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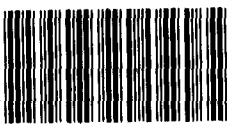
Report to Congressional Requesters

April 1990

NUCLEAR SAFETY

Concerns About Reactor Restart and Implications for DOE's Safety Culture



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GAO

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General Accounting Office
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Resources, Community, and
Economic Development Division

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April 12, 1990

The Honorable John Glenn
Chairman, Committee on
Governmental Affairs
United States Senate

The Honorable Mike Synar
Chairman, Environment,
Energy and Natural
Resources Subcommittee
Committee on Government Operations
House of Representatives

In September 1988, you asked us to review the Department of Energy's (DOE) efforts to restart three nuclear reactors at DOE's Savannah River Site in South Carolina. The Secretary of Energy has stated that restarting the three Savannah River reactors—K, L, and P—is a top DOE priority because the reactors are the nation's only production source of tritium, a radioactive gas used in nuclear weapons. Those reactors have not operated since 1988, and DOE is in the process of making a number of safety, operational, and management changes to prepare them for restart. Your offices specifically asked that we determine what potential delays may exist in the reactor restart schedule and what the operating contractor is doing to bring about a better attitude toward safety among its personnel at the Savannah River Site.

Because of the implications DOE-wide of the need for a better attitude toward safety, this report also contains information on safety attitude problems at other DOE facilities and with DOE employees.

Results in Brief

In June 1989 the Westinghouse Savannah River Company—the contractor who manages and operates the Savannah River Site—submitted to DOE the Reactor Operations Management Plan, which lays out the detailed actions needed for restart. The plan proposed to restart K reactor in September 1990, with L and P reactors to resume operation in December 1990 and March 1991, respectively.[1] As of March 1990, Westinghouse was revising the Reactor Operations Management Plan to assess the extent to which tasks added to restart requirements since

[1]Depending on DOE's operational plans, the shortest time after restarting a reactor that tritium would be available to put in weapons would be about 12 months.

June 1989 will affect the restart schedule. DOE plans to announce an official restart schedule in the latter part of April 1990, according to Savannah River Project Office officials.

Many safety, operational, and management changes will be made by the fall of 1990. Given the magnitude of change and the number of major issues still to be resolved, we believe the restart schedule currently proposed by Westinghouse (beginning with K reactor in September 1990) will more than likely be delayed. For example, the June 1989 Westinghouse Reactor Operations Management Plan for K reactor is composed of 226 separate tasks. In many cases, these tasks are interrelated and/or dependent on studies, tests, or analyses that are still ongoing. Issues that could delay restart include ultrasonic inspection of reactor vessels, training for reactor operators, preparation of new technical specifications, improving the reactors' ability to withstand earthquakes, and environmental compliance. As of late March 1990, the cumulative effect of the potential delays either was not available or not determinable, but the potential delays due to specific issues ranged from 1.5 months to over 2 years.

Although steps are being taken to improve the attitude toward safety at Savannah River, it still needs improvement. DOE and Westinghouse agree that a change is needed in the underlying attitude—or safety culture—toward reactor operating practices and safety vigilance. They also believe that such a change will not occur overnight but will be a long-term effort that cannot be fully accomplished before restart of the reactors. Tasks in the Reactor Operations Management Plan as well as other activities, such as hiring new staff, are intended to address the safety culture issue.

Westinghouse prepared a management policy statement in January 1990, describing culture change activities already being implemented or planned. However, Westinghouse does not have a comprehensive implementation plan that sets forth specific tasks and milestones for achieving all of its cultural change initiatives. Without such a plan, we believe it will be difficult for DOE to ensure that all needed actions are being taken and completed in a timely manner. Although we recognize the difficulty of measuring changes in employee attitude, DOE nonetheless needs to develop measurement indicators that will provide a continuing basis for assessing the effectiveness of its cultural change initiatives at Savannah River.

Problems with safety culture are not limited to the Savannah River Site. We, as well as others, have described a complacent attitude towards safety not only by contractor employees at Savannah River, but also by DOE personnel in general and contractors at other locations.[2] Although DOE is trying to instill a better safety attitude throughout its organization, it has no comprehensive plan to lay out how that will be done or measurement indicators to judge progress.

Potential Delays in the Reactor Restart Schedule

The Westinghouse Reactor Operations Management Plan describes the actions that need to be taken prior to restart. However, a number of technical and environmental issues will more than likely lead to a delay in the currently proposed restart schedule. Further, the length of that delay is dependent on the specific resolution of the various issues and the timing of that resolution.

