Operating Cost And Environmental Radiation Monitoring At The Shippingport Atomic Power Station

Atomic Energy Commission

BY THE COMPTROLLER GENERAL OF THE UNITED STATES

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COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

B-164105

The Honorable Richard S. Schweiker
United States Senate

Dear Mr. Schweiker:

This is our report on the operating costs and environmental radiation monitoring at the Shippingport Atomic Power Station. We made the review in accordance with your request of July 24, 1974, as modified by subsequent discussions with your office.

As you requested, we have not obtained formal review and comment on this report by officials of the Atomic Energy Commission. However, the matters presented in this report were discussed with them and with officials of the Duquesne Light Company. We considered these officials' comments in preparing the report.

We do not plan to distribute this report further unless you agree or publicly announce its contents.

Sincerely yours,

Elmer B. Staats

Comptroller General
of the United States

Contents

ABBREVIATIONS

AEC	Atomic Energy Commission
GAO	General Accounting Office
KWH	kilowatt hours
LWBR	light water breeder reactor
PWR	pressurized water reactor

COMPTROLLER GENERAL'S REPORT TO THE HONORABLE RICHARD S. SCHWEIKER UNITED STATES SENATE

OPERATING COST AND ENVIRONMENTAL RADIATION MONITORING AT THE SHIPPINGPORT ATOMIC POWER STATION Atomic Energy Commission

D I G E S T

WHY THE REVIEW WAS MADE

Senator Richard S. Schweiker asked GAO to review the operating cost and environmental radiation monitoring at the Shippingport Atomic Power Station. The facility is jointly owned by the Federal Government--through the Atomic Energy Commission (AEC)--and the Duquesne Light Company, Pittsburgh.

The Senator was interested in:

--Government cost of Shippingport until its conversion to operate with a light water breeder reactor core.

--Government cost of the Light Water Breeder Reactor project.

--Government revenues from the sale of steam to Duquesne; Duquesne revenues from selling electricity generated with that steam; and whether any economic advantage realized by Duquesne has been passed on to its customers.

--The environmental radiation monitoring program at the facility.

FINDINGS AND CONCLUSIONS

Shippingport, the first large nuclear powerplant in the United States, began generating electricity for commercial sale in December 1957. It was constructed for the Pressurized Water Reactor project to demonstrate a practical application of nuclear power for civilian use.

It operated as the Pressurized Water Reactor project until February 1974, when problems with the turbine generator forced a shutdown. Shippingport is now being prepared for another research and development effort--the Light Water Breeder Reactor project.

Currently two commercial nuclear power reactors--Beaver Valley Units 1 and 2--are being built contiguous to Shippingport. The Beaver Valley powerplants are jointly owned by several utilities; they will be operated by Duquesne.

Cost of Shippingport

The total Government cost for Shippingport--including construction cost, operating it under the Pressurized Water and Light Water Breeder Reactor projects, and related research and other technical support--is estimated at $596.9 million through fiscal year 1980. Actual Government cost for these projects through fiscal year 1974 amounted to $466.4 million.

The estimated Government cost does not include such items as (1) AEC cost to administer the projects, (2) cost to reprocess and analyze the core of the light water breeder reactor, and (3) a cost escalation adjustment for the estimated cost for fiscal years 1977-80. (See p. 5.)

Revenue collected from Duquesne

Government cost has been partially offset by $20.3 million in revenue from the sale of steam to Duquesne through fiscal year 1974. The cost is expected to be further offset by sales of steam during fiscal years 1976-80. (See p. 7.)

Economic advantage to Duquesne

In 1973 Shippingport produced 1.4 percent of Duquesne's total electricity. The cost of this electricity to Duquesne represented 1.7 percent of its total cost of electricity produced that year.

Although costs can be identified, revenues from the sale of electricity cannot. Once electricity is generated and transmitted, it becomes part of the total distribution system and cannot be traced back to specific powerplants. Any economic gain Duquesne might realize from the sale of electricity produced at Shippingport would be part of Duquesne's total earnings. Since earnings provide funds for operation and capital expansion and help attract investment capital, increased earnings reduce the extent to which additional revenue is needed from rate increases.

The sale of steam has not provided Duquesne with any significant economic advantage because the amount of electricity produced by steam from Shippingport is a relatively small part of Duquesne's total production and because the unit cost to produce electricity at Shippingport is higher than the average unit cost to Duquesne at its other facilities. (See p. 7.)

Environmental radiation monitoring in the Shippingport area

In January 1973 a professor of radiology at the University of Pittsburgh stated that radiation releases from Shippingport had been higher than reported, had exceeded permissible limits, and had harmed the local population. Special studies were conducted to investigate these controversial statements.

