

GAO

May 1989

# NUCLEAR REGULATION

## NRC's Restart Actions Appear Reasonable— But Criteria Needed



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Resources, Community, and  
Economic Development Division

B-235146

May 4, 1989

The Honorable Paul S. Sarbanes  
Vice Chairman, Joint Economic Committee  
Congress of the United States

The Honorable Barbara A. Mikulski  
United States Senate

On March 30, 1988, you asked us to determine the criteria that the Nuclear Regulatory Commission (NRC) uses to allow a nuclear plant to restart operations when it has been shut down to correct safety and/or management problems. You asked us to use the Peach Bottom, Pennsylvania, plant as an example and examine (1) Peach Bottom's operating history and NRC's rationale for allowing the plant to continue operations despite its history of problems and (2) the extent NRC would consider outstanding maintenance items before allowing the plant to restart. In addition, on October 27, 1988, you asked us to examine the manner in which NRC addressed public comments concerning Peach Bottom, identify the procedural changes NRC has made as a result of the Peach Bottom shutdown, and examine the need for an independent group to review NRC's restart decision.

## Factors Leading to the Peach Bottom Shutdown

Peach Bottom, owned by Philadelphia Electric Company (PECO), began commercial operations in 1974. Until the early 1980s, NRC inspections identified few problems. However, beginning in 1983 NRC and the Institute for Nuclear Power Operations (INPO), an industry-funded group, found that the utility's compliance with regulatory procedures and the plant management's attention to operating practices had deteriorated. In March 1987, NRC's Executive Director for Operations ordered the plant to be shut down after finding evidence that control room personnel were sleeping on the job. NRC concluded that it no longer had reasonable assurance that the plant would be operated safely (app. II describes the factors leading to the shutdown in greater detail).

## Results in Brief

As of November 1988, seven nuclear plants were shut down to correct safety and/or management problems. However, NRC does not have criteria that specify the actions that must be taken before a plant can restart operations. In November 1988, NRC's Executive Director for Operations issued staff guidelines, but the guidelines do not go far enough. The

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guidelines do not discuss public participation, independent review, or utility actions prior to restarting a plant.

Prior to the March 1987 shutdown, Peach Bottom had eight escalated enforcement actions and paid more in financial penalties than five other similarly designed plants.<sup>1</sup> However, Peach Bottom's operating performance, as measured by three industrywide indicators, was similar to the other plants. Although problems may have existed earlier, NRC did not shut Peach Bottom down prior to 1987 because it had not identified the problems that warranted the shutdown.

In addition, NRC has involved the public in its activities concerning the restart of Peach Bottom. Since September 1987, NRC has held nine meetings to receive public concerns. NRC addressed some of these concerns in an October 1988 safety evaluation report, which was distributed to public libraries near the plant.

Further, since the Peach Bottom shutdown, NRC has made several procedural changes to strengthen its inspection process and encourage professionalism among nuclear power plant workers. In addition, the Advisory Committee on Reactor Safeguards (ACRS), a legislatively mandated group of outside scientists and engineers, has reviewed NRC's activities and held two public meetings on Peach Bottom's readiness to restart operations.

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## NRC's Actions to Allow a Plant to Restart Operations

NRC does not have criteria setting out the actions that either NRC or the utility must take once a plant has been shut down to correct safety and/or management problems. However, we found that NRC took similar actions for both the Peach Bottom and the Pilgrim, Massachusetts, plants.<sup>2</sup> The actions included approval of the utility's corrective action plan as set out in a safety evaluation report, several inspections, independent review by the ACRS, public meetings, and Commission approval to restart (app. III compares the actions for Peach Bottom and Pilgrim).

In addition, in November 1988, NRC's Executive Director for Operations issued guidelines specifying the actions that NRC staff may take before allowing a plant to restart operations. At that time, seven plants were

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<sup>1</sup>For purposes of this report, we defined similar plants as boiling water reactors with Mark I containments that received operating licenses around the same time as Peach Bottom—the early 1970s.