The unresolved technical issues are still under study by DOE, Westinghouse, and/or the Defense Nuclear Facilities Safety Board, which is legislatively mandated by the Congress to oversee safety issues at DOE's nuclear facilities. For example, neither DOE nor Westinghouse has determined the exact extent to which DOE's decision to ultrasonically inspect the K reactor vessel for cracks will delay restart, but the preliminary estimate was that the time required to inspect 40 percent of the accessible welds in the reactor vessel could delay restart of K reactor by up to 1.5 months.

Additionally, the Defense Nuclear Facilities Safety Board has begun reviewing the major issues facing DOE's nuclear facilities, including reactor restart at Savannah River. At this point, the potential impact of the Board's activities on the restart schedule is unclear, but the Board has already made recommendations to the Secretary on reactor operator training and on the application of DOE orders to the reactors at Savannah River. The Board could raise issues or concerns about how restart activities are being accomplished that would delay restart.

Environmental issues also could have an impact on the proposed restart schedule. For example, DOE is preparing an environmental impact statement that could raise issues that public interest groups could use to seek an injunction against operating the reactors. Furthermore, to comply

[2]Nuclear Health and Safety: Summary of Major Problems at DOE's Rocky Flats Plant (GAO/RCED-89-53BR, Oct. 27, 1988);Modernizing and Cleaning Up DOE's Nuclear Weapons Complex (GAO/T-RCED-89-10, Feb. 22, 1989).

with requirements of the Federal Water Pollution Control Act, popularly known as the Clean Water Act, under a permit issued by the state of South Carolina, DOE must complete a cooling tower for the K reactor by the end of 1992 to prevent discharges of hot water into onsite streams and wetlands. However, on March 22, 1990, two public interest groups—the Natural Resources Defense Council and the Energy Research Foundation—notified the Secretary of their intent to sue DOE to prevent the operation of K reactor before the cooling tower is completed. These groups stated that K reactor should not be operated without a cooling tower unless the President exempts the K reactor from Clean Water Act requirements on the basis of national security needs. Resolving these and other potential environmental challenges will involve action on the part of DOE, the state, and federal courts. Appendix II provides more details on these issues.

Safety Culture Change Underway

The Nuclear Regulatory Commission (NRC)—which regulates the commercial nuclear industry—has defined safety culture for that industry as an underlying philosophy that results in personnel believing they are accountable for the safe operation of a facility, taking personal interest in constantly striving to improve safety, communicating effectively, following procedures, and being well-trained. Although DOE is not regulated by NRC, it has basically adopted its safety philosophy, and both DOE and Westinghouse have recognized that the safety culture at DOE's Savannah River Site needs improvement and that it will be a slow process.

To deal with the safety culture problem, Westinghouse is upgrading training and hiring new people from the outside who bring with them the commercial nuclear industry's concept of safety culture. Westinghouse believes this training and the infusion of "commercial" attitudes and behaviors will help change the existing culture. We identified several recent examples that demonstrate the type of attitude and behavior that DOE and Westinghouse are trying to change.

For example, in September 1989, Westinghouse found that someone had disabled a safety alarm in the P reactor because it was annoying. The alarm's purpose is to alert reactor operations personnel if the pumps that circulate cooling water for the reactor malfunction. While the person who had disabled the alarm voluntarily resigned, a DOE investigation found five other individuals who had known the alarm was off. That investigation also found weaknesses in the technical knowledge and training of plant staff and significant weaknesses in staff attitudes toward safety alarms. For example, from interviews with plant staff,

they found an attitude that the silenced alarm was not important, but rather a nuisance, and that many personnel responsible for responding to alarms "do not pursue the reason for the alarm as much as they try to silence the alarm."

Westinghouse, with input from the DOE Project Office, prepared a "White Paper" in January 1990, describing culture change activities already being implemented or planned. Although this paper is a management policy statement announcing the existence of programs, activities, and expectations for employee attitudes on reactor nuclear safety, Westinghouse does not have a comprehensive, integrated implementation plan with specific tasks and milestones for achieving the objectives of all culture change initiatives in reactor operations.

The Director of the Office of Savannah River Restart at DOE Headquarters told us that while he reviewed it, he saw no need for DOE to approve the White Paper. However, DOE does plan to evaluate the status of safety culture—and Westinghouse management's commitment to it—at the time of restart. DOE's criteria for evaluating the safety culture do not require that Westinghouse prepare an implementation plan. Without such a plan, we believe it will be difficult for DOE to ensure that all needed actions are being taken and are accomplished in a timely way.