The results of an AEC study, a study by the Environmental Protection Agency, and an investigation by a Fact Finding Committee appointed by the Governor of Pennsylvania showed that the allegations were not supported by the evidence. (See p. 4.)

The Governor's Committee pointed out, however, that environmental radiation monitoring in the Shippingport area was not extensive enough to determine whether hazardous radiation levels existed in the area. (See p. 13.)

AEC is developing a consolidated environmental radiation monitoring program for the Shippingport area. The program will monitor radiation levels in the environment more comprehensively and in greater depth than any previous monitoring program for the area. It also provides for quality control features to insure that accurate measurements are being made. (See p. 15.)

The State of Pennsylvania plans to expand its monitoring program in the vicinity of all large nuclear facilities in the State, including Shippingport, thus providing an independent source of information on radiation levels. (See p. 15.)

The consolidated monitoring program will provide greater assurance than previously that radiation levels in the Shippingport area are being accurately measured and that any hazardous buildup of radiation will be detected. (See p. 17.)

CHAPTER 1

INTRODUCTION

The Shippingport Atomic Power Station was the first large nuclear powerplant in the United States. The facility is jointly owned by the Federal Government--through the Atomic Energy Commission (AEC)--and by the Duquesne Light Company. It is principally a research and development facility. AEC's Division of Naval Reactors supervises the operations at Shippingport. The Division's responsibilities include developing and improving naval nuclear propulsion plants and directing assigned civilian power reactor programs.

In March 1954 AEC awarded a contract to Duquesne under which Duquesne agreed to

--provide a site for the reactor;

--build and operate a turbine generator at no cost to the Government;

--contribute $5 million in materials, equipment, and facilities toward the cost of the nuclear portion of the facility;

--operate and maintain the nuclear portion of the facility on a reimbursable basis, but pay the personnel costs of up to 100 employees (in July 1963 AEC began reimbursing Duquesne for these costs too); and

--pay for the steam used to generate electricity for commercial sale.

The Federal Government owns the nuclear portion of the facility. AEC paid for its construction, excluding Duquesne's contribution, and reimburses Duquesne for the cost to operate and maintain it. Cost and related fiscal information on Shippingport are presented in chapter 2.

Official groundbreaking for Shippingport took place in September 1954. Construction began in May 1955 and was completed in 1957. The reactor began to operate on December 2, 1957. Electricity was fed into the Duquesne electrical power distribution system 16 days later. Duquesne has continued to operate the facility under extensions to the original contract.

THE PRESSURIZED WATER REACTOR PROJECT

Shippingport was constructed for the Pressurized Water Reactor (PWR)[1] project. AEC authorized the project in July 1953 to demonstrate a practical application of nuclear power for civilian use. The project was to provide basic research and development information on PWR powerplants. AEC did not expect the project to provide electricity at competitive costs.

The PWR design was based on research carried out under a project to develop a large PWR to power naval ships. In terms of today's commercial PWRs, which typically are rated at 1,000 or more megawatts[2] of electricity at peak power, the Shippingport PWR was relatively small. The Shippingport PWR was originally designed to produce 60 megawatts of electricity and was later modified to increase its power capacity to 150 megawatts.

The PWR project has led to the development of much of the basic technology used in nuclear power reactors. The project showed that a PWR could be integrated into a utility's electrical power system and could be operated for long periods at or near its designed power capacity.

According to AEC, some of the specific gains in reactor technology from the PWR project have been in nuclear powerplant operating experience; nuclear fuel; reactor physics; thermal, hydraulic, and mechanical design; core instrumentation; refueling procedures; primary coolant water radiochemistry; and radioactive waste disposal. A major accomplishment was the development and use of uranium oxide--the fuel now used in practically all water-cooled reactors.

Except for periodic shutdowns for maintenance and refueling, Shippingport operated until February 1974, when its turbine generator broke. This forced the reactor to shut down and stopped operation of the PWR core, which had operated beyond its design life. AEC is currently preparing Shippingport for removal of the PWR core

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[1] A PWR is a type of power reactor in which heat is transferred from the reactor core to a steam generator by water kept under pressure to achieve very high temperature without boiling. Many reactors producing electricity today are PWRs.

[2] A megawatt is a million watts.

to install a core for another research effort--the Light Water Breeder Reactor (LWBR) project.

THE LIGHT WATER BREEDER REACTOR PROJECT

The LWBR research effort began in December 1965, when AEC approved a program to develop a breeder reactor which would create (breed) more fuel than it would consume.

