY 1989 started with the biggest Energy Awareness month ever at the Mound Facility. Activities were designed to involve a large percentage of the plant population and family members in various phases of awareness activities, from turning lights out, to carpooling, to poster contests, to general awareness. Twelve different participation contests or events were held, culminating in an energy rally.

Pictured are the judges making the final selection of the 12 winning posters, selected from over 3000 participants in the "Energy Makes Things Happen," art contest at the Richland, Hanford Site. From left to right; First Row, B.J. Hickman, R.C. Moore; Second Row, M. Kunigisky, J. Zach, C.T. Sarton, and R.S. Poplin.

Table IV-1

DOE FIELD OFFICE EMPLOYEE CONSERVATION AWARENESS FY 1989

	Number of Sites
Awards Program	30
Suggestion Program	40
Energy Conservation Training	36
Site Publication Articles	38
Posters	48
Energy Conservation	43

Westinghouse Hanford Company energy management, through the auspices of the Hanford Science Center at Richland, Washington conducted a community energy savings art contest. The theme of the contest was "Energy Makes Things Happen!". The contest gave art students from the fourth, fifth, and sixth grades the opportunity to compete. There were over 3000 participants with 120 finalists, from which the final judging selected 12 winners.

The Fermi National Accelerator Laboratory Employee Energy Conservation Suggestion Program offers cash awards ranging from $100 minimum to $5,000 maximum, based upon the level of the estimated annual net energy cost savings resulting from the suggestion. During FY 1989, a total of $18,670 in employee cash awards was made in response to suggestions with projected annual electrical energy savings of 17,800 megawatthour and annual net cost savings of $647,000. In FY 1989, fifty-four suggestions were received. Nine suggestions resulted in DOE retrofit project funding requests.

The Pinellas Plant publishes an in-house weekly information paper called "The Headliner." This paper provides a medium for information exchange between management and each employee concerning all issues, opportunities, and activities throughout the plant. It has been standard practice to provide energy conservation information through this newsletter. In addition, maintenance and operating personnel are instructed on energy conserving actions as part of the heating, ventilating, and air-conditioning maintenance program.

Westinghouse Hanford Company Employee Programs include the "Great Ideas Program" and the "Productivity Improvement and Cost Effectiveness" Program. The Great Ideas Program is a formal and organized means for employees to suggest a "better way" and, to have their ideas evaluated and implemented. The Great Ideas Program feeds productivity and cost initiatives into the "Productivity Improvement and Cost Effectiveness" Program. The Productivity Improvement and Cost Effectiveness Program is an ongoing cost reduction program, which results in tangible benefits to the DOE Richland Operations Office.

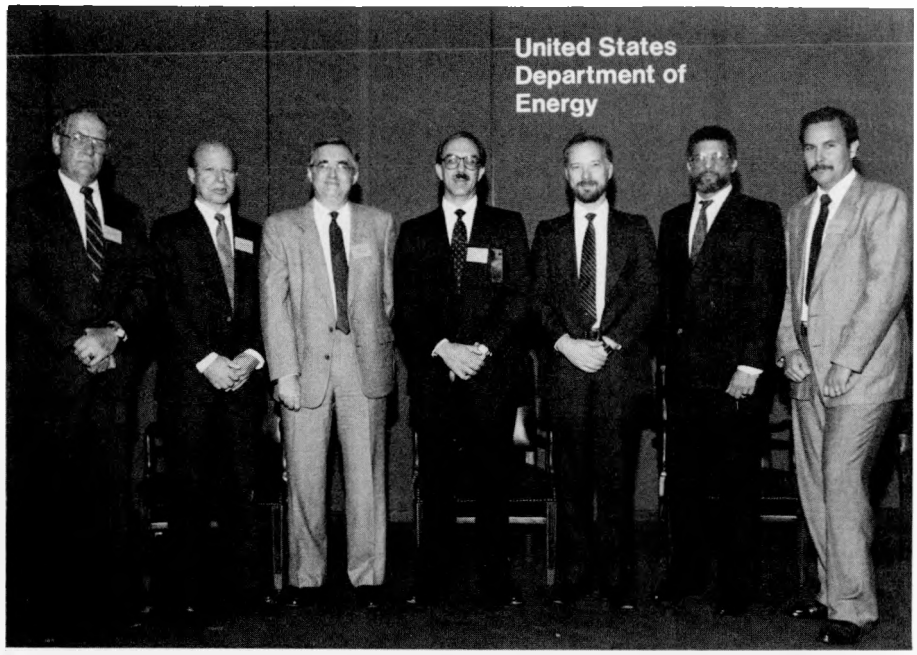
2. In-house Energy Management Awards Program

DOE continued its Annual In-house Energy Management Awards Program, which recognizes organizations and

Pictured are stickers posted at the Pantex Plant as part of the on-going energy conservation program.

employees, both DOE and DOE operating contractors, who have made significant contributions to energy conservation in DOE facilities. The following employees and groups were recipients of the Secretary's In-house Energy Management Award in FY 1989.

- Best Operations Office Energy Management Program: San Francisco Operations Office
- Best Energy Management Program for a Laboratory: Lawrence Berkeley Laboratory
- Best Energy Management Program for a Production Facility: General Electric Company, Pinellas Plant
- Awards for Outstanding Individual Efforts in Energy Management:
  - James Koffer, Rocky Flats Plant
  - Dale Sartor, Lawrence Berkeley Laboratory



Pictured are Headquarters (HQ) Managers along with four Energy Management Award recipients. From left to right are, Thomas Lavery, Pinellas Plant (Best Production Facility), David M. Barr, Chief, In-House Energy Management Branch (HQ), Charles R. Tierney, Acting Associate Director, Administration, Information and Facilities Management (HQ), J. Michael Davis, Assistant Secretary for Conservation and Renewable Energy (HQ), Dale Sartor, Lawrence Berkeley Laboratory (Outstanding Individual), Donald W. Pearman, Jr., Manager, San Francisco Operations Office (Best Operations Office), James Koffer, Rocky Flats Plant (Outstanding Individual).

3. Ridesharing/Vanpooling Programs

To encourage gasoline conservation in private automobiles used by its employees and operating contractor personnel, DOE has an ongoing comprehensive employee commuter transportation program at each of its sites to promote increased use of mass transit facilities and the forming of ridesharing groups. A transportation coordinator has been designated for each DOE site to maintain current information concerning public transportation, and to provide ridematching services for carpools and vanpools.

The Department continues to conduct formal vanpool programs at many of DOE sites. The program uses a variety of promotional materials including a set of posters, bumper stickers, a general purpose poster to promote the program, a handbook covering details of employer-sponsored, employee-owned, and third-party-owned vanpools, as well as Federal-law, State-law, insurance issues, suggested costs, and operating procedures.

During FY 1989, many Department sites continued to promote ridesharing by using zip code matching, posters, notices on bulletin boards and in newsletters, and computerized matching. Some sites also offered preferential parking for vanpools and carpools. Employees use mass transit where it is provided by local transit authorities to and from Department sites. In addition, a number of sites own or lease and operate their own buses for employees. On-site gasoline conservation is also a means of optimizing the efficiency of vehicles. The following are highlights of the FY 1989 programs at the sites.

At the Rocky Flats Area Office, the vanpool program is a joint effort of DOE, EG&G, and the Regional Transportation District of metropolitan Denver. The vans are leased by EG&G from the Regional Transportation District and DOE provides the use of Rocky Flats Area Office facilities for fueling, servicing and parking. Drivers are Rocky Flats Area Office employees picked by a selection committee based on work attendance, driving record, and supervisor recommendation. Passengers finance their transportation by a monthly payroll deduction. Each vanpool must carry nine passengers to break even. Most vans are operating at the full twelve or fifteen person capacity. At present fifty vans are in operation. It is estimated that this fleet will save 574,000 gallons of gasoline each year.

The Rideshare Program at the Ames Laboratory continued as a cooperative venture with Iowa State University for car pooling and vanpooling. The University provided a clearinghouse for employees seeking carpooling. Additionally, many Ames Laboratory employees have established independent carpools. The University also made passenger vans available for Ames Laboratory personnel participating in vanpooling.

Argonne National Laboratory-East furnishes a listing of employees, sorted by zip code for match-up to those wishing to carpool. Approximately 800 employees on-site are carpool members.

4. Federal Interagency Energy Policy Committee

This committee, also known as the "656 Policy Committee," is the group designated in Section 656 of DOE Organization Act to provide general oversight for Federal Energy Management Program matters. This group meets to discuss and establish energy policy. It is chaired by the Under Secretary of DOE and includes the designated Assistant Secretaries or Assistant Administrators of the Departments of Defense, Commerce, Housing and Urban Development, Transportation, Agriculture, Interior, U.S. Postal Service, and General Services Administration, along with similar-level representatives of the National Aeronautics and Space Administration and the Veterans Administration.

In FY 1989, the Federal Interagency Energy Policy Committee selected Mr. Dale Sartor of the Lawrence Berkeley Laboratory in Berkeley, California, to receive a Federal Energy Efficiency Award for contributions to increased energy efficiency within the Federal Government.

5. Boiler Efficiency Improvement Program

A boiler efficiency improvement program was implemented for DOE's central heating plants in FY 1983. The program consists of 4 days of both classroom and in-plant, hands-on training in boiler tuneup procedures, and the efficient operation of central heating plants. Additionally, central plant retrofit projects such as economizers, and blowdown heat recovery are identified. In FY 1984, steam trap training was added to the program scope. This portion of the program provides training in the latest steam trap technology and design, physical inspection of the site steam traps and an analysis of savings obtainable from correction of deficiencies, and an evaluation of site steam trap maintenance programs. The training program was conducted at six sites in FY 1989. The anticipated annual savings from this program if all recommendations in FY 1989 are implemented, is more than $7 million.

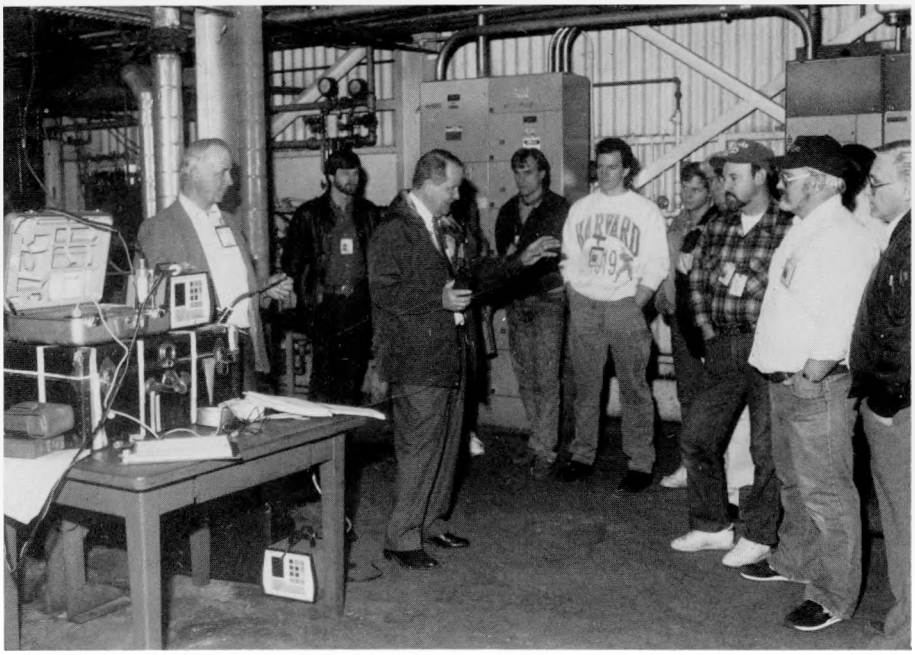
6. Heating, Ventilating, and Air-conditioning Efficiency Improvement Training Program

A Heating, Ventilating, and Air-conditioning Efficiency Improvement Training Program contract was awarded in FY 1989. The program consists of 10 hours of classroom training on heating, ventilating, and air-conditioning systems, their operation, and ways to reduce system energy consumption. In addition the training program provides 10 hours of in-plant hands-on training in testing system operation, and adjustments to improve efficiency. A report identifying system retrofits to improve operating efficiency is prepared. Seven sites will receive training in FY 1990 under the base contract. The contract includes four option years.

7. Conferences and Workshops

Periodically, the In-house Energy Management Program holds conferences in conjunction with the Public Utilities Program. Combining the two programs in one conference allows those with responsibilities in both programs to attend one conference. Also, actions and developments in each of the programs affect the other. Therefore, personnel in each program need to be knowledgeable about both programs. The conferences are attended by DOE Headquarters and field personnel, and by operating contractor personnel. The conferences serve to:

- Inform DOE field organizations of overall Department programmatic requirements, procedures, and status;



The staff of the Boiler Efficiency Institute conducted hands on training at the 300 Area Boiler Plant. The photograph shows G. Maples & D. Maples conducting test and instruction of the boiler operations with students during the training session at the Hanford Site.

- Provide field feedback to Headquarters;
- Foster communications between Headquarters and field offices; and
- Foster communications between personnel in the In-house Energy Management and the Public Utilities programs.

8. Shared Energy Savings/Third-Party Financing

The term third-party financing is used to cover a variety of financing arrangements. Its essential feature, however, is that capital is provided by private investors and targeted for a specific project or the provision of specified services. Third-party financing has recently emerged as a possible source of capital for relatively simple energy efficient projects, such as retrofits, particularly in the commercial and industrial sectors.

Legislation has removed legal and procurement constraints that hindered Federal agencies in undertaking shared energy savings projects. The legislation, the Consolidated Omnibus Budget Reconciliation Act of 1985, granted authority for Federal agencies to enter into multiyear shared energy savings contracts with energy management service companies. Typically, under such contracts, private energy service companies will install energy efficiency equipment and provide energy management services in Federal buildings at no cost to the Federal customer. The private company risks its own capital in return for a share of the value of energy savings resulting from the improvements. The private companies' activities in implementing these contracts might include an energy audit of the building, the purchase or lease and installation of equipment, or the training of personnel required to maintain or operate the equipment. The contract may also obligate the private company to provide ongoing operation and maintenance services for the life of the contract.

DOE is currently pursuing a shared energy savings project at the Lawrence Berkeley Laboratory's Materials and Molecular Research Building. A study completed on March 1, 1988, identified in detail feasible retrofits for the project. Lawrence Berkeley Laboratory has issued a Request for Proposals, and is negotiating with a firm to undertake the shared energy savings project. It is expected that a contract will be awarded by July 1990, for this project.

A second pilot test of SES was initiated in FY 1988 at Oak Ridge Associated Universities. Subsequent evaluations of the site have determined that insufficient energy savings retrofit projects exist to attract SES contractors.

In mid 1989, the Secretary of Energy requested additional field nominations for a pilot test of SES. Fourteen project nominations were received with the majority of the submittals for cogeneration plants (eight nominations), with only three building retrofit projects proposed. The majority of the nominations do not have studies completed and will need to be further developed before determining whether they are viable candidates for an SES project.

The initial screening has identified cogeneration projects at Brookhaven National Laboratory, Naval Petroleum Reserves No. 1, Kansas City Plant, and Princeton Plasma Physics Laboratory as having the highest potential for SES. The Department of Energy is currently developing a generic solicitation document for cogeneration projects, and should make final project selections by September 1990.

9. Metering

In-house Energy Management has a program to submeter existing facilities to monitor and record actual consumption. Metering permits energy managers to determine usage patterns, load characteristics, possible energy conser-

This 25 megawatt cogenerator at the Energy Technology Engineering Center in southern California produces electricity from steam generated during power plant component testing at another Energy Technology Engineering Center facility. The cogeneration "Power Pak" had revenues of $3,580,000 in FY 1989. Enough electricity is produced to light 5,000 homes.

vation opportunities, and in some cases, bill customers directly for their energy consumption.

Typical FY 1989 metering accomplishments are:

The Mound Facility's General Plant Project committee approved $400,000 in funds to be used to install additional submetering throughout the site. Design will start in mid FY 1990, with construction to start in late FY 1990 or early FY 1991. A total of 36 electric, 4 steam, and 15 chilled water meters will be installed. All new meters will be connected to the plant's Direct Digital Control System.

Argonne National Laboratory-East began a two-phase project to automate the site electric meters. This project encompasses modification of existing meters (total of 124) in 49 buildings to provide electric demand readings to be recorded at the central energy monitoring and control system. Modifications include adding a pulse initiator to each meter.

The Solar Energy Research Institute's metering program received funding for two projects: a portable metering project, which provided equipment to identify potential reductions in electrical usage and demands; and a primary metering project which will reduce electrical demand charges.

The Environmental Hazard Elimination Project at the Pinellas Plant is 100 percent complete. These switchgear replacements are marked at each feed. This new metering capability will provide valuable data for managing and reporting energy use and individual load data for engineering.

One of the metering programs at Brookhaven National Laboratory involves a computerized metering system, which continually monitors electric usage for 84 locations of approximately 150 meters. This system allows energy management group personnel to locate excess energy use and identify problem areas. Brookhaven National Laboratory is currently implementing an expansion of these systems to meter additional locations. The laboratory is also continuing to install steam and condensate meters and plans to connect them into the computerized metering system, to assist in identifying excess use and problem areas.

The Oak Ridge Gaseous Diffusion Plant installed a Sodium Softener System. The old makeup water treatment facility was designed to soften and clarify 20,000,000 gallons of water a day to be used as makeup in the gaseous diffusion process. Shutdown of the diffusion activities in late 1987 resulted in a decrease in water need to approximately 250,000 gallons per day. This need could be met by using sanitary water, however, the water first had to be softened. The installation of the softener system has resulted in an annual savings of approximately $330 thousand.

Pacific Northwest Laboratories completed an In-house Energy Management funded portable metering project in FY 1989. This project constructed six portable meters which will be used by members of the Hanford Energy Management Committee in developing future In-house Energy Management funded projects and enhancing Hanford's Energy Management Program.

Eighty-eight permanent electric meters and twenty-one gas meters are utilized to assess energy use at Lawrence Berkeley Laboratory. In FY 1989, all of the interruptible power and approximately 40 percent of firm electrical power was back-charged to the program, creating an incentive for energy conservation.

Pictured is an energy management employee utilizing a Programmable Power Meter Installation at the Lawrence Livermore National Laboratory Main Substation — B-424. This multifunction meter provides instantaneous readouts and historical storage of all electrical variables to pinpoint energy costs and conservation opportunities.

