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Annual Report on In-house Energy Management

U.S. Department of Energy
Assistant Secretary, Management and Administration
Directorate of Administration
Office of Project and Facilities Management
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CHAPTER I

OVERVIEW

A. Introduction

Each Federal Executive agency is required by the Code of Federal Regulations (CFR) to submit an "Annual Report on Energy Management." During Fiscal Year 1988, the Department of Energy (DOE) completed its third year of operation under its Ten-Year Inhouse Energy Management Plan for FY 1986 - FY 1995. This Annual Report will address program activities during FY 1988, 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;

Figure I-1
The Department of Energy

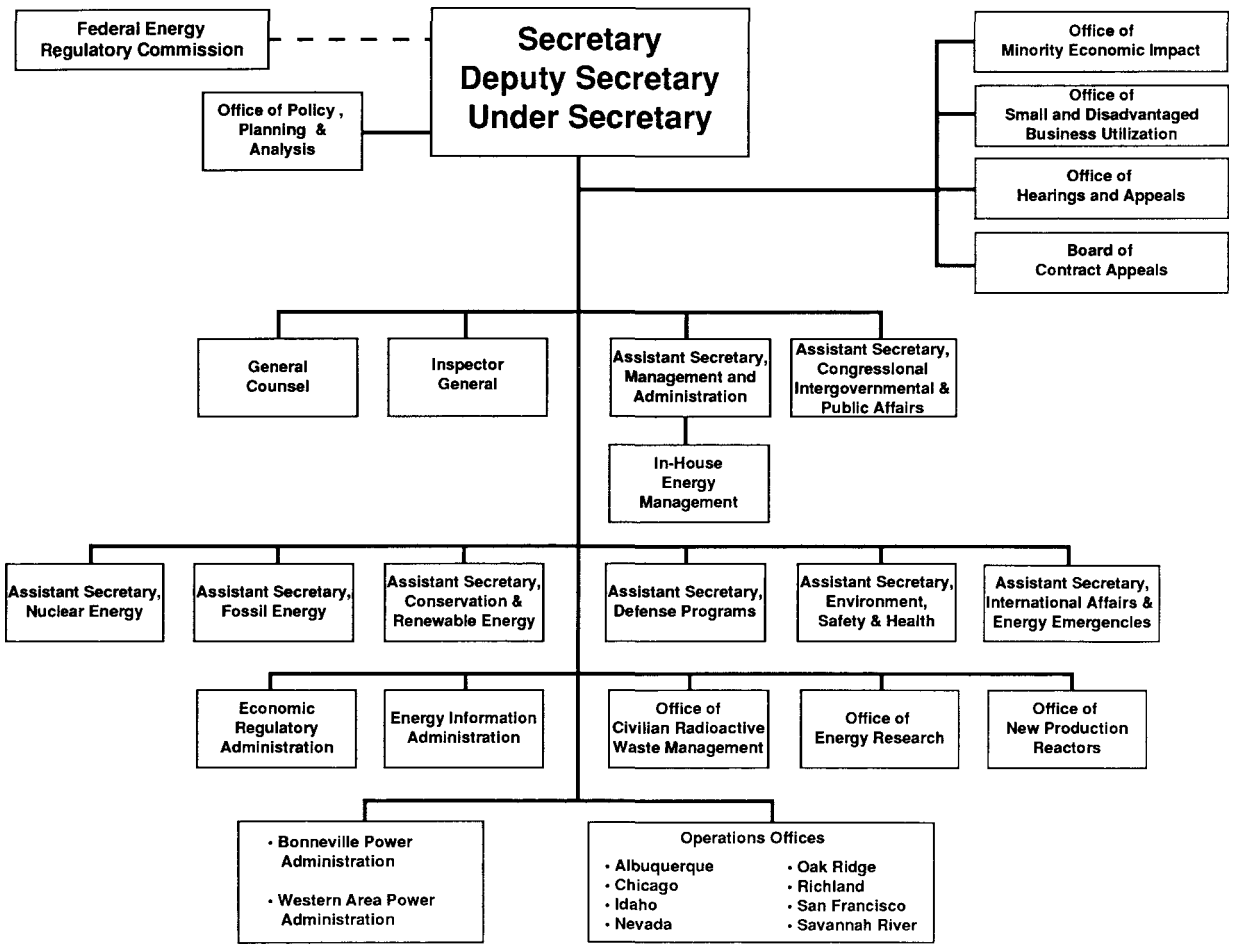
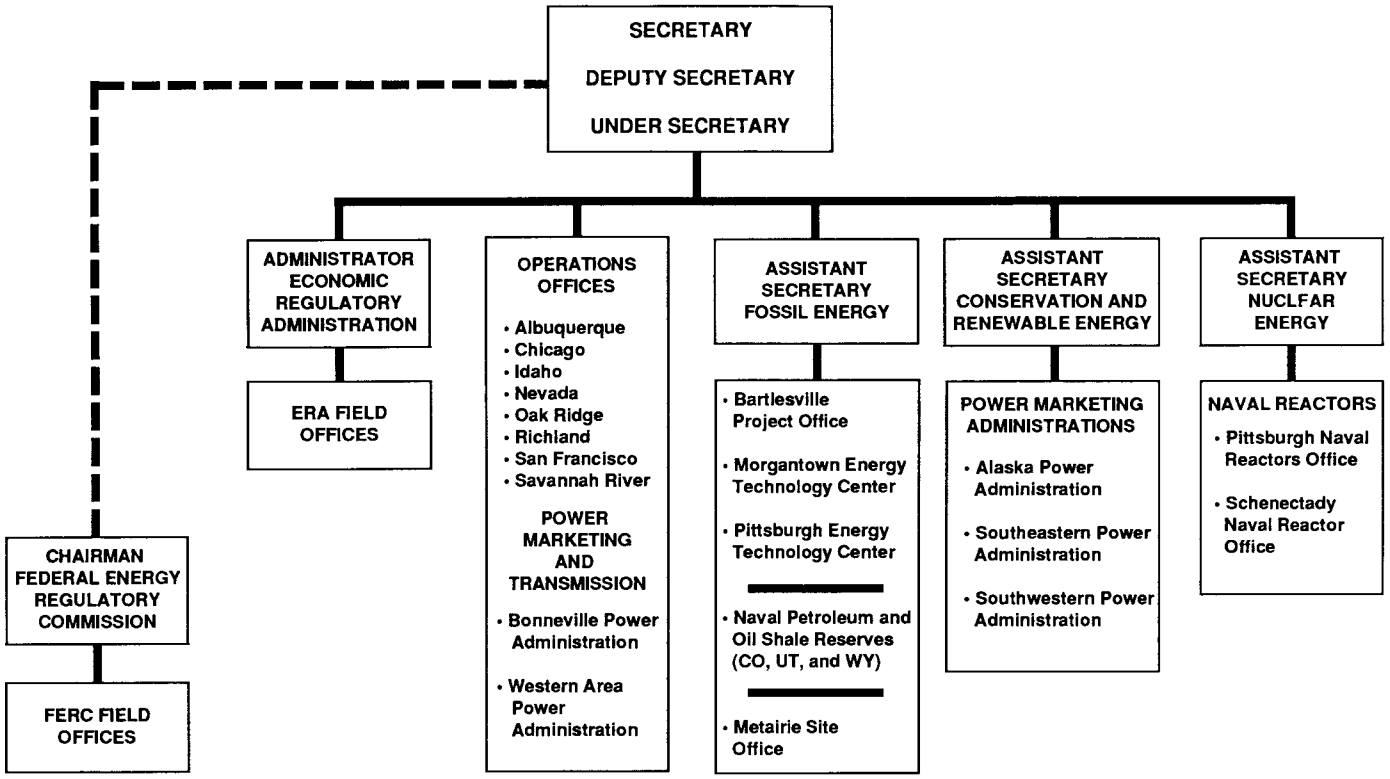


Figure I-2
Department of Energy
Field Relationships



- 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.

The field comprises approximately 9,000 buildings with 92 million square feet of floor space, and 13,300 vehicles, including a fleet of 1,900 special purpose and off-road construction/maintenance vehicles and 5,859 General Services Administration (GSA) assigned vehicles. GSA assigned vehicles increased from 2,500 in FY 1987 to 5,859 in FY 1988 because of the ownership of vehicles at the Albuquerque Operations Office being transferred to the GSA. 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 1988 was 96.7 trillion British Thermal Units (Btu's) at a cost of $315 million. Of this, 56.6 trillion Btu's was consumed in the buildings category (60 percent), 37.4 trillion Btu's in the metered process category (40 percent), and 2.7 trillion Btu's 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 1988. Figure I-4 shows DOE consumption in these years by energy type.

Figure I-3
DOE Total Energy Consumption
FY 1985 & FY 1988

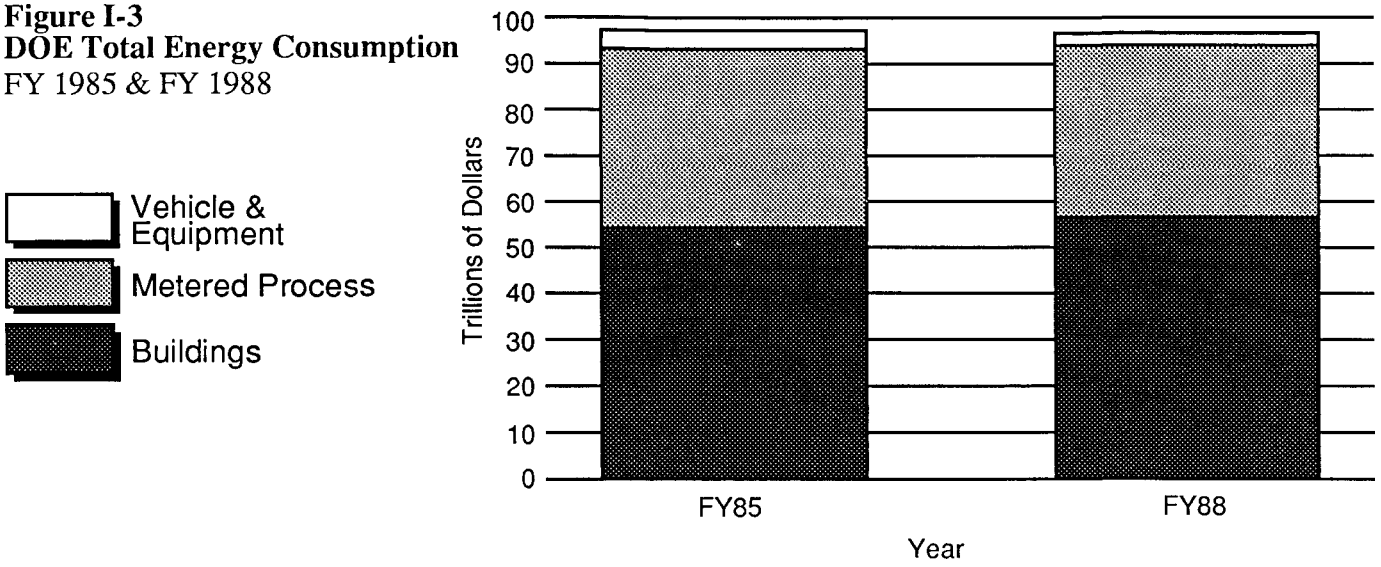
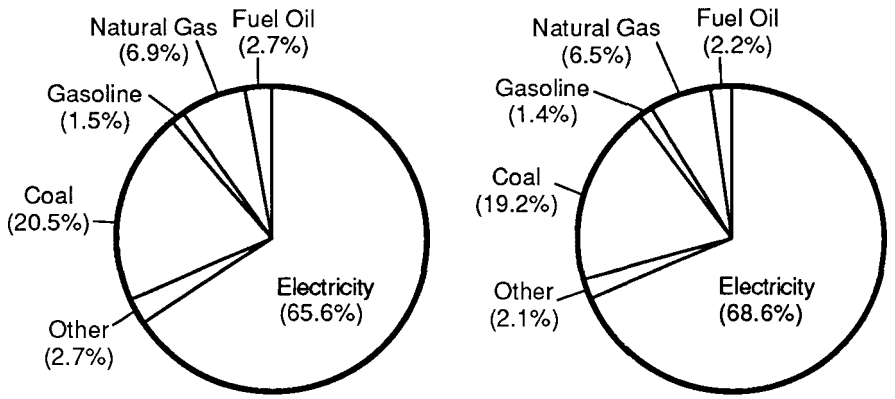


Figure I-4
DOE Total Energy Use by Type



FY 1985
(97.1 Trillion Btus)

FY 1988
(96.7 Trillion Btus)

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 Deputy Assistant Secretary for Administration, and the Assistant Secretary, Management and Administration.

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 Study Manuals and a Life Cycle Costing Handbook.

- 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 improvement 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, Ventilation, and Air-conditioning (HVAC) training, and evaluation of solid waste alternatives 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 Savings/Third-Party Financing Program - The shared 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. 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 vehicle 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 1988.

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 an 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 0.5 percent less in FY 1988 than in the base year. A portion of this reduction is attributable to shut down of nuclear reactors at the Savannah River and Richland Operations Offices. The reduction in energy consumption was accomplished despite a 7 percent

increase in total square footage. This means there was an increase in the energy efficiency of DOE facilities.

a. Buildings

DOE consumed 56.6 trillion Btu's during FY 1988 in the buildings category. This is a 3.1 percent increase 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 4.0 percent in FY 1988. This is a significant improvement in energy efficiency.

b. Metered Processes

DOE consumed 37.4 trillion Btu's in the metered process category in FY 1988. This is a decrease of 5.0 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 12.7 percent in FY 1988.

c. Vehicles and Equipment

DOE consumed the least energy in this category, 2.7 trillion Btu's in FY 1988. This is a 5.5 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 1988 was 7.5 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 economic return.

Since the beginning of the retrofit program, in FY 1977, through FY 1988, 685 projects, costing $177.8 million were funded to save energy and funds in buildings and metered processes. The funded projects have a projected annual savings upon completion of 15.1 trillion Btu's and $74.2 million. These savings represent a 2.4 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, $26.0 million has been invested at all DOE sites. Some of the surveys and studies funded during FY 1988 were cogeneration feasibility studies, a nuclear facility ventilation study, and a waste heat recovery study. A total of 48 studies and surveys were funded during FY 1988.

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 sitewide 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, is responsible for the management and administration of a utilities program to ensure acquisition of adequate, reliable, and economical utility services for DOE sites. GSA has delegated authority to the Secretary of Energy to enter into long-term utility contracts, except GSA areawide contracts, for periods not exceeding 10 years, for all utility services to DOE sites. The branch is responsible for reviewing and approving Utility Procurement Plans for proposed utility service acquisitions in excess of $150,000 annually (or $250,000 when acquiring the service under a GSA areawide contract).

The branch, in cooperation with the Office of General Counsel, is responsible for representing DOE consumer interests before Federal and State regulatory bodies. Rate proceedings initiated in FY 1988 have a potential savings upon completion of $1.5 million. The total savings for the past 7 years is $23.9 million.

During FY 1988, the branch developed and assisted in conducting a 3-day Utilities Acquisition course. Course sessions were held in Las Vegas, NV, and New Orleans, LA and trained DOE and Management and Operating contractor personnel in the principles and implementation of planning, negotiation, and rate-making processes of utility services acquisition.

The branch represented DOE on the Federal Acquisition Regulation (FAR) Utilities Committee to develop changes to FAR 8.3, Acquisition of Utility Services. Also, DOE Order 4540.1B, UTILITY ACQUISITION AND MANAGEMENT, was published. This order establishes policies and procedures for the acquisition and management of utility services and for intervention in utility regulatory proceedings to represent the consumer interest of DOE.

5. Manuals, Guidelines and Standards

The Department has been applying a consistent present value analysis life cycle 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 written in FY 1987 and 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 all 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

A. Introduction

Energy consumption in buildings accounts for 59 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 30 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 1988, DOE buildings (and the unmetered processes they house) used 56.6 trillion Btu's of energy at a cost of $173.7 million. Figure II-1 presents building energy consumption and cost by fuel type during FY 1988. There are 7,500 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.

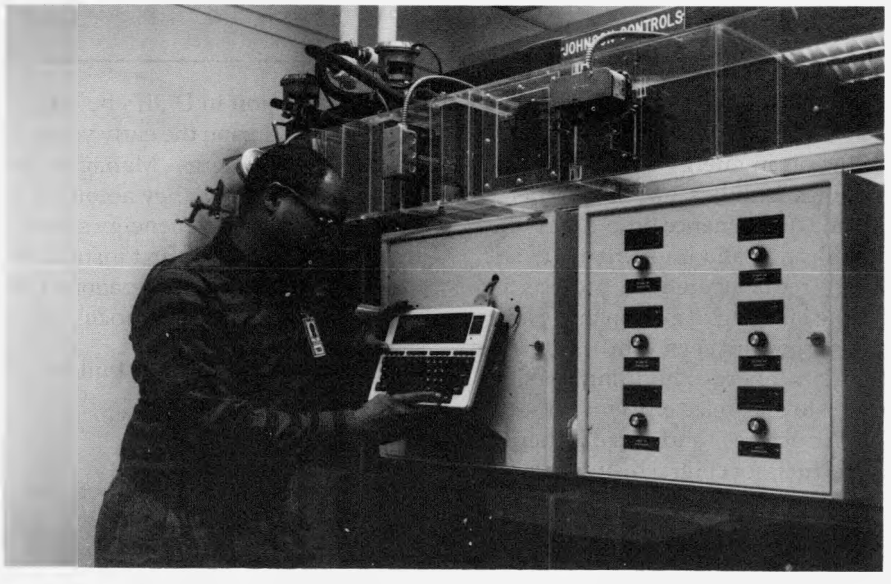
B. Program Objectives

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 usage in FY 1985, used as the baseline, was 54.8 trillion Btu's consumed in 70.6 million gross square feet (gsf) of space. This equates to a baseline usage of 777,133 Btu's/gsf. 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.

Table II-1
DOE BUILDINGS INVENTORY

	FY 1985	FY 1988
Number of Buildings	7,419	7,529
Buildings Square Feet	68,304,800	75,892,900

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



Shown is a Direct Digital Control simulator panel used at the Kansas City Plant. The panel provides in-house maintenance and operating personnel with hands-on training in the overall operating efficiency of Heating, Ventilating, and Air conditioning systems, and is used as a troubleshooting tool for existing systems.

Figure II-1
DOE Building Energy Cost & Use
FY 1988

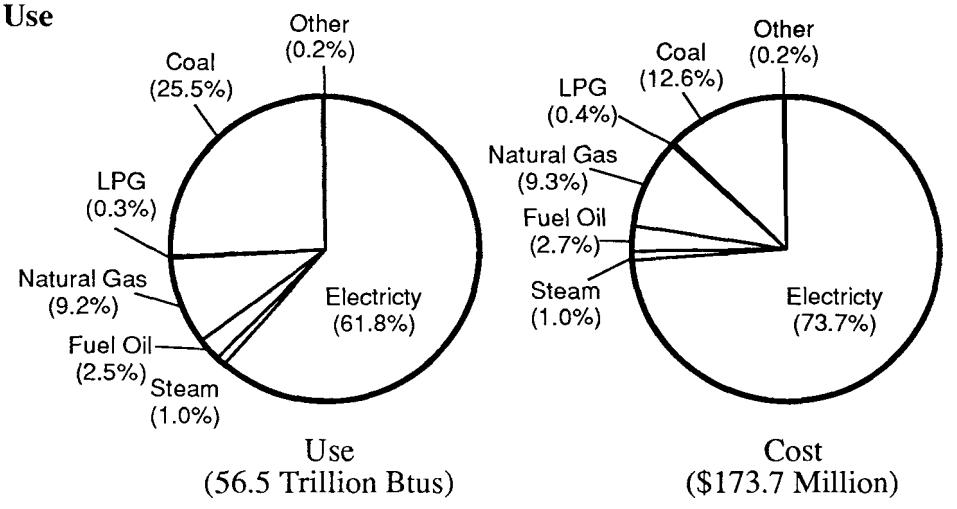
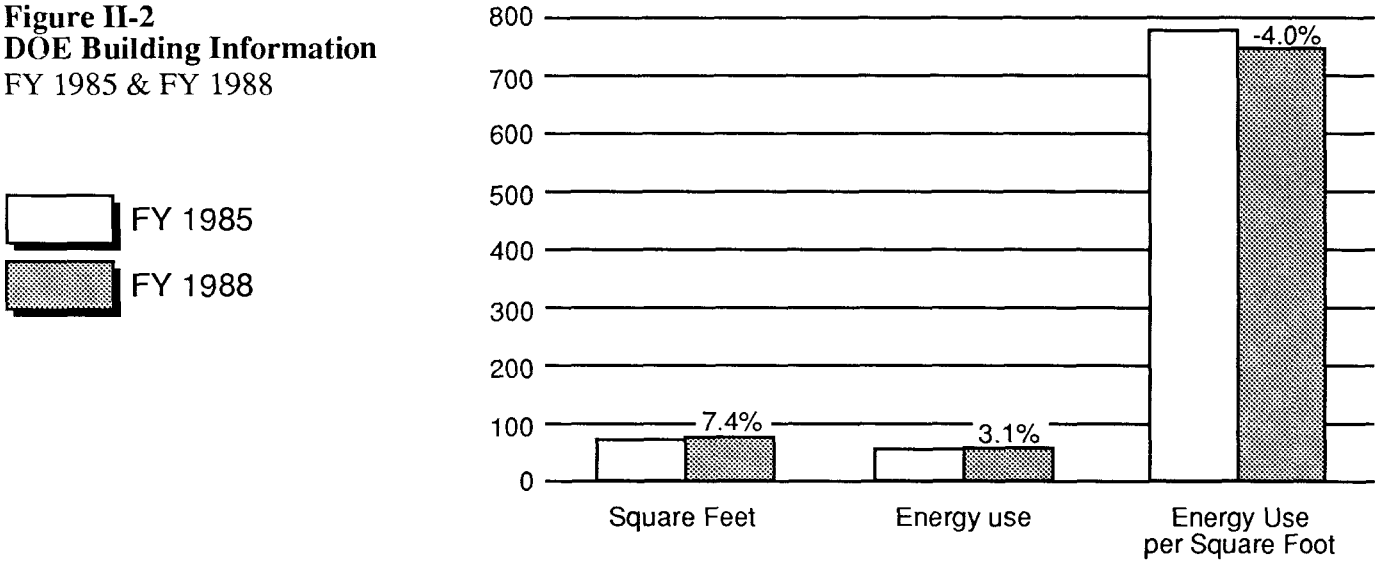


Figure II-2
DOE Building Information
FY 1985 & FY 1988



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 energy building 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.