The objective of the LWBR project is to design, fabricate, and operate at Shippingport a reactor core which will produce slightly more fuel than is consumed. This is done by converting thorium--a material in plentiful supply--into nuclear fuel while the reactor operates. If successful, the LWBR core will demonstrate the technical feasibility of installing breeder cores in existing and future PWRs. According to AEC officials, the success of this project will determine the extent of commercial application of LWBRs.

As of December 1974, the LWBR schedule called for the installation of the LWBR core at Shippingport to be completed in early 1976 and for operations to begin in July 1976. AEC expects to operate the LWBR for about 3 years. At the end of that time, the LWBR core will be removed and analyzed to determine the extent to which breeding had occurred.

POSSIBILITY OF EXCESSIVE RADIATION IN THE SHIPPINGPORT AREA

Over the years Shippingport has received considerable attention. In recent years this was mainly due to the possibility of excessive radiation releases from the facility.

In June 1969 Duquesne and several other utilities started construction on the first of two commercial nuclear powerplants to be located next to Shippingport. The two nuclear power reactors--Beaver Valley Units 1 and 2--would be located, along with Shippingport, on a 449 acre site owned by Duquesne on the south bank of the Ohio River in Beaver County, Pennsylvania. The site is approximately 25 miles northwest of Pittsburgh. Duquesne will operate the Beaver Valley units. Since they would be commercial facilities, an AEC license would be required to build and operate them. AEC's licensing regulations require applicants for construction permits and operating licenses for nuclear powerplants to submit environmental reports for AEC's review and evaluation.

AEC requires that applicants' environmental reports include measurements of the radiation levels in the vicinity of the proposed nuclear facility. These measurements identify the baseline radiation levels in the environment before a nuclear facility begins to operate. Using these baseline radiation levels, the operating impact of the nuclear facility on the environment can be determined.

The information submitted to AEC in the environmental report accompanying the application for a construction permit for Beaver Valley Unit 2 included measurements of the radiation levels in samples of air, soil, and milk. Primarily on the basis of these radiation measurements, a professor of radiology at the University of Pittsburgh stated in January 1973 that radiation releases from Shippingport had been higher than reported, had exceeded AEC permissible limits, and had harmed the local population.

Special efforts were made to investigate the statements regarding excessive radiation. An AEC study, an Environmental Protection Agency study, and an investigation by a Fact Finding Committee appointed by the Governor of Pennsylvania showed that the statements were not supported by the evidence. The measurements on which the statements were based were questionable due to an inadequate sampling program.

CHAPTER 2

COST AND RELATED INFORMATION ON SHIPPINGPORT

Senator Richard S. Schweiker asked us to review certain matters involving Shippingport. As subsequently agreed with the Senator and his staff, we are providing information on the following matters:

--Government cost of the facility until its conversion to operate with the LWBR core.

--Government cost of the LWBR project.

--Government revenues from the sale of steam to Duquesne; revenues received by Duquesne from the sale of electricity generated with that steam; and whether any economic advantage realized by Duquesne was passed onto its customers.

--The environmental radiation monitoring program at the facility.

Cost and related information obtained from AEC and Duquesne on Shippingport is presented below. Information on environmental radiation monitoring in the Shippingport area is included in chapter 3.

COST OF SHIPPINGPORT

The estimated total Government cost of the PWR project and the LWBR project through fiscal year 1980 is $596.9 million. Duquesne spent $25.3 million for the construction of Shippingport for a total of $622.2 million, as follows:

	Amount (millions)
AEC cost (fiscal years 1954-80):	
Construction of nuclear portion of facility	$ 59.5
Equipment for PWR and LWBR projects	37.6
Reimbursement to Duquesne for operation and maintenance of nuclear portion of facility through fiscal year 1976	39.0

		Amount (millions)
Technical support and evaluation (note a)		
PWR project (note b)	$229.4	
LWBR project	225.1	$454.5
Other PWR project cost		6.3
Estimated total Government cost		596.9
Duquesne cost (note c):		
Contribution to construction of nuclear portion of facility		$ 5.0
Construction of turbine generator portion of facility		20.3
Estimated total Duquesne cost		$25.3
Estimated total cost		$622.2

[a]Represents contract cost for research, design, development, and evaluation of the projects.

[b]Includes estimated cost to reimburse Duquesne for facility management during fiscal years 1977-80.

[c]Does not include Duquesne's cost to operate and maintain turbine generator portion of the facility.

A breakdown of the Government cost for the PWR project, including the cost of building and equipping the facility, and the LWBR project is shown in appendixes I and II, respectively. Actual Government cost through fiscal year 1974 was $466.4 million.