CHAPTER V

HIGHLIGHTS OF FIELD ENERGY CONSERVATION ACHIEVEMENTS FOR FY 1989

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HIGHLIGHTS OF FIELD ENERGY CONSERVATION ACHIEVEMENTS FOR FY 1989

A. Introduction

Previous chapters of this report have presented the achievements of the DOE towards meeting the energy conservation goals of the In-house Energy Management Program. DOE's ability to meet these goals is based upon the contributions made by field organizations. This chapter summarizes the accomplishments of major field offices and highlights their significant energy conservation achievements, FY 1985 - FY 1989. The following charts present field office information in each of six categories: survey funding; retrofit project funding; total energy consumption; British Thermal Units consumption per square foot for buildings; British Thermal Units consumption per square foot for metered processes; and, projected dollar savings realized through implementation of energy saving retrofit projects.

Figure V-1 presents the total dollar investment for technical surveys and studies which are undertaken to identify energy conservation retrofit projects. Funding distribution among field offices reflects the quantity and quality of proposals submitted. Selection of projects to be funded is based on economic return. Through FY 1989, the Albuquerque Operations Office received approximately 23 percent of the total survey funding, the largest single share. Figure V-2 shows the amount of funds distributed to the various Operations Offices for retrofit projects. The Chicago Operations Office received the largest amount of building retrofit project funding, approximately 33 percent of the DOE total through FY 1989. Figure V-3 presents the FY 1989 total energy consumption at the Operations Office level and provides a comparison level with FY 1985. There is no reduction goal for total energy consumption.

The energy consumption per square foot of building space is presented in Figure V-4 and is again compared to the base-year of FY 1985. The Richland and Savannah River Operations Offices have made the most progress in FY 1989 toward the reduction goal of 10 percent by FY 1995. Figure V-5 presents energy consumption per square foot of metered process space for FY 1989 compared to the base-year. These reduction achievements are very sensitive to levels of operations at the field sites. For example, the Richland and Savannah River Operations Offices' reduction was due in large part to programmatic reductions at both sites. Individual Operations Office energy consumption detail is provided at the conclusion of the chapter.

Annual cost avoidance realized through the implementation of energy retrofit projects is presented in Figure V-6. From its $195.2 million investment in retrofit projects through FY 1989, DOE will realize an annual cost avoidance of approximately $78 million. The Chicago, Albuquerque and Oak Ridge Operations Offices contributed the greatest cost reduction, with predicted annual savings of 36 percent, 24 percent, and 15 percent, respectively.

B. Field Offices

1. Albuquerque Operations Office

Established in 1943, the Albuquerque Operations Office operates an extensive weapons laboratory and production complex extending from Florida to California, has seven area offices, and administers two major multi-program laboratories. Field-level coordination of nuclear weapons research, development and production is the primary mission of the Albuquerque Operations Office. Other major missions include: operation of the transportation safeguards systems to assure safe and secure movement of weapons and strategic quantities of nuclear materials within the continental United States; nuclear weapons accident response, both within the continental United States and worldwide; and field-level planning and coordination of assigned non-weapons energy programs.

Solar energy research is high on the list of diverse non-weapons research at the Albuquerque Operations Office, which includes fuels, medicine, space and waste management. Among the programs: radioisotopic heat sources and electrical power supplies, particularly for space use by both DOE and NASA; laser isotope separation; inertial and magnetic fusion; high energy physics; radioactive waste disposal; transportation of radioactive materials; geothermal energy; fossil fuel; hydrogen as gas fuel; cryogenics; biomedical and medical, both physiological and technological, particularly on cancer and heart disease; engine combustion, both efficiency enhancement and pollution control; the environment; and safeguards and security.

The Albuquerque Operations Office has responsibility for nuclear waste management research and development and implementation responsibility for three of the major Federal nuclear waste management programs; the Waste Isolation Pilot Plant Project; the Transuranic Waste Technology Development program; and the Uranium Mill Tailings Remedial Actions project.

During FY 1989, the Albuquerque Operations Office managed an active In-house Energy Management Program at its many sites. Eight retrofit projects were funded in FY 1989. The retrofit projects' total funding is $1,677,000. Upon completion, these projects are projected to save 98 Billion British Thermal Units annually. The average payback is 2.8 years.

At the Rocky Flats Plant smaller horsepower compressors were installed in Buildings 371 and 707 to keep purge air flowing through the supplied breathing air system instead of running the main compressors resulting in annual savings of 570,000 kilowatthours.

Also, contributing to energy conservation in the future were the No. 4 Boiler rebuild, New Water Treatment Program, and New Ventilation Rate Standard which will eventually reduce electrical power consumption.

These major accomplishments will add to the aggressive energy management program at Rocky Flats and help to continue the reduction in plant energy use in future years.

It is Mound Facility policy to meter all major services in buildings (electrical, condensate and chilled water), with separate meters on process systems if the process consumption is a significant, identifiable part of the building load. Long-term plans are to tie all meters into the plant-wide Direct Digital Control System, eliminating the requirement for personnel to manually read meters monthly. FY 1988 metering funds were received to install meters in facilities previously unmetered; construction on this project will be completed in early FY 1990. All new construction includes full metering. Mound Facility has committed $400,000 in General Plant Project funds to install submeters on the most process-intensive areas within buildings.

During FY 1989 a West Boilerhouse condenser water project was completed at the Kansas City Plant, which will improve the operating efficiency of the cooling towers and chillers. This project installed variable frequency variable speed pumps, Direct Digital Control System and condenser water filters. Also an FY 1988 energy conservation metering project was about 50 percent complete in FY 1989. A total of 34 meters were installed and will be tied into the Direct Digital Control System in FY 1990.

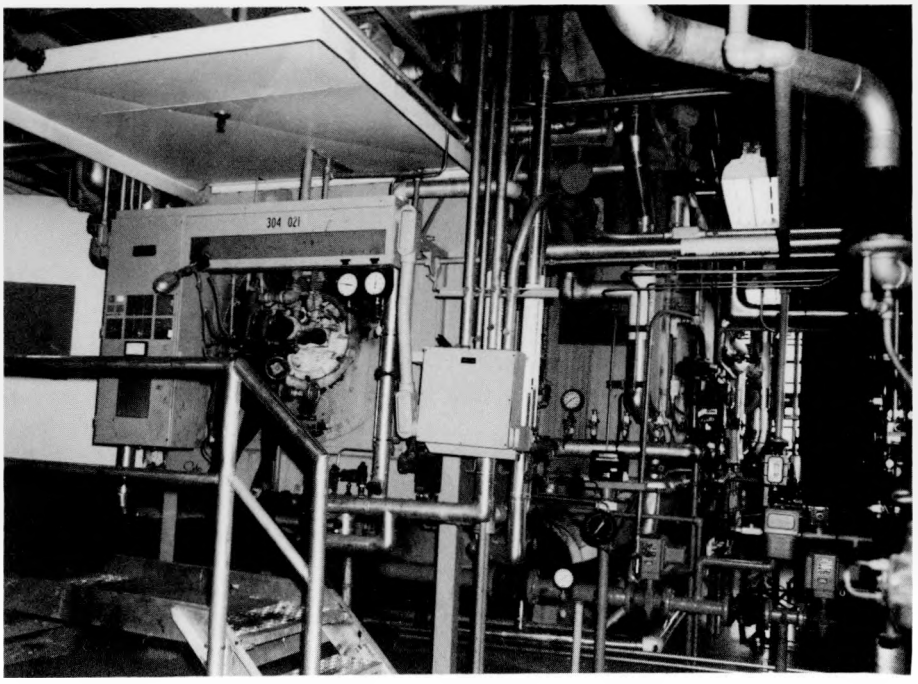
Energy conservation retrofit projects at the Kansas City Plant avoided an estimated $2,173,000 in utility costs for electricity and natural gas during FY 1989. An estimated $11,115,000 has been avoided since FY 1985.

Figures V-3A, V-4A, and V-5A present the total energy consumption and buildings and metered process energy consumption per square foot at the Albuquerque Operations Office for FY 1989 as compared to FY 1985.

2. Chicago Operations Office

The Chicago Operations Office is responsible for the implementation of Federally-funded, energy-related research and development programs and projects scattered throughout the country. In this role, the Chicago Operations Office guides, oversees, and administers two multiprogram laboratories (Argonne National Laboratory and Brookhaven National Laboratory), several single-purpose laboratories (Fermi National Accelerator Laboratory, MIT/Bates Linear Accelerator Center, Princeton Plasma Physics Laboratory, the Solar Energy Research Institute, and Ames Laboratory), and two DOE-operated laboratories (Environmental Measurements Laboratory and the New Brunswick Laboratory). In addition, Chicago Operations Office funds and monitors energy-related research and development work conducted at many universities, and funds and monitors energy related State and local Governments' programs.

The principal programmatic activities under Chicago Operations Office's cognizance include: interlaboratory nuclear materials measurements for Defense Programs; basic and applied research in high energy and nuclear physics; development of fusion and



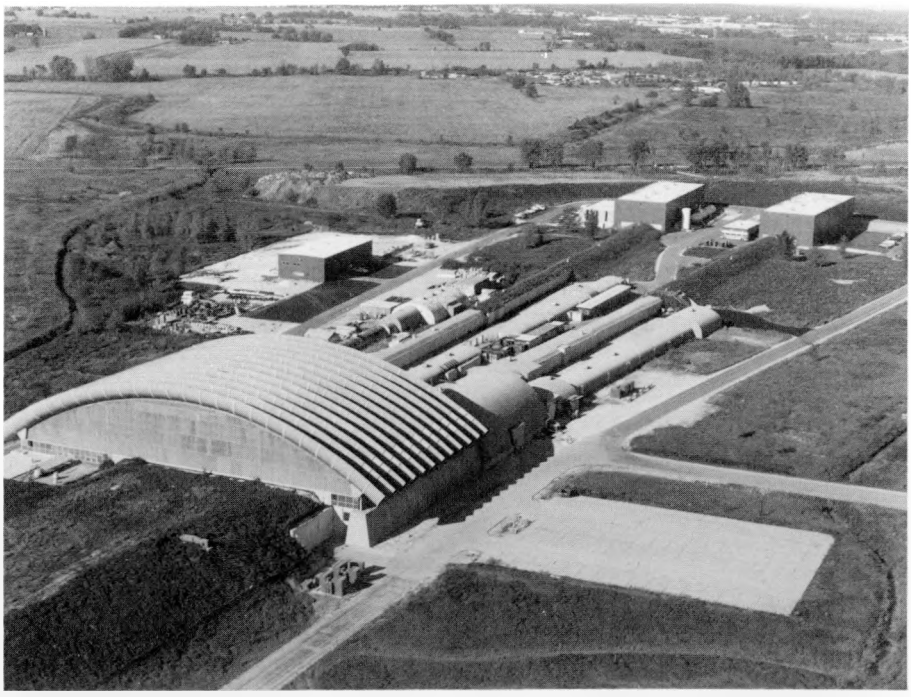
Modifications to these mud drums of Boiler No. 7, at the Rocky Flats Plant increase the efficiency of bottom blowdown, and are saving over $70 Thousand annually in gas cost due to cleaner heat transfer surfaces.

fission energy; development of nuclear waste handling technologies for long-term storage of and transportation of nuclear wastes; research and development of renewable energy sources, such as solar-electric, thermal, electrochemical storage; and other high-risk, high-cost programs and projects.

During FY 1989, the Chicago Operations Office received funding from the In-house Energy Management Program to initiate 10 studies at seven of its sites. As a result of previous energy saving studies, 22 retrofit projects, which will save $1,603,000 per year, and have a simple payback of 4.01 years, were funded in FY 1989 at Chicago Operations Office sites.

The major FY 1989 energy management program element at Fermi National Accelerator Laboratory was the continued work toward the completion of the eleven retrofit projects that had received DOE funding through FY 1989. These eleven projects represent $1.4 million of funding approval and will produce a projected annual energy cost savings of $367,000.

As a direct result of the Princeton Plasma Physics Laboratory In-house Energy Management program effort, there was a reduction of 17.6 percent in the FY 1989 laboratory's buildings energy consumption vs. the FY 1985 base-year. This reduction, when normalized to account for ambience and Princeton Plasma Physics Laboratory's unusually high bay areas in British Thermal Units/cubic foot (which a square foot factor does not reveal), there was a significant overall energy consumption reduction of 31.8 percent in the Princeton Plasma Physics Laboratory Buildings British Thermal Units/cubic foot index FY 1989 vs. FY 1985. Reflected within these building statistics are a 27.5 percent reduction in buildings electrical usage and a 29.1 percent reduction in building heating British Thermal Units energy usage (fuel oil, natural gas, and LPG); subsequently achieving total savings of $562 Thousand in electric and heating fuel costs.



An aerial view of the 37,500 square feet arch-roofed Meson Detector experimental building at the Fermi National Accelerator Laboratory where a 1200 kilowatt electric hot water heating boiler is being replaced with a natural gas fired boiler, which will result in a projected energy cost savings of $69,000 per year.

During FY 1989 Brookhaven National Laboratory's energy management group continued its efforts towards reducing site energy consumption and costs. These efforts involved auditing numerous site buildings and developing conservation of energy project proposals for submission to the DOE In-house Energy Management program. As a result of these efforts, over 4.1 million dollars was funded during FY 1989 for the implementation of energy conservation projects.

Energy usage at the Field Test Laboratory Building, the Seri Area Office's largest Government-owned building and highest consumer of energy, has decreased every year since the base-year of FY 1985 from 380,437 British Thermal Units/square feet to 260,857 British Thermal Units/square feet in FY 1988. In FY 1989 the energy usage decreased to 200,174 British Thermal Units/square feet. This reduction has been primarily achieved through improved operation and maintenance of the boilers and Heating, Ventilating, and Air-conditioning Systems.

Figures V-3B, and V-4B, and V-5B summarize the Chicago Operations Office's total energy consumption, and buildings and metered process energy consumption per square foot for FY 1989, as compared to FY 1985.

3. Idaho Operations Office

The primary mission of the Idaho National Engineering Laboratory is to furnish engineering services and products, principally in nuclear energy and associated technologies. Emphasis is placed on those areas, which require, or particularly benefit from, the laboratory's unique facilities, geography, environment, or expertise. The laboratory provides use of its unique facilities for the benefit of members of the scientific and technical community, and maintains close interaction with scientific personnel in universities and industry.

To fulfill its mission, the Idaho National Engineering Laboratory focuses its scientific and technical efforts on

defense-related nuclear materials production centered largely on receipt, storage and processing of spent fuels, and management of nuclear wastes; reactor development and operation, principally conducted at the Advanced Test Reactor and associated programs in materials testing, isotope production, irradiation services, and training and test support; waste management and waste technology development for the Low-Level and Transuranic Waste Programs; nuclear safety research; service and support to other laboratories, which have major facilities at the site; other energy research programs and support to the Department of Defense and the Nuclear Regulatory Commission; and areas of unique capability, research and development supporting a technology base appropriate to its various missions, and maintenance of the capability to provide the Government and the public with informal and independent scientific opinion in its areas of competence.

At the Idaho National Engineering Laboratory construction of the Advanced Test Reactor Waste Heat Recovery System Phase II is ahead of schedule. This project will use a portion of the Advanced Test Reactor secondary coolant to be circulated to major facilities within the Test Reactor Area space heating before being dumped to the cooling tower. The Waste Heat Recovery System is expected to begin operation during the FY 1990 heating season.

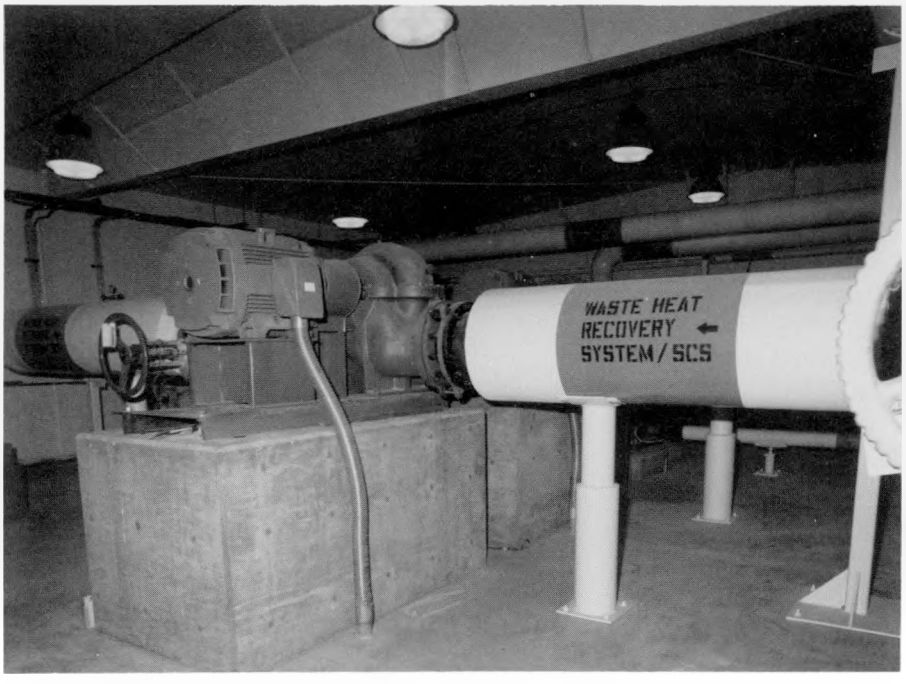
The West Valley Demonstration Project Site has eliminated a large source of energy loss by replacing the leaking underground steam lines where practical with above ground insulated lines. A 150 horsepower blower motor was replaced by a high efficiency motor. The air compressor and boiler control replacements are resulting in less downtime for equipment and more efficient use for the products generated.

Figures V-3C, V-4C, and V-5C summarize the Idaho Operations Office total energy consumption, and buildings and metered process energy consumption per square foot for FY 1989, as compared to FY 1985.

4. Nevada Operations Office

The primary mission of the Nevada Operations Office is testing nuclear explosives for the nation's nuclear weapons research, development, and testing program. Major activities included in that mission are large diameter hole drilling and mining for underground emplacement of nuclear test devices; and design, fabrication, installation, and operation of complex electronic systems related to nuclear device detonation, data acquisition, and diagnostics.