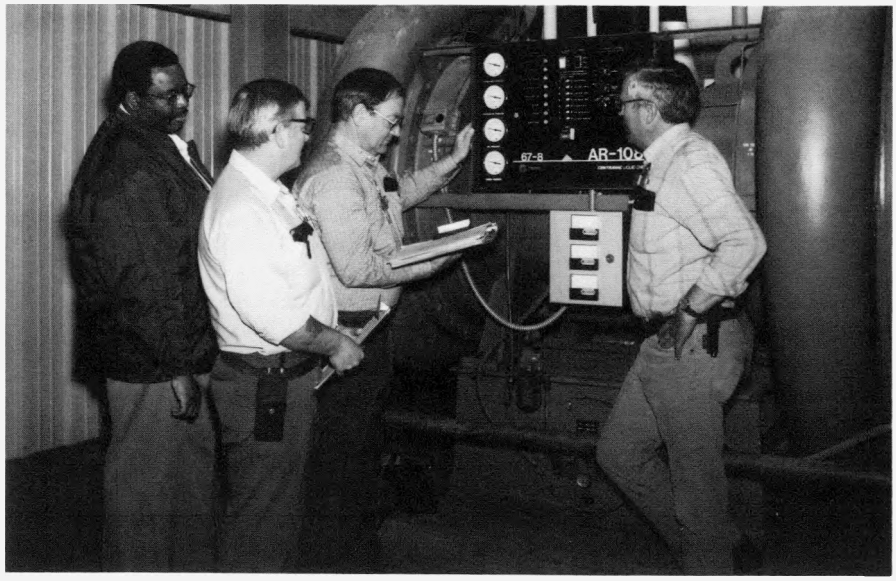
Measures to improve operations and maintenance procedures have been implemented primarily through the publication and use of energy conservation guidelines, how-to manuals, training programs for operating and administrative personnel, and employee awareness programs. Efforts such as steam trap maintenance 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 monitor and control building energy use patterns.

There have been various actions to improve the operations and maintenance

of DOE facilities during FY 1988. These included:

- The Rocky Flats Plant continued an energy conservation project to replace the nearly 2000 steam traps on plant site. At this time, nearly 800 traps have been replaced with Venturi nozzle type traps. Funding for the remaining replacements has been received and engineering has been completed. Steam trap maintenance has now begun to drop in man-hours as more Venturi nozzle traps are installed.

- An Employee Energy Conservation Awareness Committee was established at the Nevada Test Site to develop more detailed and specialized conservation projects. The committee has also promoted publicity for energy conservation awareness programs, including activities such as beneficial suggestion program, In-house Energy Management evaluation, and specialized training for efficient energy management and utility contract improvement.



Employees of the Oak Ridge Y-12 Plant Utilities Department are trained in the efficient operation of all large utilities equipment such as the 1,200 ton chiller shown in the picutre. The Utilities Department operates seven central chiller facilities which have a total capacity or more than 40,000 tons of refrigeration.

- The Hanford Site began a Water Storage Freeze Protection Project that will install steam control valves and related instrumentation to regulate the steam-heated freeze protection systems on six above ground (Hi- Tank) water storage tanks. An annual savings of $17K will be realized by modulating the steam heating as necessitated by tank temperature and weather conditions.

- The major FY 1988 Energy Management Program element at the Fermi National Accelerator Laboratory, was DOE funding approval for a state-of-the-art

Pictured is a Steamguard Venturi nozzle steam trap installed at Rocky Flats Plant. This FY 1988 project will save about 32 billion British Thermal Units of natural gas annually when completed.

Supervisory Control and Data Acquisition (SCADA) System to permit continuous load monitoring and metering on each of the site wide underground 13.8 KV distribution feeders, demand limiting, load shedding and remote manual or programmed switching during normal, standby or emergency operations. It is projected that the SCADA system will produce energy cost savings of $234,000 per year.

- Several main boiler steam valves were insulated as a result of a DOE Heating Plant Energy Audit completed by the Boiler Efficiency Institute at the Naval Reactors Facility Site (Idaho Falls, ID). Insulation of these valves will save an estimated 107 million Btu's per year.

- At the Naval Petroleum and Oil Shale Reserves in Colorado, Utah, and Wyoming, 41 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.

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 (HVAC) systems. 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 1988 was $26 million.

Some of the studies and surveys funded or completed in FY 1988 are:

- A significant energy conservation project study was completed at the Brookhaven National Laboratory. The study addressed the feasibility of further expanding the site Energy Management Control System. As a result of this study, funding has been requested to connect an additional four buildings to the site system.

- A Process Ventilation Improvements Study at the Paducah Gaseous Diffusion Plant justified a $300 thousand retrofit with a 2-year payback.

- A Cogeneration Feasibility Study was initiated at the Hanford Site in FY 1988. This study evaluated the economic feasibility of maintaining electrical generating capacity at the 100 N Facility following cold standby of the nuclear reactor. The project appeared to be viable since the boilers and turbine generator equipment were available and little expense would be required to implement the project.

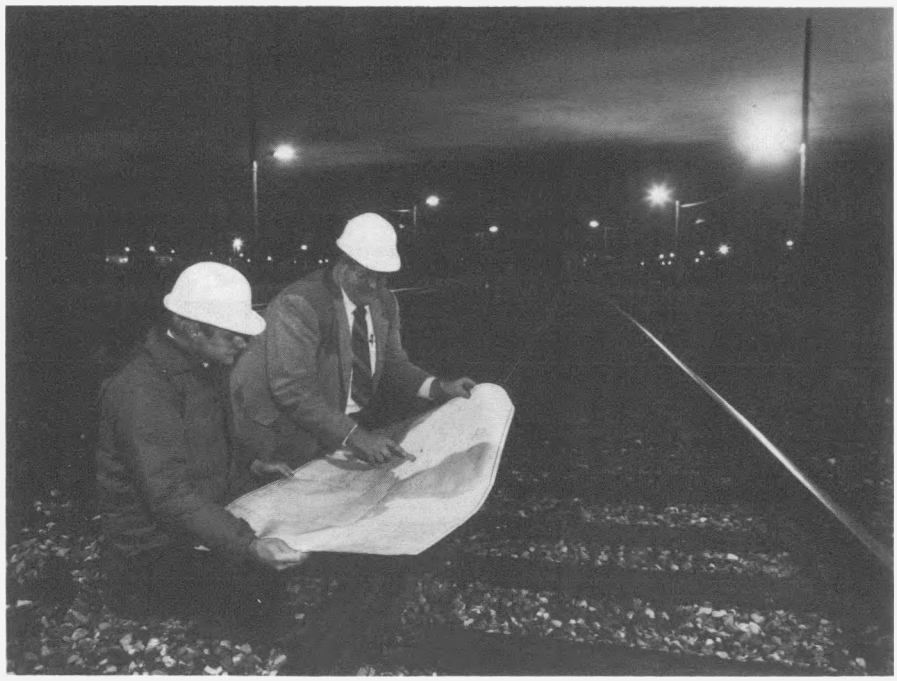
3. Building Retrofit Projects

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.

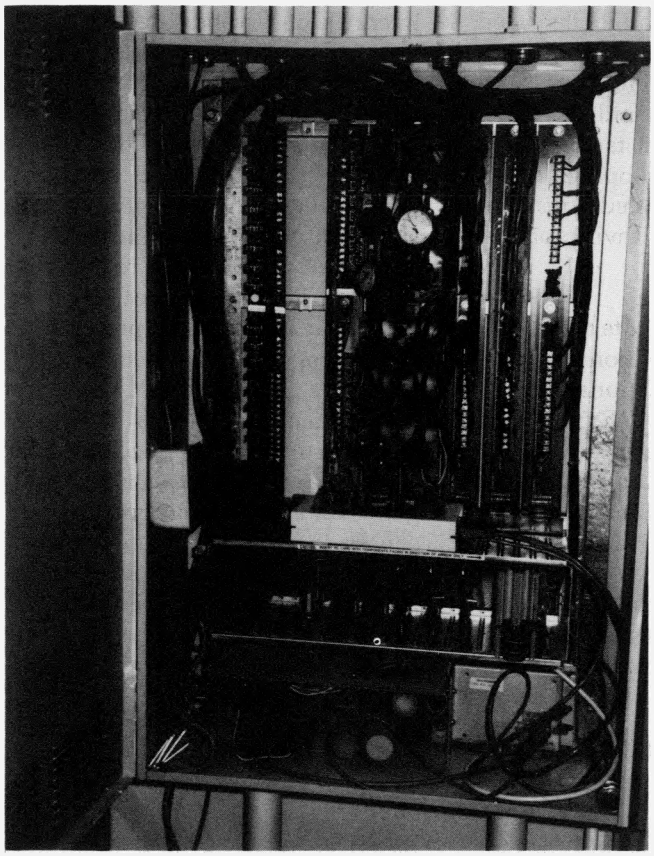
The majority of the retrofit projects at DOE facilities have fallen into five general energy saving categories:

- Energy monitoring and control system installations
- HVAC system modifications
- Mechanical equipment and boiler modifications
- Electric light and power improvements
- Building insulation and storm-window improvements.

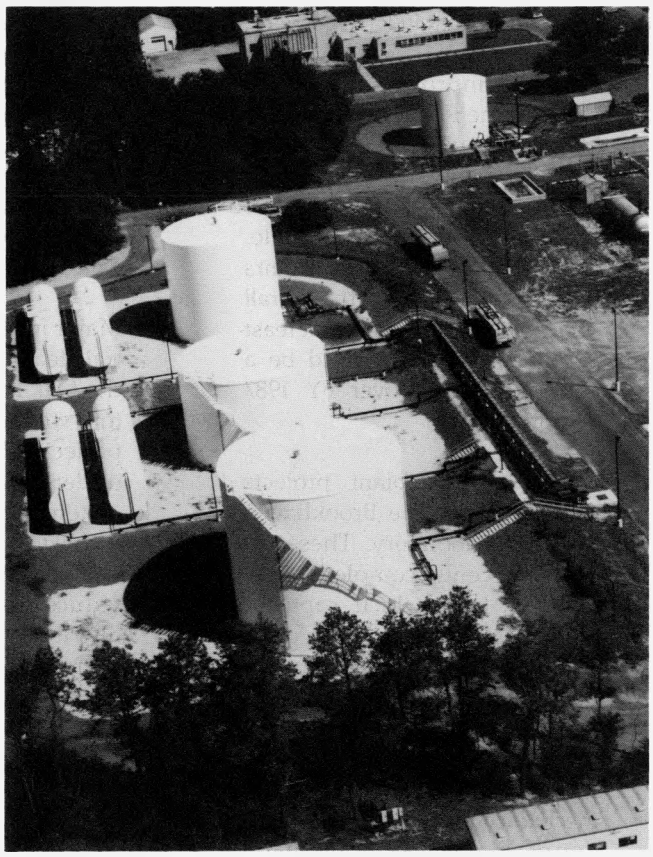
Since the beginning of the retrofit program in FY 1977, DOE has funded a



Outdoor security lighting was upgraded from incandescent to low pressure sodium at the Hanford Site.



This is one of many Field Interface Devices installed in one of the buildings at Sandia National Laboratory. These devices are installed in the Plant Control Center to remotely control the equipment operation to reduce energy usage.



Recently completed, this 1.2 million gallon fuel storage facility located at Brookhaven National laboratory will allow for off-season "stock-piling" of low cost fuel oils.

total of 685 projects for $177.8 million. Of this total, 66 projects at a cost of $17 million were funded in FY 1988. These projects benefit both buildings and metered processes. The annual savings from the FY 1988 program in the buildings category, upon projects completion, will be 580 billion Btu's and $3.4 million. The annual savings in the buildings category from projects funded from FY 1977 - FY 1988 are 11.5 trillion Btu's and $55.6 million.

Examples of retrofit projects benefiting buildings, which were completed in FY 1988 are:

The replacement of an existing air compressor with an electronic system in one of the buildings at the Pittsburgh Energy Technology Center. The electronic system will save 400,000 kWh and $17,000 annually. The project was funded for $25,000.

At the Lawrence Berkeley Laboratory two projects were completed: Magnet Cooling Fan Control was funded for $17,000. The annual savings is $5,000. Also, the Energy Management Control System upgrade project was funded for $28,000. The annual savings is $21,000.

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.

Table II-2
BUILDINGS ENERGY CONSERVATION ACTIVITIES SUMMARY THROUGH FY 1988

Activity		FY 1977-87	FY 1988	FY 1977-88
Retrofit Projects	Number Conducted	569	66	685
	Est. Cost ($000)	160,801	17,000	177,780
Surveys and Studies		FY 1978-87	FY 1988	FY 1978-88
	Est. Cost ($000)	24,095	1,900	25,995

Representative central plant improvements accomplished in FY 1988 were:

- Several improvements were made to the Rocky Flats Central Steam Plant during FY 1988. One of the boilers was completely rebuilt. Three other boilers were cleaned of over 1/8 inch of scale. It is estimated that these repairs and work will increase the overall steam plant efficiency by at least 15 percent, which would be a $200,000 savings over FY 1987 operation costs.

- Several central plant projects were begun at the Brookhaven National Laboratory. These include a recently completed heat recovery loop which captures waste heat exhausted from plant equipment and utilizes it to pre-heat boiler feed water, new insulation on steam facility piping and valves, and development of a new proposal to modify several plant mechanical systems for conservation of energy. Specific mechanical modifications planned for the Central Steam Facility include: use of equipment exhaust steam to pre-heat boiler combustion air, installation of variable speed throttle valves on boiler feed pump turbine drives, installation of variable frequency drives on boiler fan motors and insulation of heated fuel oil tanks. When complete, these proposed modifications are expected to result in an annual energy savings of over 4.6 billion Btu's.

- Major improvements to the central steam distribution system at the Oak Ridge National Laboratory were started in FY 1988. The project will replace the existing underground steam distribution system serving the eastern portion of Oak Ridge National Laboratory. The project will greatly reduce losses from the steam distribution piping and provide energy recovery from condensate.

5. New Construction Program

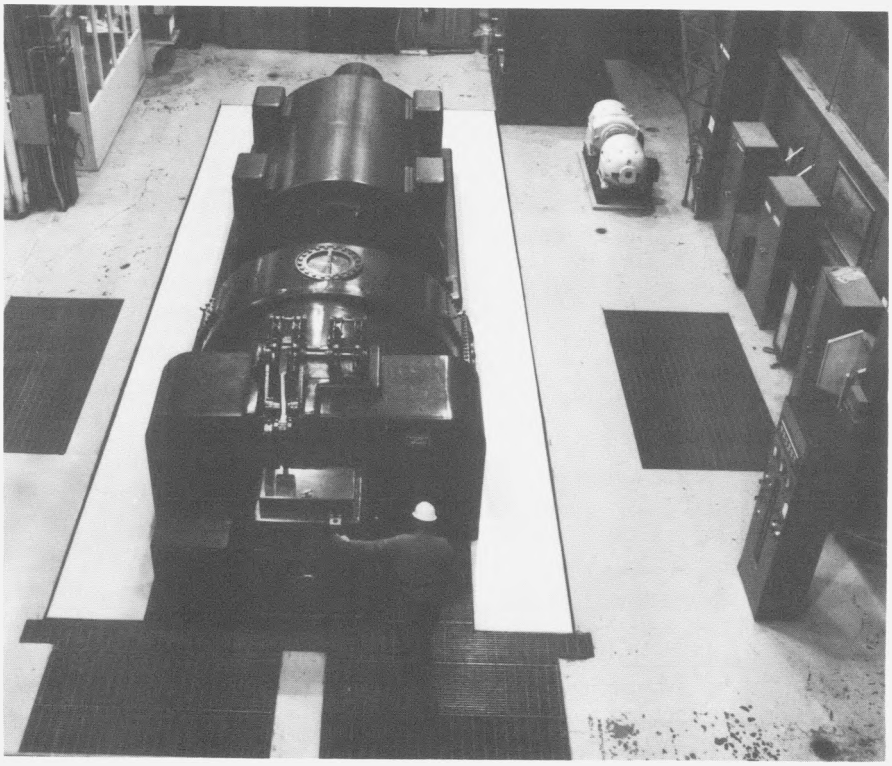
The energy conservation design criteria which were revised in FY 1985, impose specific requirements such as: computer-aided dynamic analyses of alternative design concepts for energy consumption evaluation; a formal Energy Conservation Report which must include a list of the major energy conservation features incorporated and the expected building performance in Btu's 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 266 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 reduction in average energy use per gross square foot of floor area as compared with FY 1975.

The building designs reviewed represent a total of 5,231,773 gross square feet and a combined total projected average energy use of 2,091,050 million Btu's per year, which is equivalent to 399,682 Btu's per gross square feet per year. When compared to the Department's average building energy use in FY 1975 of 997,749 Btu's/gsf, the new Federal buildings represent a 60 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 50 percent reduction in average buildings energy use.

It should be noted that the 266 new Federal building designs do not necessarily represent a typical cross section of building types in the FY 1975 data base with which these comparisons are being made. Also, these comparisons use a mixture of design



The 100N Auxiliary Boilers and 15 megawatt turbine generator pictured was studied in FY 1988 to evaluate the economic feasibility of generating electricity for the Hanford Grid.

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.

A new building (14,000 gross square feet) was constructed at the Pittsburgh Naval Reactors Office, Bettis Site. This addition houses new, advanced computer systems and was designed to meet DOE 45 percent goal for reducing building energy by incorporating energy saving features such as windowless walls, roof and wall insulations, and energy efficiency lighting and cooling systems.

D. Achievements for FY 1988

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 1988, measured from the new baseline year of FY 1985, was $11.3 million, and cost avoidance from FY 1986 through FY 1988 was $21.5 million.

The Department has decreased its energy use per square foot in buildings by 4 percent in FY 1988. 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 HVAC and building envelope
- Energy efficient lighting including reduced lighting levels
- Energy management control systems.

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 1988, experimental and production metered processes used 37.4 trillion Btu's of energy at a cost of $126 million. Figure III-1 presents metered process energy consumption and cost by fuel type during FY 1988. There are 1,077 buildings housing the metered processes included in these figures. Table III-1 compares FY 1988 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 two 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 baseyear was 39.3 trillion Btu's consumed in 14.6 million gross square feet of space for metered processes, and 2.9 trillion Btu's 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

Table III-1
FY 1988 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 88	% Change	FY 85	FY 88	% Change
Electricity	120,604	113,113	- 6.2	31,614	31,356	- .81
Natural Gas	3,208	3,420	+ 6.6	778	1,072	+37.8
Fuel Oil	5,934	2,847	-52.0	1,126	765	-32.0
Coal	11,225	6,565	-41.5	5,777	4,152	-28.1
LPG	103	53	-48.5	20	14	-29.2
Purchased Steam	25	15	-40.6	10	9	-10.2
Total	141,099	126,023	-10.7	39,325	37,370	- 4.9