The estimated total Government cost does not include such items as:

--The cost for AEC to administer the PWR and LWBR projects. (Consistent with AEC policy, cost of program administration is not allocated to specific projects and AEC officials told us that the cost to administer the PWR and LWBR projects cannot be reasonably determined.)

--The cost to reprocess and analyze the LWBR core to determine whether, and to what degree, breeding occurs. (According to AEC officials, this cost cannot be currently estimated with any reasonable accuracy.)

--A cost escalation adjustment for the estimated cost for fiscal years 1977-80.

REVENUE COLLECTED FROM DUQUESNE

AEC's cost for the PWR project has been partially offset by $20.3 million in revenue from the sale of steam to Duquesne through fiscal year 1974. That steam resulted in the production of 4,624,366,000 net[1] kilowatt hours (KWH) of electricity. In the AEC contract with Duquesne, a steam revenue rate of 8 mills per KWH was established for the first 1,467,500,000 net KWHs. This net production was reached during fiscal year 1964.

In negotiating the steam revenue rate for electricity production in excess of that amount, guidance was obtained from a task force composed of representatives from AEC and the Federal Power Commission. The negotiated rate was on a graduated scale ranging from 2.30 to 3.07 mills per KWH and was set at not less than the average cost of fuel to produce electricity in all but one of Duquesne's other powerplants.

AEC and Duquesne are currently negotiating a contract extension for the operation of Shippingport and the sale of steam during fiscal years 1977-80, after installation of the LWBR core. AEC is consulting with experts on utility rates to assist in negotiating the steam revenue rate.

ECONOMIC ADVANTAGE TO DUQUESNE

According to Duquesne officials, the unit cost to Duquesne to produce electricity at Shippingport was higher than the average unit cost at its other facilities. The cost to Duquesne to operate Shippingport's turbine generator and purchase Shippingport steam during 1973 was about $1.3 million. This amount was about 1.7 percent of Duquesne's total cost of about $76.8 million for electricity produced at all of its facilities during the year. The steam from Shippingport was used to produce 184,888,801 net KWH of electricity in 1973, which represented 1.4 percent of Duquesne's total of 13,290,775,949 net KWH of electricity. Duquesne's unit cost to produce electricity at Shippingport in 1973 was about 7 mills per KWH as compared to the unit cost of about 5.8 mills per KWH for total electricity produced.

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[1] Net KWH are gross KWH produced minus KWH consumed by the nuclear portion of the plant.

Although the operating cost for Shippingport can be specifically identified, the revenue received from the sale of electricity cannot be identified. Once electricity is generated and transmitted it becomes part of the total distribution system and cannot be traced back to specific powerplants.

Under the system by which electricity rates are set by the Pennsylvania Public Utility Commission, a utility's earnings is a principle element in review of rate schedules. Any economic gain Duquesne might realize from the sale of electricity produced at Shippingport would be part of Duquesne's total earnings. Since earnings provide funds for operation and capital expansion and help attract investment capital, increased earnings reduce the extent to which additional revenue is needed from rate increases.

CONCLUSIONS

AEC's total estimated cost of the PWR and LWBR projects is based on the best currently available information. However, the estimate does not include certain cost which cannot be reasonably estimated. AEC's cost has been partially offset by revenue from the sale of steam to Duquesne through fiscal year 1974 and is expected to be further offset by revenue from the sale of steam to Duquesne during fiscal years 1977-80.

The revenue from the sale of electricity produced by steam from Shippingport has not provided Duquesne with any significant economic advantage because the amount of electricity generated at Shippingport is a relatively small part of Duquesne's total production and because the unit cost to produce electricity at Shippingport is higher than the average unit cost to Duquesne at its other facilities.

CHAPTER 3

ENVIRONMENTAL RADIATION MONITORING IN THE SHIPPINGPORT AREA

Senator Schweiker had expressed concern about the actions being taken or planned to insure that the radiation levels in the Shippingport area would be accurately and adequately measured, particularly in light of the finding of the Governor's Fact Finding Committee which pointed out that environmental radiation monitoring in the Shippingport area was not extensive enough to determine whether hazardous radiation levels existed.

REQUIREMENTS OF ENVIRONMENTAL RADIATION MONITORING

AEC's Manual Chapter 0513 on Effluent and Environmental Monitoring and Reporting, which is applicable to AEC-owned nuclear facilities, requires AEC and its contractors to monitor the radiation levels in the vicinity of AEC's nuclear facilities. Title 10 of the Code of Federal Regulations requires environmental radiation monitoring for commercially owned nuclear facilities. AEC's Regulatory organization requires that environmental radiation monitoring programs be included in the specifications of operating licenses.