This Advanced Test Reactor Waste Heat Recovery System at the Idaho National Engineering Laboratory will remove approximately 5000 gallons per minute of secondary coolant from an existing 36" underground pipe, running from the Advanced Test Reactor primary heat exchangers to the cooling tower. The warm secondary coolant (at a temperature between 120°F and 140°F) will be used to provide space heating in 13 of the major buildings at the Test Reactor Area.

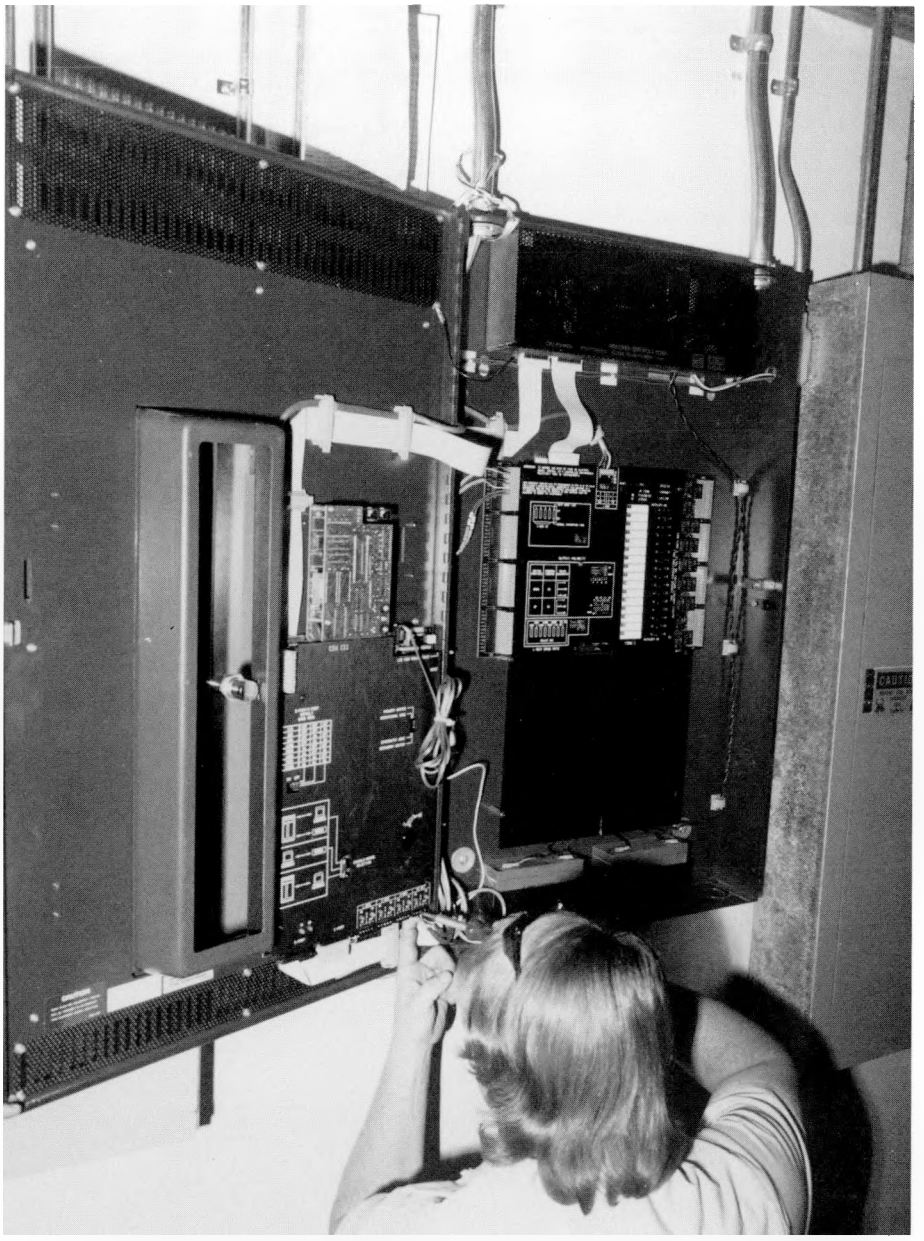


Either of two main distribution pumps as shown here will be used to circulate the secondary coolant water through the Advanced Test Reactor Waste Heat Recovery System loop. A small third pump will be used to circulate 200 gallons per minute of coolant through the loop to prevent freeze up in winter when the Advanced Test Reactor is not operating.

The Nevada Operations Office also has the primary responsibility for maintaining DOE's nuclear emergency response and nuclear test treaty verification capabilities. It has a major role in the DOE civilian radioactive waste management program, which involves detailed characterization of a portion of the Nevada Test Site to determine its suitability for construction of a high-level radioactive waste repository. Other significant activities support DOE mission area assignments in low-level radioactive defense waste management and liquified gaseous fuels spill program.

At the Nevada Operations Office Reynolds Electric and Engineering Company and EG&G/Energy Measurements have a continuing program to inform all employees of the Energy Conservation Program and, in turn, have management provide evaluation and examination of the variations from previous and current consumption levels. Nevada Operations Office accomplishments are well advised employees, who energetically support conservation; continued surveillance by maintenance and operating personnel; the development of cost effective retrofit projects; the inclusion of energy conservation guidelines in architect-engineer designs; continuing lighting audits, the implementation of operating building energy temperature restrictions, and changes accordingly, especially when facilities are not being utilized. The energy slogan contest conducted by Reynolds Electric and Engineering Company was well received by the employees and will become an annual event.

The operating contractor's internal appraisal systems successfully motivate all personnel to contribute their suggestions and innovations for continual advancement of energy conservation. The results of internal appraisals are passed upward from the department level and provide a basis for the annual update of the contractor's "Ten-Year Plan for Energy Management." The criteria for this program includes development, improvement, issuance, and maintenance of construction and operation for DOE facilities, vehicles, and equipment.



Pictured is the Andover Controls AC256 Master Plus microcomputer based programmable controller at the North Las Vegas facilities. This energy monitoring system resulted in an estimated annual energy savings of 16,369 million British Thermal Units.

Nevada Operations Office operating contractors completed 17 site funded energy management retrofit projects in FY 1989.

Figures V-3D and V-4D present comparison of FY 1989 with base-year FY 1985 total energy and buildings energy per square foot consumption at the Nevada Operations Office.

5. Oak Ridge Operations Office

Established under the Manhattan Project during World War II, Oak Ridge Operations Office's programs have expanded from a narrow focus on atomic energy to a broad spectrum of energy research, development, and production. The Oak Ridge Operations Office, one of DOE's most diversified field offices, manages facilities in Tennessee, Kentucky, Ohio, and

Louisiana, and also provides administrative assistance to the DOE Office of Scientific and Technical Information.

Major assignments of the Oak Ridge Operations Office include: the production of enriched uranium by gaseous diffusion to produce fuel for nuclear power plants (Portsmouth and Paducah Gaseous Diffusion Plants and Oak Ridge Gaseous Diffusion Plant which is presently in standby); support of the national defense effort through the manufacture of weapons components (Y-12 Plant); the processing of uranium feed materials and the production of uranium fuel cores for plutonium production reactors (Fernald Plant); wide-range research and development efforts on a variety of energy technologies including nuclear fusion, fuel reprocessing, fossil energy, waste technology, materials research (Oak Ridge National Laboratory); and providing educational and training programs serving public, vocational, professional, and technical group (Oak Ridge Associated Universities).

Noteworthy accomplishments during FY 1989 at Oak Ridge Operations Office sites include both continuing and new benefits from utility contracts with primary electrical suppliers. Substantial benefits still accrue from Tennessee Valley Authority contract provisions, which allow the purchase of "unfirm" power. During FY 1989, the Paducah Gaseous Diffusion Plant saved about $10 million by purchasing electrical power under these contract provisions. The Strategic Petroleum Reserve is focusing major efforts on renegotiation of power contracts with three suppliers--Gulf States Utilities, Houston Lighting and Power Company, and Louisiana Power and Light. Total potential benefits are unknown at this time, however, examples of potential savings under the Gulf States Utilities contracts are:

1. Benefits of $60 thousand a month at the Big Hill Facility for "30 minute interruptible" power.

2. Savings in the range of $150 thousand to $300 thousand due to negotiated favorable rates for the Sulphur Mines Site.

The following is a summary of other energy management actions at sites under the cognizance of the Oak Ridge Operations Office during FY 1989.

The Oak Ridge Gaseous Diffusion Plant site replaced eighty light diffusers for $400 to achieve lighting improvements in the Charlotte Hall office building. Lighting level improvements of 20 to 25 percent were achieved making it unnecessary to buy 25 new lights, which would have cost $2,500.

At the Paducah Gaseous Diffusion Plant, continuing emphasis on conservation is yielding dividends. Shutdown of exhaust fans during low production demands has achieved savings of about $100 thousand.

Figures V-3E, V-4E, and V-5E present the total energy consumption and buildings and metered process energy consumption per square foot for FY 1989 as compared to FY 1985 at the Oak Ridge Operations Office.

6. Pittsburgh Naval Reactors Office

The Pittsburgh Naval Reactors Office administers the operation of the Bettis Atomic Power Laboratory. The Bettis Atomic Power Laboratory is a research and development facility, which includes the Bettis site located in West Mifflin, Pennsylvania and the Naval Reactors Facility in Idaho Falls, Idaho.

The Bettis Atomic Power Laboratory's mission is primarily concerned with the design, development and operational follow-up of nuclear reactor power plants for propulsion of Naval surface and submarine vessels. Other programmatic activities include evaluating nuclear reactor operations, training Naval personnel for the nuclear fleet, and the examination and evaluation of depleted reactor cores.

An In-house Energy Management survey program was established in FY 1986 and continued during FY 1989. This program focused on reducing process energy with the initial surveys performed by personnel who are most knowledgeable with the facilities, operations, and technical work program schedules and requirements. This

Shown is the Central Heating Plant Boiler House at the Naval Reactors Facility Site (Idaho Falls, ID). The three chimneys and main combustion chambers of the Naval Reactors Facility boilers were sand blasted to clean the combustion products off the heat transfer elements. This sand blasting is estimated to save 3.54 billion British Thermal Units per year.

in-house survey program is expected to continue over the next several years.

The most important element of the Bettis Laboratory energy management program is the identification, evaluation and implementation of life-cycle cost effective retrofit projects. Most of the energy savings required to meet the energy management goals for FY 1995 are expected to come from these projects. Energy savings realized from projects completed during FY 1989 will result in a 11.9 billion British Thermal Units's reduction per year or about 8.8 percent of the Bettis Laboratory's required goal by FY 1995.

Satisfactory progress towards the Bettis Laboratory Ten-Year Plan was achieved during FY 1989 as a result of completed energy conservation actions and retrofit projects. Collectively, the Bettis and Naval Reactor Facility projects completed to date are estimated to save approximately 66.6 billion British Thermal Units annually, which represent a reduction of 49 percent from the total Bettis Laboratory ten year goal of 135.8 billion British Thermal Units. Out of this total 10.6 billion British Thermal Units are for fuel oil which represents a 82.8 reduction from the 12.8 billion British Thermal Units identified for petroleum consumption.

Construction of a new building addition was completed at the Bettis site during FY 1989. This new building addition was designed in compliance with previous DOE requirements and standards relating to energy management. Designs for any new Bettis or Naval Reactor Facility buildings or building additions will now be performed in accordance with the requirements of DOE Order 6430.1A, GENERAL DESIGN CRITERIA, including the guidelines of the Mandatory Energy Conservation Performance Standards for New Federal Buildings (Title 10 Code of Federal Regulations, Part 435), as applicable.

7. Richland Operations Office

The Richland Operations Office is responsible for management of over 870 buildings and metered process facilities, which occupy 6.8 million square feet of space at 10 major locations on the Hanford Site (570 square miles).

The mission of the Richland Operations Office is diverse. Rockwell Hanford Operations is responsible for Chemical Processing Waste Management, Site Services, and the Basalt Waste Isolation Project at Hanford. The mission of the Hanford Engineering Development Laboratory is to develop advanced nuclear power concepts, with special emphasis on breeder reactor fuels, materials, components, and systems. It is also the focal point for materials research for the fusion program.

The Pacific Northwest Laboratory performs basic and applied research and engineering development for the Department in nuclear energy technology and waste management; defense nuclear materials production; renewable energy technology development; energy conservation; and environment, health and safety programs. The Pacific Northwest Laboratory is a DOE multiprogram laboratory and includes the important role as the research and development laboratory for the Hanford site, especially for defense missions.

The Hanford Energy Management Committee is chaired by the Site Management Division and is composed of six representatives. The Hanford Energy Management Committee provides major leadership and thrust to awareness of the need for energy management at the site, and demonstrating the ability of the different contractors and site functions to work together to increase energy efficiency. The Hanford Energy Management Committee promotes energy management success through the willingness of its representatives to openly share their mutual energy management problems, successes, and opportunities for improvement. State-of-the-art technology is evaluated for operations enhancement through the Hanford Energy Management Committee with initial screening by the research and development representatives.

FY 1989 completes the fourth year of Hanford's Ten-Year Energy Management Plan FY 1985 - FY 1995. A 10 percent reduction by FY 1995 in each of the control categories has been set as a goal with the FY 1985 consumption being the baseline. The FY 1989 consumption reflects a 15.6 percent reduction in the buildings category, a 30.5 percent reduction in the vehicles and other equipment category with an overall site reduction of 23.8 percent for total energy consumption. These figures would project a successful energy management program and are in part a result of the program. However, much of the FY 1989 reduction is a result of programmatic reductions at Hanford and milder climatic conditions in FY 1989 and compared to FY 1985 conditions.

Figures V-3F, V-4F and V-5F present the total energy consumption and buildings and metered process energy consumption for FY 1989, as compared with FY 1986 at the Richland Operations Office.

8. San Francisco Operations Office

The San Francisco Operations Office is responsible for activities in the States of California, Arizona, Nevada, Hawaii, and the Pacific Trust Territories. Its function is to implement programs through integration of policies as applied to a specific site or contract. The San Francisco Operations Office has responsibility for major activities in the areas of defense programs, nuclear energy, magnetic fusion, energy research, fossil energy, conservation and renewable energy technology development.

A major portion of the mission is accomplished through program and business management of assigned DOE management and operating contractors. These include Lawrence Livermore National Laboratory, Lawrence Berkeley Laboratory, the Stanford Linear Accelerator Center, and the Energy Technology Engineering Center.

The San Francisco Operations Office, through its personnel compliment of some 300 employees, presents a broad range of capabilities including technical program/project management, environment and safety, procurement, personnel, industrial relations, financial management, legal, patents, safeguards and security, audit and management information and telecommunications functions. Technical programs and projects managed cover a wide variety of areas from basic science through field tests to manufacturing development.

FY 1989 represented an overall continuation of energy management at the San Francisco Operations Office and its four Management and Operating contractor sites, in an on-going effort to identify future cost effective projects to derive additional savings. Major accomplishments at San Francisco Operations Office sites during this timeframe are as follows:

The Lawrence Berkeley Laboratory's In-house Energy Management program received national recognition when the laboratory and Dale Sartor were honored with the awards for Outstanding Laboratory and Individual Achievement in energy management by DOE. In addition, the Federal Energy Efficiency Award was made to Dale Sartor. Other accomplishments at Lawrence Berkeley Laboratory included:

Off-peak and interruptible power which saved Lawrence Berkeley Laboratory over $1.27 million in FY 1989; Lawrence Berkeley Laboratory received utility conservation rebates amounting to $69 Thousand; the DOE funded Building Automation Opportunity Survey was completed and resulted in $1.8 million in retrofit projects that will save an estimated $400 Thousand annually; the Lighting Conservation Opportunity survey was completed and resulted in $3,565 Thousand of retrofit projects with potential annual savings of over $600 Thousand; the annual Christmas shutdown was implemented successfully. Preliminary review of the shutdown indicated a savings in both electricity and natural gas totalling over $50 Thousand.

The Energy Technology Engineering Center completed the Heating, Ventilating, and Air-conditioning System efficiency improvement and preheater modification to the sodium components test installation. Heat exchangers (preheaters) for the H-1 and H-2 sodium heaters are used for stack gas routing to preheat the combustion air to 600°F. This increases the thermal efficiencies of the heaters and significantly reduces fuel consumption. Annual energy savings are estimated at 235,260 Million British Thermal Units. Annual dollar savings are estimated at $633,000.

A major accomplishment for FY 1989 was the success of Lawrence Livermore National Laboratory's surveys and studies program. As a result of these studies, the energy management section has been authorized funding for $2.9 million for energy savings retrofit projects. These projects will accrue energy savings for the overall DOE goal of a 10 percent energy savings in laboratory buildings by FY 1995. The most noted accomplishment for FY 1989 at Lawrence Livermore National Laboratory was the continued reduction in overall energy usage. Significant contributors to this effort were the employee awareness program and the continued successful implementation of the retrofit program by DOE. The following data will explain just how much energy was saved and where the laboratory stands in meeting the DOE goals for FY 1995. The FY 1985 energy consumption at Lawrence Livermore National Laboratory in the buildings category was 655 Thousand British Thermal Units/gross square foot. To achieve the DOE 10 percent goal, 589.5 Thousand British Thermal Units/gross square foot, by FY 1995 requires a reduction in consumption of 65.5 Thousand British Thermal Units/gross square foot. The current FY 1989 building energy use category of 581 Thousand British Thermal Units/gross square foot has already exceeded the target of 589.5 Thousand British Thermal Units/gross square feet, with a 11.3 percent drop from the FY 1985 goal.

During FY 1989, at Stanford Linear Accelerator Center, work has been continuing on the 12.47 kilovolt distribution system capacitor banks project. It is expected that this project will result in an annual savings of 715,000 kilowatthour. This project is scheduled for completion in the first quarter of FY 1990. The Heating, Ventilating, and Air-conditioning control systems upgrade proposal for the Administration and Engineering Building and Central Laboratory has been approved by DOE. Work on this project is expected to start in the second quarter of FY 1990. Work has also begun on the lighting control system in the Administration and Engineering Building, to remotely control lighting, in order that lights will not be left on late at night when the building is unoccupied. Completion of this project is expected during the second quarter of FY 1990.

Figures V-3G, V-4G and V-5G present total energy consumption and buildings and metered process energy consumption per square foot for FY 1989, as compared with FY 1985 at the San Francisco Operations Office.