Further, the Secretary of Energy has said that changing the safety culture is one of the most critical issues facing the department. Therefore, measuring the progress of the safety culture change is an important, yet difficult task. Tracking the accomplishment of specific tasks and milestones of the various activities related to safety culture change would be one measure of progress. Additionally, DOE needs to develop measurement indicators that will provide a continuing basis for gauging the effectiveness of its culture change initiatives at Savannah River. Comparison over time of indicators could be used along with other information DOE and Westinghouse management collect as part of their day-to-day contact with workers to judge if attitudes are changing.

Once these elements are in place, they would also be an important enhancement to the criteria DOE uses to make a determination every 6 months about whether Westinghouse's performance, particularly in the safety area, should result in an award fee—a bonus above Westinghouse's costs and agreed-to base fee under the contract.

Safety Culture Changes Are Needed by DOE Employees and Contractors at Other Facilities

Problems with safety culture are not limited to the Savannah River Site. We, as well as other groups such as the National Academy of Sciences and DOE's Advisory Committee on Nuclear Facility Safety, have described a complacent attitude toward safety not only by employees at Savannah River but also by DOE personnel in general and contractors at other locations. We, for example, have identified a number of safety problems at DOE facilities and have described a DOE management structure that emphasizes production over safety and relies heavily on contractor judgments about safety. This attitude has contributed to the numerous safety problems being raised at most of DOE's nuclear facilities and in the case of Rocky Flats has led to its continued shutdown status.

DOE is trying to instill a new attitude throughout DOE and its contractors toward safe operations of DOE's nuclear facilities. To begin to change the culture within its own organization, DOE is taking actions such as hiring more technical staff with commercial industry backgrounds and starting to reorganize its management structure. However, as we pointed out in our recent report on the status of the reorganization of DOE's safety management functions,[3] it may be difficult to hire the technical staff DOE needs, and the reorganization is not being put into place in a timely way.

Another Secretary of Energy initiative directed, in part, at culture change is the Tiger Teams. These teams are special task forces composed of DOE employees that assess a facility's performance in the environmental, safety, and health (ES&H) areas. In February 1990, DOE released a preliminary analysis of trends in its Tiger Team assessments.[4] Some of the overall concerns were that 50 percent of the facilities lack sufficient oversight by DOE operations offices or area offices responsible for contractor activities and 50 percent of the facilities did not know ES&H authorities and responsibilities and did not have an adequate ES&H program. Further, the press release describing the assessments stated that

"67 percent of the facilities had problems communicating ES&H policy and objectives to all levels of the organization, which has resulted in a lack of or slowness of culture change"

[3]Environment, Safety, and Health: Status of DOE's Reorganization of Its Safety Oversight Function (GAO/RCED-90-82BR, Jan. 30, 1990).

[4]This analysis was based on assessments at Rocky Flats Plant in Colorado, Feed Materials Production Center in Ohio, West Valley Demonstration Project in New York, Y-12 Plant in Tennessee, Pantex Plant in Texas, and Mound Plant in Ohio.

The press release stated more broadly that "The preliminary analysis of the results of the assessments indicates trends which may prove endemic to DOE facilities."

The Secretary of Energy has acknowledged that DOE staff need to change their attitude toward safety and the Tiger Team assessments demonstrate that there is still work to be done. According to the Under Secretary of Energy, DOE will not be able to competently manage its facilities unless such a change in attitude is accomplished. However, while there are many activities ongoing as a result of the Tiger Team assessments and other initiatives that relate to changing safety culture, there is no specific plan that describes the various efforts or identifies measurement indicators for gauging the progress toward instilling an attitude change throughout DOE.

Conclusions

Reactor restart is an ongoing activity and many safety, operational, and management changes have been or will be made. Given the magnitude of change, the number of unresolved questions, and the fact that the responses to some of these questions are based on studies, tests, or analyses that still must be completed, we believe the currently proposed restart schedule (beginning with K reactor in September 1990) will probably be delayed. Given that the critical path to restart is dependent on a number of different issues, it is not clear at this time what the extent of that delay would be.

Changing the Savannah River reactor operations safety culture is critical to a sound program for restarting the reactors as well as for safe long-term operation. We recognize that changing management and workers' attitudes about safety is an integral part of the many management and technical changes that are ongoing or planned for these reactors. Moreover, measuring an attitude change is at best a difficult task. We believe that the White Paper that Westinghouse developed is a step in the right direction by describing actions already being taken or planned, but it does not go far enough.

Therefore, given the critical importance and long-term nature of this endeavor, we believe a comprehensive implementation plan would identify the specific tasks contributing to the needed change in safety culture, milestones for their accomplishment, and measurement indicators that would provide a continuing basis for assessing the effectiveness of cultural change initiatives at Savannah River. Further, such a plan could be a valuable management tool for Westinghouse and DOE to

demonstrate to their employees the importance of culture change, and by bringing together the various activities related to culture change in one document, reinforce how closely linked a good safety attitude is to all activities and changes being made at Savannah River.