An environmental radiation monitoring program generally measures gross radioactivity (such as alpha, beta, and gamma) and/or specific radionuclides (such as strontium-90, cobalt-60, cesium-137, and iodine-131) in water, air, and soil and in biological systems in the vicinity of nuclear facilities.

Such a monitoring program is useful in evaluating the effectiveness of a nuclear facility's effluent[1] release program; in identifying the ultimate disposition of radioactivity released to the environment, including its pathways to man; and in computing radiation exposures to people.

AEC has provided guidance in developing environmental radiation monitoring programs for both its own activities and those of its licensees. AEC is preparing specific guidance for licensees to

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[1]Gaseous and low-level liquid radioactive wastes deliberately discharged by nuclear facilities on a controlled basis.

design such programs. Licensees are now referred to a publication of the Environmental Protection Agency for detailed guidance.

For its own activities, AEC guidance states that judgment regarding the extent of environmental radiation monitoring must be exercised by AEC field offices and contractors based on such considerations as (1) the potential hazard to the area, (2) quantities and concentrations of materials released, (3) specific local public interest or concern, and (4) the extent and type of activity in the area.

AEC regulations provide that, before a nuclear facility begins operation, the radiation in the environment around the facility should be ascertained to establish baseline radiation levels.

HISTORY OF ENVIRONMENTAL RADIATION MONITORING AT SHIPPINGPORT

At Shippingport AEC has monitored radiation levels as close to the source of radioactivity as possible. The closer the measurement to the source, the more accurately the radioactivity released to the environment can be determined. For the Shippingport reactor, the source is the nuclear fuel and the closest point is the water (primary coolant) that circulates through the reactor core to cool the nuclear fuel.

Emphasis has been placed on monitoring the radioactivity in the primary coolant; however, monitoring is also done in the secondary coolant, steam system, gas emission stack, and waste water discharges. According to AEC, the amount of radioactivity released by the nuclear fuel has been so small that it is difficult to measure it in the coolant. AEC officials told us that the primary radionuclide created as a result of reactor operation is cobalt-60. This radionuclide is measured in the coolant. If levels of this radionuclide are controlled, then all other radionuclides created by reactor operation are kept within their limits.

In 1956, before Shippingport began operating, a monitoring program was established to determine the baseline radiation levels in the vicinity of the facility. The baseline study was made under AEC's general direction, with the sampling and analytical work performed by the AEC contractor-operated Bettis Atomic Power Laboratory.

Radiation measurements were taken on (1) soil and vegetation within a 5-mile radius, (2) water, algae, and mud in the river above and below the site, (3) well water within a 5-mile radius, and (4)

airborne radioactivity within a 1-mile radius, including atmospheric fallout. A total of seven reports were issued on the baseline study.

When Shippingport began operations in December 1957, the environmental radiation monitoring program included extensive sampling of the water, air, and soil around the facility.

Water samples, taken at two upstream and two downstream locations, were analyzed weekly for gross alpha and beta radiation and the specific radioactivity of uranium and potassium-40. One upstream sampling station was about 20 miles from the facility at a Duquesne non-nuclear powerplant; the other was at the cooling water intake at the facility. The downstream sampling stations were on the water intake lines of two water treatment plants. Random samples were collected weekly from the river about 1 mile downstream.

Five air monitoring stations were used to record gross radioactivity levels in the area. The data recorded by each station was checked and tabulated weekly. One of the stations was located at the Shippingport site; three others were located about one-half mile from the site to the north, east, and south. The locations were selected on the basis of the prevailing air currents. Another station was moved periodically to different locations. The stationary monitoring stations were at the same locations where baseline radiation levels had been determined.

Soil samples were collected and analyzed quarterly for gross radioactivity and specific uranium radioactivity from 20 locations within a 5-mile radius.

Except for a few minor revisions, the monitoring program continued as originally implemented through September 1961, when AEC determined that fewer sampling locations closer to the facility would provide equal or better information. By early 1962, water sampling locations were reduced to the facility's intake and discharge points on the river. Air monitoring was reduced to three locations--150 yards southeast, 150 years west, and one-half mile north-northwest of the facility's gas emission stack. Soil sampling was reduced to collecting 10 soil samples annually to be held for analysis, if needed.

As operating experience was gained, the scope of the monitoring program continued to change. In 1966 atmospheric fallout collection was reduced to one location, and continuous monitoring of airborne

radioactivity in the environment was eliminated. To monitor airborne releases of radioactivity in case of an accident, 12 film badges--photographic film used to absorb radiation--were located around the perimeter of the facility and analyzed quarterly for gross beta and gamma radioactivity. Sampling of river sediment upstream and downstream from the facility's discharge point was begun on a quarterly basis for gross radioactivity.