9. Savannah River Operations Office

The Savannah River Operations Office, established in 1952, is one of the key installations in the special nuclear

materials production and research program under DOE. It is responsible for energy research and development, production of nuclear materials for national defense, and related environmental research activities. The entire 300 square mile site was designated as the first National Environmental Research Park in 1972. Major assignments include isotope production, fuel and target fabrication, and chemical separations; management of liquid, solid, and gaseous radioactive wastes; joint studies with the U.S. Forest Services on forest management at the Savannah River Site; comprehensive program of environmental monitoring; and environmental research related to the effects of different forms of energy utilization on the environment.

Total energy consumption decreased 44 percent compared to FY 1985. This is primarily due to all operable reactors at the Savannah River Site being shutdown in FY 1989 for upgrades and new buildings having a more energy efficient design. Construction activity on-site continued at a steady pace. Building square footage has increased 17 percent since FY 1985.

Beginning April 1, 1989, Westinghouse Savannah River Company became the prime operating contractor at the Savannah River Site. The responsibility for the site energy management program was then given to the Power Engineering Department. In September 1989, a new Ten-Year In-house Energy Management plan was issued to replace the existing Five-Year Energy Plan. This Ten-Year Plan outlines the site's plan to meet the FY 1995 energy reduction goals as set forth by DOE Order 4330.2C, IN-HOUSE ENERGY MANAGEMENT.

A feasibility study to replace P-Area Powerhouse at the Savannah River Site was conducted in FY 1989. This study evaluated the energy conservation and economical savings of replacing the P-Area powerhouse. It analyzed the system impact of permanently shutting down the 184-P powerhouse and replacing the existing electrical and steam production with purchased power from the utility and steam from a coal-fired package boiler. This study also examined the proposed installation of nine combustion turbine units to provide emergency standby electrical power.

Following the study's completion, a project titled Installation of Combustion Turbine Generator Units at Par Pond was initiated. This project has an estimated annual cost savings of $2.2 million. Energy savings have been calculated to be approximately 119 Billion British Thermal Units per year. This project and the new central power facilities project, were nominated, as requested by the Secretary of Energy, for the department's shared energy savings program.

Figures V-3H, V-4H and V-5H summarize the Savannah River Operations Office total energy consumption and buildings and metered process energy consumption per square foot for FY 1989 as compared to FY 1985.

10. Schenectady Naval Reactors Office

The Schenectady Naval Reactors Office manages the Knolls Atomic Power Laboratory. The mission of the Knolls Atomic Power Laboratory is to support the United States Navy's Nuclear Power Program through the development of advanced reactor plant designs, while providing design agency support of the operating fleet and training nuclear propulsion plant operating personnel.

Major accomplishments at Knolls Atomic Power Laboratory during FY 1989 were:

A design and construction contract was awarded for insulation retrofit of three Knolls Atomic Power Laboratory buildings. Once installed this work will amount to an estimated $35,000 per year savings in fuel oil and electricity costs. A construction contract was awarded for replacement of Kesselring Site boilers and issuance of a revised 10 year energy plan propos-

Pictured is the P-Area Powerhouse at the Savannah River Site. This Powerhouse is proposed to be shutdown as a result of the In-House Energy Management funded "Feasibility Study to Replace P-Area Powerhouse." Its high cost electrical and steam production would be replaced with purchased power from the utility and steam from a coal-fired package boiler.

ing specific conservation items intended to meet the mandated 10 percent reduction in energy usage was issued.

C. Power Administrations

1. Alaska Power Administration

The Alaska Power Administration operates, maintains, and markets power from Alaska's two Federal hydroelectric projects. These projects are the 30,000 kilowatt Eklutma Project serving the Anchorage-Palmer area and the 47,160 kilowatt Snettisham Project serving the Juneau area. The Alaska Power Administration also investigates and plans for developing and utilizing Alaska's water, power, and related resources. Much of the work focuses on hydroelectric resources, transmission systems, and power market analyses. These programs are closely coordinated with other Federal, State and local agencies.

2. Bonneville Power Administration

The Bonneville Power Administration provides support services and acts as a catalyst for achieving the electric power and conservation objectives of the Pacific Northwest. The Bonneville Power Administration works to assure the region an adequate, economical, reliable, efficient, and environmentally acceptable power supply. It is a wholesaler of electric power in the Pacific Northwest and operates several power generation facilities.

3. Southeastern Power Administration

Southeastern Power Administration's mission is the marking of Federal hydroelectric power produced at Corps of Engineers' constructed projects in 10 Southeastern States. These States are: West Virginia, Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Tennessee, and Kentucky.

The Southeastern Power Administration transmits and disposes of the surplus electric power and energy generated at Federal reservoir projects so as to encourage the most widespread and economical use at the lowest possible rates to consumers consistent with sound business principles, giving preference in the sale of power to public bodies and cooperatives.

The program of the Southeastern Power Administration includes the negotiation, preparation, execution, and administration of contracts for the sale and purchase of electric power, the preparation of wholesale rates and repayment schedules, arranging for use of transmission and related facilities to interconnect reservoir projects and serve contractual loads, and activities pertaining to the operation of power facilities to ensure maximum contributions to area power supply.

Lacking transmission facilities of its own, Southeastern Power Administration, utilizes existing utility systems to integrate, provide backup, and transmit its power, where necessary, to customer load centers. Where possible, Southeastern Power Administration's projects are integrated hydraulically, electrically, and financially, and its power is in turn integrated with area power resources. A large number of area systems depend upon Southeastern Power Administration's power to meet load requirements, provide reserves, and help meet emergency conditions. Southeastern Power Administration's power contributes very substantial benefits to area systems and citizens and is important to the maintenance of the area's existing pluralistic power industry.

Southeastern Power Administration, within the provisions of its contracts, is committed to maintain contracts with the various utilities it serves to provide delivery of peaking power in a manner that will reduce the use of oil-fired generation to serve peaking loads or for generation during emergency outages of other equipment. These additional deliveries are designed to save as much oil as possible and are accomplished with the full cooperation of the Corps of Engineers.

4. Southwestern Power Administration

The Southwestern Power Administration's mission is to market hydroelectric power in the Southwestern Region from dams operated by the U.S. Army Corps of Engineers. At present, 23 hydroelectric facilities are in operation at multipurpose reservoirs in Missouri, Oklahoma, Arkansas, and Texas. The installed capacity of these 23 projects is 2,150,350 kilowatts. The power is marketed in Kansas and Louisiana, as well as in the States where it is generated.

To transmit power from the dams to its wholesale customers, the Southwestern Power Administration has built and maintains a high-voltage transmission line system, currently comprising 1,380 miles. The Southwestern Power Administration sells wholesale power to approximately 90 customers consisting of municipal utility systems, rural electric generation and transmission cooperatives, and Federal and State agencies.

The Southwestern Power Administration's headquarters are located in Tulsa, Oklahoma. The Operations Center, which controls the transmission of power, and the Engineering Center are in Springfield, Missouri. Maintenance personnel are located in Springfield, Missouri; Jonesboro, Arkansas; and at Gore and Tupelo, Oklahoma.

5. Western Area Power Administration

The Western Area Power Administration is responsible for the Federal

electric power marketing and transmission function in 15 central and western states encompassing a 1.3 million square mile geographic area. The Western Area Power Administration sells power to 609 customers consisting of cooperatives, municipalities, public utility districts, private utilities, Federal and State agencies, and irrigation districts. These wholesale power customers, in turn, provide service to millions of retail consumers in California, Nevada, Montana, Arizona, Utah, New Mexico, Texas, North Dakota, South Dakota, Iowa, Colorado, Wyoming, Minnesota , Nebraska, and Kansas. The Western Area Power Administration is responsible for the operation and maintenance of 16,554 miles of transmission lines, 259 substations, and various other power facilities in the above geographic areas and also for planning, construction, and operation and maintenance of additional Federal transmission facilities that may be authorized in the future. Electric power that the Western Area Power Administration markets is generated at 51 hydropower plants owned and operated by the Bureau of Reclamation, the U.S. Army Corps of Engineers and the International Boundary and Water Commission. Additionally, the Western Area Power Administration markets the United States' entitlement from the coal-fired Navajo generating station near Page, Arizona. Current installed generating capacity that Western markets is over 10,407 megawatts.

As mandated by the Hoover Power Plant Act of 1984, Western expanded its customer Conservation and Renewable Energy program to require all firm power customers to have active, continuing Conservation and Renewable Energy programs to ensure proper stewardship of the Nation's natural resources. During FY 1989, stern's five area offices reviewed 430 customer Conservation and Renewable Energy plans. Of those, 353 original submittals were accepted and another 51 were accepted after additional information was provided. Implementation of these customer plans will increase energy efficiency. Western facilities that use Western power will benefit from this increased efficiency because more lower cost Federal hydropower will be available for their use.

During FY 1989, Western continued examining ways to make control building in the Bismarck District Office more energy efficient. Control buildings often lack air conditioning, have little heating, and almost no insulation. These conditions make it difficult to operate solid state metering and relaying equipment, which require consistent temperatures.

Control building have been audited and metered to determine how much energy they consume. This information is being compiled in an internal report to Bismarck District Office. The report will help Western choose the most effective ways to make the buildings more energy efficient. Study findings helped Western assess the dependability of its control systems and the accuracy of its computer models on energy usage for a variety of standardized construction buildings. This work will carry over into designs for retrofitting control buildings throughout Western.

During FY 1989, Colorado State University in Fort Collins analyzed the lighting of Power Marketing and Operations Complex at Loveland Area Office. Retrofitting the lighting began in FY 1989.

Western continued to use infrared heat detection equipment during FY 1989 at all field sites to find problems with electrical equipment or buildings. The equipment enables Western to detect poor building insulation and faulty electrical equipment, such as loose connections and malfunctioning transformers and capacitors. Using the equipment regularly helps improve efficiency, prevents unscheduled outages, reduces equipment losses, and ensures reliable service to Western customers. Additionally, Western has begun to use infrared scanning to check the quality of new construction.

D. Energy Technology Centers

1. National Institute for Petroleum and Energy Research

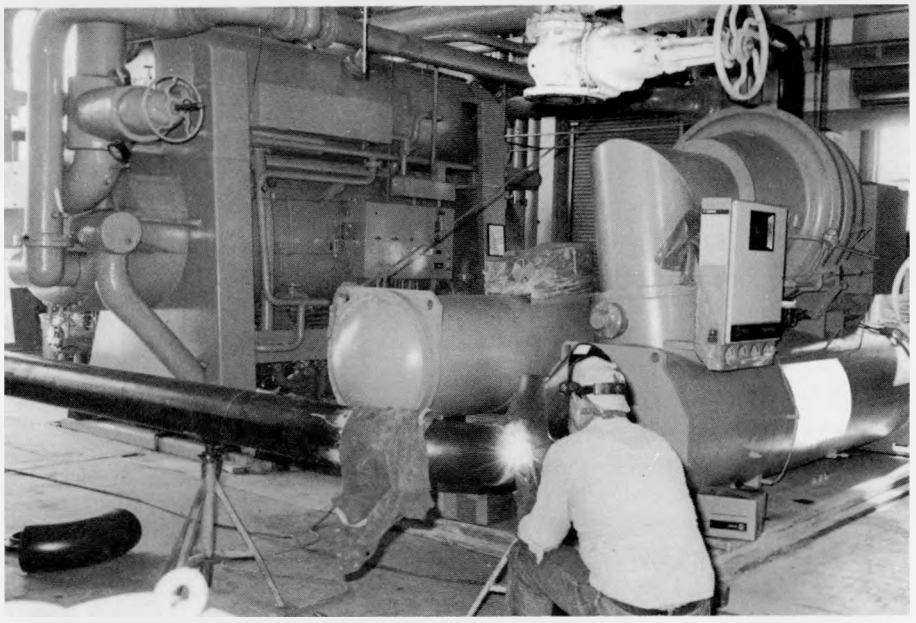
The research program of the National Institute for Petroleum and Energy Research includes projects on enhanced oil and gas recovery; characterization and utilization of syncrudes from coal, oil, shale and tar sands as petroleum substitutes; definition of refining characteristics of liquids derived from alternative fuel sources; a comprehensive data bank of crude oil properties representing worldwide sources; better utilization of petroleum products, as in recycling of used lubrication oils; research directed toward safeguarding the environment; and improved efficiencies of automotive engines and use of alternative fuels.

The most significant recent effort at the National Institute for Petroleum and Energy Research was the replacement of the major equipment in the central power plant. This facility uses 85 percent of the natural gas consumed on center and 30 percent of the electricity. The changes that were completed in FY 1988 and FY 1989, have shown, through reduced energy costs, that the projected savings were accurate. The equipment has performed to all expectations. During FY 1989 the free cooling option on the new chiller was automated so that the switching from mechanical cooling to free cooling mode was done automatically based on temperature and humidity of the outside air. The projects funded in FY 1989 to add boiler trim controls and a variable drive to the power plant cooling tower will be operational in FY 1990.

2. Morgantown Energy Technology Center

The Morgantown Energy Technology Center is the lead center for 13 fossil energy programs: coal gasification, fluidized-bed combustion, instrumentation and control components, gas stream cleanup, fuel cells, heat engines, low-rank coals, unconventional gas recovery, underground coal gasification, oil shale technologies, tar sands, and Arctic and off-shore research.

Morgantown Energy Technology Center managers oversee diverse projects conducted by DOE national laboratories, academic institutions, and through contracts with the private sector; in some projects, industry cost-sharing augments the program funding. An integral phase of both sponsored and in-house research is the transfer of technology to those who will apply it in U.S. industry. Communication vehicles from the Morgantown Energy Technology Center include databases, publications, conferences, patents, personnel exchange, contracts, technical exchange programs, and visitors to the Center.



Pictured is the New Chiller and Free Cooling Heat Exchanger being installed at the power plant of the National Institute for Petroleum and Energy Research Center. This new system will save approximately $1,500 per year in energy costs.

Shown is Building 84 renovation at the Pittsburgh Energy Technology Center, featuring inefficient glazing to be replaced by energy conserving brick and insulated block system.

At the Morgantown Energy Technology Center, scientists and engineers conduct in-house research to support the 13 lead mission areas. The thrust of the research program is to develop a scientific and engineering database that will allow industry to develop and commercialize new technologies. Emphasis is placed on concepts that significantly improve the environmental performance, the energy efficiency, and the cost effectiveness of fossil fuels, allowing the U.S. to shift from reliance on dwindling conventional oil resources toward more abundant domestic fuels.

The major thrust of the FY 1989 energy conservation program at the Morgantown Energy Technology Center was to increase the efficiency of the boiler and steam distribution system. A consultant made a list of recommendations and projects were written to implement the recommendations. All of the cost effective recommendations have been or are being implemented at this time.

3. Pittsburgh Energy Technology Center

The Pittsburgh Energy Technology Center has evolved over the past four decades into one of the Federal Government's largest and most comprehensive coal technology research centers, performing a major role in DOE's mission to ensure an adequate supply of clean energy from coal. The program at the Pittsburgh Energy Technology Center emphasizes basic research and development in new technologies that hold promise for increasing the industrial use of coal in the long term.

At present, the Pittsburgh Energy Technology Center has lead mission for the DOE's fossil energy research and development programs in the areas of coal liquefaction, coal

preparation, alternate fuel mixtures, flue gas cleanup, magnetohydrodynamics, advanced research and technology development of direct coal liquefaction and liquefaction processes, university coal research, peat processing, anthracite, and the phenomena of solids transport.

Major accomplishments at the Pittsburgh Energy Technology Center included completion of energy conservation survey numbers three and four. Survey number three provided an analysis of the existing energy management system and, provided plans and construction specifications to establish a utility metering system for the entire Plateau Area Complex. This system when installed will be invaluable for assessing future energy conservation changes. Survey number four identified two major energy conserving opportunities for the Plateau Area Complex. It would be a great advantage to have the metering system installed and functioning to measure real gains achieved by implementation of either of the opportunities presented by this survey.

E. Petroleum Reserves

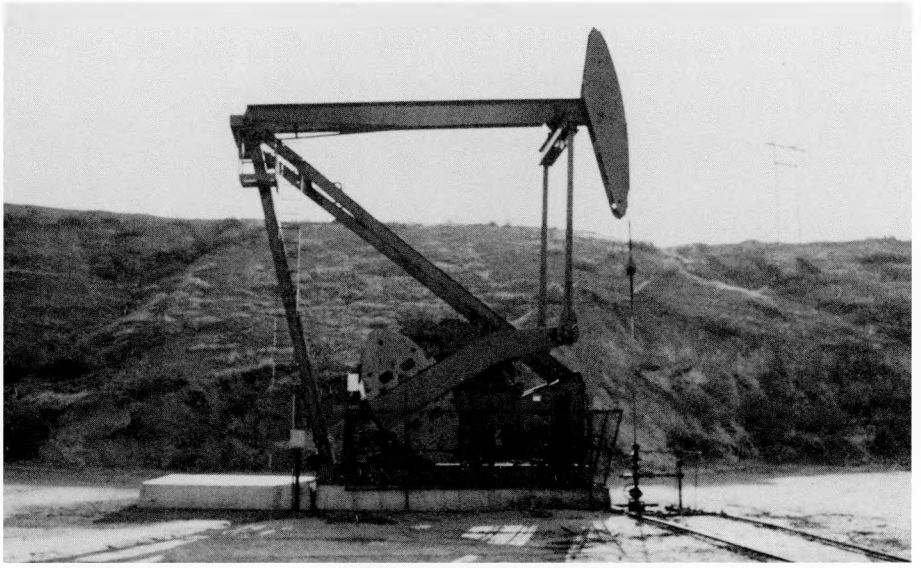
1. Naval Petroleum Reserves

The Elk Hills Naval Petroleum Reserve No. 1 is a 48,000-acre oil field, located 30 miles west of Bakersfield, California, producing oil and associated hydrocarbons from subsurface reservoirs at their maximum efficiency rates. The maximum efficiency rate is the maximum sustainable oil and gas daily production rate, which will permit economic development and depletion of the reservoir without detriment to the ultimate recovery. The Naval Petroleum Reserves No. 3 consists of 9,481 acres located approximately 35 miles north of Casper, Wyoming. The mission is to produce crude oil, natural gas and natural gas liquids from the subsurface petroleum bearing zones at the maximum efficient rate.