Figure III-1
DOE Metered Process Energy Cost & Use
FY88

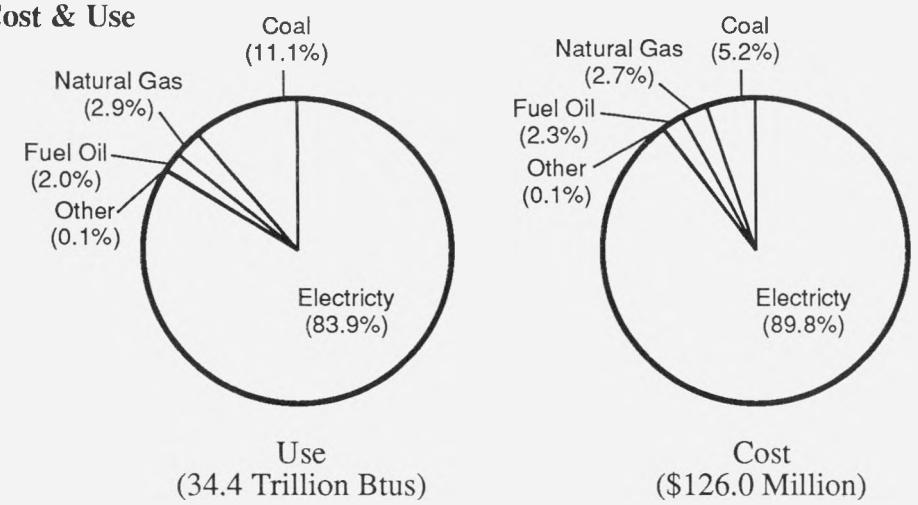


Figure III-2
DOE Metered Process
Energy Use FY 1985 & FY 1988

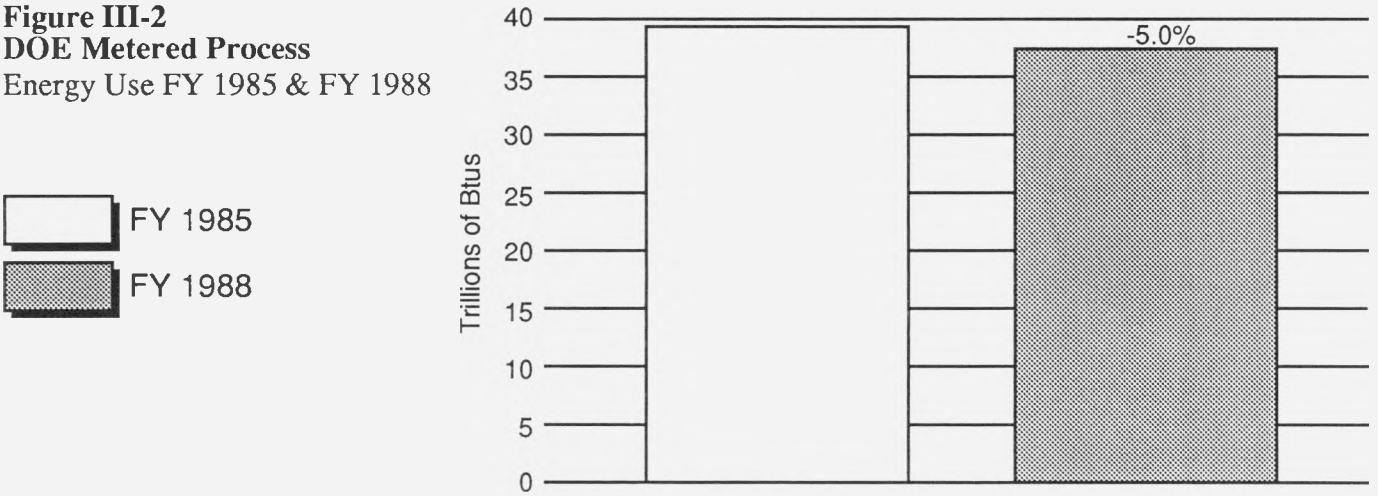
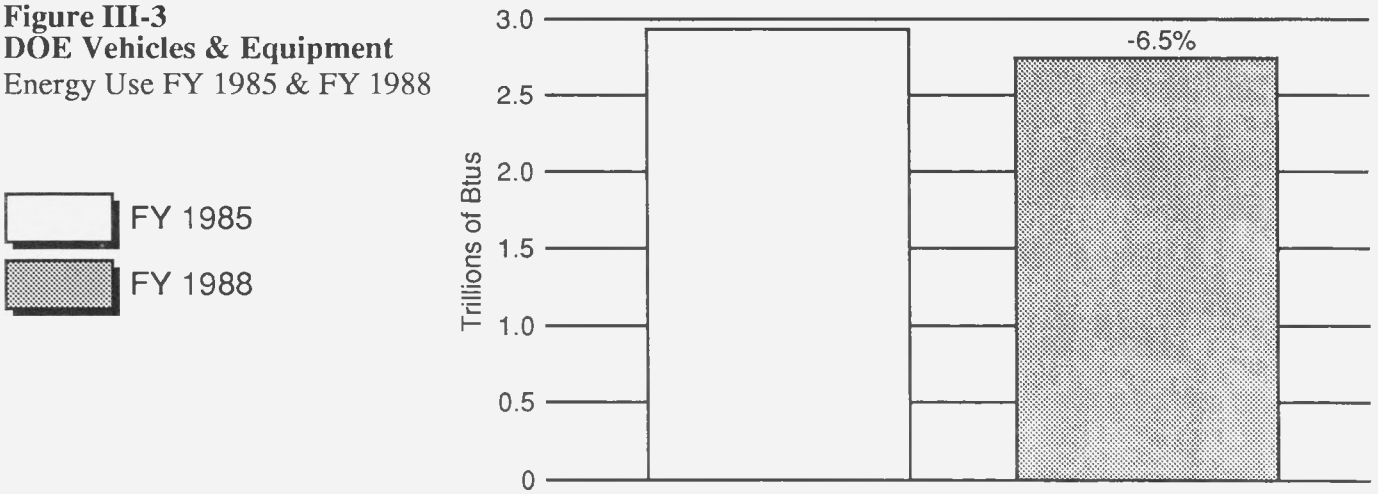


Figure III-3
DOE Vehicles & Equipment
Energy Use FY 1985 & FY 1988



Energy efficient cooling towers replace three existing Paducah Gaseous Diffusion Plant towers. A 1000 Hp reduction will result from the completion of construction awarded in 1988.

intensive research equipment used in a variety of physics experiments.

One of the studies funded in FY 1988 was at the Hanford Site. With the placement of N Reactor in cold standby, steam for start-up and shutdown is no longer required. The study was initiated to determine if the boilers in the 100 N Area could be used in conjunction with an existing 15 megawatt steam-turbine generator to cost effectively provide electrical energy to the Hanford Site transmission grid. The results of the study indicated that electricity provided to the Hanford Site by the Bonneville Power Administration is more cost effective than electricity that would be generated by the 100 N boiler/turbine equipment.

Work began on a Massachusetts Institute of Technology, Bates Linear Accelerator Center retrofit project for the design and purchase of energy efficient RF tubes for the accelerator's high power klystrons. In addition to saving a projected $90,000 annually in electrical energy costs, the project also expects to prolong tube life up to three times the present design.

One of the process surveys funded in FY 1988 was conducted at the Lawrence Berkeley Laboratory. This was a study of energy use in metered process energy at the Bevatron Experimental Facility. Potential retrofit projects resulting from the study are the replacement of ignitron rectifiers, mercury vapor rectifiers, copper-oxide rectifiers and rerouting and replacement of cables. A 10 percent savings would result in $347,000 saved per year at $.05/kWh (low cost interruptible service).

Through FY 1988, DOE has funded process retrofit projects at an investment cost of $36.3 million. These projects are expected to yield an annual energy savings of 3.6 trillion Btu's and $18.5 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 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 CFR 101 and are shown in Table III-2 along with DOE performance. In FY 1988, 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 1988 DOE fleet of vehicles and equipment.

Variable speed drives like the one pictured are currently being installed on 40 laboratory fume hoods at Brookhaven National Laboratory to efficiently match exhaust fan speed to fume hood sash location.

D. Achievements in Operations Energy Conservation

The Department, during FY 1988, used 5 percent less metered process energy than it did in FY 1985, the base year. This equates to a 12.7 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.

- The Y-12 Plant energy management activities included installations of energy efficient plate heat exchangers, a state of the art 2000 ton cooling tower at Bldg. 9204-4, two new flash gas compressors at the central nitrogen plant, dual fuel (coal and natural gas) firing systems at the steam plant, motion detector switches for outside lights at employee entrances, and equipment replacements/ modifications and personnel relocations.

- At the Hanford Site a Perimeter Lighting Retrofit project replaced an aging incandescent lighting system with energy-efficient low pressure sodium lighting. The project was completed during FY 1988 and is expected to save $24,000 annually.

- Lawrence Livermore National Laboratory, had an initial study to assess the feasibility of a new lighting system that would allow the Laboratory to use only two bulbs in what is normally a four bulb fixture. This test proved successful and led to a DOE funded demonstration project which is currently underway.

E. Emergency Conservation Plan

Title 10 of the CFR, 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 × 2 Light Trucks		4 × 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

Table III-3

DOE MOTOR VEHICLE FLEET DATA (FY 1975 - FY 1988)

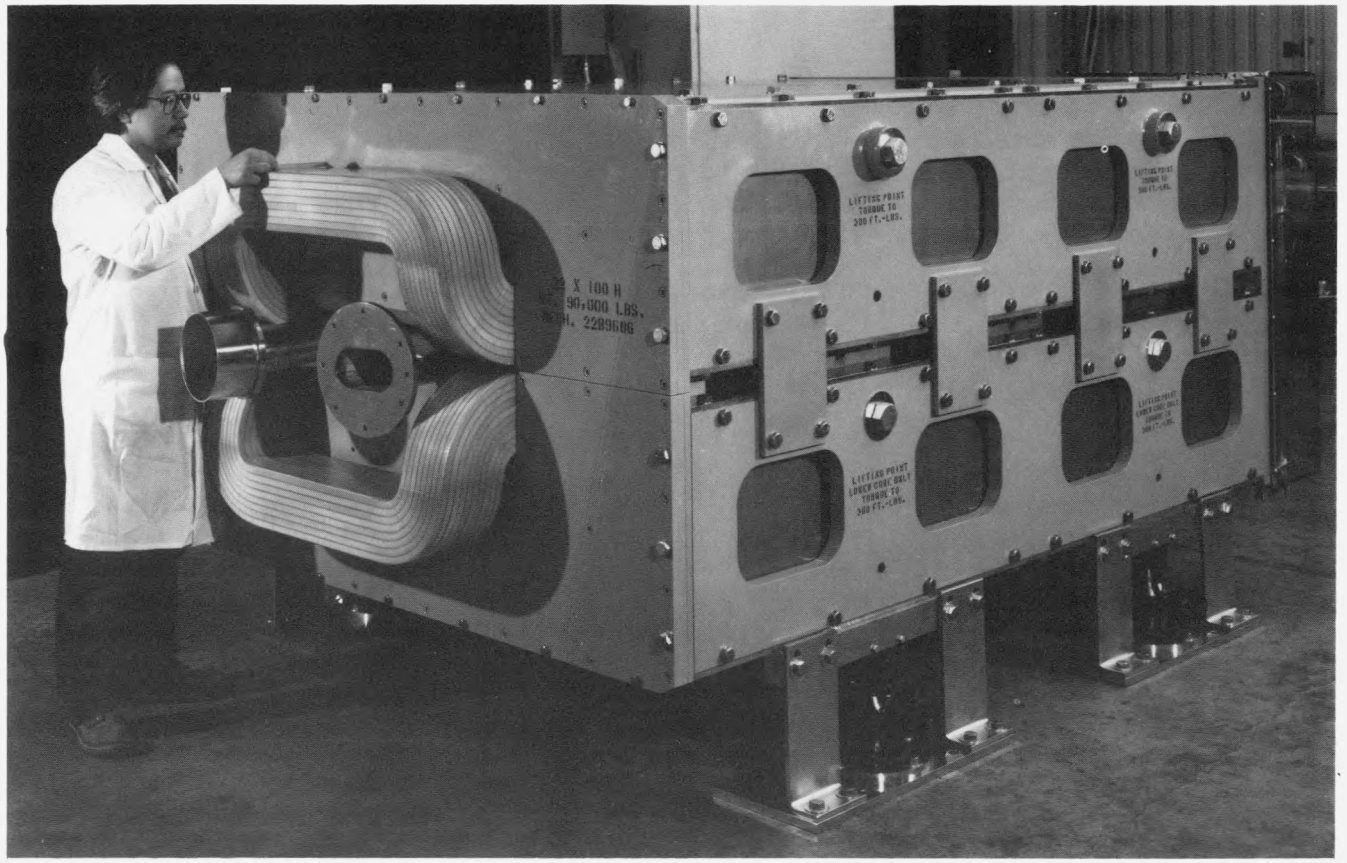
Years	Passenger Vehicles	Trucks	Special Purpose*
1975	2,265	7,133	—
1976	2,265	7,447	—
1977	2,264	8,251	—
1978	2,379	9,061	—
1979	2,329	9,096	—
1980	2,374	9,182	1,549
1981	2,366	9,223	1,710
1982	2,273	9,499	1,683
1983	2,326	9,717	1,794
1984	2,351	10,395	2,127
1985	2,291	10,761	2,162
1986	2,297	10,742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

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

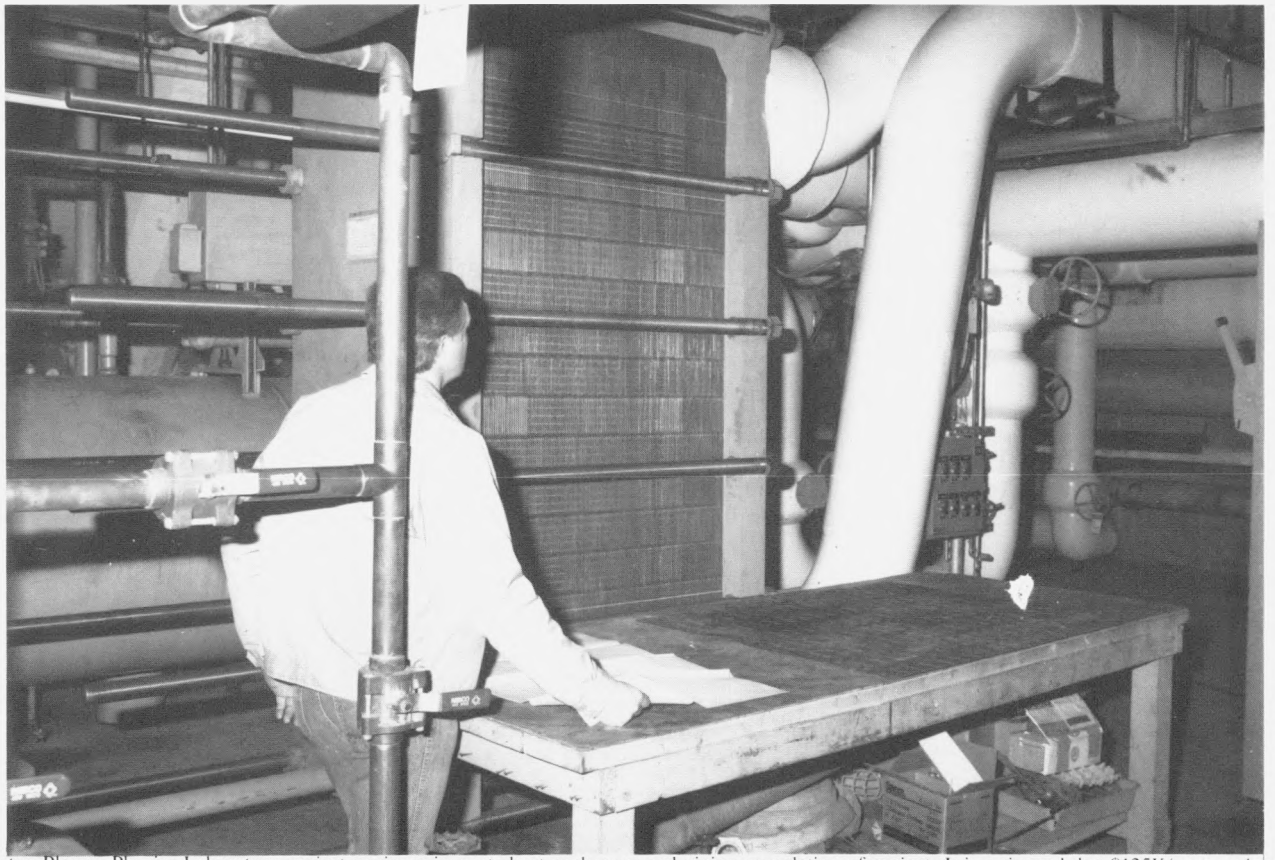
Table III-4

DOE FLEET OPERATIONS FY 1988

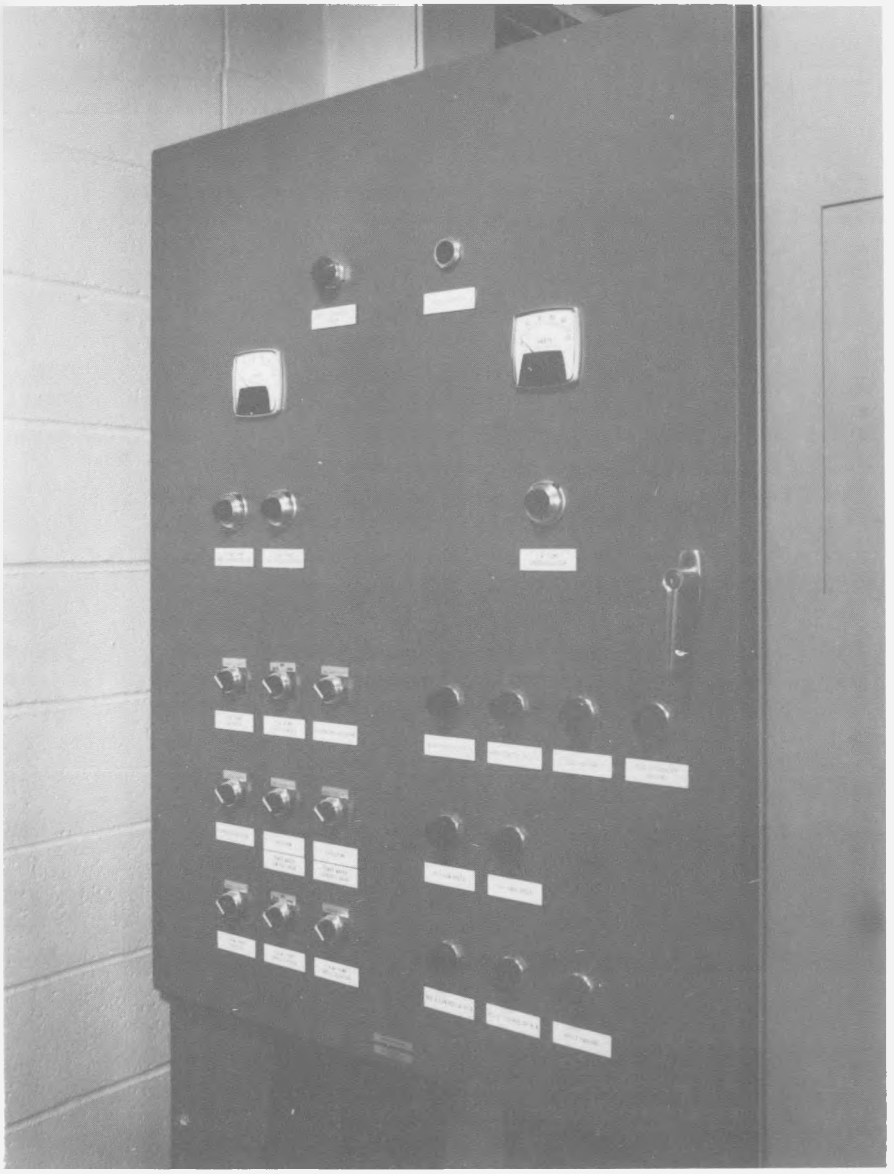
Vehicles on Hand	
Sedans	1,717
Station Wagons	162
Ambulances	55
Buses	261
Trucks	9,221
Special Purpose	1,901



Pictured is the new Pulsed Switching Magnet at Lawrence Berkeley Laboratory's Bevalac Facility. The new magnet will use a fraction of the power consumed by the two magnets it is replacing.



Princeton Plasma Physics Laboratory project engineer inspects heat exchanger and piping completion of project. It is estimated that $125K/year savings in process electricity will be realized.



Variable speed drives such as this one have been installed on several large horsepower pumps and fans at Brookhaven National Laboratory to efficiently match motor speed to system demand, thereby greatly reducing motor power consumption.

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

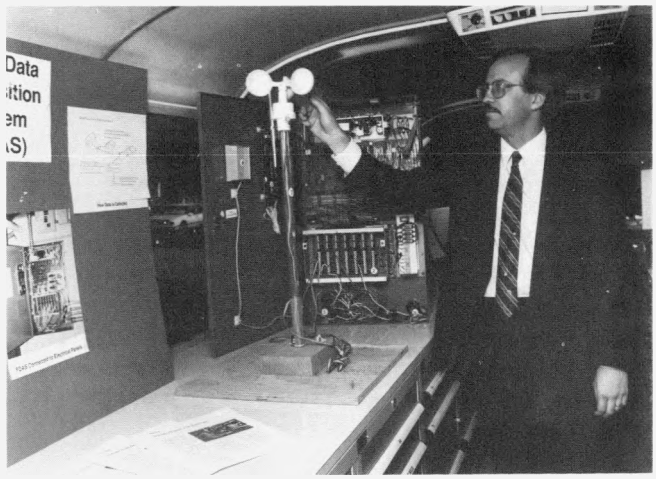
As part of the In-house Energy Management Program, DOE established a Department-wide Energy Conservation Employee Awareness Program to promote energy conservation for its civil service and operating contractor employees. A variety of promotional techniques, such as newsletters, posters, films, lectures, 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 1988.

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

- The Fermi National Accelerator Laboratory conducts a formal Employee Energy Conservation Suggestion Program. Cash awards range from a $100 minimum to $5,000 maximum, based upon the level of the estimated annual energy cost savings resulting from the suggestion. In FY 1988, three suggestions resulted in annual net savings of $130,000.

- The Reynolds Electrical and Engineering Company and the EG&G/Energy Measurements Company at the Nevada Operations Office, endeavor to educate all personnel on the subject of energy conservation. Energy con-servation information is disseminated regularly through check stuffers. Also, energy conservation posters are exhibited on light switches, bulletin boards, and other conspicuous places in most buildings as daily reminders to the building occupants.

This display was present at the Hanford, WA Site Family Day which featured the new energy awareness logo, as well as ways the site saves energy, by steam trap upgrades and energy efficient buildings.



Shown is a Pacific Northwest Laboratory research engineer demonstrating the capabilities of the Mobile Energy Laboratory for Energy Awareness Month.

Updated policies and standards for energy conservation are periodically conveyed by Company directives. News bulletins are frequently circulated to brief all contractor personnel on energy related technological advancements.

- Oak Ridge Gaseous Diffusion Plant staff produced a video, called "The Great Energy Debate." The video portrayed a comical view of two political candidates, the Misers and the Watt Wasters, running for the energy office. The message of the video to promote energy conservation, and the quality was such that the program was distributed to other DOE field offices, contractors, and Headquarters employees.

- At Lawrence Berkeley Laboratory articles are generated by the Applied Science Energy Group and energy coordinator in the weekly Lawrence Berkeley Laboratory newspaper. With assistance from Applied Science's energy conservation group in FY 1988, an employee awareness program was instituted in one of Lawrence Berkeley Laboratory's buildings to reduce lighting energy consumption. Lighting circuits were instrumented and monitored before and after the "lights out" program. The effort resulted in a 40 percent reduction of off-hour lighting.

2. In-house Energy Management Awards Program

DOE has also instituted an Annual In-house Energy Management Awards Program, which recognizes organizations and 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 1988.