In 1969 the proposed construction of the Beaver Valley Unit 1 powerplant caused a change in the location of four of the film badge stations and film badge analyses were increased from quarterly to monthly.

In September 1973 the monitoring program was expanded to include additional monitoring at and near the boundary of the facility and at various other locations using thermoluminescent dosimeters--a device that measures gamma and intense beta radiation. AEC officials consider them to be an improvement over film badges.

In October 1974 three groups of these dosimeters were being used for environmental radiation monitoring at Shippingport. The first group of 19 dosimeters was around the perimeter of the facility. The second group of 13 dosimeters was around the perimeter of the Duquesne property. The third group of 11 dosimeters was located at various locations up to 10 miles from the facility. All the dosimeters were analyzed by AEC's Bettis Atomic Power Laboratory.

Weekly water samples and quarterly sediment samples were being taken from the river and analyzed for radioactivity.

According to AEC officials, the current monitoring program at Shippingport was designed primarily to alleviate public concern about hazardous radiation levels in the environment and to identify any radioactivity accumulating to levels higher than the baseline levels.

NEED FOR IMPROVEMENTS IN ENVIRONMENTAL RADIATION MONITORING IN THE SHIPPINGPORT AREA

In January 1973, at the time of the statements regarding excess radiation in the Shippingport area, the specific radionuclides involved (strontium-90 and iodine-131) were not being measured under the Shippingport monitoring program. At the facility, measurements were being taken of the radiation levels in liquid and gaseous effluents by drawing off and analyzing samples of the reactor coolant, waste

water discharges, and emission stack gases. Measurements of radiation levels in the environment consisted of gross beta and gamma radioactivity at 12 film badge stations at the site perimeter and of sampling water and sediment both up and downstream from the facility's waste water discharge point. The water samples were analyzed for gross radioactivity and potassium-40 radioactivity.

Several investigations of the statements about excessive radiation releases from Shippingport indicated that environmental radiation monitoring in the Shippingport area was not extensive enough to determine whether hazardous radiation levels existed. AEC reviews of the environmental monitoring program for the Beaver Valley units identified a number of management problems in the program. The problems identified during these investigations and any recommendations to correct them follow.

--AEC's Regulatory organization criticized Duquesne's management controls over the Beaver Valley monitoring program and identified specific deficiencies in designing and implementing the program, including the sampling plan and analytical procedures of Duquesne's contractor.

--The Environmental Protection Agency, as a result of its study of the possibility of excess radiation in the area, recommended verification of analytical results with an independent source as part of a quality assurance program.

--The Governor's Committee investigation showed that information on radiation releases obtained from the on-site monitoring program at Shippingport could not be verified because comprehensive environmental radiation monitoring was not being done around the facility. The Committee noted that environmental radiation monitoring programs for Shippingport were inadequately designed and implemented for determining the environmental impact of radiation releases from the facility. The Committee also criticized the fact that responsibility for radiation monitoring in the area is divided between AEC's Regulatory organization (Beaver Valley units) and the Division of Naval Reactors (Shippingport facility) and recommended that AEC's Directorate of Regulatory Operations be given authority over Shippingport. The Committee also recommended that the Pennsylvania Department of Environmental Resources operate an independent monitoring program in the vicinity of all large nuclear facilities in or near the State.

Criticism of the design and implementation of the Beaver Valley monitoring program

AEC requires that, before a nuclear facility begins to operate, an environmental radiation monitoring program be designed and implemented to identify baseline radiation levels and to enable the program to be inspected by AEC.

Duquesne's environmental radiation monitoring program for the Beaver Valley units started in January 1971. As of November 1974 the program had been inspected twice by AEC's Regulatory organization. The inspections of the program were conducted in January 1973 and August 1974, and the inspectors identified specific deficiencies in the program. They were principally concerned about Duquesne's lack of management control over the monitoring program which permitted the deficiencies to occur. The January 1973 inspection pointed out that Duquesne was totally dependent on its environmental radiation monitoring contractor for information on any environmental problems.

AEC Regulatory officials told us that the corrective actions taken or planned by Duquesne to resolve the specific deficiencies and to improve its management control over the program appear to satisfactorily respond to the problems noted during the inspections.

As part of the AEC study of the statements concerning excess radiation in the Shippingport area, AEC's Health and Safety Laboratory, New York City, was asked to review the sampling and analytical procedures used by Duquesne's contractor for the Beaver Valley environmental radiation monitoring program. In a March 7, 1973, report, the Laboratory criticized the program's reliance on gross radiation measurements because, although gross radioactivity measurements show whether or not permissible radiation levels have been exceeded, they do not identify the specific radionuclides involved.