<sup>2</sup>In April 1986 the Boston Edison Company shut down Pilgrim to correct long-standing safety and management problems. NRC authorized the plant to restart operations in December 1988.

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shut down because of management and safety concerns. The Executive Director took this action after determining that NRC's past activities had not been uniform. The guidelines discuss the need for NRC to determine the root causes leading to a shutdown, evaluate the utilities' corrective actions, assess the competence of plant management, and ensure the physical readiness of the plant to restart operations. However, the guidelines do not discuss the need for independent review, public participation, or utility actions prior to restarting a plant.

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## Peach Bottom's Operating History

On the basis of a comparison of Systematic Assessment of Licensee Performance (SALP) evaluations, we found that Peach Bottom was in the lower range of SALP ratings among the plants we reviewed. In addition, all the plants had between 4 and 18 escalated enforcement actions—Peach Bottom had 8. However, Peach Bottom's operating performance as measured by three industry indicators (availability, capacity, and unplanned outages)<sup>3</sup> was similar. According to NRC staff, they did not shut Peach Bottom down earlier because before 1987 NRC had not identified problems warranting a shutdown—even though they may have existed.

In 1980 NRC implemented the SALP program to periodically assess utilities' performance in 10 to 12 technical areas. We found that Peach Bottom rated somewhat lower than 15 other plants on past SALP reviews. For example, Peach Bottom had more marginally satisfactory ratings than 9 other plants between 1980 and 1986 (app. IV shows the SALP results for Peach Bottom and the other plants).

In addition, Peach Bottom had more inspection violations than five other plants. Under its regulations, NRC categorizes violations by five levels of severity—level I violations are the most safety significant and level V violations are the least. Once NRC finds a violation and determines the severity, it can take one or more of three enforcement actions: issue a Notice of Violation, impose a civil penalty (fine), or issue an enforcement order requiring the utility to stop operations. The order can be issued in lieu of, or in addition to, a civil penalty.

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<sup>3</sup>Availability reflects the ratio of hours that a plant was available to operate to the number of hours that it actually operated; capacity reflects the ratio of energy that a plant produces during a given period to the energy that the plant could have produced at maximum capacity under continuous operation; unplanned outages reflect outages caused by plant shutdowns other than for normal maintenance.

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Between 1970 and March 1987, NRC issued eight Notices of Violation against Peach Bottom for levels I, II, and III violations and PECO paid a total of \$485,000 in civil penalties. The number of violations at the other plants ranged from 4 to 18, and the utilities paid between \$42,500 and \$1.0 million in civil penalties (app. V shows the Notices of Violations and civil penalties from 1970 through March 1987). On the other hand, Peach Bottom's performance was similar to the other plants when compared with three industrywide indicators. (App. VI shows cumulative data for the three indicators from the start of commercial operations at each plant through March 1987.)

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## Outstanding Maintenance Items

NRC has required PECO to reduce its sizable maintenance backlog. At the time NRC ordered the shutdown, Peach Bottom had about 3,650 maintenance items that needed to be repaired. According to an NRC document, comparisons of outstanding maintenance items among plants may be irrelevant because plants accumulate backlogs that can or must be deferred until a plant undergoes a refueling outage, and each utility has a different approach to identify and track maintenance activities.

However, subsequent PECO inspections identified a significant number of maintenance repairs. By April 1988, for example, PECO had a backlog of about 11,200 items. According to NRC, 3,200 items related to safety equipment; the remaining items had no impact on safe or reliable plant operations. In July 1988 NRC conducted a special maintenance inspection to evaluate PECO's activities. The inspection team reviewed maintenance records, observed selected maintenance tests, and inspected plant equipment. In its October 1988 report, the team found that Peach Bottom's maintenance program was adequate and the plant's management had committed to a strong maintenance program. At that time, PECO reported that it had completed work on over 14,000 maintenance items. Subsequently, NRC conducted an integrated assessment team inspection in February 1989, in part, to review Peach Bottom's maintenance personnel qualifications, administrative procedures, and management policies. In its March 1989 report, the team concluded that PECO's staff should be able to control maintenance activities in the future. As of March 1989, PECO reported that Peach Bottom had only 220 outstanding maintenance items.