- Best Operations Office Energy Management Program: San Francisco Operations Office

Table IV-1
DOE FIELD OFFICE EMPLOYEE CONSERVATION AWARENESS FY 1988

	Number of Sites
Awards Program	38
Suggestion Program	40
Energy Conservation Training	39
Site Publication Articles	40
Posters	52
Energy Conservation	48

- Best Energy Management Program for a Laboratory: Oak Ridge Operations Office

- Best Energy Management Program for a Production Facility: Hanford Facility

- Awards for Outstanding Individual Efforts in Energy Management:
  - Don E. Combs, Idaho National Engineering Laboratory
  - Larraine Kapka, Mound Facility
  - Dale Sartor, Lawrence Berkeley Laboratory

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 1988, 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 1988 programs at the sites.

- The Lawrence Berkeley Laboratory has long standing transportation programs. One of the programs provides shuttle bus services with provisions to carry bicycles as the primary alternative to driving individual vehicles. At the present time, shuttle buses provide service up to 12 hours per day to and from public transit, as well as on-site and between the Laboratory and the University of California Berkeley Campus. The three bus routes are providing approx-

imately 550,000 passenger trips per year. In FY 1988 the Laboratory hosted the first meeting of the Northern Chapter of the Association of Commuter Transportation, and also held its first "Traffic Busters Day." Employees were encouraged to carpool, vanpool, use transit, ride bicycles, use the shuttle buses or walk to work.

- The Y-12 Plant has an on-going site program to replace the older, inefficient fleet of multi-passenger vans and crew trucks, used to transport workers from their changehouses to their work areas. The replacement vehicles are smaller and more efficient. One hundred such vehicles were replaced in 1988. Also, 52 scooter-type vehicles were added to the fleet of in-plant- only transportation.

- Lawrence Livermore National Laboratory continues to conduct a very successful Ridesharing Program. The Stockton Metropolitan Transit District, in cooperation with Lawrence Livermore National Laboratory, has a bus which picks up employees from various areas in Stockton and transports them to the Laboratory. There are plans to add another bus early in FY 1989. In FY 1988 there were approximately 3129 participants in the Ridesharing Program.

- The Pittsburgh Energy Technology Center has developed a zoning concept that enables the organization of related functions in designated areas of the site. Traffic during working hours is reduced by means of a shuttle van serving all facilities on-site at 15 minute intervals. This program decreases the energy consumed in the movement of personnel and material. The local shuttle service coordinates with the public bus system on arrival and departure schedules.

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 1988, the Federal Interagency Energy Policy Committee selected Ms. Larraine Kapka of the Mound Facility in Miamisburg, Ohio, and the Westinghouse Hanford Company in Richland, Washington, to receive Federal Energy Efficiency Awards 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, design, and physical inspection of the field site steam traps and an analysis of

Shown is Argonne National Laboratory-West Building 768 Boiler No. 4 and boiler operator. Boiler operator training programs and boiler tuning have improved boiler operating efficiencies.

savings obtainable from correction of deficiencies; and an evaluation of site office steam trap maintenance programs. The training program was conducted at 7 sites and boiler testing was completed at two sites in FY 1988. The anticipated annual savings from this program if all recommendations in FY 1988 are implemented, is more than $5 million.

6. 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;
- 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.

7. Shared 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 savings projects. The legislation, the Consolidated Omnibus Budget Reconciliation Act of 1985, granted authority for Federal agencies to enter into multiyear shared 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 three pilot shared energy savings projects. The first shared energy savings project is 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 Qualifications, and has received interest from seven firms to participate in the solicitation process. It is expected that a contract will be awarded by November 1989, for this project.

The most recent pilot project was requested by the Oak Ridge Associated Universities for the purchase, installation and testing of a computerized energy management system to monitor and control energy use for eight buildings at seven remote sites. However, after closer examination, it appears that there are not sufficient energy savings retrofit projects at this site to attract a shared energy savings contractor. A decision will be made in the near future to either proceed with a shared savings contractor or to directly fund any identified retrofit projects.

Work is also continuing on the development of a third-party financed cogeneration project at the Brookhaven National Laboratory. The goal of this project is to provide up to 20 megawatts of electrical power to the facility. A feasibility report for this project identified annual savings of approximately $4 million. The project is currently under review by the Office of Energy Research, and the Chicago Operations Office.

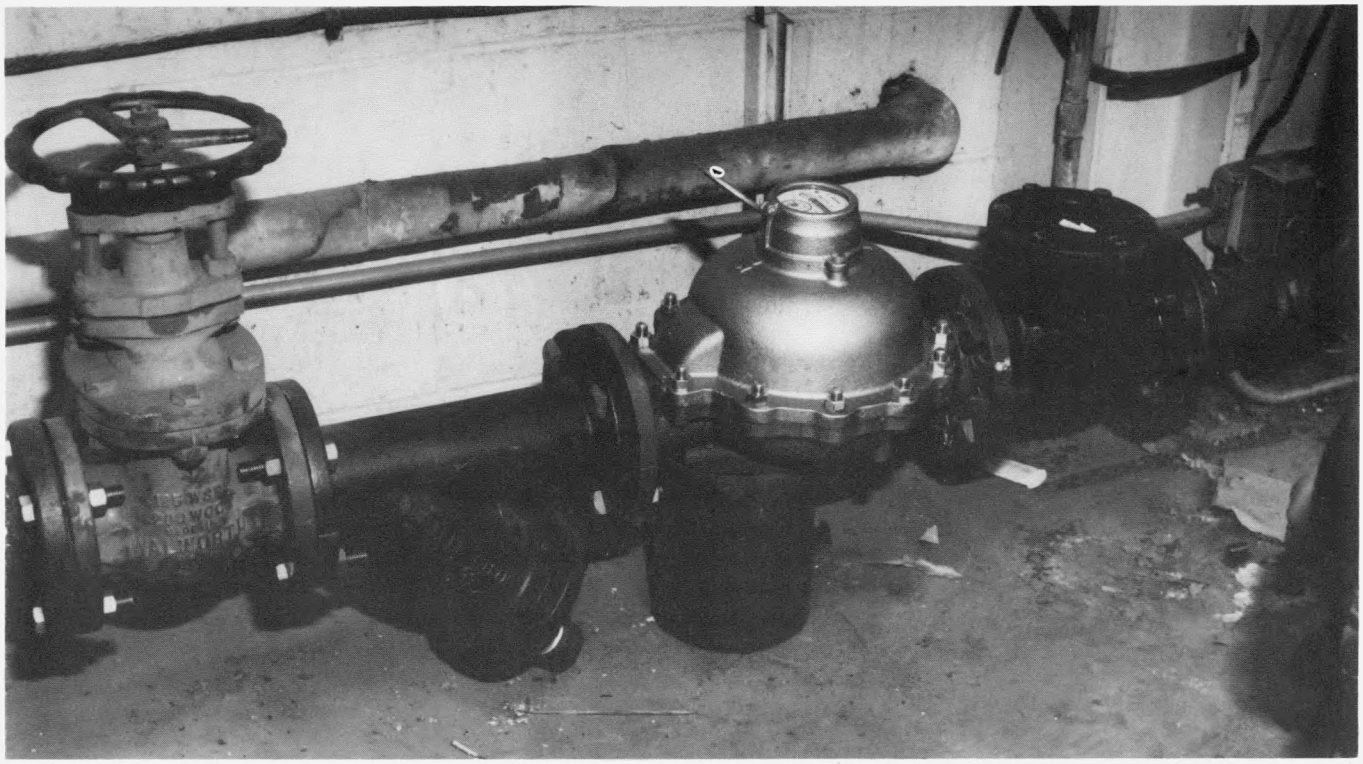
8. Metering

The In-house Energy Management group 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 conservation opportunities, and in some cases, bill customers directly for their energy consumption.

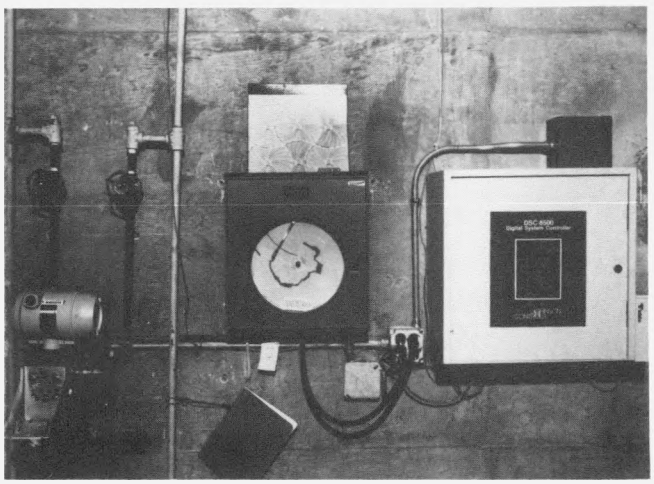
Typical FY 1988 metering accomplishments are:

- The Brookhaven National Laboratory is continuing a site demand limiting program which involves monthly meetings with representatives of the Energy Management Group at the laboratory, and large electric power users on- site to set a maximum monthly demand target for the upcoming month.

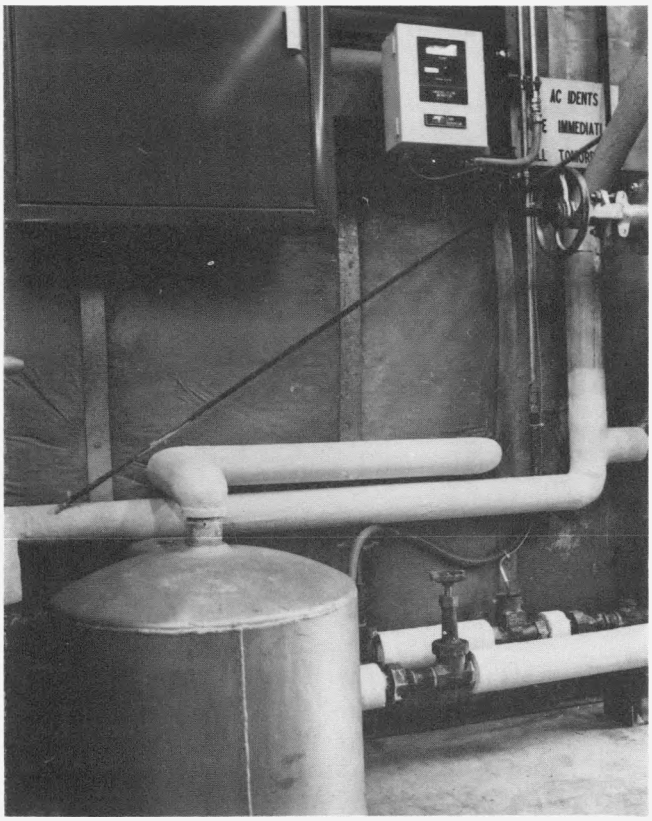
  A central demand monitoring computer located within the energy management group office is then set to alarm in various machine control rooms at the planned maximum demand. As site power demand approached the preset target demand, energy management group personnel are notified through the computer's alarm function. The demand limiting computer also alarms and notifies large power users throughout the site who in



Condensate meters such as this one are being installed in buildings throughout Brookhaven National Laboratory to monitor building steam consumption.



Pictured is a typical steam metering installation with smart transmitter, local flow chart recorder and local digital computer. The local and central computers are part of the Argonne National Laboratory-East site-wide Energy Monitoring and Control System that provides numerous functions, such as Heating, Ventilating, and Air-conditioning control, in addition to metering.



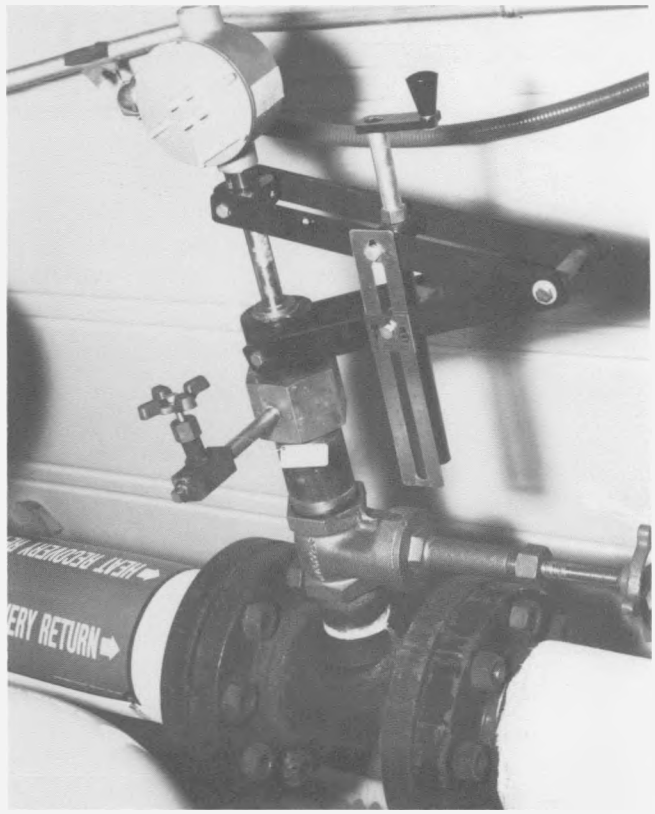
Pictured is a new insertion type condensate flow meter with readout. These meters, installed in several buildings at Argonne National Laboratory-West, measure condensate flowrate and temperature, and aid in billing procedures, heating load management and justification of energy conservation retrofits.

turn attempt to reduce power use by shutting off equipment and/or restricting usage. This program proved very successful by avoiding higher than necessary monthly peaks and their associated demand charges on numerous occasions during FY 1988. The program resulted in a savings of $1,750,000 due to avoided demand charges in FY 1988.

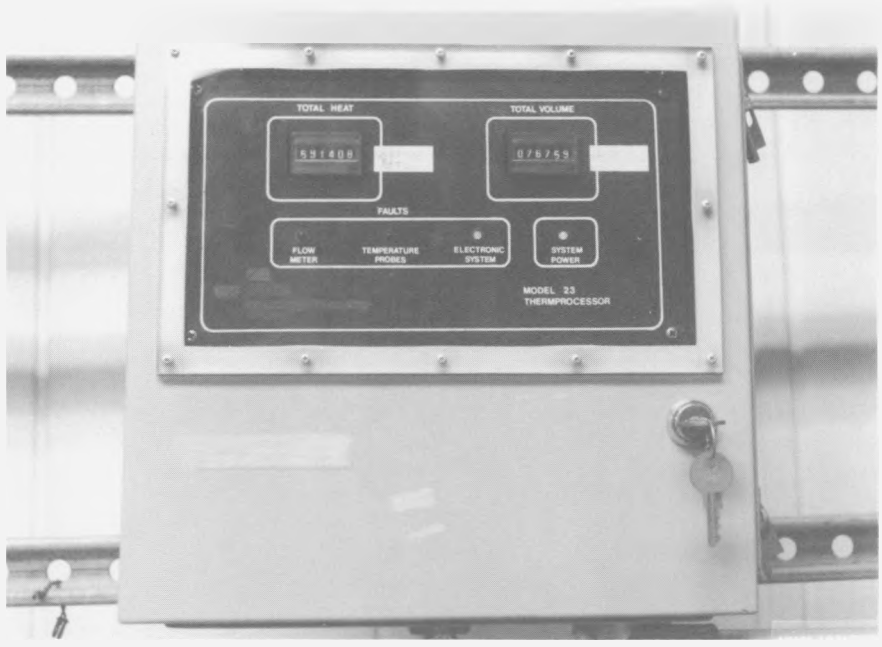
- The Lawrence Berkeley Laboratory has implemented a metering and accounting project that would double natural gas metering, automate the collection, analysis, and billing of metered data, and implement a reporting system to maximize the usefulness of metered data.

- The Westinghouse Hanford Company initiated two steam metering projects. The two projects will install insertion turbine type steam meters in two areas of the site. This instrumentation will permit measurement of instantaneous steam flow, temperature, and pressure at essential locations and also provide flow totalization. The steam data will be used for diagnostics and user billings to identify steam savings strategies and encourage user conservation.

- The Savannah River Operations Office has installed additional power services metering. This project provides the additional metering necessary to improve the cost/ quantity program at the site. Also, a comprehensive meter survey of the Savannah River Plant was conducted. Survey information was compiled, custodians were identified, and the power cost distribution program was rewritten. The information for this meter survey is used to bill programs directly for their energy consumption.



The meter shown is part of a heat recovery system which uses computer heat to preheat makeup air to a large once-through laboratory ventilation system at Schenectady Naval Reactors.



Electrical signals from the above meter are relayed to this remote microprocessor which calculates the energy savings. The systems saves between 250 and 600 gallons of fuel oil per day during the heat season.

CHAPTER V

HIGHLIGHTS OF FIELD ENERGY CONSERVATION ACHIEVEMENTS FOR FY 1988

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 1988. The following charts present field office information in each of six categories: survey funding; retrofit project funding; total energy consumption; Btu consumption per square foot for buildings; Btu 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 1988, 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 32 percent of the DOE total through FY 1988. Figure V-3 presents the FY 1988 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 Operations Office has made the most progress in FY 1988 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 1988 compared to the base year. These reduction achievements are very sensitive to levels of operations at the field sites. For example, the Savannah River Operations Offices' reduction was due in large part to reactors being shutdown during FY 1988. 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 $177.8 million investment in retrofit projects through FY 1988, DOE will realize an annual cost avoidance of approximately $70 million. The Chicago and Albuquerque Operations Offices contributed the greatest cost reduction, with predicted annual savings of 36 percent and 27 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 multiprogram 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 world-wide; and field-level planning and coordination of assigned nonweapons energy programs.

Solar energy research is high on the list of diverse nonweapons research at the Albuquerque Operations Office, which includes fuels, medicine, space and waste manage-

ment. 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 1988, the Albuquerque Operations Office managed an active In-house Energy Management Program at its many sites. Three retrofit projects were funded in FY 1988. The retrofit projects' total funding is $862,000. Upon completion, these projects are projected to save 60 billion Btu's annually. The average payback is 2.3 years.

In FY 1988 the Rocky Flats Plant changed electric rate schedules with the Public Service Company of Colorado. This change from a time of day (sch TT) to a general rate (sch TCT) will save the plant about $250,000 annually.

Construction of a new steam distribution and condensate return system was completed at the Pantex Plant in FY 1988. Completion of a new steam plant is scheduled in October 1989. The new plant will be a smaller, more efficient gas fired plant. When the new system is operational, it will result in significant energy savings. A life cycle cost analysis shows a 6 year payback.

The Administration Building Energy Conservation Modifications project was completed at the Los Alamos National Laboratory in FY 1988. This project included modifications to the existing HVAC system in the Laboratory's main administration building. A new Honeywell Delta Net Excel building automation system was installed and put into service in April 1988. It is anticipated that this system will reduce the consumption of electricity and natural gas in this building by 11 percent and 60 percent, respectively. Data on energy consumption is being collected and will be available at the end of FY 1989.

Exhibits 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 1988 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.

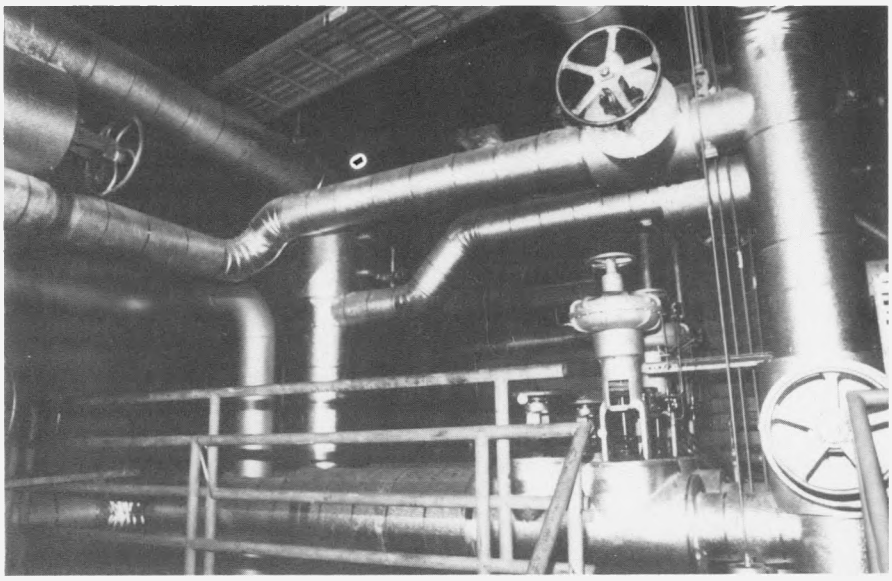
The principal programmatic activities under Chicago Operations Office's cognizance include: interlaboratory nuclear materials measurements for Defense Programs; basic and applied research in high energy and nuclear physics; development of fusion and fission energy; development of nuclear waste handling technologies for long-term storage of and transportation of nuclear wastes; research and development of renewable energy sources, such as solar-electric, thermal, electro-chemical storage; and other high-risk, high-cost programs and projects.

During FY 1988, the Chicago Operations Office received funding from the In-house Energy Management Program to initiate 8 studies at 2 of its sites. As a result of previous energy saving studies, 15 retrofit projects which will save $1,889,600 and have a simple payback of 2.45 years were funded in FY 1988 at Chicago Operations Office sites.