On October 15, 1974, Duquesne issued its proposed environmental technical specifications under which it will operate the Beaver Valley units. The proposed technical specifications include a detailed description of the monitoring program and provide for measuring specific radionuclides in nearly all forms of sampling.

Verification and validation of radiation measurements

In June 1973 Duquesne told AEC that the Beaver Valley monitoring program would be expanded and that provision would be made for independent verification of radiation measurements. To provide a continuous check on the accuracy of the sample results it reported, Duquesne's contractor for radiation monitoring arranged for an Environmental Protection Agency laboratory to analyze some of the same samples of water, milk, air, vegetation, fish, and wildlife that the contractor was analyzing.

AEC's Regulatory organization has contracted with the Pennsylvania Department of Environmental Resources for monitoring in the vicinity of three nuclear facilities, including Beaver Valley Unit 1. The contract specified that the Environmental Protection Agency would be consulted in planning the monitoring program and that the program results would be made public. The current contract covers the 1-year period through January 15, 1975. As of December 1974, AEC was planning to renew this contract for another year.

Pennsylvania was expanding its own environmental radiation monitoring effort throughout the State, in response to the Governor's Committee recommendation that the State begin an independent environmental radiation monitoring program in the vicinity of all large nuclear facilities in or near the State.

The Director of the Pennsylvania Bureau of Radiological Health, Department of Environmental Resources, told us in September 1974 that the Bureau had submitted a proposal for an expanded monitoring program in its fiscal year 1975-76 budget. The expanded program would provide the Bureau with additional staff, equipment, and laboratory facilities.

In November 1974 the Director told us that the expanded program had been submitted for the Governor's approval and that he expected the Governor would approve it. The Bureau's monitoring program had already been expanded with the addition of three professional staff members, a new laboratory, and some new laboratory equipment.

Consolidated environmental radiation monitoring program for the Shippingport area

AEC is currently developing a consolidated environmental radi-

ation monitoring program for the Shippingport area because of the two nuclear powerplants being built adjacent to Shippingport. The monitoring program will primarily be based on the programs designed by Duquesne and approved by the AEC Regulatory organization for the Beaver Valley units. It will also include AEC's requirements for the LWBR core at Shippingport.

Shippingport operations are supervised by AEC's Division of Naval Reactors; commercially owned nuclear facilities are licensed and inspected by AEC's Regulatory organization. These two organizational units in AEC do not report and are not responsible to each other. Under such circumstances, a consolidated environmental radiation monitoring program for Government and commercial nuclear facilities would not normally occur. According to AEC, however, such a program for the Shippingport area is desirable and feasible because of the proximity of the reactors involved and of the single management organization (Duquesne) operating the facilities.

Duquesne and AEC's Bettis Atomic Power Laboratory are jointly designing the consolidated monitoring program. The proposed design calls for more extensive sampling than the current program at Shippingport. For example, the monitoring program at Shippingport involves sampling the radioactivity in air, water, and sediment. In the consolidated program additional samples will be taken of soil, drinking water, well water, fish, wildlife, milk, vegetation, and food crops. The consolidated monitoring program will also include more extensive measurements for specific radionuclides.

AEC planned to have the Bettis Atomic Power Laboratory provide Duquesne with the Shippingport requirements for the consolidated monitoring program in December 1974. Although the details of the consolidated program have not been completed, AEC officials told us that Duquesne has agreed to be responsible for administering the monitoring program and that the Bettis Atomic Power Laboratory will support it as follows:

--Identify the technical requirements for the program and provide a listing of qualified contractors to Duquesne.

--Assist Duquesne in evaluating the facilities and procedures of its contractor which will operate the monitoring program.

--Monitor the implementation of the program (to include sample locations, analyses, and number of samples) and

evaluate proposed changes to it.

--Evaluate contractor's performance through the use of split samples and analyses by other independent laboratories, to insure that analytical results are accurate and that the program's quality controls are functioning properly.

--Analyze environmental radiation data before Duquesne reports the data to the AEC Regulatory organization.

Bettis Atomic Power Laboratory officials have stated that one technical requirement under the monitoring program should be Duquesne's approval of its contractor's procedures for sample collection and analyses. Duquesne disagreed on the basis that, because the contractor's procedures are proprietary, Duquesne's approval is not necessary if the results of quality control checks on the contractor's performance, such as split sampling and independent analyses, were satisfactory. This disagreement had not been resolved at the completion of our work.

The target date for implementing the consolidated monitoring program is June 1, 1975. The first semiannual report, scheduled for the period January to July 1975, will be based mainly on data from the existing separate monitoring programs for Shippingport and Beaver Valley.