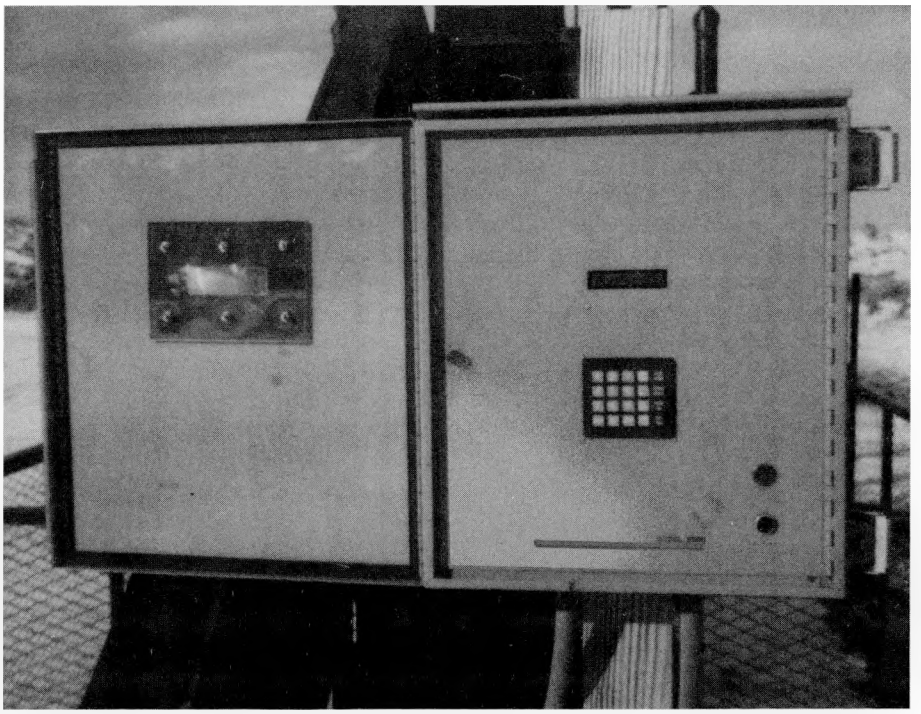
The Naval Oil Shale Reserves No. 1 and 3 consist of 40,760 acres and 14,130 acres, respectively, located approximately 7 miles west of Rifle, Colorado. Naval Oil Shale Reserve No. 2 consists of about 90,400 acres located approximately 55 miles southeast of Vernal, Utah. These three oil shale reserves were established as a future vast resource of oil.

Although some natural gas is being produced by Naval Oil Shale Reserves No. 3 under a gas protection plan, the primary mission of these oil shale reserves is to maintain readiness for future development when warranted by economic conditions.

The following are some of the energy conservation measures taken in FY



Optimization of oil well artificial lift units, as shown in this photograph, is maintained at Naval Petroleum Reserves in California by timed pump-off controllers.



Pictured is a typical oil well automatic pump-off controller used at Naval Petroleum Reserves in Colorado, Utah, and Wyoming and Naval Petroleum Reserves in California for the optimization of oil well artificial lift units.

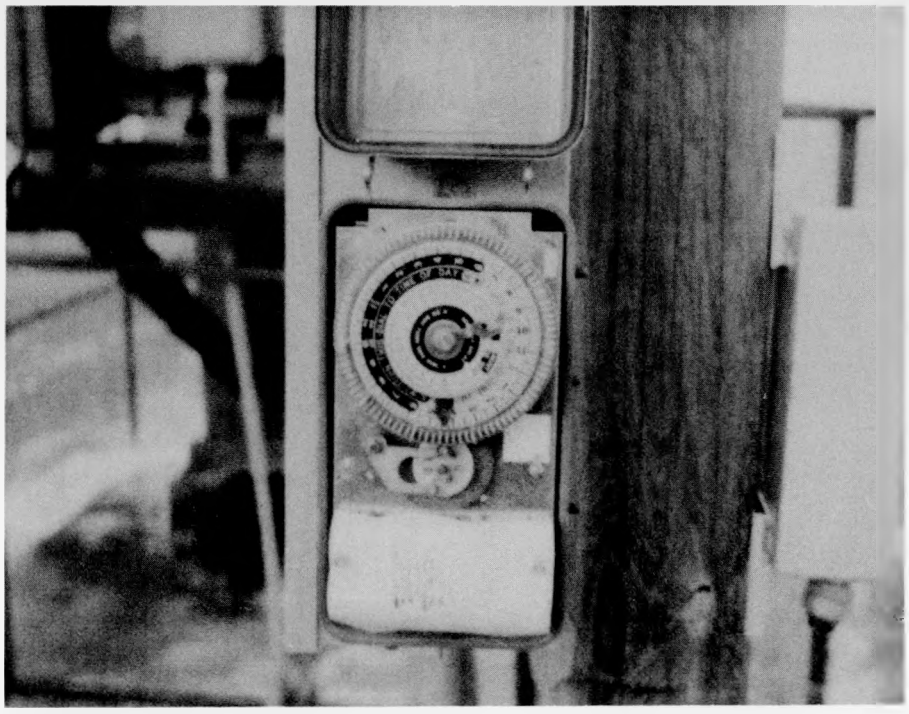
1989 at Naval Petroleum Reserves. Natural hot water was utilized to heat produced fluids running to some tank batteries. This action reduced the fuel gas required for separation of the oil and water emulsion by 30 million cubic feet per day for an estimated annual savings of approximately $10,000. Some wells having a high gas-oil ratio were shut-in to reduce the amount of gas processed through the gas plant by approximately 25 percent. This action allowed two compressors to be put on standby and resulted in an estimated savings in electrical energy for an 8 month period of approximately $100,000.

Thirty-one oil wells were permanently shut-in during FY 1989. The oil production from these wells had declined to a point where the daily operating costs exceeded the revenue generated. In addition, an average of six wells per month were temporarily shut-in to improve production by cyclic operation. Shutting-in the wells eliminated the need for electricity to operate the pumping units and thereby reduced electrical demand. This action resulted in an electrical energy savings of approximately $25,000.

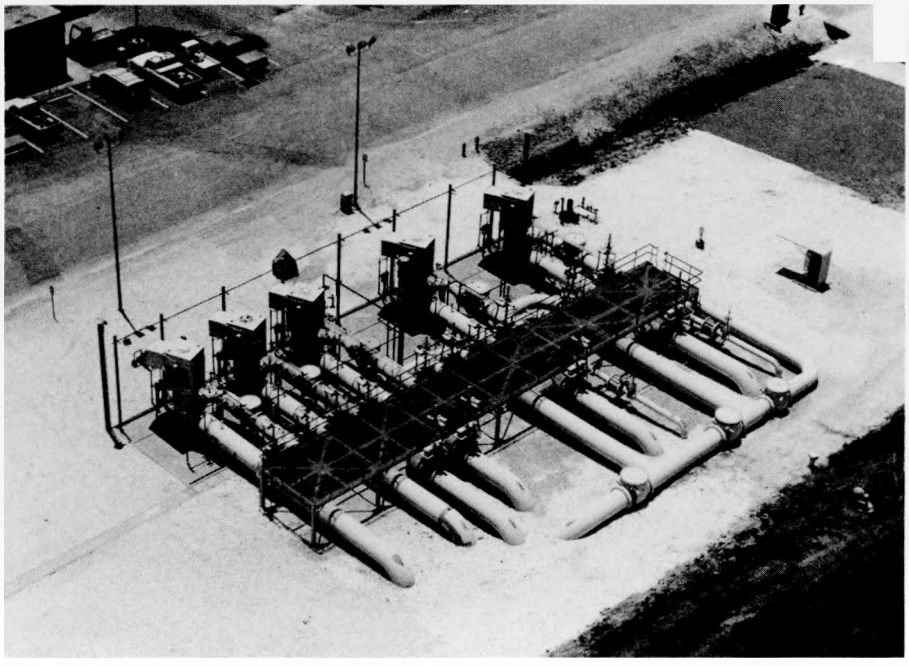
Also, during FY 1989, 22 time clocks were installed on new oil wells. Approximately 80 percent of the producing oil wells are now controlled by time clocks to reduce electrical demand. This action reduced power consumption of these pumping units by approximately 20 percent for an estimated annual savings in electrical energy of approximately $5,000.

2. Strategic Petroleum Reserves

The mission of the Strategic Petroleum Reserves is to protect the United States and its allies from a serious oil supply disruption. Current planning provides for a reserve of 750 million barrels of crude oil, with about 550 million barrels of crude oil in storage at the end of FY 1989. The Strategic Petroleum Reserve stores crude oil in salt domes. Most energy is used to create cavern capacity to store this crude oil. Wells are drilled into the salt domes and well piping is then connected to pumps; water is circulated through the wells to dissolve (leach) the salt to create capacity for oil storage. The brine produced is either discharged through pipelines into the Gulf of Mexico or injected into brine disposal wells.



Pictured is a typical oil well time clock control used at Naval Petroleum Reserves in Colorado, Utah, and Wyoming to reduce electrical demand.



Shown is the main Strategic Petroleum Reserve, Saint James Terminal pumping station for the oil transfer tank farm which includes five 1,500 horsepower electric motors at Strategic Petroleum Reserve. A study is underway to evaluate the economic and operational feasibility of providing a variable speed drive to one of the motors. If feasible, the motor speed will be controlled so that only the required flowrates are produced.

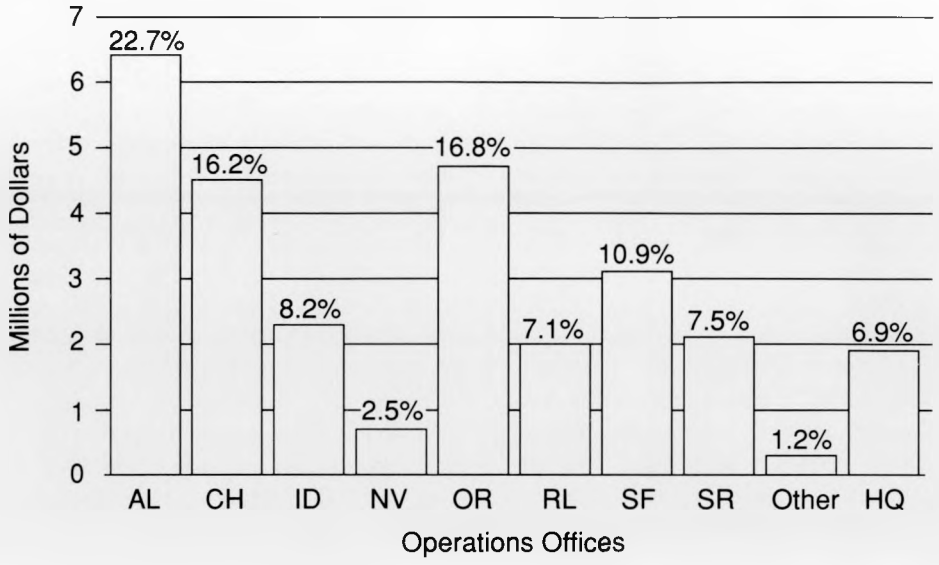
The Strategic Petroleum Reserves stresses electric load management as part of the energy management program. Load management includes scheduling and timing of operations in order to take advantage of special electrical rates; decreasing total electrical consumption; and increasing the energy efficiency of equipment systems.

The Strategic Petroleum Reserve's major effort during FY 1989 was focused on renegotiation of electrical power contracts with three primary electrical suppliers, Gulf States Utilities, Louisiana Power and Light, and Houston Lighting and Power Company. This effort will continue well into FY 1990. The power contracts renegotiation effort provides the best opportunity for energy cost savings on the Strategic Petroleum Reserves project. Electrical costs are projected to cost about $60 million over the next 5 years.

Negotiation with Gulf States Utilities Company included Strategic Petroleum Reserves coordinating requirements and procedures to begin taking "30 Minute Interruptible" Electrical power at the Big Hill facility beginning in 1989. This type of power, once delivered, will provide a savings of approximately $60,000 per month.

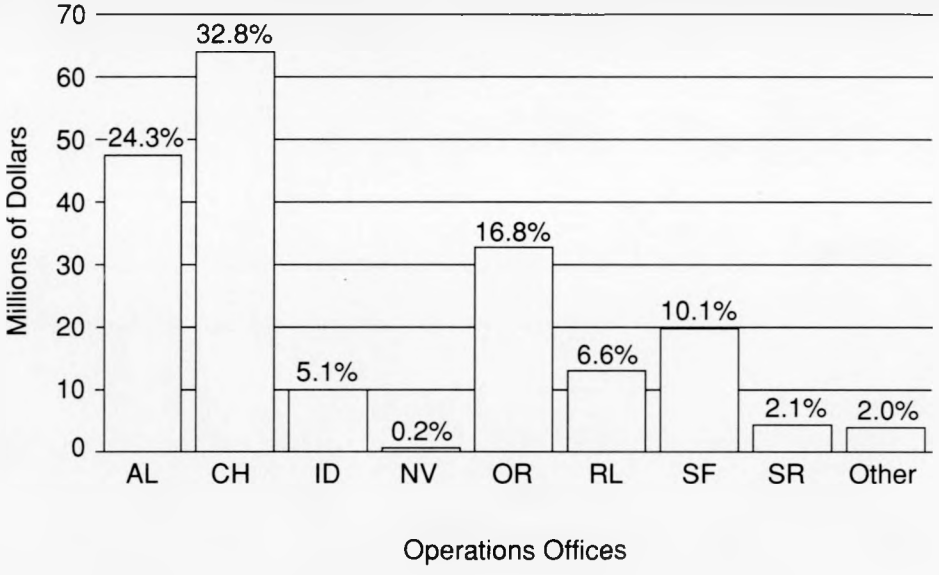
A contract was signed for the Sulphur Mines site which provides a favorable electrical rate for that site during not only routine operations, but also during the decommissioning draw down schedule to occur during late FY 1990 and throughout FY 1991. Saving as a result of this contract are estimated between $150,000 to $300,000.

Figure V-1
Survey Funding FY 1978-1989
$28.0 Million Total Funding



Abbreviations:
AL-Albuquerque
CH-Chicago
ID-Idaho
NV-Nevada
OR-Oak Ridge
RL-Richland
SF-San Francisco
SR-Savannah River

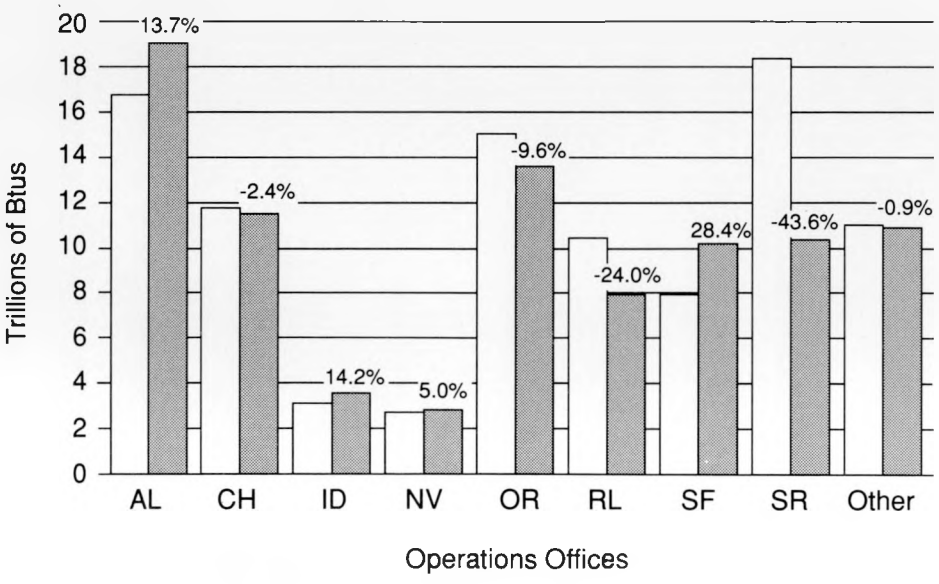
Figure V-2
Energy Project Funding
FY 1978-1989
$195.2 Million Total Funding



Abbreviations:
AL-Albuquerque
CH-Chicago
ID-Idaho
NV-Nevada
OR-Oak Ridge
RL-Richland
SF-San Francisco
SR-Savannah River