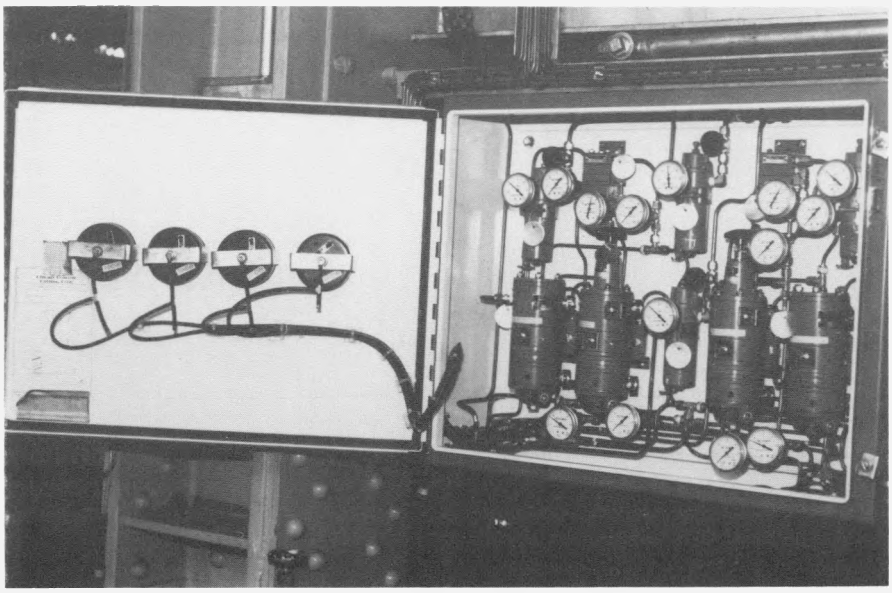
The Fermi National Accelerator Laboratory completed construction of an 83,000 square feet (sq. ft.) Central Computer Facility (CCF) and a 50,000 sq. ft. D-0 Collider Facility in FY 1988. These facilities represent the first of a new generation of "intelligent" energy efficient buildings. They consume 35 percent and 45 percent respectively of the energy typical of similar facilities designed 10 years ago. The entire CCF building is driven as a giant heat engine to reclaim and redistribute energy while monitoring wind, weather, solar intensity, cooling ponds, and heat generation patterns throughout the building. The D-O Collider Facility HVAC systems utilize high efficiency, multistaged reciprocating chillers with filtered lake water cooling, computerized Direct Digital Controls (DDC) and full building energy conservation features.

At Argonne National Laboratory, construction is nearing completion for the steam pressure reduction system at the boiler plant which employs pressure reducing valves. The steam will be distributed to the site at 100psig instead of the current 200 psig delivery pressure. This will reduce thermal losses and losses due to leaks.

Exhibits V-3B, and V-4B, and V-5B summarize the Chicago Operations Office's total energy consumption,



Shown is a pressure reducing station at Argonne National Laboratory-East Boiler House, Building 108 with two pressure reducing valves to make up steam flow required to site, over and above that available from Idaho Fan steam turbine exhaust.



Pictured is a panel, on the main floor of Argonne National Laboratory-East Boiler House, Building 108. This panel contains controls for operation of the valves that reduce site steam distribution pressure.

and buildings and metered process energy consumption per square foot for FY 1988, 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.

The Idaho National Engineering Laboratory completed the Advanced Test Reactor Waste Heat Recovery System Phase I construction. The project converted all Test Reactor Area Steam heated buildings to electric heating and allowed the less energy efficient boilers and deteriorated distribution system to be removed from services.

Exhibits 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 1988, as compared to FY 1985.

4. Nevada Operations Office

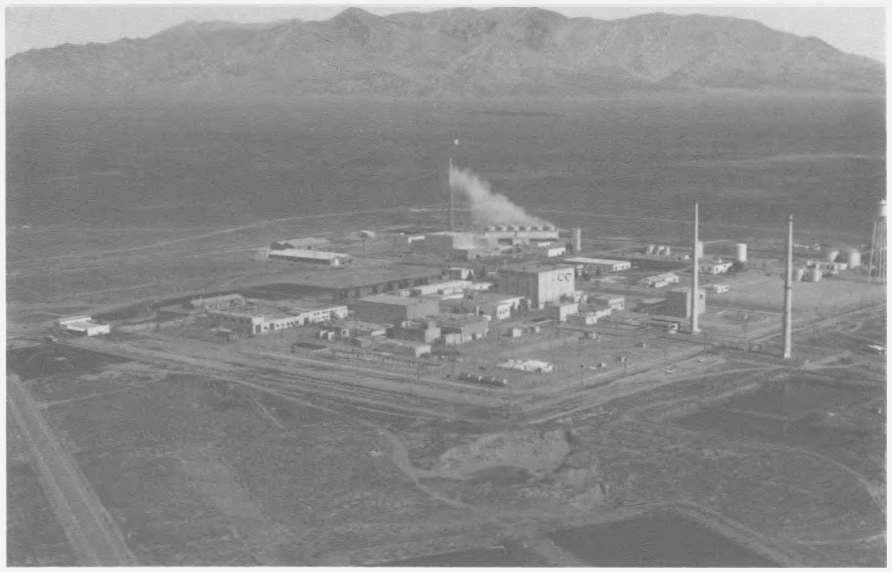
The primary mission of the Nevada Operations Office is testing nuclear explosives for the nation's nuclear weapons research, development, and testing program. Major activities included in that mission are large diameter hole drilling and mining for underground emplacement of nuclear test devices; and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

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.

Energy management accomplishments at the Nevada Operations Office sites included entering into a 20 year agreement with the Western Area Power Administration, for approximately 20MW of electric service from the Parker-Davis Project. The Operations Office is in the process of negotiating a 10 year agreement with the Valley Electric Association to provide transmission capacity for delivery of the Parker-Davis power to the Nevada Test Site. The effort will save approximately $300,000 per year when the site begins receiving the Parker-Davis power.

Other Nevada Operations Office energy management accomplishments were installation of roof insulation on a solid concrete building at the Nevada Test Site. It has been estimated that this project will save approximately 64,000 kWh and 4,400 gallons of fuel oil annually. A plate and frame heat exchanger was installed in the same building to by pass the 100 ton chiller during the fall, winter, and spring when ambient outside temperatures drop below 75 F. During these periods the cold condenser water from the cooling tower cools the chilled water through this highly efficient heat exchanger without the use of the chiller. Since air conditioning is required in this building year round, it is estimated that when this system becomes operational approximately 50 percent of the compressor operating time and an estimated 270,000 kWh of electrical energy will be saved annually.

An Advanced Test Reactor Waste Heat Recovery System project at Idaho National Engineering Laboratory is having loop piping assembled as pictured, prior to being placed into the trench. Heat proviously wasted in the cooling tower will be circulated through the loop to provide plant space heating.



The Advanced Test Reactor Waster Heat Recovery System is being installed in this area of the Idaho National Engineering Laboratory and should be completed by 1992.

Exhibits V-3D and V-4D present comparison of FY 1988 with base year FY 1985 total energy and buildings energy per square foot consumption at the Nevada Operations Office.

5. Oak Ridge Operations Office

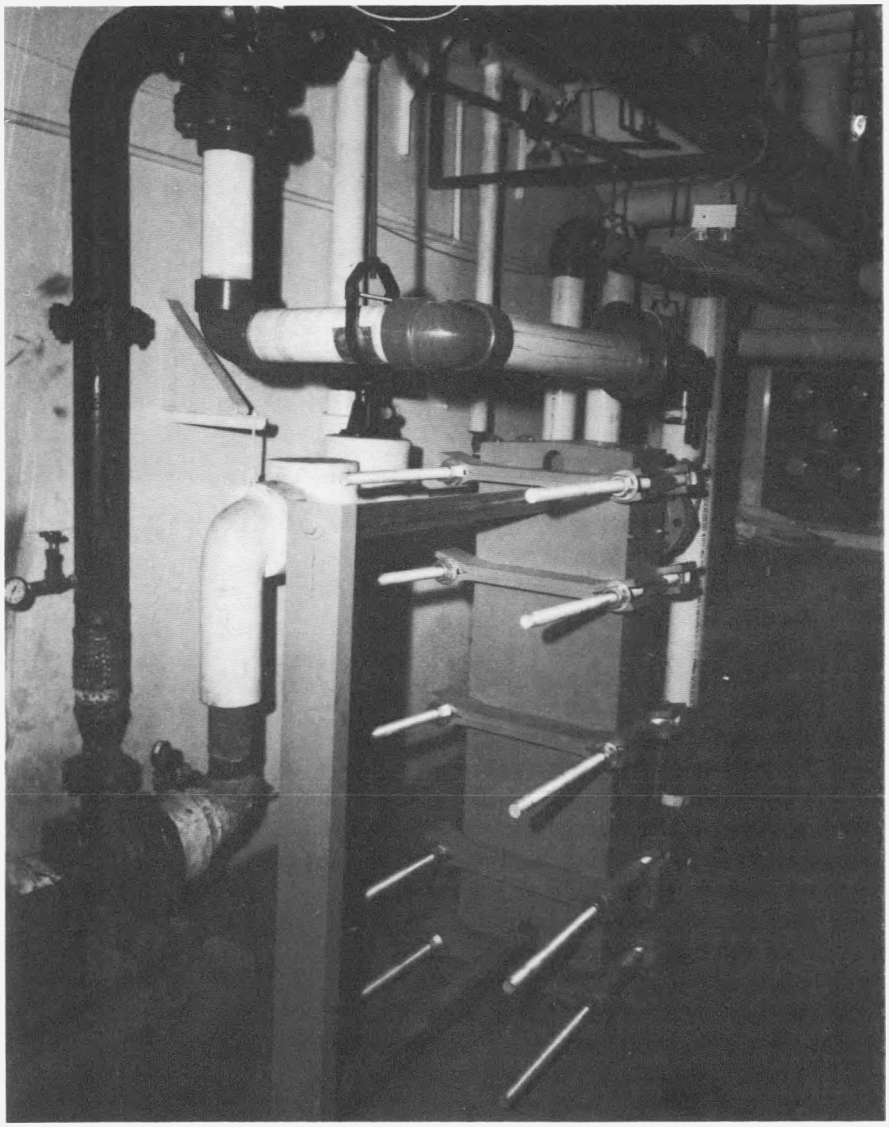
Established under the Manhattan Project during World War II, Oak Ridge Operations Office's programs have expanded from a narrow focus on atomic energy to a broad spectrum of energy research, development, and production. The Oak Ridge Operations Office, one of DOE's most diversified field offices, manages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

In FY 1988, a contract amendment was negotiated with the Tennessee Valley Authority that provided maintenance allowances and line loss credits for the use of DOE owned/K-25 operated 161-KV transmission lines and switchyards. This action represented an estimated cost savings of $300,000 annually.

The following is a summary of other energy management actions at sites under the cognizance of the Oak Ridge Operations Office during FY 1988.



This heat exchanger has been installed at the Nevada Test Site. It is estimated that this system will save approximately 50 percent of the compressor operating time and an estimated 270,000 kilowatthour of electrical energy will be saved annually.

The Oak Ridge National Laboratory conducted five energy conservation studies. The studies ranged from a cogeneration study for the central steam plant, to direct digital control systems for laboratory buildings. From these studies two retrofit projects will be developed. Also, several new buildings came on-line in FY 1988. These buildings will consume approximately 50 percent less energy than similar buildings constructed prior to 1975.

Five new buildings were completed during FY 1988 at the Y-12 Plant. Types of buildings constructed include (1) change house, (2) two office buildings, (3) a highly specialized computer facility, and (4) a combination change house, office, and guard headquarters building. Some of the typical energy conservation features included in the new buildings included: night-setback thermostats, variable air volume distribution systems, insulated double glazing, windowless walls, skylights and light shelves, increased building envelope insulation, high-pressure sodium lights and automatic lighting controls, computerized energy monitoring and control systems, and utilization of steam and chilled water produced at central facilities.

The Paducah Gaseous Diffusion Plant performed a Process Ventilation Improvement Study that justified a $300 thousand retrofit with a 2-year payback. In addition, a Plant Lighting System Replacement Study justified multiple retrofit projects. Some retrofit benefits already are accruing from the site funded studies, while others are resulting in improved operating economies.

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 1988 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 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 1988. 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 in-house survey program is expected to continue over the next several years.

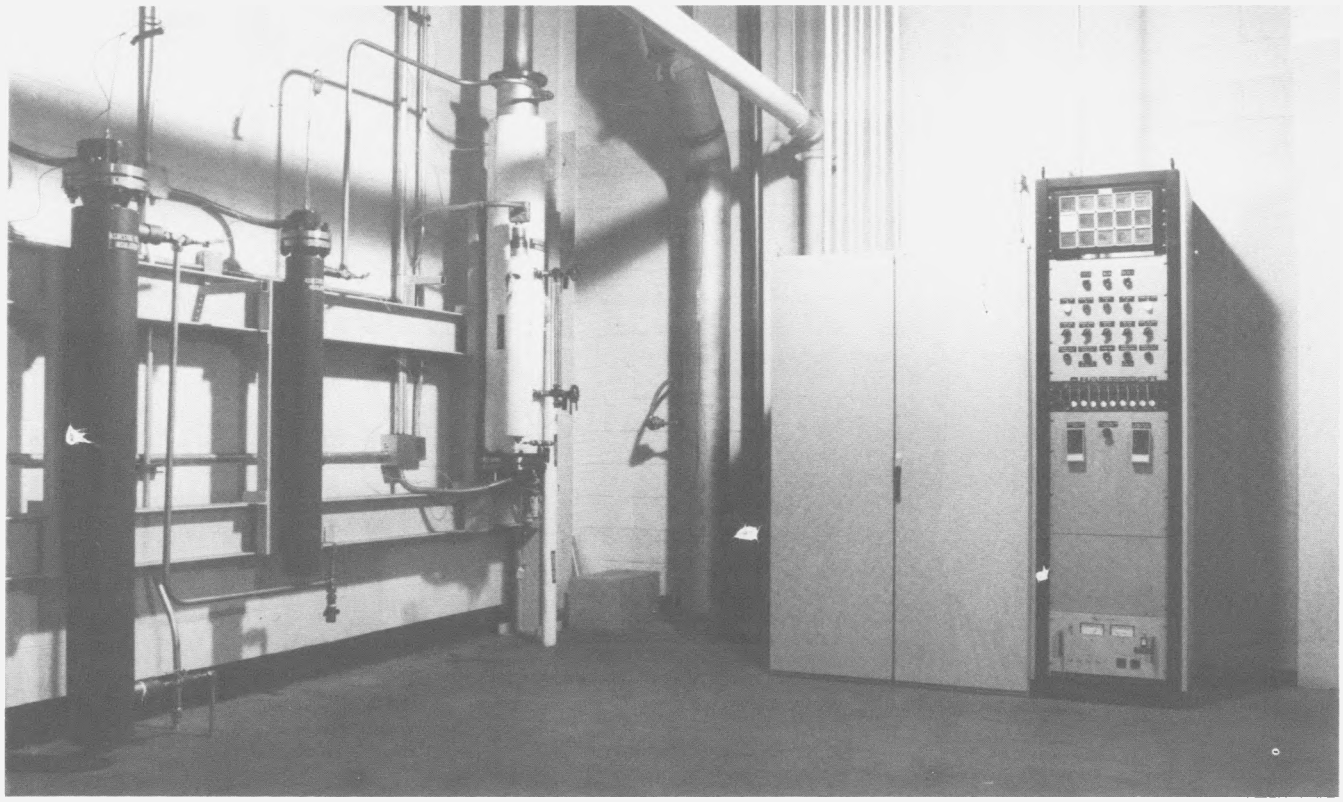
The most important element of the Bettis Laboratory energy management program is the identification, evaluation and implementation of life-cycle cost effective retrofit projects. Most of the energy savings required to meet the energy management goals for FY 1995 are expected to come from these projects. Energy savings realized from projects completed during FY 1988 will result in a 3.8 billion Btu's reduction per year or about 3 percent of the Bettis Laboratory's required goal by FY 1995. At the Naval Reactors Facility several main boiler steam valves were insulated as a result of a DOE Heating Plant Energy Audit completed by the Boiler Efficiency Institute. Insulation of these valves will save an estimated 107 million Btu's per year. In addition, a 100,000 gallon tank which provides raw water storage for one of the prototype reactor plants was insulated to afford increased freeze protection and reduce energy consumption. This previously uninsulated tank will require approximately 90 percent less heat and will save an estimated 960 million Btu's per year.

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



Shown are the electric heaters and an automatic control panel for the new Pure Water System (PWS) which was installed in the Thermal and Hydraulic Laboratory at the Bettis Site (West Mifflin, PA). The new, upgraded system has doubled the rate of production of pure water and is estimated to save about 167 megawatthour of electricity annually as compared to the older, less efficient PWS.

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 site continued an aggressive energy management program during FY 1988. Four In-house Energy Management funded energy saving projects and four Hanford funded projects were active in FY 1988. The FY 1988 consumption at Hanford reflects a 9.72 percent reduction in the buildings category, a 19.16 percent reduction in the metered process category, and a 7.18 percent reduction in the vehicles and other equipment category with an overall site reduction of 14.85 percent for total energy consumption. These figures would project a successful energy management program and are in part a result of that program. However, much of the FY 1988 reduction is a result of programmatic reductions at Hanford and milder climatic conditions in FY 1988 as compared to FY 1985 conditions.

The Hanford Energy Management Committee provides major leadership and thrust to Hanford's Energy Management Program. The committee is composed of representatives from the operating contractors, Pacific Northwest Laboratory's research and development, and the Richland Operations Office. The inclusion of the Laboratory research representatives as part of the committee is to facilitate technology transfer from the Laboratory research groups to the rest of Hanford to achieve energy efficient site operations and construction. This integration of research into on-going and future energy conservation activities of the site contractors also serves as a catalyst to generate new energy conservation activities at Hanford.

Exhibits V-3F, V-4F and V-5F present the total energy consumption and buildings and metered process energy consumption for FY 1988, as compared with FY 1986 at the Richland Operations Office.

Pictured are steam plant boiler forced draft fans at the 200 E Hanford, WA Site. An In-house Energy Management funded project will install fan enclosures and ductwork for return warm air from the steam plant ceiling to the boiler inlets.

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 1988 represented an overall continuation of energy management at the San Francisco Operations Office and its four sites, in an on-going effort to identify future cost effective projects to derive additional savings. Major accomplishments during this time follow.

A major program element to Lawrence Berkeley Laboratory's In-house Energy Management Program is process retrofit for conservation. The most significant FY 1988 projects were the Bevalac Facility's installation of a Pulsed Switching Magnet and the outdoor lighting upgrade. The new magnet which has replaced two solid core dipholes will be used to bend the Bevalac output beam into two major beamline chan-

nels which serve the Bavalac nuclear science program and radiotherapy program for cancer patients. The magnet uses pulsed power thereby requiring less than one eighth the energy of the two magnets that it replaced.

The outdoor lighting upgrade project replaced all incandescent and mercury lights with more energy efficient high pressure sodium or 9-watt florescent lights. All lights are now photocell controlled, so that they stay on only during darkness.

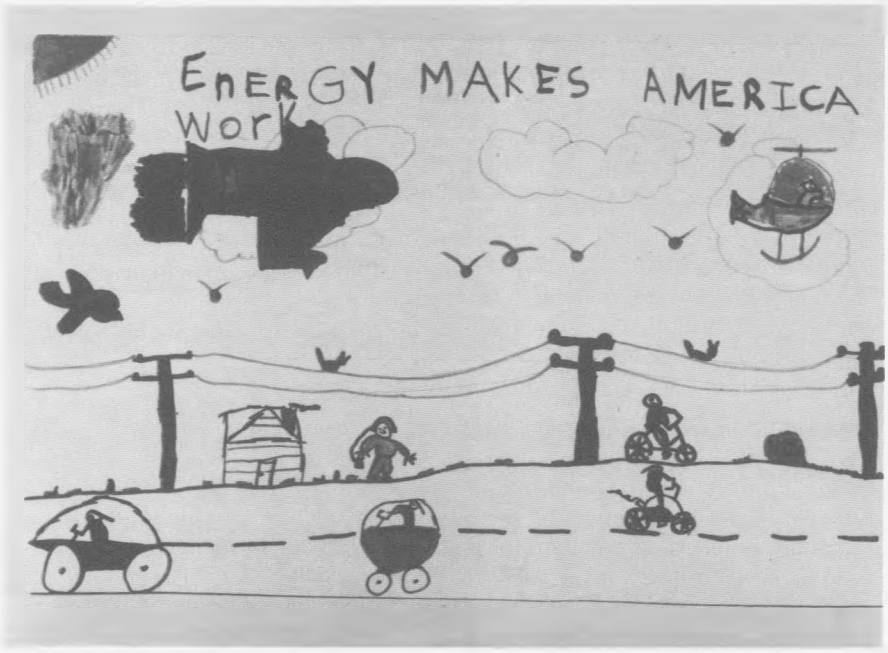
The Energy Technology Engineering Center completed initial operation of a "Power Pak" cogeneration system. The Power Pak is a cogeneration installation that will produce electricity from steam generated during power component testing at an existing Energy Technology Engineering Center facility. DOE will use Power Pak revenue to reduce operating expenses and testing costs at the Energy Technology Engineering Center site; Power Pak will pay for all fuel costs and significantly offset other operating expenses.

A major accomplishment in FY 1988 for the Lawrence Livermore National Laboratory was the success in their survey and study program. As a result of these studies, the Energy Management Group was able to put together approximately $2.0M in retrofit projects. These projects will conserve energy, but also help increase the reliability of the equipment.

The most noted accomplishment of FY 1988 for the Energy Management Group was the drop in building energy consumption. Significant efforts in employee awareness and retrofit projects may be the primary reason for their success. In FY 1985 Lawrence Livermore National Laboratory's consumption in the buildings category was 655 kBtu's/gsf. To achieve the DOE goal by FY 1995 would require a reduction in consumption by 65.5 kBtu's/gsf. or to a level of 589.5 kBtu's/gsf. The FY 1988 usage was 617.4 kBtu's/gsf.; a 5.9 percent drop from the FY 1985 consumption.

The Stanford Linear Accelerator project to install variable motor controls on two ventilating fan motors at the Stanford Linear Accelerator Computer Building (Building −50) was completed in FY 1988. It is expected that this project will result in savings of 73,000 kWh annually.

Exhibits V-3G, V-4G and V-5G present total energy consumption and buildings and metered process energy consumption per square foot for FY 1988, as compared with FY 1985 at the San Francisco Operations Office.