## Public Participation in NRC's Restart Activities

According to NRC staff, neither the Atomic Energy Act nor NRC's regulations require the agency to meet with or respond to public comments as part of its restart activities. However, following the shutdown of both Pilgrim and Peach Bottom, NRC held a number of public meetings. For Peach Bottom, NRC and PECO held nine in Pennsylvania and Maryland to provide the public an opportunity to comment on NRC's restart activities and PECO's restart plan.

In September and November 1987, NRC held three public meetings on PECO's restart plan. According to NRC staff, the purpose of the meetings was to obtain an understanding of the public's concerns rather than respond to comments raised. Subsequently, in May 1988 NRC held three more meetings. In its October 1988 safety evaluation report on Peach Bottom, NRC responded to the public's concerns. NRC distributed the report to libraries near the plant. In addition, in February and March 1989 NRC held three other public meetings and responded directly to comments made. Therefore, we believe that NRC made a reasonable effort to involve the public in its restart activities for Peach Bottom.

## Procedural Changes as a Result of Peach Bottom

NRC has made two procedural changes as a result of the Peach Bottom shutdown. First, NRC revised its regulations (10 C.F.R. 50.70) to permit inspections of commercial power plants without providing advance notice to the utility. Second, NRC published a final policy statement in the January 24, 1989, *Federal Register* concerning the conduct of nuclear power plant operations including employees' behavior. NRC's commissioners believed that the policy statement would strengthen safety awareness at all NRC-licensed facilities.

## Independent Review of NRC's Restart Decision

In the case of Peach Bottom and Pilgrim, the ACRS reviewed NRC's restart decision. For Peach Bottom, the ACRS examined PECO's restart plan and NRC's activities to ensure that the utility took the actions required. The ACRS also reviewed NRC's safety evaluation and integrated assessment team inspection results and a SALP report covering the period June 1987 through July 1988. In addition, the ACRS and its subcommittee held two meetings in Bethesda, Maryland, to independently review NRC's actions and offer the public an opportunity to express its concerns about the plant. At a March 1989 meeting, the ACRS said that, subject to completion of certain equipment modifications and procedural changes, such as providing operational training to health physics technicians who had no power plant experience, PECO could restart Peach Bottom without undue risk to public health and safety.

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## Conclusions and Recommendation

Although seven nuclear power plants had been shut down to correct safety and/or management problems as of November 1988, NRC does not have criteria specifying the actions that must be taken to ensure that a plant can safely restart operations. NRC issued guidelines in November 1988 that discuss the need for ensuring the readiness of the plant to restart operations. However, the guidelines do not have to be followed and do not discuss the need for independent review, public participation, or utility actions prior to restarting a plant.

We found that NRC took similar actions to assess both Peach Bottom's and Pilgrim's readiness to restart operations. The actions seem reasonable because they include NRC's review and approval of the utility's corrective action plan, several inspections, independent review by the ACRS, and public participation.

However, we believe that NRC needs to establish criteria to ensure that a consistent process is used to assess the readiness of any plant that has been shut down for management and/or safety problems. The criteria should describe both NRC and utility actions that must be taken before allowing a plant to restart operations. The criteria should be flexible enough to allow NRC to add requirements on a plant-by-plant basis giving consideration to overall design, personnel, and management.

Therefore, to ensure that each plant's readiness to restart is assessed, we recommend that the Chairman, NRC, develop criteria that at a minimum include review and approval of the utility's corrective action plan, inspections to ensure the actions are taken, independent review of NRC's actions, and public participation.