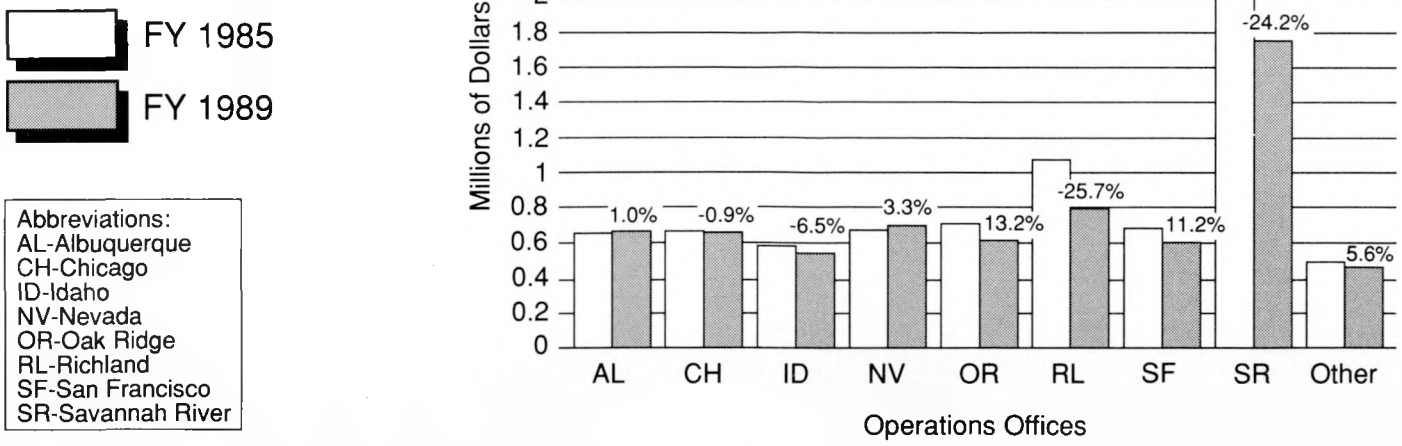
Figure V-3
Total Energy Use

FY 1985
FY 1989



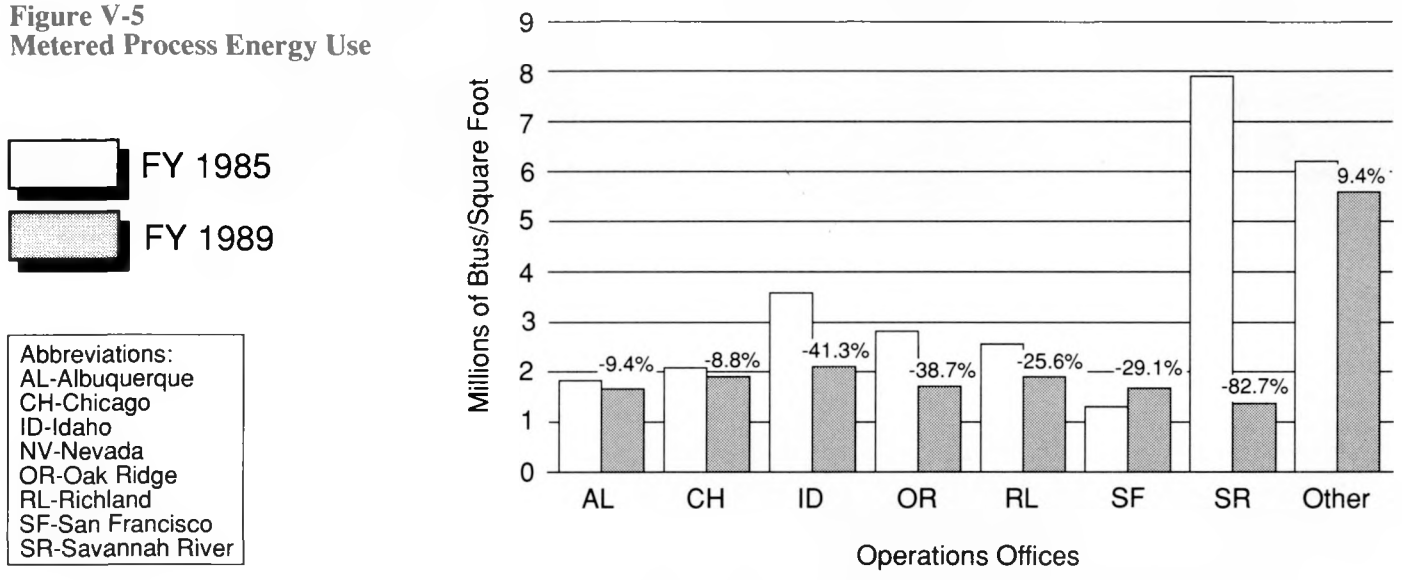
Abbreviations:
AL-Albuquerque
CH-Chicago
ID-Idaho
NV-Nevada
OR-Oak Ridge
RL-Richland
SF-San Francisco
SR-Savannah River

Figure V-4
Buildings Energy Use per Square Foot



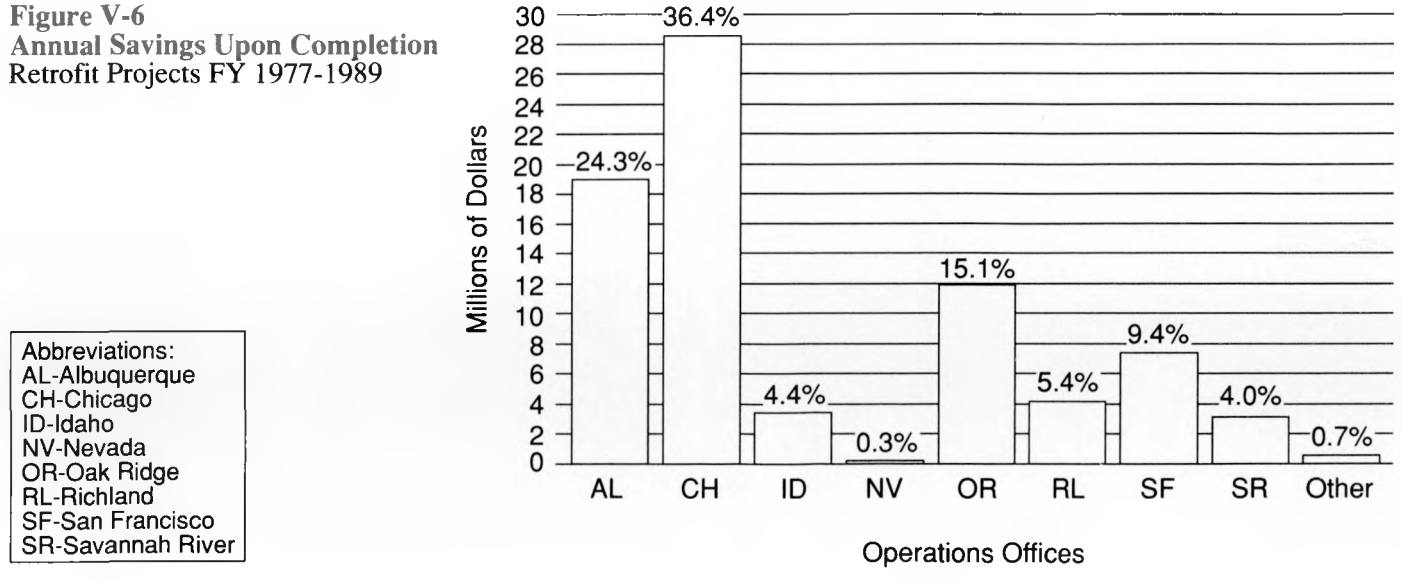
Abbreviations:
AL-Albuquerque
CH-Chicago
ID-Idaho
NV-Nevada
OR-Oak Ridge
RL-Richland
SF-San Francisco
SR-Savannah River

Figure V-5
Metered Process Energy Use



Abbreviations:
AL-Albuquerque
CH-Chicago
ID-Idaho
NV-Nevada
OR-Oak Ridge
RL-Richland
SF-San Francisco
SR-Savannah River

Figure V-6
Annual Savings Upon Completion
Retrofit Projects FY 1977-1989



Abbreviations:
AL-Albuquerque
CH-Chicago
ID-Idaho
NV-Nevada
OR-Oak Ridge
RL-Richland
SF-San Francisco
SR-Savannah River

Figure V-3A
Albuquerque Total Energy Use
FY 1989 & Base Year

FY 1985

FY 1989

101 Albuquerque/DOE Building
102 Kansas City Plant
104 Los Almos National Lab
105 Inhalation Toxicology Research Inst.
106 Mound Facility
107 Pantex Plant
108 Pinelias Plant
109 Rocky Flats Plant
110 Ross Aviation
111 Safeguards
112 Sandia Labs, Albuquerque
113 Sandia Labs, Livermore
114 Sandia Labs, Tonopah
115 Precision Forge

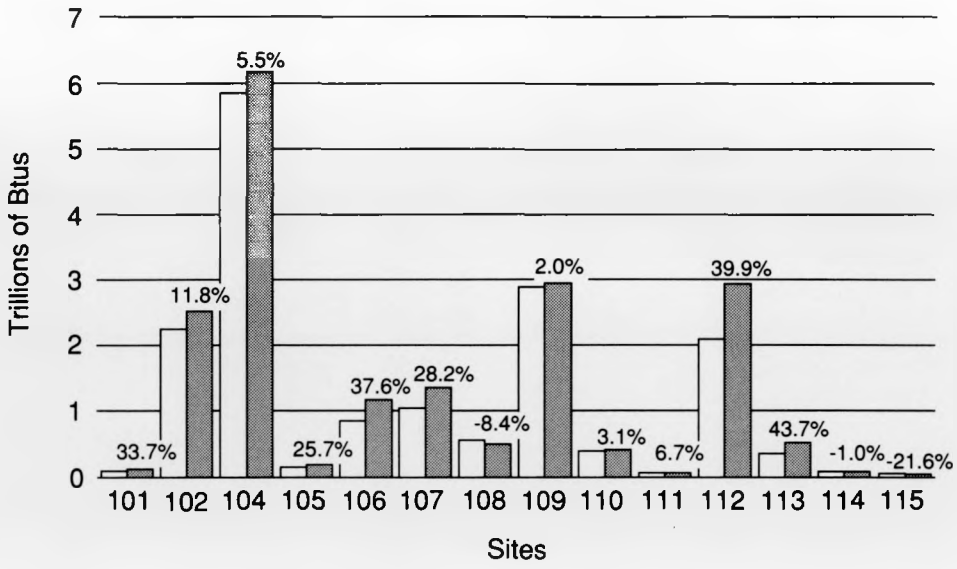


Figure V-4A
Albuquerque Buildings Energy Use
FY 1989 & Base Year

FY 1985

FY 1989

101 Albuquerque/DOE Building
102 Kansas City Plant
104 Los Almos National Lab
105 Inhalation Toxicology Research Inst.
106 Mound Facility
107 Pantex Plant
108 Pinelias Plant
109 Rocky Flats Plant
110 Ross Aviation
111 Safeguards
112 Sandia Labs, Albuquerque
113 Sandia Labs, Livermore
114 Sandia Labs, Tonopah
115 Precision Forge

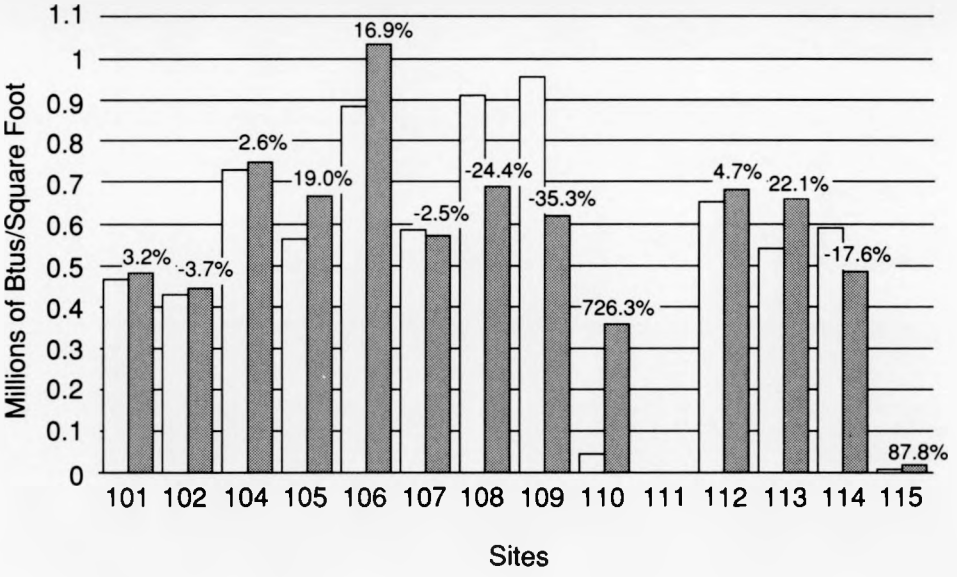


Figure V-5A
Albuquerque Metered Process Energy Use
FY 1989 & Base Year

FY 1985

FY 1989

104 Los Almos National Lab
105 Inhalation Toxicology Research Inst.
106 Mound Facility
107 Pantex Plant
108 Pinelias Plant
109 Rocky Flats Plant
110 Ross Aviation
111 Safeguards
112 Sandia Labs, Albuquerque
113 Sandia Labs, Livermore
114 Sandia Labs, Tonopah
115 Precision Forge

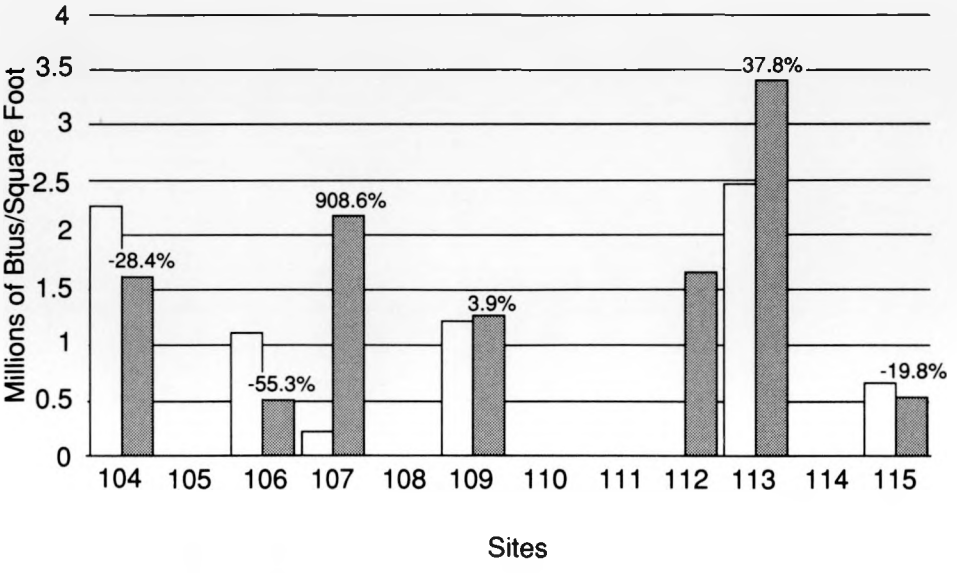


Figure V-3B
ChicagoTotal Energy Use
FY 1989 & Base Year

FY 1985

FY 1989

301 Ames Laboratory
302 Argonne National Lab-East
303 Argonne National Lab-West
304 Brookhaven National Lab
305 Fermi National Accelerator Lab
307 Princeton Plasma Physics Lab
309 MIT Bates Linear Accelerator
310 Notre Dame University
320 University of Utah
321 Solar Energy Research Institute

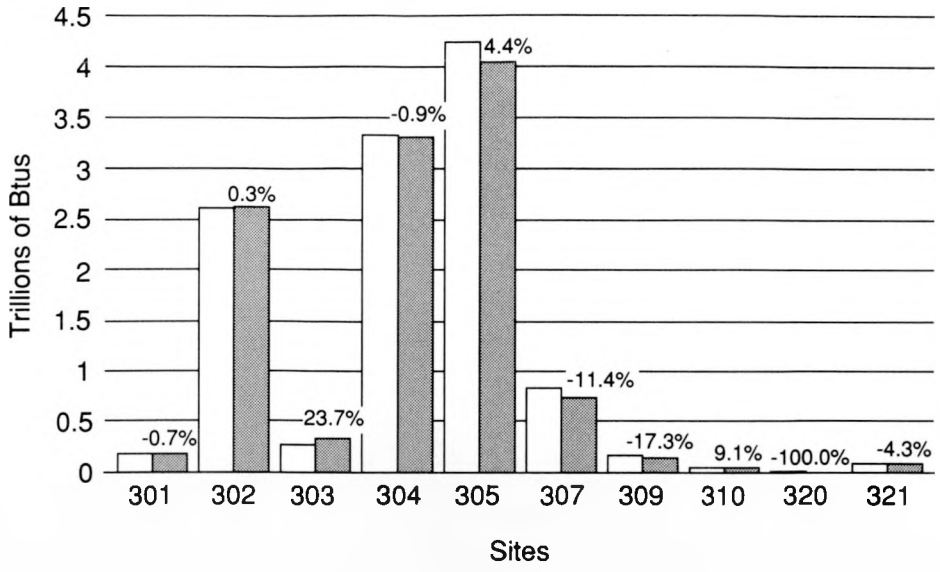


Figure V-4B
Chicago Buildings Energy Use
FY 1989 & Base Year

FY 1985

FY 1989

301 Ames Laboratory
302 Argonne National Lab-East
303 Argonne National Lab-West
304 Brookhaven National Lab
305 Fermi National Accelerator Lab
307 Princeton Plasma Physics Lab
309 MIT Bates Linear Accelerator
310 Notre Dame University
320 University of Utah

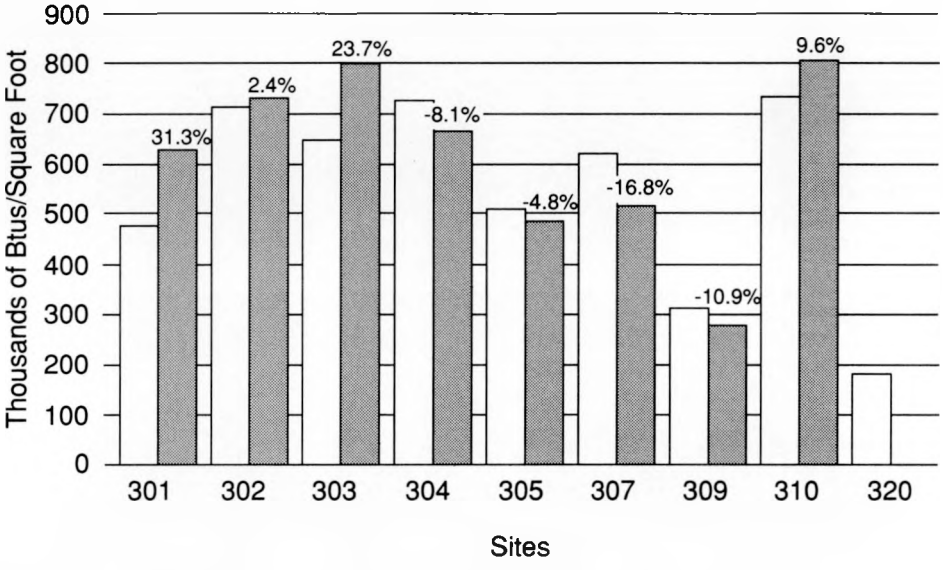


Figure V-5B
Chicago Metered Process Energy Use
FY 1989 & Base Year

FY 1985

FY 1989

302 Argonne National Lab-East
303 Argonne National Lab-West
304 Brookhaven National Lab
305 Fermi National Accelerator Lab
307 Princeton Plasma Physics Lab
309 MIT Bates Linear Accelerator
310 Notre Dame University
320 University of Utah
321 Solar Energy Research Institute