As part of American Energy Month, the Savannah River Site (SRS) promoted energy conservation with energy awareness contest in local area schools. A grand prize winner was selected from each school and awarded a $50 US Savings Bond. Shown is the grand prize winner's poster of the SRS energy awareness contest.

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.

In support of reactor operations the Savannah River Site utilizes a 2600 acre cooling water impound known as Par Pond to Supply cooling water to one of the reactors. The project to increase efficiency of the par pond pumphouse was continued in FY 1988. This project will replace the existing pump impellers with a more efficient design.

As part of American Energy Month, the Savannah River Operations Office promoted energy conservation with energy awareness contests in local area schools. Using the National theme, "Energy Makes American Work' students competed in poster or essay contests. A grand prize winner was selected from each school and awarded a U.S. Savings Bond.

Exhibits 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 1988 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.

In FY 1988 the Knolls Atomic Power Laboratory formed an energy conservation task force. The primary purpose of this task force is to identify specific areas for energy conservation action. Typical of the activity of this group was the effort of a sub-task force formed at the Kesselring Site who introduced 21 energy saving suggestions with a potential total annual savings of $772,000.

The Knolls Atomic Power Laboratory completed the design to upgrade the Kesselring Site boilerhouse. The upgrade will include installation of two new energy efficient fire-tube boilers manufactured in 1951.

The transfers of electrical loads at the Knolls Site to improve metering of "building" and "metered process" electrical usage was completed.

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 kW Eklutma Project serving the Anchorage-Palmer area and the 47,160 kW 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 on 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 1,440 miles. The Southwestern Power Administration sells wholesale power to approximately 92 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 574 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 16,300 miles of transmission lines, 254 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 50 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 10,204 megawatts.

Western Area Power Administration efforts in FY 1988, included building retrofits and modifications such as improved lighting fixtures, air-conditioning, reconfiguration, heat exchanger modifications, thermopane window replacement, airlock vestibules, and wall and roof insulation. Western sets specific conservation requirements on building retrofits, modifications, or new construction. It also requires energy evaluation of all facilities being modified. Design of new buildings and modification of existing buildings uses state-of-the-art technology to achieve increased energy savings.

During FY 1988, Western completed the Glendo Control Building near Glendo, Wyoming, and an addition to the Loveland Area Office maintenance building in Loveland, Colorado. Both facilities incorporate such energy-efficient technologies as air-to-air heat pumps, energy-efficient windows, and improved insulation.

Also, Western put into commercial operation its second direct current (DC) tie, Sidney AC-DC-AC Converter Station (Sidney DC Tie) in Sidney, Nebraska. The first such DC Tie was built at Miles City, Montana. Both of these highly efficient, state-of-the-art facilities provide efficient transfer of power between eastern and western electrical systems with minimal losses. They help Western serve its customers in the most efficient manner.

Western is participating with the Bonneville Power Administration and other utilities in the western United States on the California-Oregon Transmission Project (COTP), which is intended to carry energy surplus from the Pacific Northwest to the southwestern United States, which has a greater demand for energy than it can meet by itself. The project will entail the construction of a new 500,000-volt alternating current (AC) transmission line. Western has finished designing its portion of the transmission system and is designing the three substations that will be its responsibility. The COTP, for which planning began 5 years ago, is tentatively scheduled for completion in 1992. Two other 500,000-volt AC lines are already in operation between southern Oregon and northern California. Other participants in COTP are Pacific Gas and Electric, Southern California Edison, and the Transmission Association of Northern California, a group of municipalities and smaller utilities.

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 effort in FY 1988 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. An existing absorption chiller was replaced with a new Trane centrifical chiller. This equipment change should result in an annual

The Morris Substation in Minnesota was insulated and sided as part of the general retrofitting to make the building more energy efficient. The work is an example of some energy conservation measures Western Area Power Administration is taking.

As part of the energy-efficient retrofit, 24 gauge aluminum is placed over the northwest door sill 2×6 of the Morris Substation, owned by Western Area Power Administration.

savings of $75,000/yr. Installation of this new unit showed a payback of 2.9 years from energy savings.

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 data bases, publications, conferences, patents, personnel exchange, contracts, technical exchange programs, and visitors to the Center.

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 data base 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 1988 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.

E. Petroleum Reserves

1. Naval Petroleum Reserves

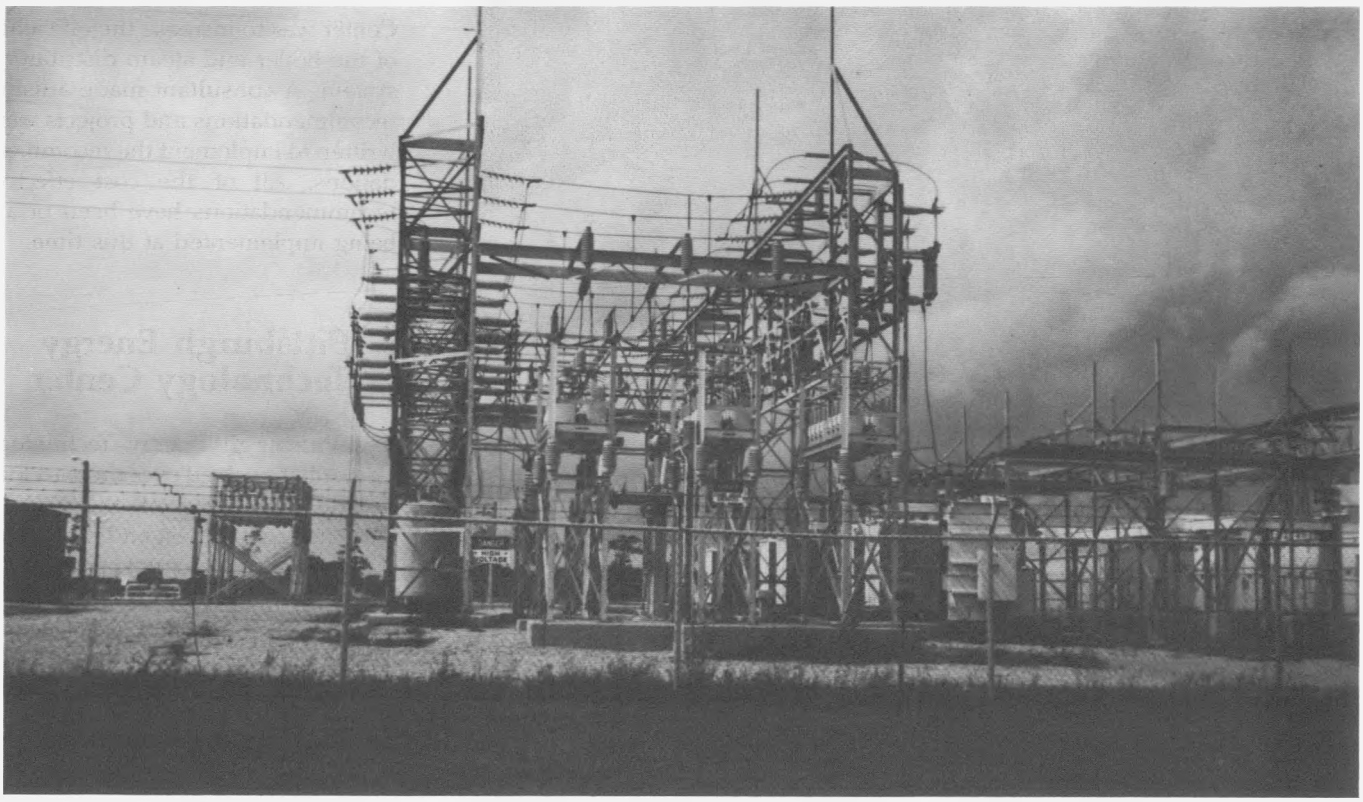
The Elk Hills Naval Petroleum Reserve No. 1 is a 48,000-acre oilfield, located 30 miles west of Bakersfield, California, producing oil and associated hydrocarbons from subsurface reservoirs at their Maximum Efficiency Rates. The Maximum Efficiency Rate is the maximum sustainable oil and gas daily production 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 and 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 89,600 acres located approximately 55 miles southeast of Vernal, Utah. These three oil shale reserves were established as a future vast resource of oil. Their current mission is to maintain readiness for future development when warranted by economic conditions.

Energy conservation measures at the Naval Petroleum Reserves stress efficient pumping operations. The following are some of the energy conservation measures taken in FY 1988 at Naval Petroleum Reserve No. 3. During FY 1988, 41 time clocks were installed on new oil wells. Approximately 80 percent of the producing oil wells were controlled by time clocks to reduce electrical demand. Forty-two oil wells were shut-in during FY 1988. The oil projection from these wells had declined to a point where the daily operating costs exceeded the revenue generated. Shutting-in the wells eliminated the need for electricity to operate the pumping units and thereby reduced electrical demand. This resulted in an estimated annual savings in electrical energy of approximately $10,000.

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 1988. 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



The Alligator (Main) Electrical Substation at the Strategic Petroleum Reserve West Hackberry shown here was purchased by the Government. The discontinued payment of facilities charges for this substation has resulted in a yearly cost savings of $288,000.

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.

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 following is a summary of energy management actions at sites under the cognizance of the Strategic Petroleum Reserves Office during FY 1988.

Alternative leaching plans at the Big Hill oil storage site were analyzed for electrical power cost efficiency. The choice of the low pressure leach plan over alternative plans results in an overall cost savings of approximately $3,000,000 over the life of the leaching operation.

Planning for leaching cavern 101 at the Bayou Choctaw oil storage site resulted in significant energy cost avoidance. The choice of a reduced leach rate plan (one leach pump) at Bayou Choctaw will avoid approximately $400,000 in additional energy costs over the life of the leaching operation.

Use of a special electrical rate schedule at the Big Hill site resulted in approximately $500,000 in direct and avoided energy costs.

Figure V-1
Survey Funding
FY 1978 through 1988
$26.0 Million Total Funding

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

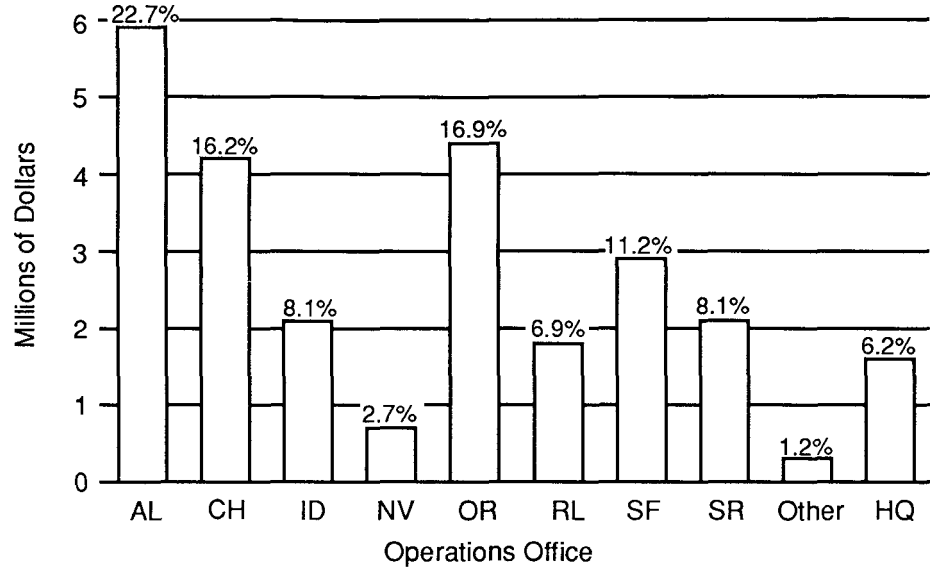


Figure V-2
Energy Project Funding
FY 1978 through 1988
$177.8 Million Total Funding

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

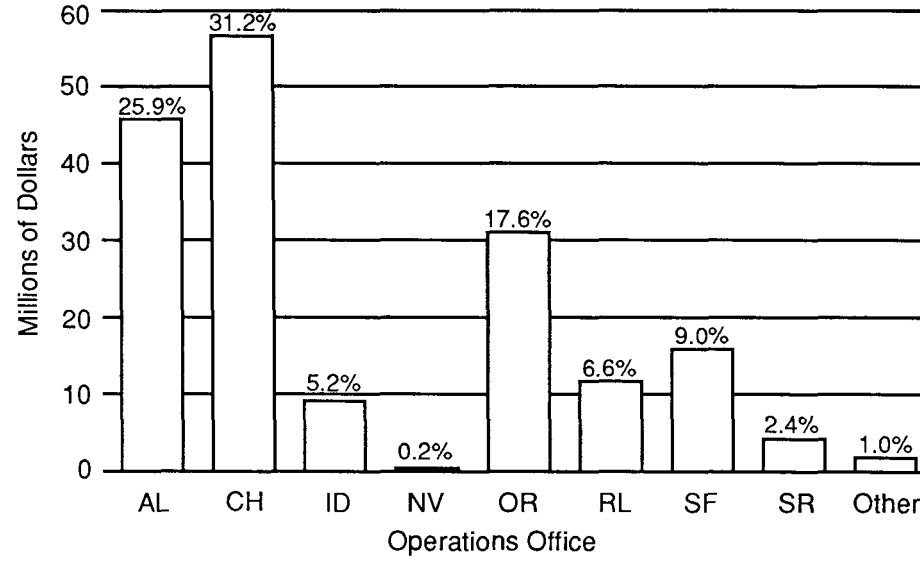


Figure V-3
Total Energy Use

FY 1985
FY 1988

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

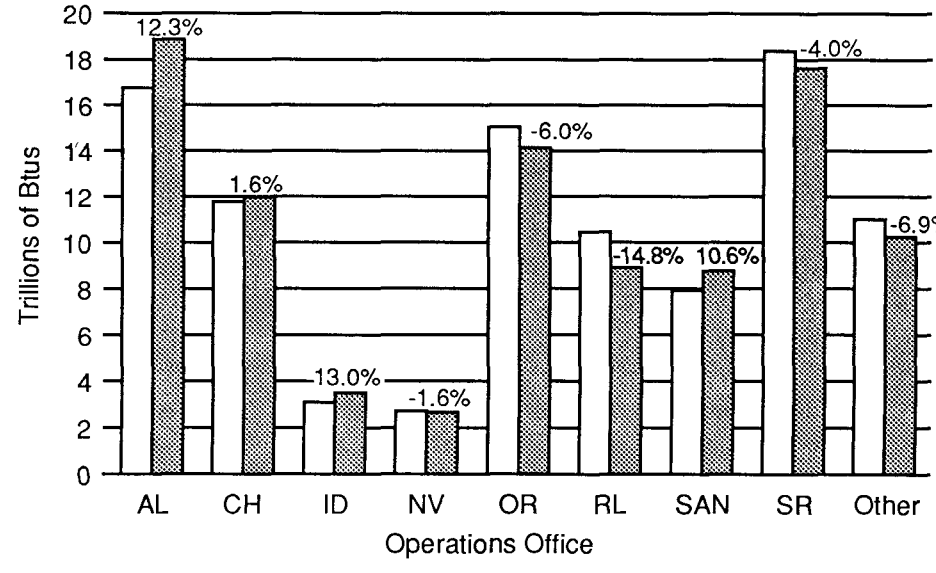
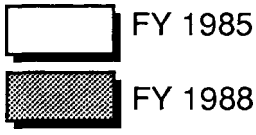


Figure V-4
Building Energy Use per Square Foot



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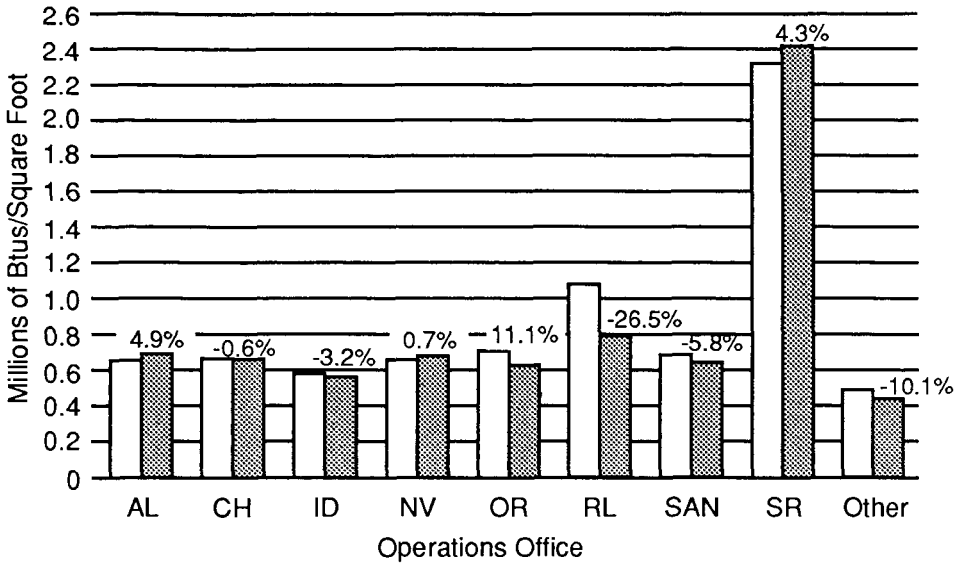
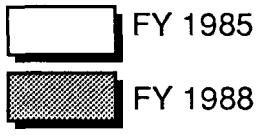


Figure V-5
Metered Process Energy Use per Square Foot



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

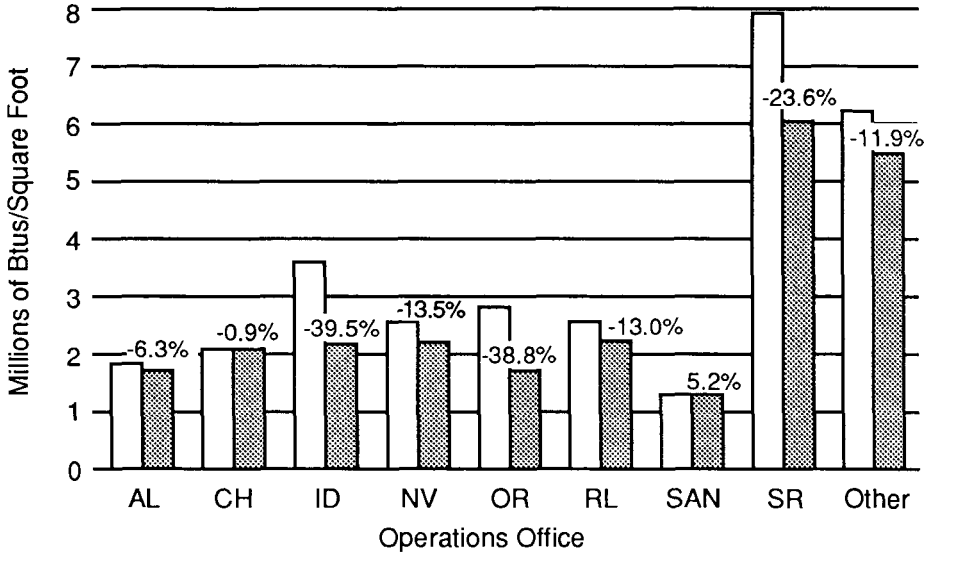


Figure V-6
Annual Savings Upon Completion
Retrofit Projects FY 1977-1988

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

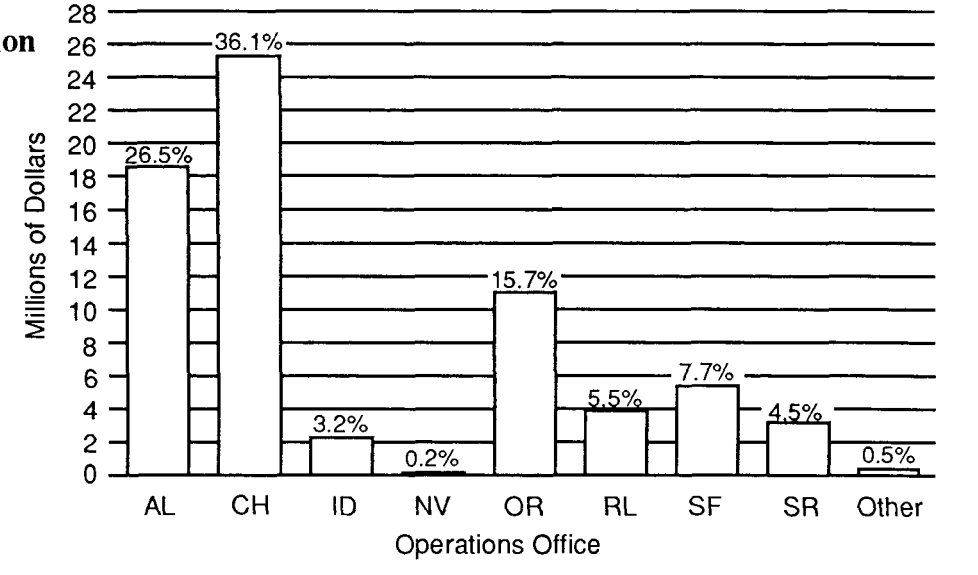


Figure V-3A
Albuquerque Total Energy Use
FY 1988 & Base Year

FY1985

FY 1988

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

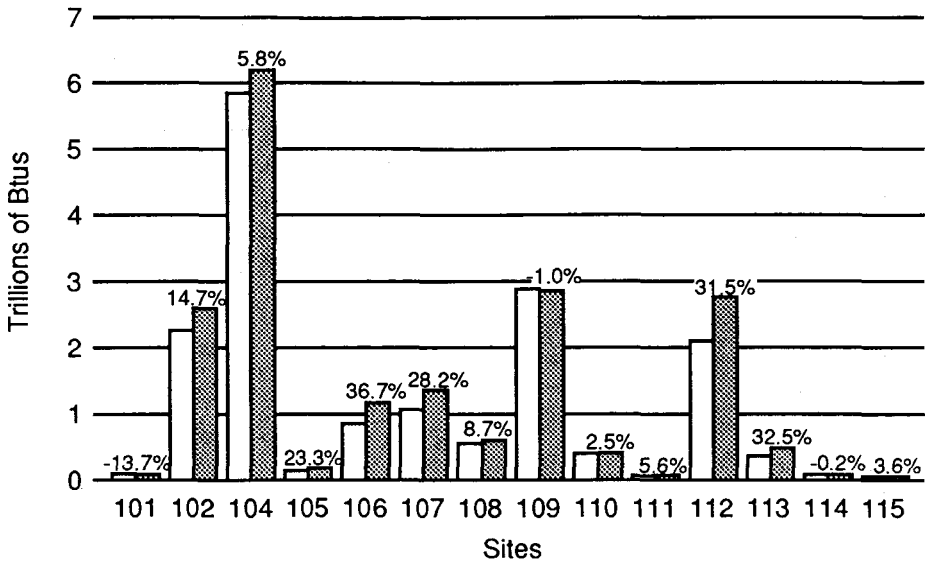


Figure V-4A
Albuquerque Building Energy Use
FY 1988 & Base Year

FY1985

FY 1988

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
112	Sandia Labs, Albuquerque
113	Sandia Labs, Livermore
114	Sandia Labs, Tonopah
115	Precision Forge