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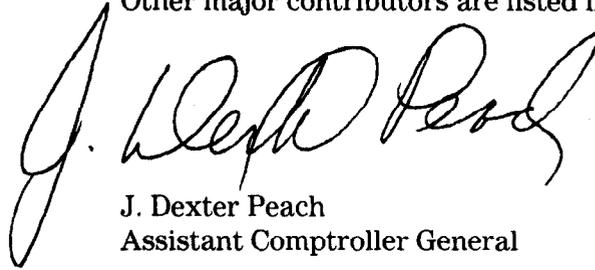
We conducted our work at NRC headquarters in Washington, D.C., and its Region I office in King of Prussia, Pennsylvania. (Our objectives, scope, and methodology are discussed in detail in app. I.)

We discussed the facts presented in this report with NRC staff. Generally, they agreed with the facts but offered some clarifications that were incorporated where appropriate. As requested, we did not ask NRC to review and comment officially on the report. Our work was performed between April 1988 and March 1989 in accordance with generally accepted government auditing standards.

Unless you publicly announce its contents earlier, we plan no further distribution of this report for 30 days from the date of this letter. At

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that time, we will send copies to the Chairman, NRC; other interested parties; and make copies available to others upon request. This work was performed under the direction of Keith O. Fultz, Director, Energy Issues. Other major contributors are listed in appendix VII.



J. Dexter Peach  
Assistant Comptroller General

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**Abbreviations**

ACRS	Advisory Committee on Reactor Safeguards
GAO	General Accounting Office
INPO	Institute of Nuclear Power Operations
NRC	Nuclear Regulatory Commission
NRR	Office of Nuclear Reactor Regulation
PECO	Philadelphia Electric Company

# Objectives, Scope, and Methodology

On March 30, 1988, and October 27, 1988, the former Chairman, Joint Economic Committee (now Vice Chairman), and Senator Barbara Mikulski asked us to determine the criteria the Nuclear Regulatory Commission (NRC) uses to allow a nuclear plant to restart operations when it has been shut down to correct safety and/or management problems. In addition, we were asked to examine (1) Peach Bottom's operating history, (2) NRC's rationale for allowing the plant to continue operations when it had a long history of operating and management problems, (3) the extent NRC would consider outstanding maintenance items before allowing the plant to restart, (4) the manner in which NRC addressed public comments about the plant, (5) the procedural changes NRC has made as a result of the Peach Bottom shutdown, and (6) the need for an independent group to review NRC's restart decision.

To obtain the information needed, we reviewed the Atomic Energy Act and a November 1988 internal policy on NRC's actions following plant shutdowns. In addition, we reviewed NRC reports for inspections conducted in 1976, 1978, 1980, and 1985 through 1987 at Peach Bottom as well as inspections conducted since the plant was shut down in March 1987. Specifically, we reviewed the results of the maintenance team, emergency operating procedures, security, and integrated assessment team inspections. We also examined the Institute of Nuclear Power Operations' January 1988 letter to the Philadelphia Electric Company, which describes serious performance problems at Peach Bottom and identifies significant weaknesses in management's attention to plant operations.

In addition, we

- compared the actions NRC took for Peach Bottom with the actions taken to allow the Pilgrim plant in Massachusetts to restart operations;
- obtained statistics on three industry performance indicators (capacity, availability, and unplanned outages) for Peach Bottom and 15 other similarly designed plants (boiling water reactors with Mark I containments built during the same time as Peach Bottom) from Licensed Operating Reactors Status Summary Report (NUREG-0020, Volume 11, Number 4), which summarizes data on nuclear power plants from the start of commercial operations through March 31, 1987;
- examined NRC's Systematic Assessment of Licensee Performance reports from 1980 through 1986 for Peach Bottom and 15 other plants;
- obtained information on several types of enforcement actions—notices of violation and civil penalties—for Peach Bottom and the other plants from 1970 through March 1987, and to obtain a broader comparison, we

included several plants that began commercial operations a few years before Peach Bottom;

- reviewed NRC's response to the 90 public comments received on Peach Bottom and determined whether NRC's response as set out in its October 1988 safety evaluation report addressed the concerns raised; and
- obtained the Advisory Committee on Reactor Safeguards, (ACRS) recommendation concerning Peach Bottom's restart status and determined the mechanism that NRC used to consider these recommendations in its decision-making activities.