CONCLUSIONS

Environmental radiation monitoring programs are useful as a continuing check that the radiation releases from nuclear facilities are not building up to hazardous levels in the environment.

The consolidated environmental radiation monitoring program will measure radiation levels in the vicinity of the three operating reactors in the Shippingport area, which share and could effect the same environment.

The consolidated program will monitor radiation levels in the environment more comprehensively and in greater depth than any previous monitoring program for the area and will provide for quality control features to insure that accurate measurements are being made. Pennsylvania's planned expansion of its monitoring program in the vicinity of all large nuclear facilities will provide an independent source of information on radiation levels.

The consolidated environmental monitoring program which meets the approval of AEC, if properly implemented, will provide greater assurance than previously that radiation levels in the Shippingport area are being accurately measured and that any hazardous buildup of radiation will be detected.

CHAPTER 4

SCOPE OF REVIEW

We conducted the review at AEC Headquarters in Germantown and Bethesda, Maryland; at the AEC Division of Naval Reactors in Arlington, Virginia; and at several locations in Pennsylvania.

We visited and discussed the Shippingport operation with officials of the Pennsylvania Department of Environmental Resources, Harrisburg; AEC's Regulatory Region I, King-of-Prussia; AEC's Bettis Atomic Power Laboratory, West Mifflin; Duquesne Light Company, Pittsburgh; and the Shippingport Atomic Power Station, Shippingport.

ESTIMATED GOVERNMENT COST
FOR THE PWR PROJECT

Fiscal year	Total cost	Technical support & evaluation	Facility management	Other project activities	Construction and equipment cost
			(000 omitted)		
1954	$ 7,700	$ 7,200	$ -	$ 500	$ -
1955	11,400	10,000	-	200	1,200
1956	22,300	14,600	-	600	7,100
1957	47,000	14,400	-	300	32,300
1958	25,100	16,700	500	300	7,600
1959	17,800	15,500	800	500	1,000
1960	19,700	16,800	1,900	500	500
1961	21,400	16,000	1,300	1,500	2,600
1962	26,800	19,100	1,400	1,000	5,300
1963	16,600	11,600	1,700	500	2,800
1964	17,700	8,400	3,100	200	6,000
1965	15,800	7,100	2,500	200	6,000
1966	7,100	5,200	1,400	-	500
1967	9,000	7,400	1,300	-	300
1968	6,700	4,900	1,500	-	300
1969	5,100	3,000	1,900	-	200
1970	5,000	3,200	1,600	-	200
1971	5,700	3,100	1,900	-	700
1972	5,500	3,100	1,900	-	500
1973	6,600	2,700	2,300	-	1,600
1974	8,300	2,500	3,400	-	2,400
1975	[a]14,100	4,000	4,200	-	5,900
1976	[a]14,900	4,000	4,400	-	6,500
1977	[b]7,000	-	-	-	300
1978	[b]7,200	-	-	-	500
1979	[b]8,500	-	-	-	800
1980	[b]8,600	-	-	-	800
Estimated total cost	[b]$368,600	[b]$200,500	[b]$39,000	$6,300	$93,900

[a]Includes some unseparable costs directly related to the LWBR such as plant modification and site work for installation of the LWBR core.

[b]The total of $368,600,000 includes $28,900,000 budgeted for Technical support and evaluation and Facility management for fiscal years 1977-80; no breakdown of the $28,900,000 is available. Estimated cost for fiscal years 1977-80 does not include adjustments for cost escalation.

ESTIMATED GOVERNMENT COST
FOR THE LWBR PROJECT (note a)

Fiscal year	Total cost	Technical support and evaluation (note b)	Equipment cost
	(000 omitted)		
1966	$ 8,414	$ 8,414	$ -
1967	11,558	11,558	-
1968	14,695	14,695	-
1969	13,734	13,449	285
1970	15,776	15,393	383
1971	25,466	23,990	1,476
1972	24,313	23,795	518
1973	24,141	23,792	349
1974	20,017	19,898	119
1975	[c]22,186	22,100	86
1976	[c]18,100	18,100	-
1977	9,700	9,700	-
1978	4,300	4,300	-
1979	6,600	6,600	-
1980	9,300	9,300	-
Estimated total cost	$228,300	$225,084	$3,216

[a]Cost of reprocessing and evaluating the LWBR core is not included and cannot be accurately estimated at this time. Estimated cost for fiscal years 1977-80 does not include adjustments for cost escalation.

[b]Estimated cost of management contract for Shippingport for fiscal years 1977-80 is included under PWR project cost (see note b, appendix I).

[c]Some of the estimated cost of the LWBR project for fiscal years 1975-76 is included under the PWR project cost (see note a, appendix I).