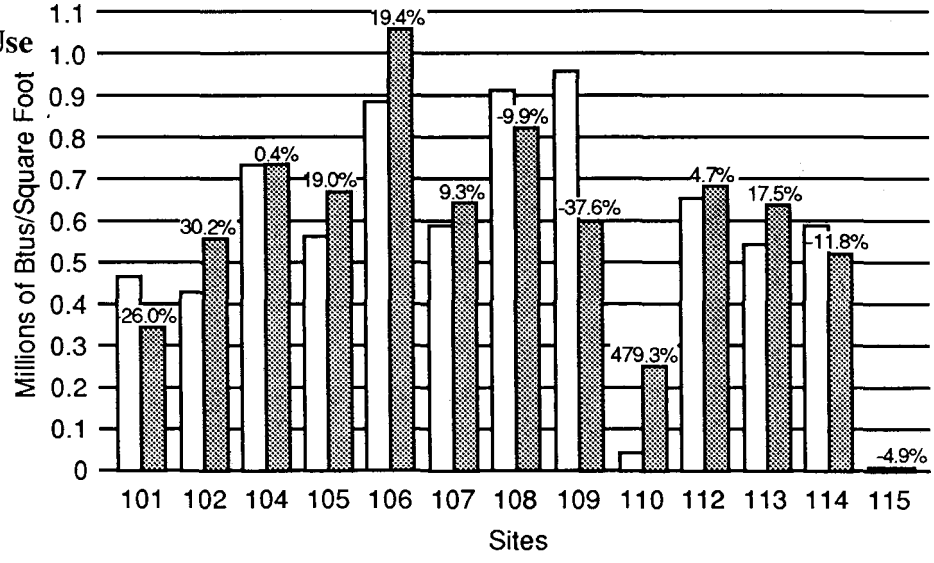


Figure V-5A
Albuquerque Metered Process Energy Use
FY 1988 & Base Year

FY1985

FY 1988

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
112	Sandia Labs, Albuquerque
113	Sandia Labs, Livermore
114	Sandia Labs, Tonopah
115	Precision Forge

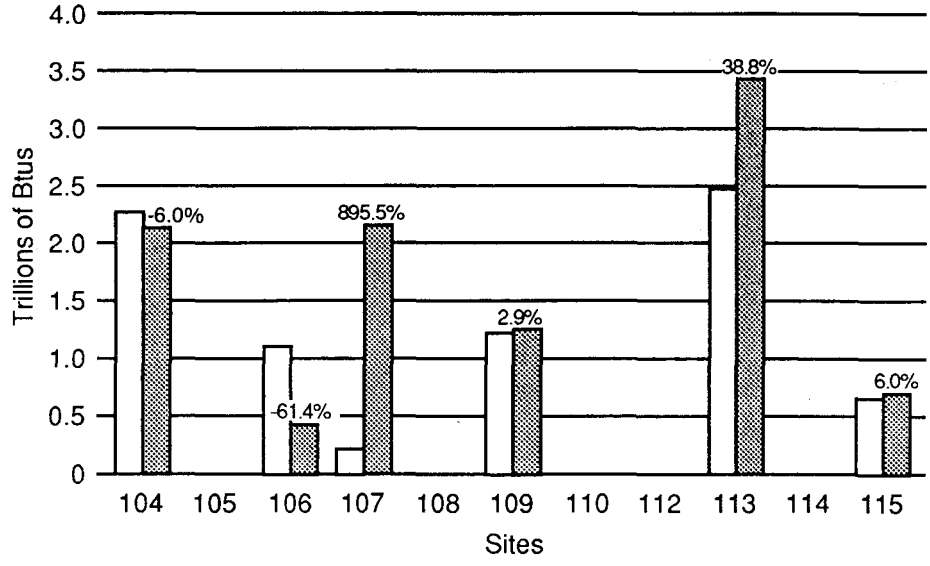


Figure V-3B
Chicago Total Energy Use
FY 1988 & Base Year

FY1985

FY 1988

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 Lab
310	Notre Dame University
320	University of Utah
321	Solar Energy Research Institute

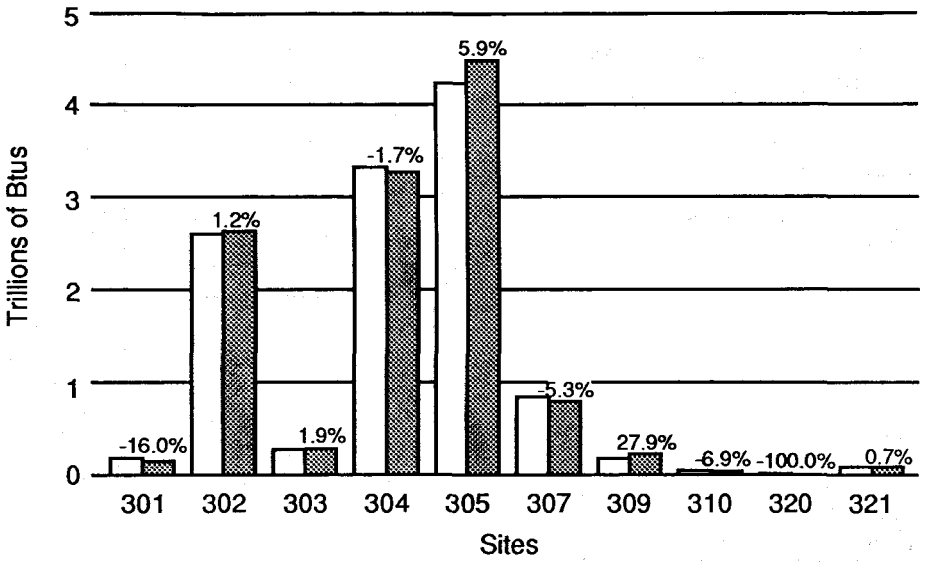


Figure V-4B
Chicago Building Energy Use
FY 1988 & Base Year

FY1985

FY 1988

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 Lab
310	Notre Dame University
320	University of Utah

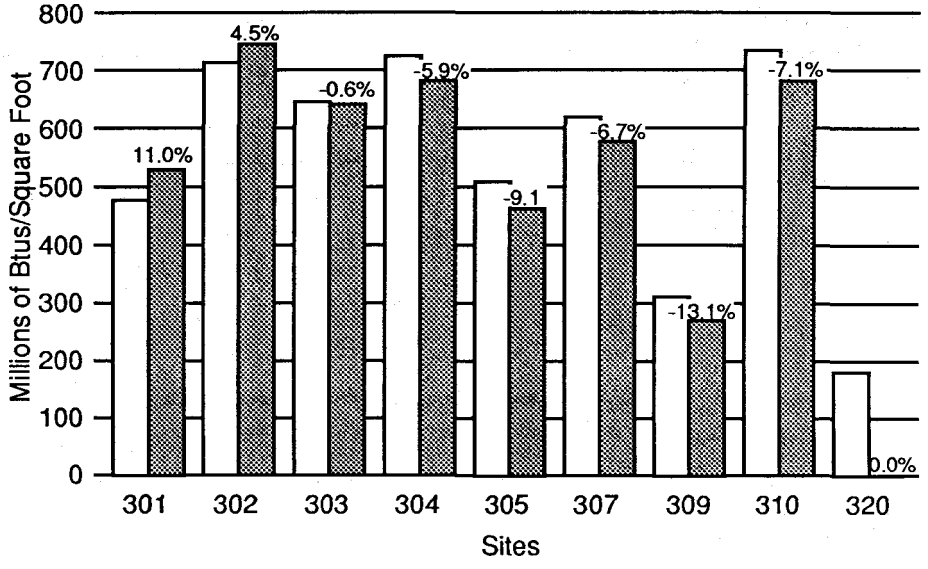


Figure V-5B
Chicago Metered Process Energy Use
FY 1988 & Base Year

FY1985

FY 1988

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 Lab
310	Notre Dame University
321	Solar Energy Research Institute

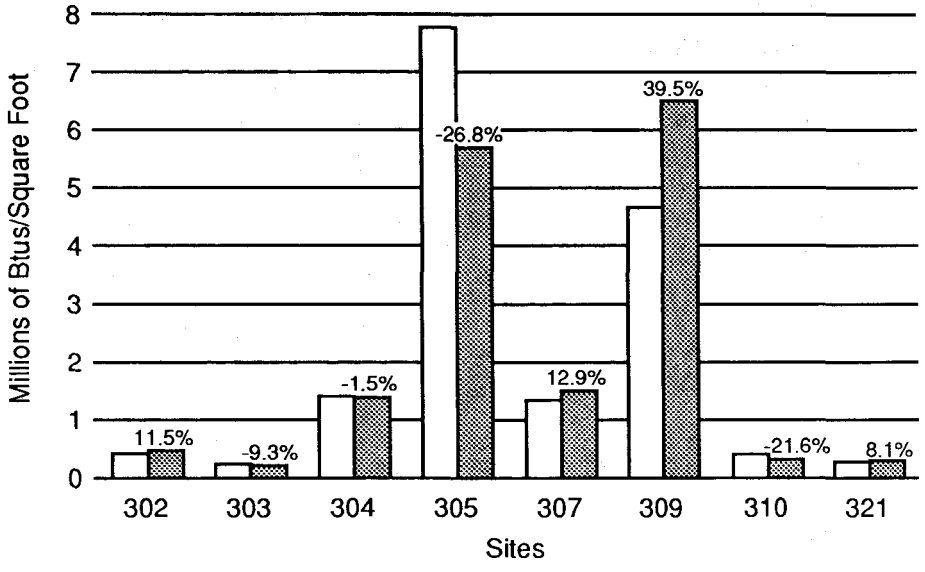
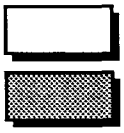


Figure V-3C
Idaho Total Energy Use
FY 1988 & Base Year



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

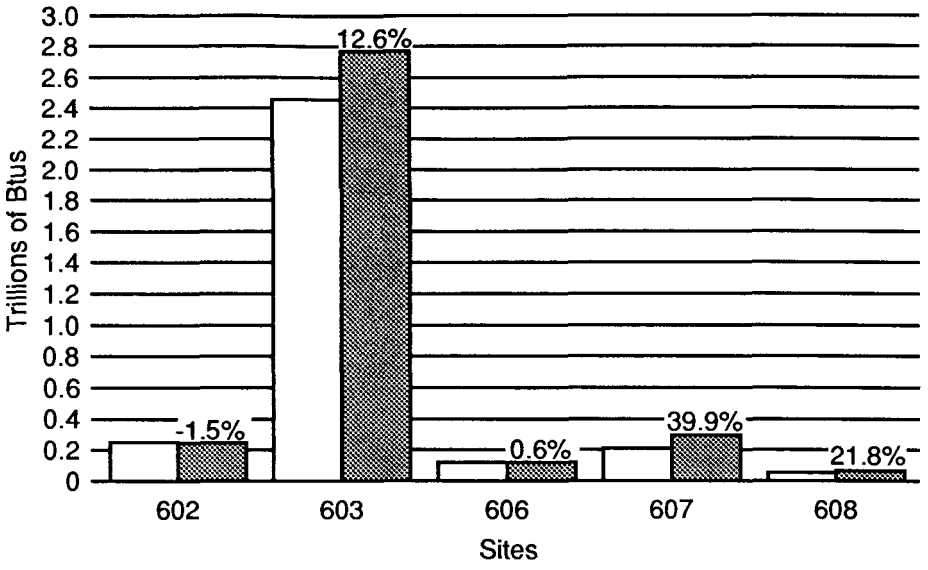
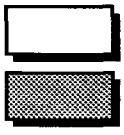


Figure V-4C
Idaho Building Energy Use
FY 1988 & Base Year



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

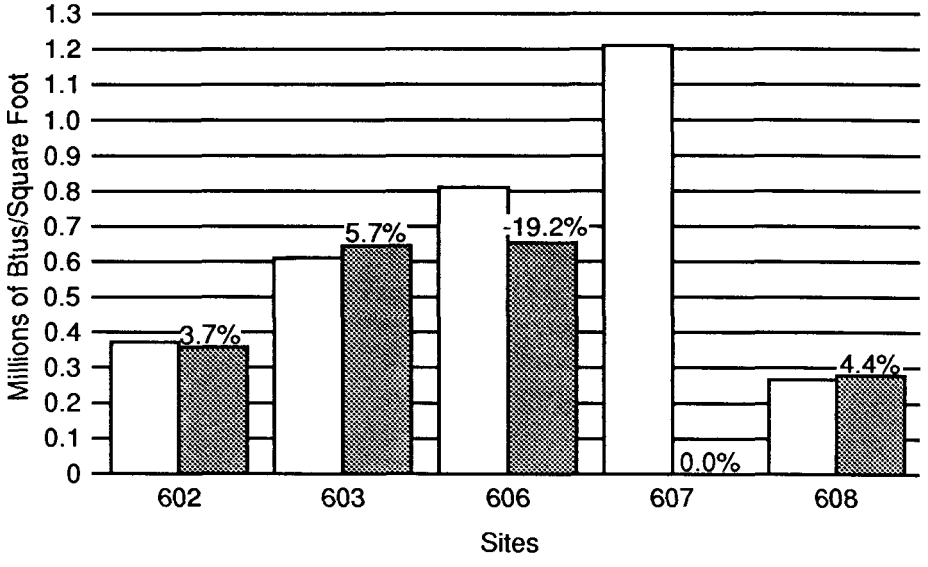
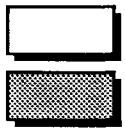


Figure V-5C
Idaho Metered Process Energy Use
FY 1988 & Base Year



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

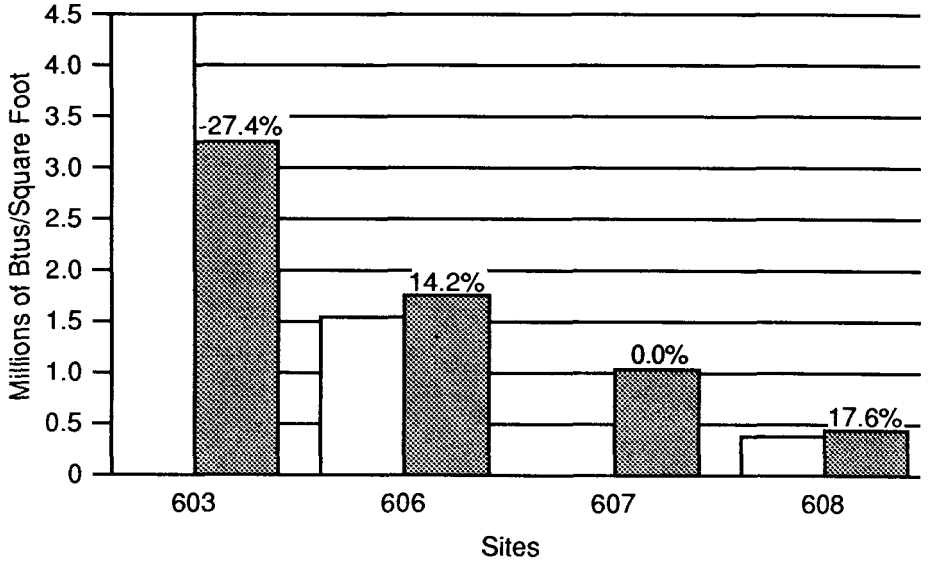
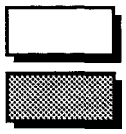


Figure V-3D
Nevada Total Energy Use
FY 1988 & Base Year



901	EG&G Nevada
902	Nevada Test Site
903	REECo Las Vegas
912	EG&G Kirkland
913	EG&G Santa Barbara
914	EG&G Los Almos
915	EG&G San Ramon
916	EG&G Woburn

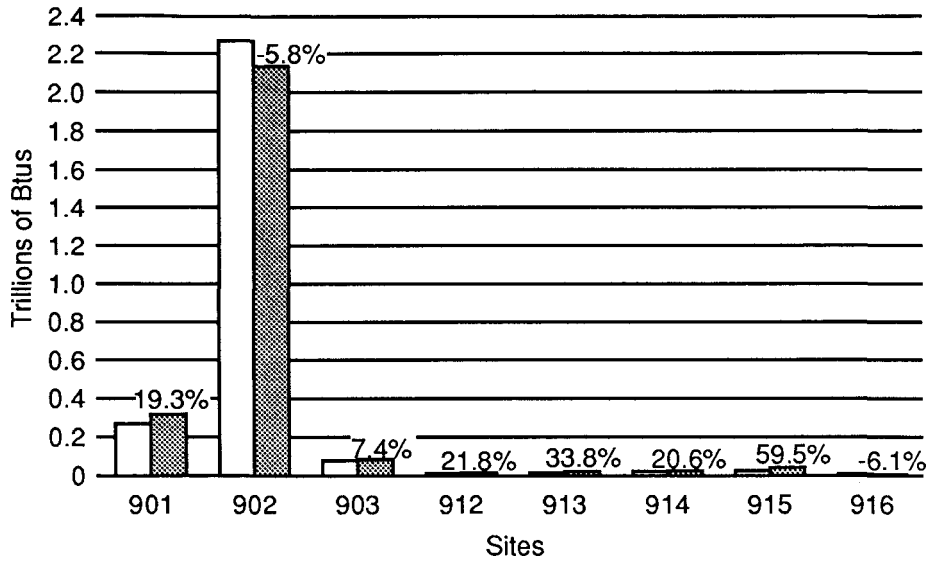
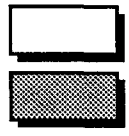


Figure V-4D
Nevada Building Energy Use
FY 1988 & Base Year



901	EG&G Nevada
902	Nevada Test Site
903	REECo Las Vegas
912	EG&G Kirkland
913	EG&G Santa Barbara
914	EG&G Los Almos
915	EG&G San Ramon
916	EG&G Woburn

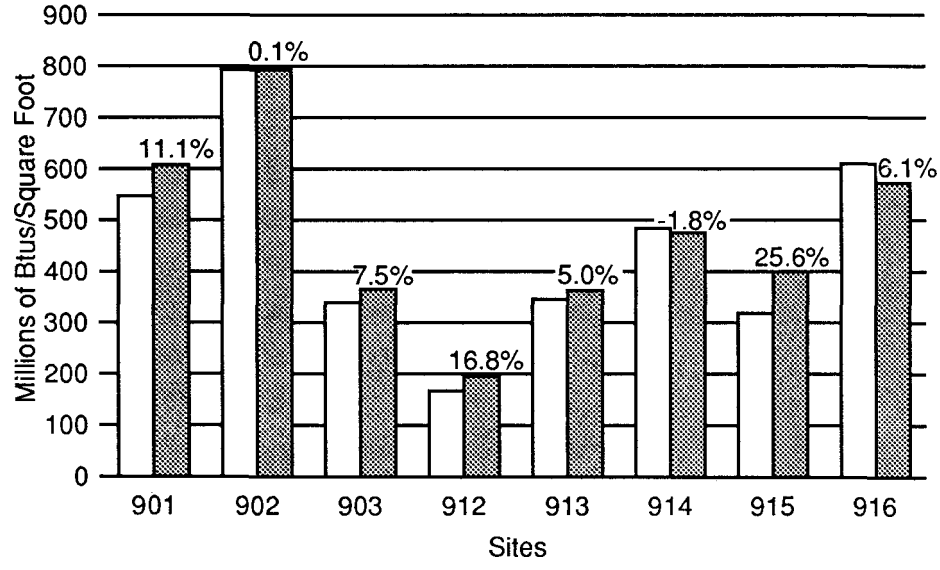


Figure V-3E
Oak Ridge Total Energy Use
FY 1988 & Base Year

FY1985

FY 1988

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 Resources Division
1008 Paducah Gaseous Diffusion Plant
1009 Portsmouth Gaseous Diffusion Plant
1010 Rust Engineering Company
1011 Office of Scientific & Technical Info.

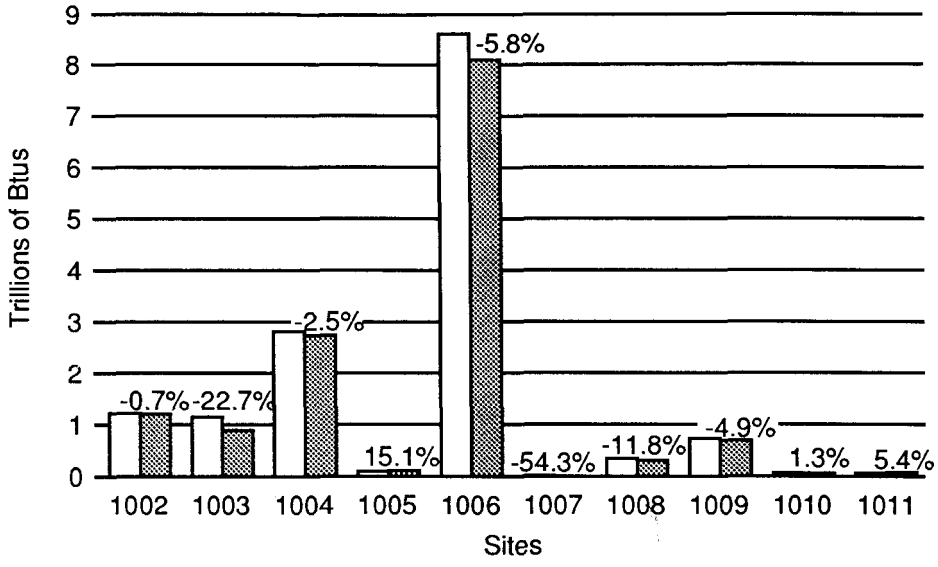


Figure V-4E
Oak Ridge Building Energy Use
FY 1988 & Base Year

FY1985

FY 1988

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 Resources Division
1008 Paducah Gaseous Diffusion Plant
1009 Portsmouth Gaseous Diffusion Plant
1010 Rust Engineering Company
1011 Office of Scientific & Technical Info.