Further, we met with NRC staff in the Offices of Enforcement, Executive Director for Operations, Nuclear Reactor Regulation, Governmental and Public Affairs; Region I, King of Prussia, Pennsylvania; and the ACRS. In addition, we attended a February 28, 1989, public meeting in Bel Air, Maryland, and an ACRS meeting in Bethesda, Maryland, on March 8 and 9, 1989, concerning Peach Bottom.

We discussed the facts in this report with NRC's project manager for Peach Bottom and staff in the Offices of Nuclear Reactor Regulation, Enforcement, and General Counsel and incorporated their views where appropriate. As requested, we did not ask NRC to review and comment officially on this report. Our review was conducted between April 1988 and March 1989 in accordance with generally accepted government auditing standards.

# Factors Leading to the Peach Bottom Shutdown

Beginning in 1983, NRC found problems at Peach Bottom. For instance, NRC levied \$210,000 in civil penalties for violations at Peach Bottom in 1983 and 1984 because of inadequate management involvement in plant activities and the complacent attitude of staff toward performing their duties. In addition, in 1985 an NRC inspector observed a worker who appeared to be sleeping in the control room. In March 1987, NRC found widespread evidence that control room personnel were asleep on the job and determined that the practice had been going on for some time. As a result, on March 31, 1987, NRC's Executive Director for Operations ordered the plant to be shut down since NRC no longer had reasonable assurance that the plant would be operated safely.

Around the same time that NRC began to identify problems at Peach Bottom, the Institute for Nuclear Power Operations (INPO) also found evidence of declining performance at the plant. After a plant evaluation, INPO expressed its concern over long-standing problems at Peach Bottom including inadequate PECO support in implementing changes at the site. Between 1984 and 1987, INPO conducted several additional corporate, maintenance, and plant evaluations. On January 11, 1988, INPO sent a letter to PECO describing "serious performance problems" and concluded that these problems existed at all plant levels and in the PECO corporate structure. INPO also found

- grossly unprofessional behavior by a wide range of shift personnel that was condoned by shift supervisors;
- PECO management had ample warning that serious problems were developing at Peach Bottom, and a corporate culture had developed that downplayed, rejected, or ignored problems; and
- the lack of accountability in PECO and at Peach Bottom was pervasive, and the situation had existed for several years.

# Comparison of NRC's Actions for Peach Bottom and Pilgrim

Activities conducted	Peach Bottom	Pilgrim
Shutdown order	X	<sup>a</sup>
Corrective action plan submitted	X	X
Safety evaluation report issued	X	X
Maintenance team inspection	X	X
Emergency operating procedures team inspection	X	X
Integrated assessment team inspection	X	X
Advisory Committee on Reactor Safeguards (ACRS) review	X	X
Regional recommendation to Director, Nuclear Reactor Regulation (NRR) <sup>b</sup>	X	X
Director, NRR recommendation to Executive Director for Operations (EDO) <sup>b</sup>	X	X
EDO briefing of Commissioners <sup>b</sup>	X	X
Commission decision	X	X
Number of public meetings	9 <sup>c</sup>	5

<sup>a</sup>Boston Edison shut down Pilgrim, however, NRC issued a confirmatory action letter describing the activities that the utility had to take before NRC would allow the plant to restart.

<sup>b</sup>According to NRC staff, they use one document that consolidates these actions.

<sup>c</sup>The ACRS held two additional meetings.