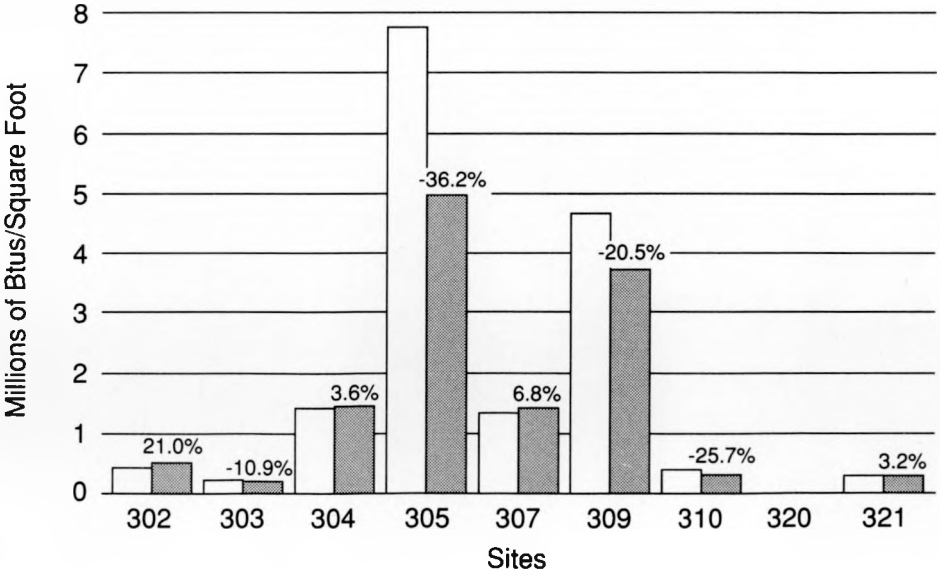
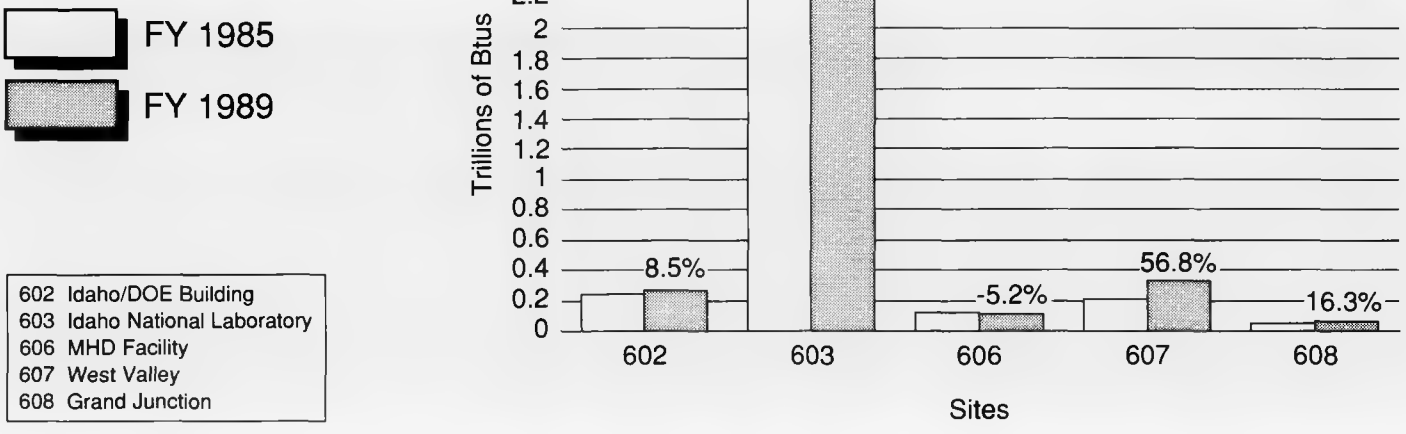
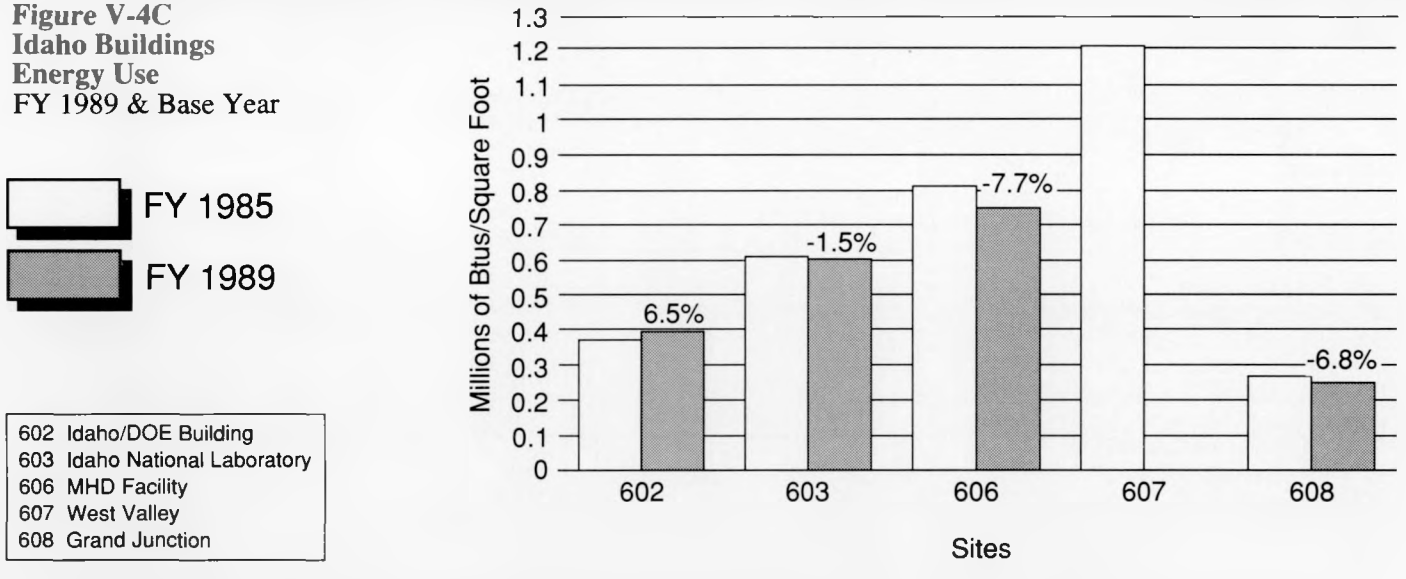


Figure V-3C
Idaho Total Energy Use
FY 1989 & Base Year



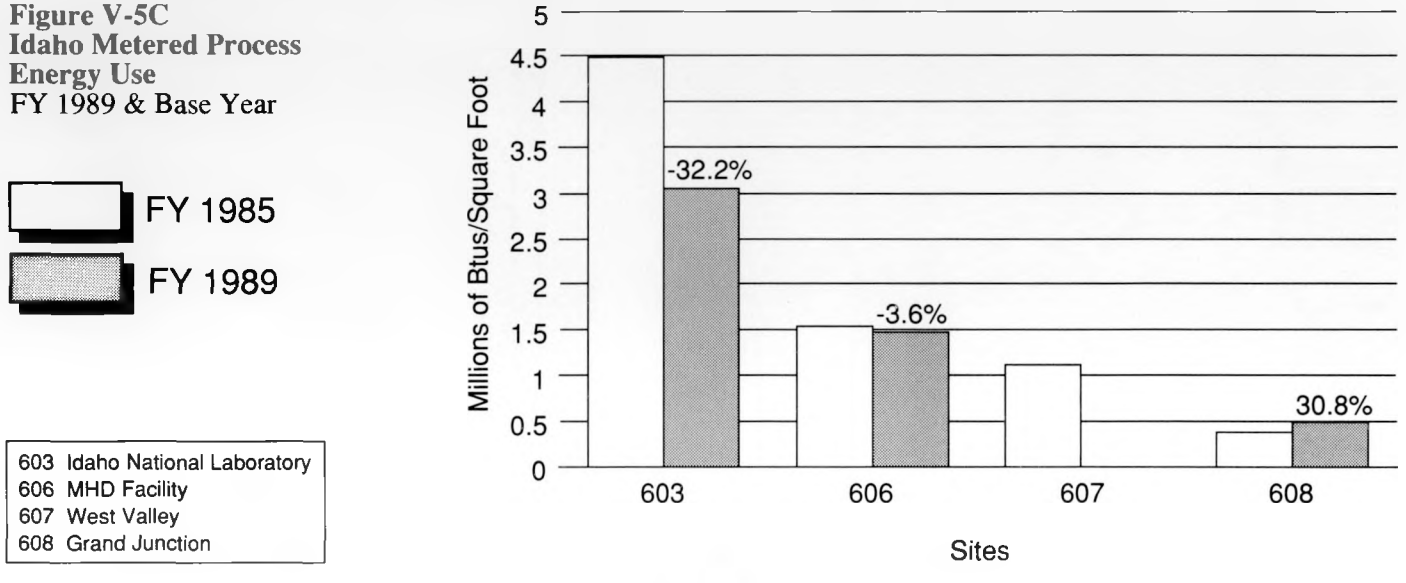
602 Idaho/DOE Building
603 Idaho National Laboratory
606 MHD Facility
607 West Valley
608 Grand Junction

Figure V-4C
Idaho Buildings Energy Use
FY 1989 & Base Year



602 Idaho/DOE Building
603 Idaho National Laboratory
606 MHD Facility
607 West Valley
608 Grand Junction

Figure V-5C
Idaho Metered Process Energy Use
FY 1989 & Base Year



603 Idaho National Laboratory
606 MHD Facility
607 West Valley
608 Grand Junction

Figure V-3D
Nevada Total Energy Use
FY 1989 & Base Year

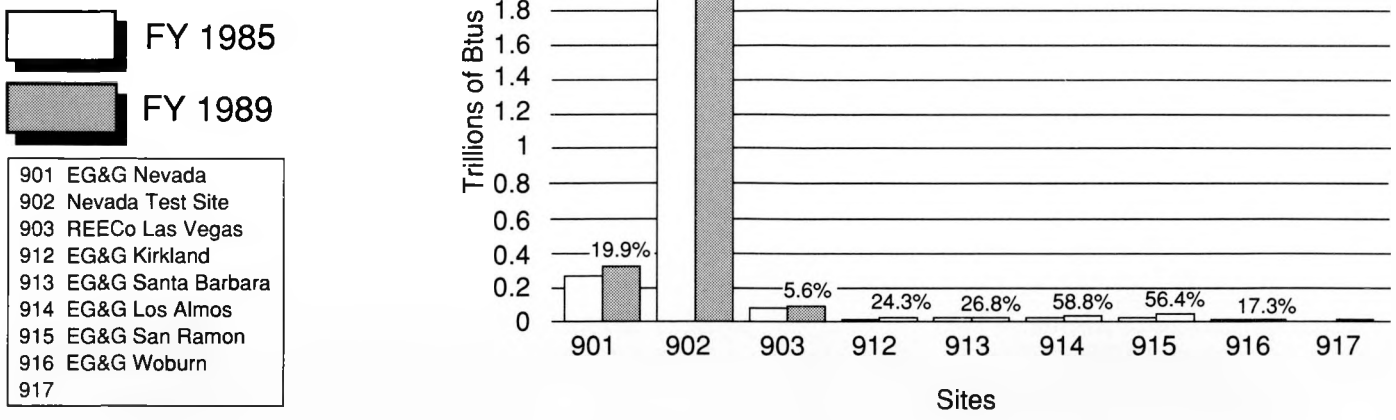


Figure V-4D
Nevada Buildings Energy Use
FY 1989 & Base Year

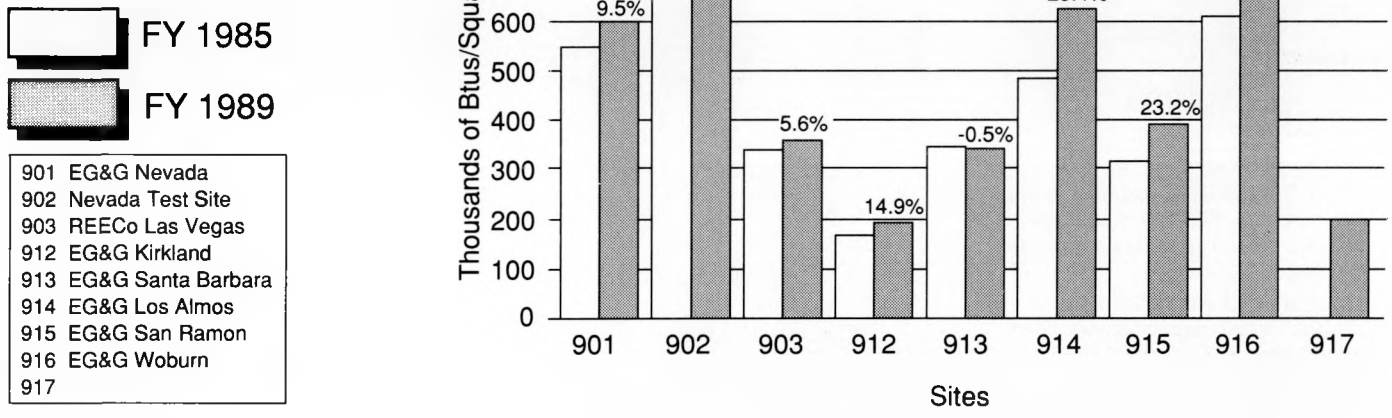


Figure V-3E
Oak Ridge Total Energy Use
FY 1989 & Base Year

FY 1985
FY 1989

1002 Fernald Plant
1003 Oak Ridge Gaseous Diffusion Plant
1004 Oak Ridge National Laboratory
1005 Oak Ridge Associated Universities
1006 Oak Ridge Y-12 Plant
1007 Information Resourses Division
1008 Paducah Gaseous Diffusion Plant
1009 Portsmouth Gaseous Diffusion Plant
1010 Rust Engineering Company
1011 Office of Scientific & Technical Info.

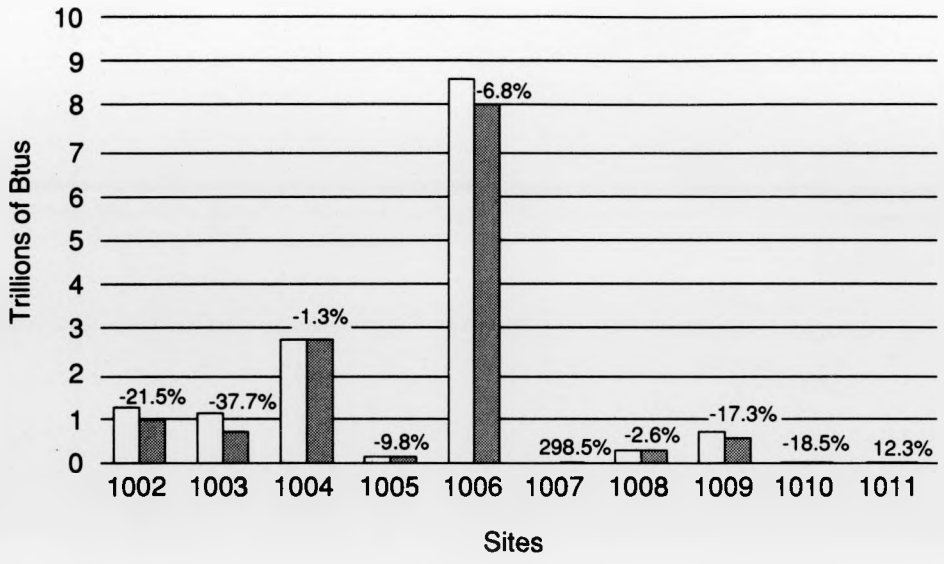


Figure V-4E
Oak Ridge Buildings Energy Use
FY 1989 & Base Year

FY 1985
FY 1989

1002 Fernald Plant
1003 Oak Ridge Gaseous Diffusion Plant
1004 Oak Ridge National Laboratory
1005 Oak Ridge Associated Universities
1006 Oak Ridge Y-12 Plant
1007 Information Resourses Division
1008 Paducah Gaseous Diffusion Plant
1009 Portsmouth Gaseous Diffusion Plant
1010 Rust Engineering Company
1011 Office of Scientific & Technical Info.

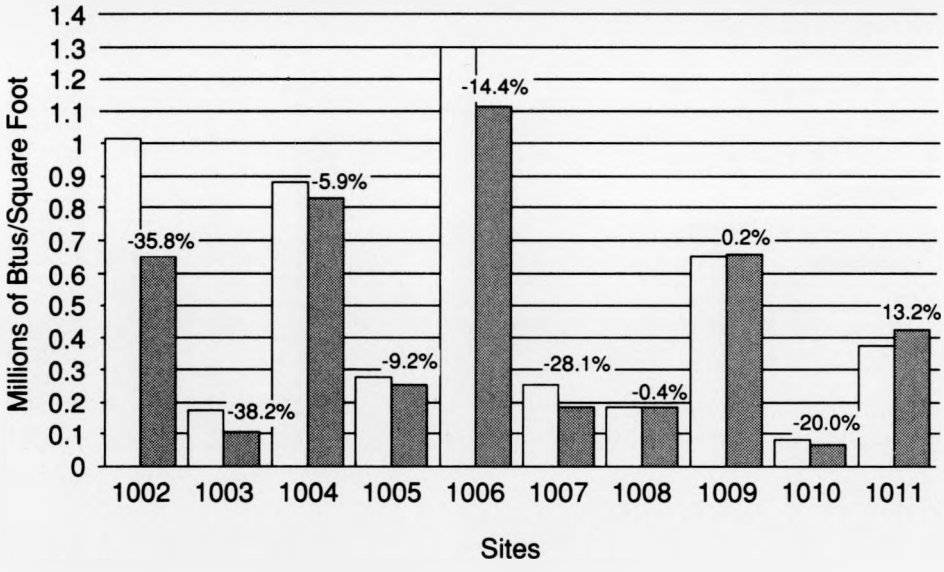


Figure V-5E
Oak Ridge Metered Process Energy Use
FY 1989 & Base Year

FY 1985
FY 1989

1004 Oak Ridge National Laboratory

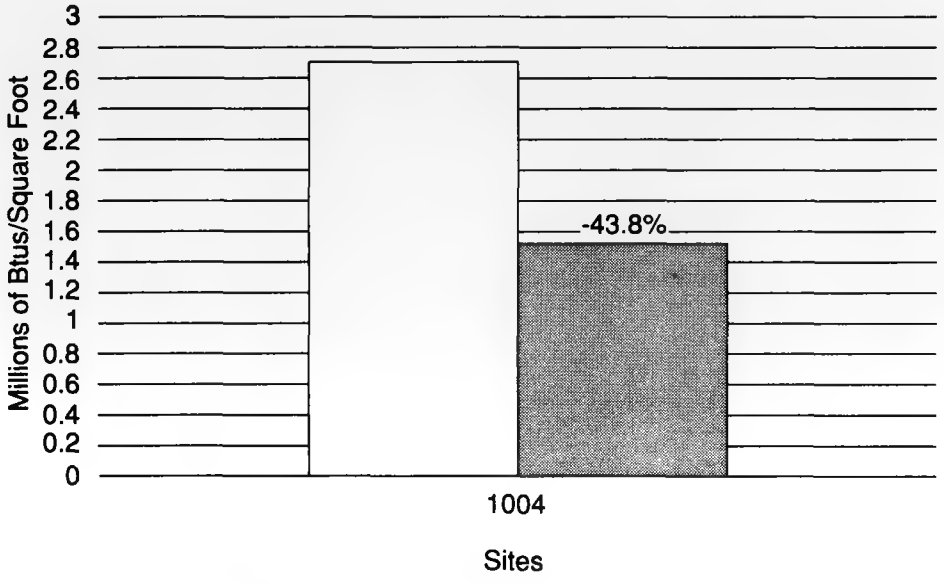


Figure V-3F
Richland Total Energy Use
FY 1989 & Base Year

FY 1985
FY 1989

1309 Misc
1310 100 Area
1320 200 West Area
1330 200 East Area
1340 300 Area
1350 400 Area
1360 500 Area
1370 600 Area
1380 1100 Area
1390 3000 Area