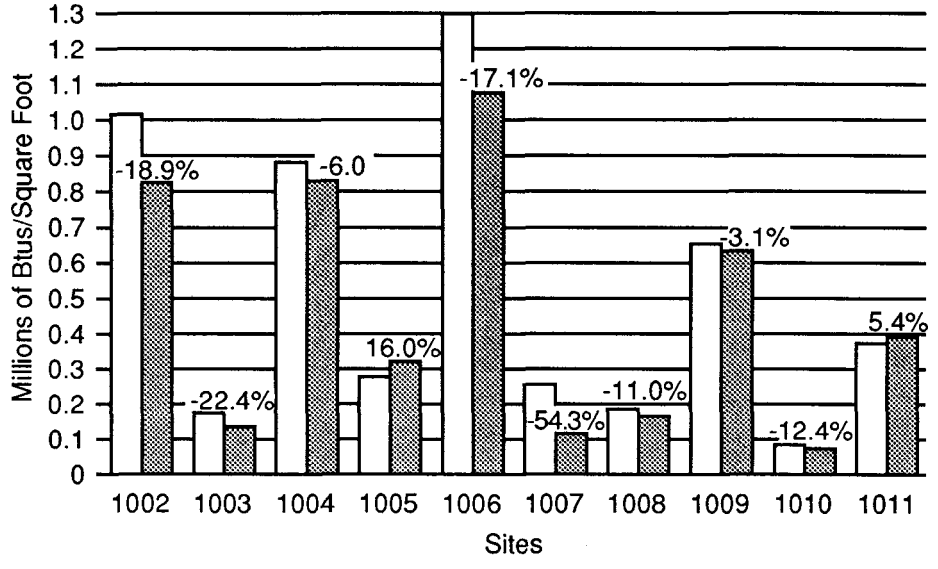


Figure V-5E
Oak Ridge Process Energy Use
FY 1988 & Base Year

FY1985

FY 1988

1004 Oak Ridge National Laboratory

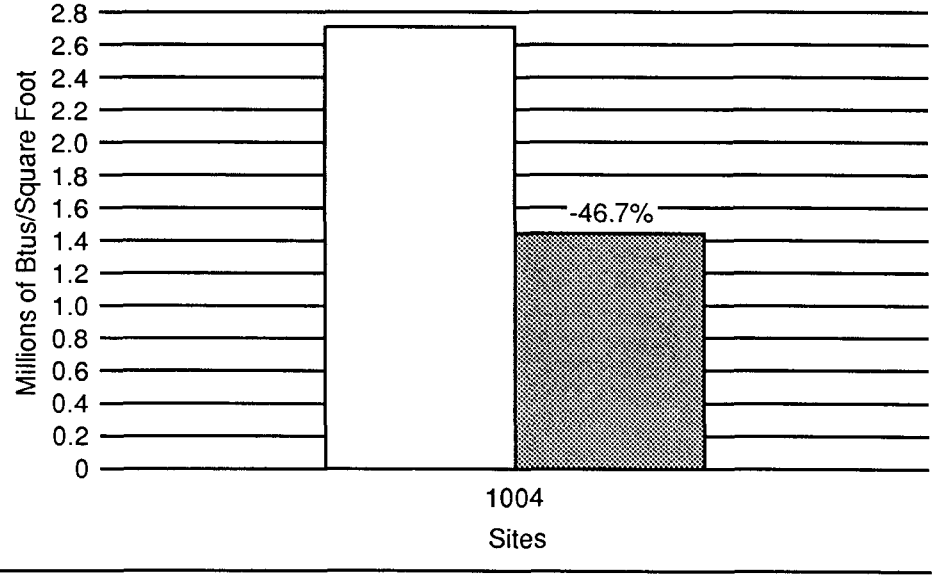
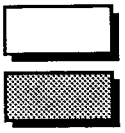


Figure V-3F
Richland Total Energy Use
FY 1988 & Base Year



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

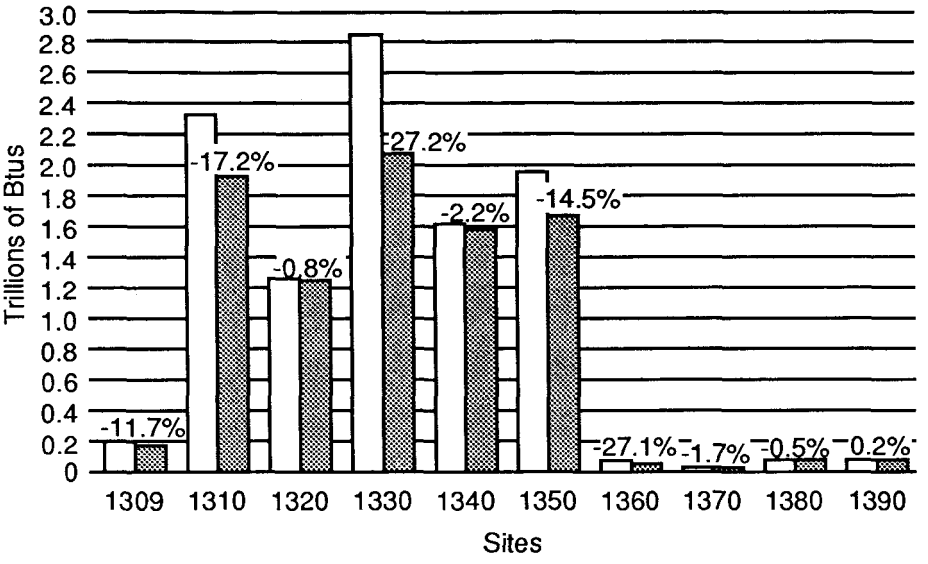
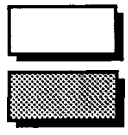


Figure V-4G
San Francisco Building Energy Use
FY 1988 & Base Year



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

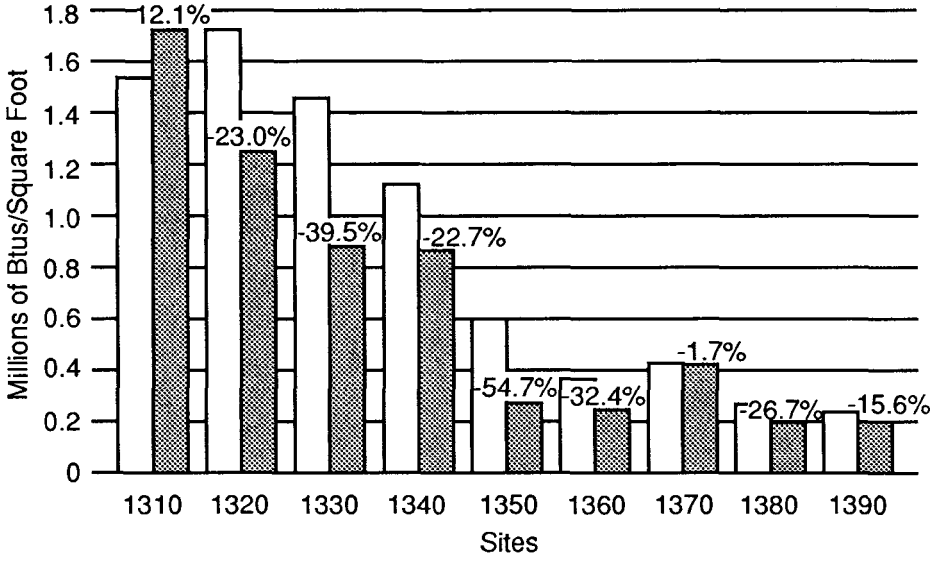
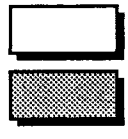


Figure V-5G
San Francisco Process Energy Use
FY 1988 & Base Year



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

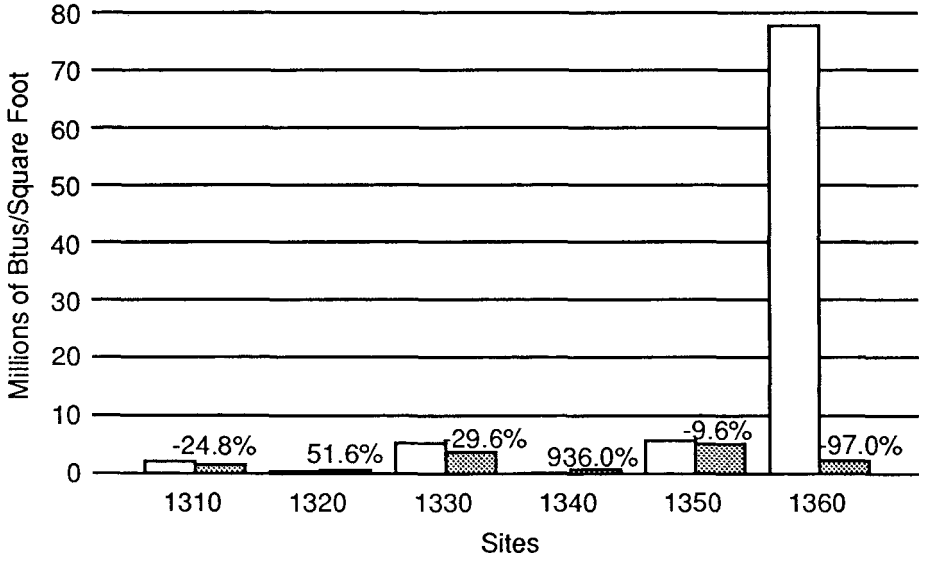
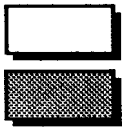


Figure V-3G
San Francisco Total Energy Use
FY 1988 & Base Year



1401 Lawrence Berkeley Laboratory
1402 Energy technology Engineering Center
1403 Lawrence Livermore National Laboratory
1404 Stanford Linear Accelerator Laboratory

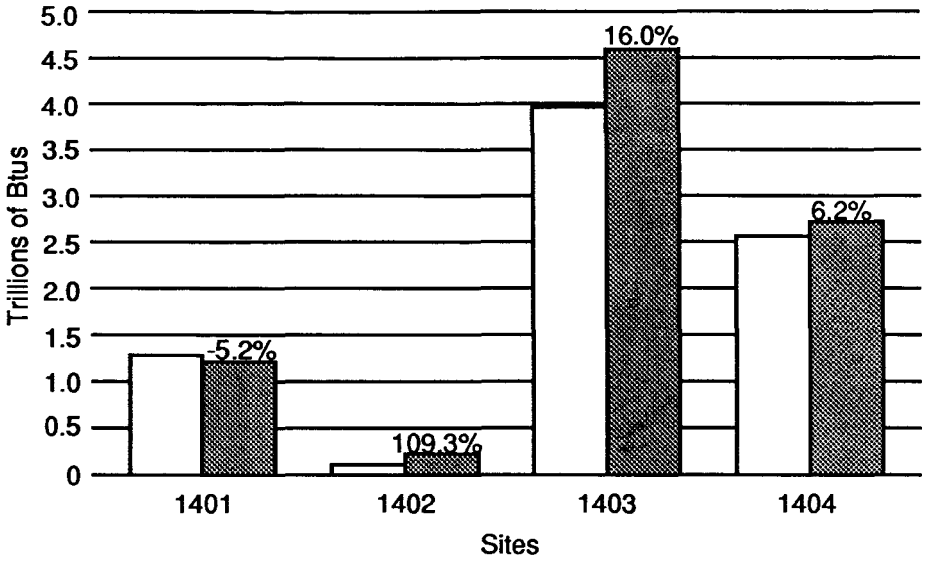
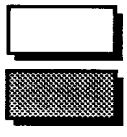


Figure V-4G
San Francisco Building Energy Use
FY 1988 & Base Year



1401 Lawrence Berkeley Laboratory
1402 Energy technology Engineering Center
1403 Lawrence Livermore National Laboratory
1404 Stanford Linear Accelerator Laboratory

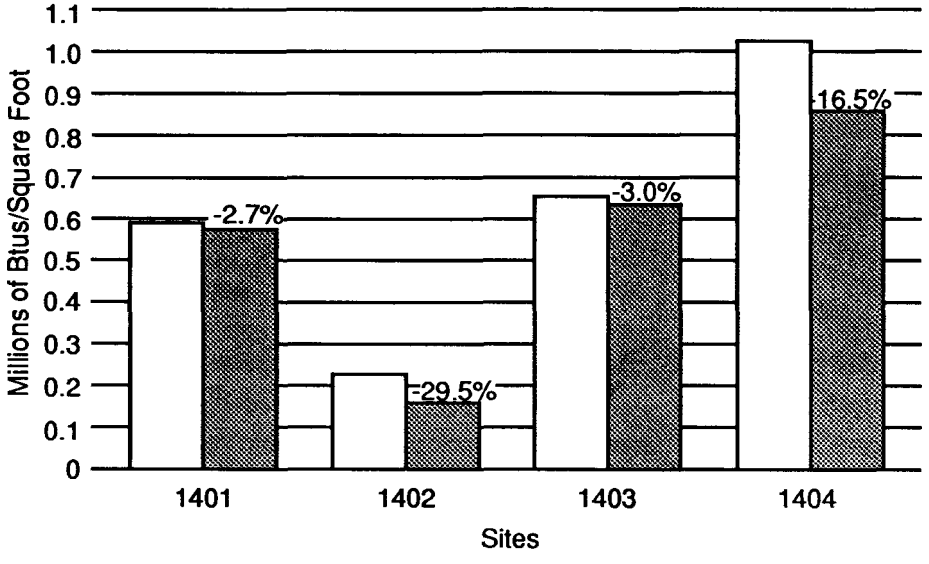
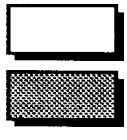


Figure V-5G
San Francisco Process Energy Use
FY 1988 & Base Year



1401 Lawrence Berkeley Laboratory
1402 Energy technology Engineering Center
1403 Lawrence Livermore National Laboratory
1404 Stanford Linear Accelerator Laboratory

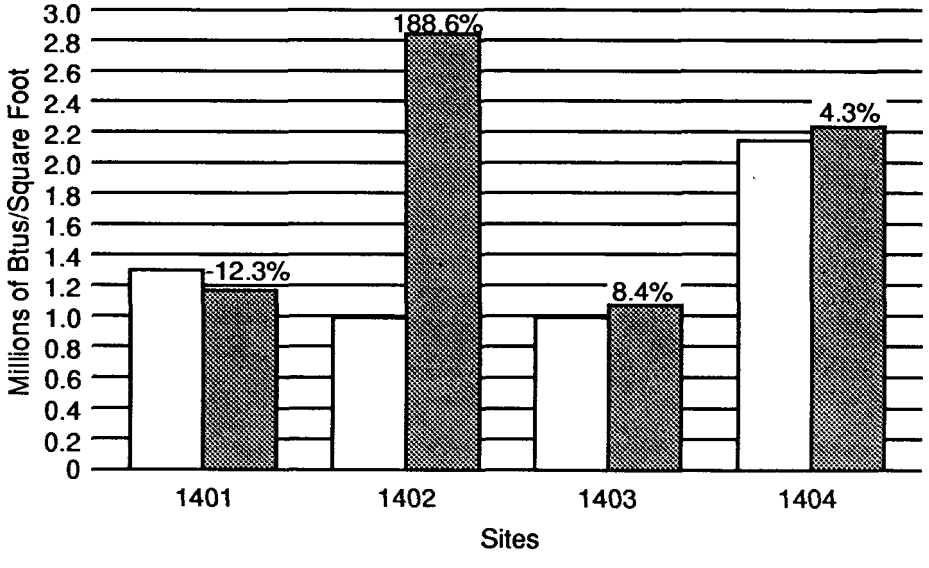


Figure V-3H
Savannah River Total Energy Use
FY 1988 & Base Year

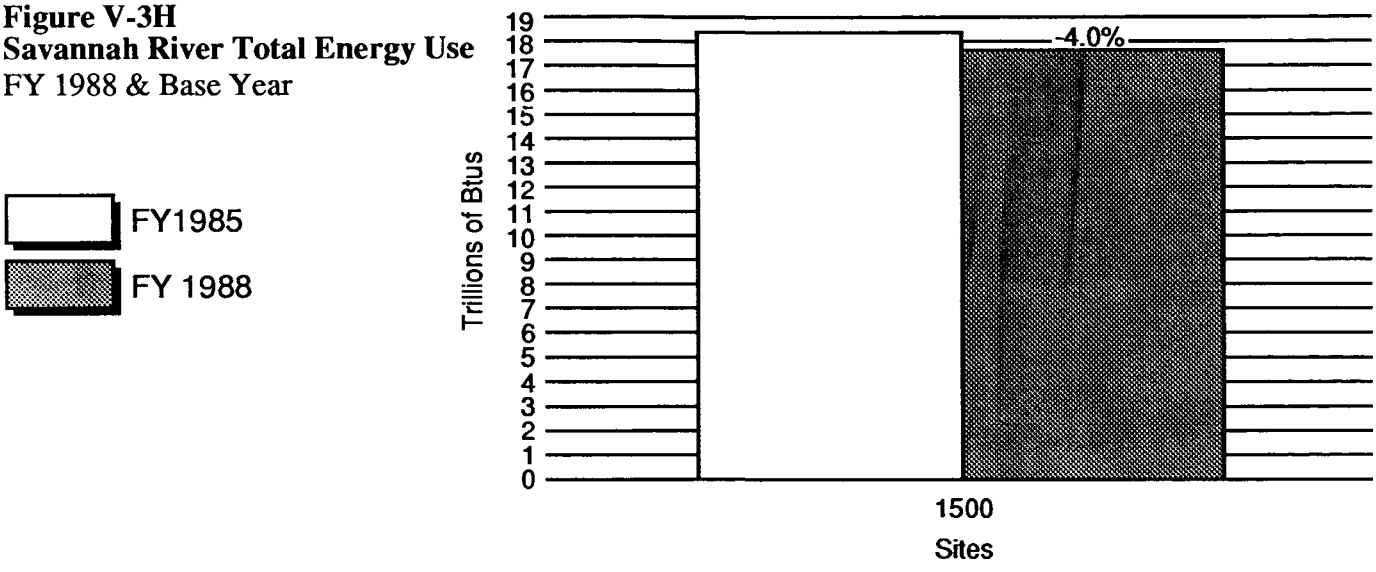


Figure V-4H
Savannah River Building Energy Use
FY 1988 & Base Year

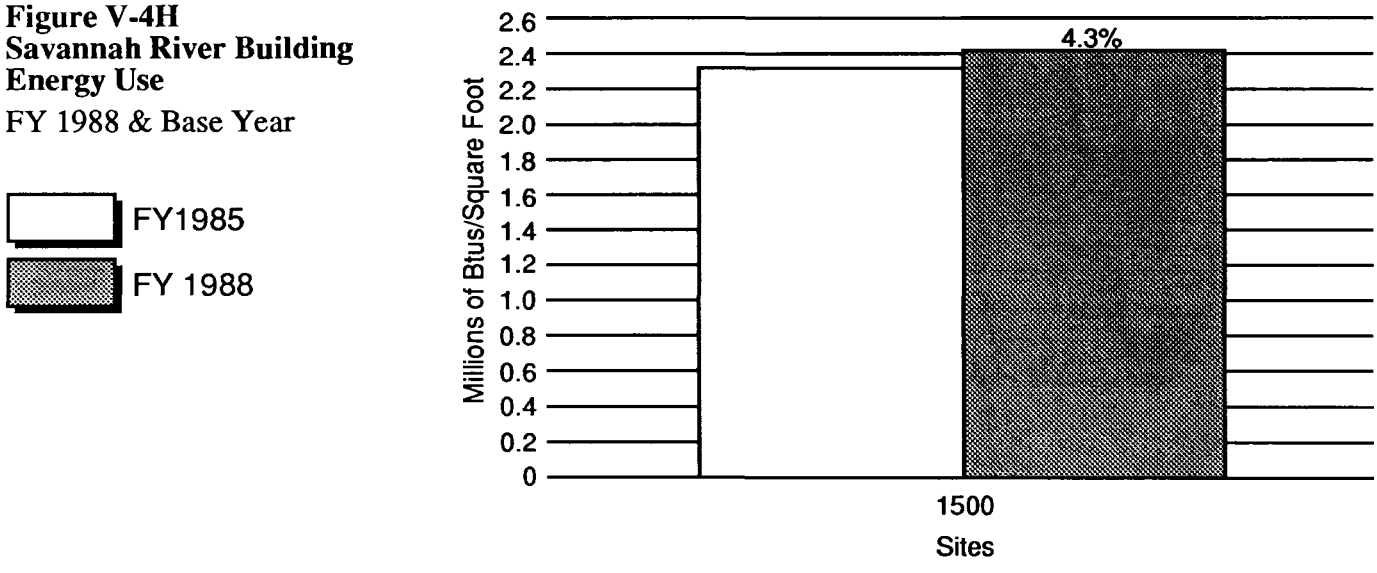


Figure V-5H
Savannah River Process Energy Use
FY 1988 & Base Year