# Systematic Assessment of Licensee Performance Results

In 1980 NRC implemented the Systematic Assessment of Licensee Performance (SALP) program to periodically assess utilities' performance in 10 to 12 technical areas. For each area, NRC rates the utility as follows: an aggressive and safety-oriented management that allocates resources to achieve a level of performance that substantially exceeded regulatory requirements—rating 1, sufficient management attention to safety and a level of performance above that needed to meet regulatory requirements—rating 2, or insufficient management attention and resources to ensure safety and marginally satisfactory performance—rating 3. Table IV.1 shows SALP results for Peach Bottom and 15 other plants between 1980 and 1986.

**Table IV.1: SALP Results for Peach Bottom and 15 Other Plants, 1980-1986**

Plant	Number of SALPs	Number of various ratings assigned		
		1	2	3
Peach Bottom 2 and 3	7	11	40	13
Dresden 2 and 3	6	14	35	11
Monticello	6	29	26	2
Vermont Yankee	5	31	15	0
Pilgrim	6	12	26	14
Quad Cities 1 and 2	5	17	26	4
Cooper Station	6	25	31	3
Fitzpatrick	6	12	36	7
Browns Ferry 1, 2, and 3	5	1	21	24
Brunswick 1 and 2	5	7	27	13
Hatch 1	6	7	43	5

# Notices of Violations and Civil Penalties for Peach Bottom and 15 Other Plants, 1970-March 1987

<b>Plant/licensee</b>	<b>Notices of violation<sup>a</sup></b>	<b>Civil penalties paid by licensee</b>
Peach Bottom 2 and 3 Philadelphia Electric Co.	8	\$485,000
Dresden 2 and 3 Commonwealth Edison	10	348,500
Monticello Northern States Power	4	42,500
Vermont Yankee Vermont Yankee Nuclear Power	7	109,000
Pilgrim Boston Edison	13	666,000
Quad Cities 1 and 2 Commonwealth Edison	7	389,000
Cooper Station Nebraska Public Power District	8	212,000
Fitzpatrick New York Power Authority	5	146,000
Browns Ferry 1, 2, and 3 Tennessee Valley Authority	18	1,004,625
Brunswick 1 and 2 Carolina Power and Light	10	918,000
Hatch 1 Georgia Power	10	379,000

<sup>a</sup>For this review, we compared the most severe violations (levels I, II, and III). NRC may levy civil penalties for these three types of violations.

Source: Computer runs from NRC's Enforcement Action Tracking System.

# Cumulative Performance Indicators for Peach Bottom and Other Plants

Plant	Date of commercial operation	Availability factor <sup>a</sup>	Capacity factor <sup>b</sup>	Unplanned outage rate <sup>c</sup>
Peach Bottom 2	July 1974	64.4	56.4	13.3
Peach Bottom 3	Dec. 1974	68.8	59.1	8.6
Dresden 2	June 1970	71.5	55.8	11.8
Dresden 3	Nov. 1971	68.3	53.5	12.1
Monticello	June 1971	76.0	68.9	4.6
Vermont Yankee	Nov. 1972	76.3	68.6	6.5
Pilgrim	Dec. 1972	61.6	53.2	12.4
Quad Cities 1	Feb. 1973	78.4	63.2	5.4
Quad Cities 2	Mar. 1973	74.8	60.3	7.6
Cooper Station	July 1974	73.5	57.2	4.8
Fitzpatrick	July 1975	70.2	60.8	12.1
Browns Ferry 1	Aug. 1974	52.5	45.4	36.9
Browns Ferry 2	Mar. 1975	51.3	43.6	35.6
Browns Ferry 3	Mar. 1977	50.0	44.7	35.3
Brunswick 1	Mar. 1977	60.5	48.7	16.4
Brunswick 2	Nov. 1975	56.8	43.4	16.1
Hatch 1	Dec. 1975	66.8	56.6	14.3

<sup>a</sup>Reflects the ratio of hours that a plant was available to operate to the number of hours that it actually operated.

<sup>b</sup>Reflects the ratio of energy that a plant produces during a given period to the energy that the plant could have produced at maximum capacity under continuous operation during the same period.

<sup>c</sup>Reflects power outages covered by plant shutdowns other than for normal maintenance.

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