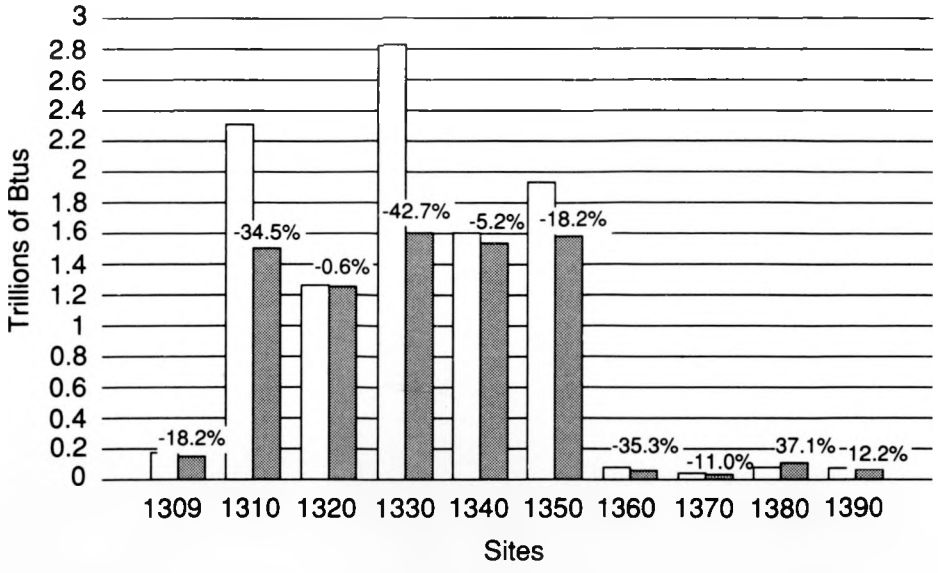


Figure V-4F
Richland Buildings Total Energy Use
FY 1989 & Base Year

FY 1985
FY 1989

1310 100 Area
1320 200 West Area
1330 200 East Area
1340 300 Area
1350 400 Area
1360 500 Area
1370 600 Area
1380 1100 Area
1390 3000 Area

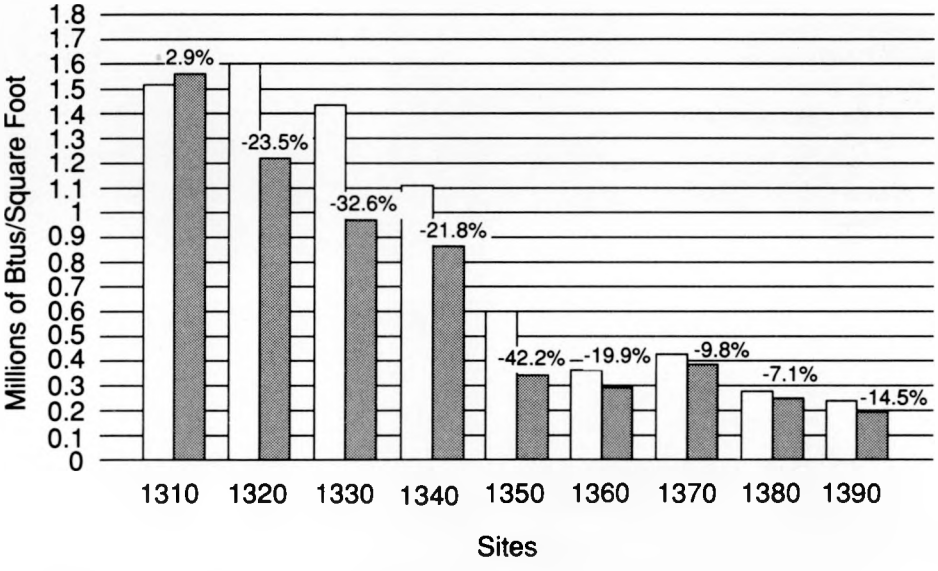


Figure V-5F
Richland Metered Process Energy Use
FY 1989 & Base Year

FY 1985
FY 1989

1310 100 Area
1320 200 West Area
1330 200 East Area
1340 300 Area
1350 400 Area
1360 500 Area

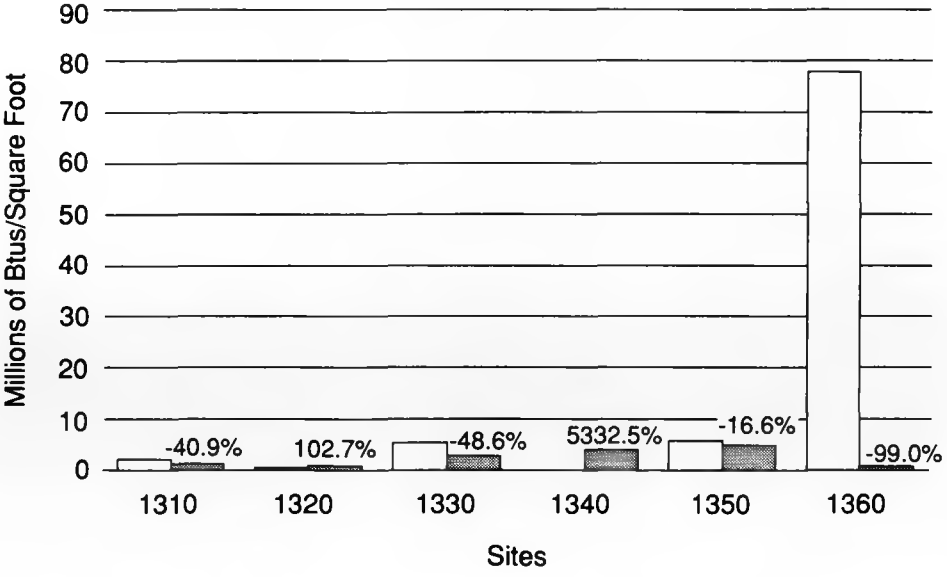


Figure V-3G
San Francisco Total Energy Use
FY 1989 & Base Year

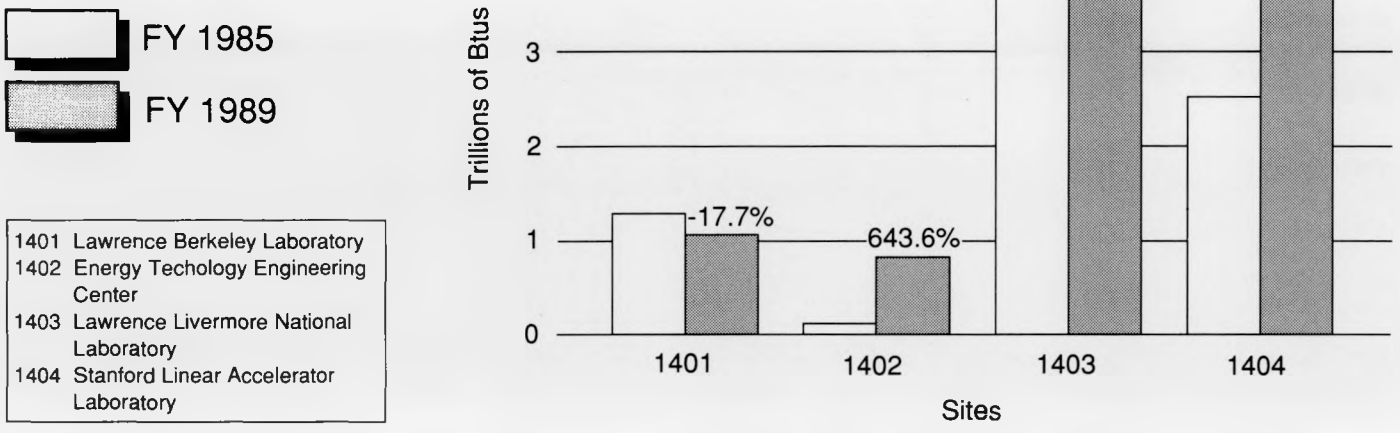


Figure V-4G
San Francisco Buildings Energy Use
FY 1989 & Base Year

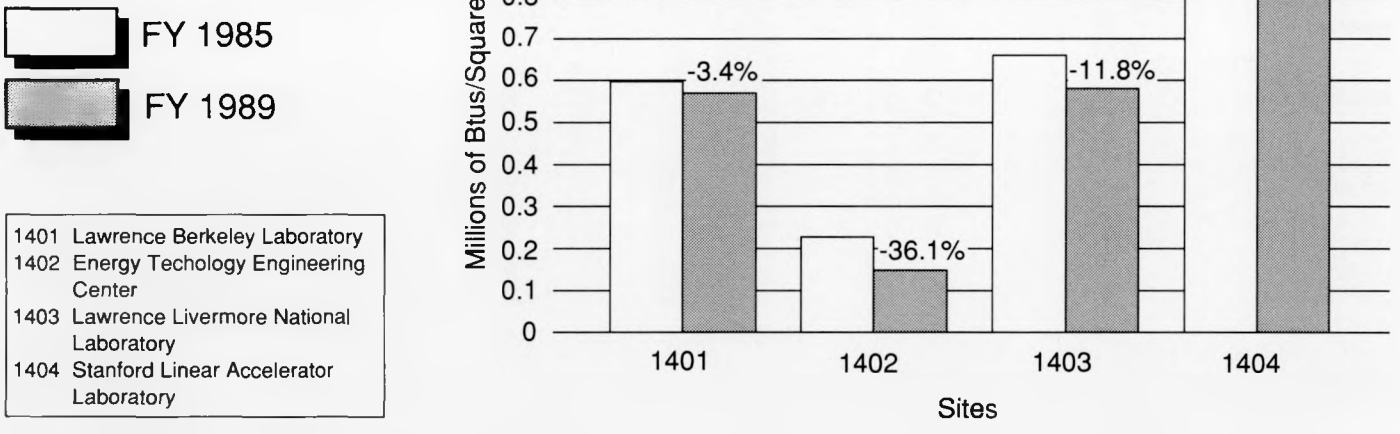


Figure V-5G
San Francisco Metered Process Energy Use
FY 1989 & Base Year

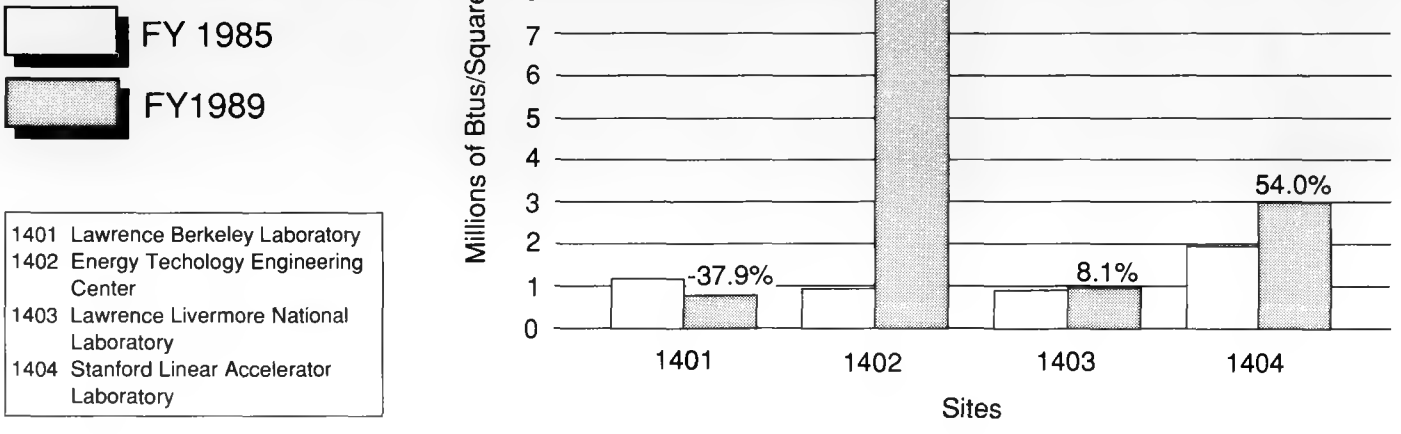


Figure V-3H
Savannah River Total Energy Use
FY 1989 & Base Year

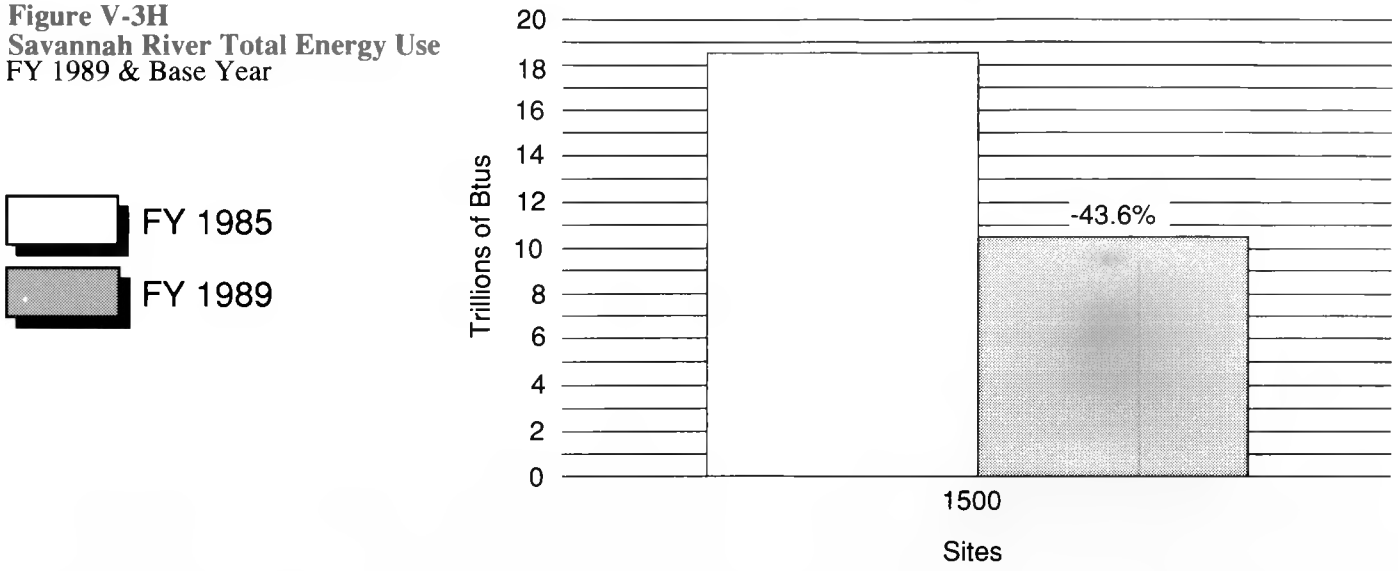


Figure V-4H
Savannah River Buildings Energy Use
FY 1989 & Base Year

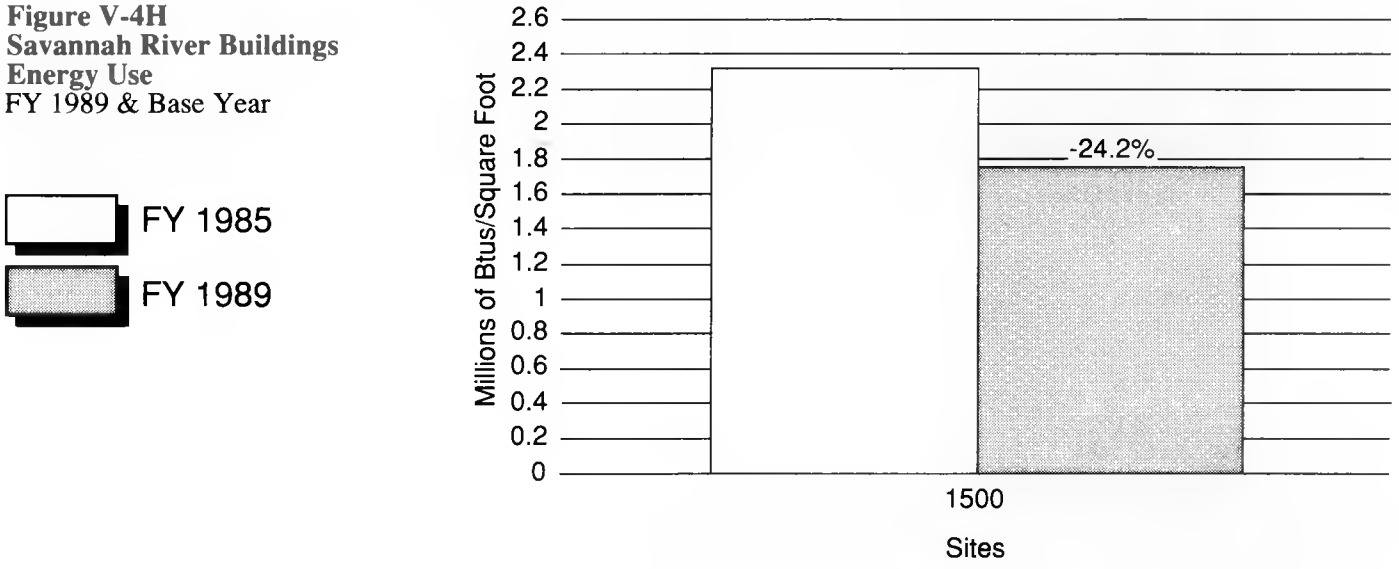


Figure V-5H
Savannah River Process Energy Use
FY 1989 & Base Year