The Director of the Office of Savannah River Restart at DOE headquarters told us that while he reviewed it, he saw no need for DOE to approve the White Paper that Westinghouse prepared. We believe that because attitude is difficult to measure, DOE's review and approval of a plan to implement the White Paper would help to ensure that measurement indicators are adequate for DOE to judge whether attitude change is occurring. In addition, because the Secretary believes that a good safety attitude is an integral component of safe reactor operations, such a plan would be an important enhancement of the factors DOE uses to establish criteria for assessing Westinghouse's safety performance.

Additionally, a complacent safety attitude has also been previously identified within the DOE organization agencywide, and the Tiger Team assessments demonstrate that problems still exist. Therefore, a similar plan to the one just described for Westinghouse would describe the steps DOE plans to take to effect a safety attitude change by its own personnel and other contractors agencywide. As with the Westinghouse plan, DOE needs to develop measurement indicators to provide a continuing basis for assessing the effectiveness of DOE's cultural change initiatives agencywide. This plan would lay out for the Congress and the public how DOE intends to move from employee emphasis of production over safety and total reliance on contractors to a technically sound, strong management organization, which will contribute to the rebuilding of confidence in DOE management of its nuclear facilities. Moreover, given safety problems being raised at other DOE locations, such a plan will help to ensure that contractor employees at its other nuclear facilities have the proper attitude toward safety.

Recommendations

To achieve the desired safety culture change in Savannah River reactor operations, we recommend that the Secretary of Energy require that Westinghouse prepare a comprehensive, integrated implementation plan with specific tasks, milestones, and measurement indicators. We also recommend that DOE review the plan to ensure it is complete and then formally approve it. Further, after approving Westinghouse's plan, we recommend that the Secretary direct the Assistant Secretary for Defense Programs to use the plan, along with other factors, to establish

the award fee criteria for the 6-month award fee evaluation period beginning October 1, 1990.

To ensure that safety culture is changed DOE-wide, we recommend that the Secretary develop a departmentwide plan for bringing about the needed changes in the safety culture in DOE and for contractors at other DOE nuclear facilities, to include measurement indicators.

To develop the information for this report, we reviewed Westinghouse and DOE documents and interviewed DOE and Westinghouse officials responsible for reactor restart in Washington, D.C., and at the Savannah River Site. We performed our work from June through November 1989, updating information through March 1990. Appendix I contains more details on our scope and methodology.

We discussed the facts in this report with DOE officials, who generally agreed with them, and we incorporated their views where appropriate. As requested, however, we did not obtain official agency comments on a draft of this report. As arranged with your offices, unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days from the date of this letter. At that time we will send copies of this report to the appropriate congressional committees, the Secretary of Energy, and the Director, Office of Management and Budget. Copies will also be made available to other interested parties who request them.

This work was done under the direction of Victor S. Rezendes, Director, Energy Issues, (202) 275-1441. Other major contributors to this report are listed in appendix V.

J. Dexter Peach
Assistant Comptroller General

Contents

Abbreviations

DOE	Department of Energy
EIS	environmental impact statement
EPA	Environmental Protection Agency
ES&H	environmental, safety, and health
GAO	General Accounting Office
INPO	Institute for Nuclear Power Operations
NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination System
NRC	Nuclear Regulatory Commission
PRA	Probabilistic Risk Assessment
RCED	Resources, Community, and Economic Development Division
SRS	Savannah River Site

Reactor Restart Activities Are Ongoing

Three nuclear reactors located at the Department of Energy's (DOE) Savannah River Site (SRS) are the nation's only production source of tritium, a radioactive gas critical to the effectiveness of nuclear weapons. Because tritium decays at an annual rate of 5.5 percent, the tritium contained in deployed nuclear weapons must be replenished periodically to maintain the weapons' capabilities.

Background on Reactor Restart

DOE's three tritium producing reactors—K, L, and P—have been shut down since 1988 to make hardware improvements, upgrade operator qualifications, expand staffing and training, increase management involvement, and improve oversight. Restarting the reactors is a top DOE priority because continued operation is the only practical way to meet this nation's near-term requirements for new tritium.

The decision to make these changes at SRS before restarting the reactors was precipitated by an August 1988 incident, which occurred during start-up of the P reactor. This incident occurred because reactor operators continued start-up even though they were faced with unexplained reactor operations.[1] This incident, and how the contractor and DOE subsequently addressed it, raised a number of concerns including the complacent attitude of DOE and contractor employees toward safety, inadequate operator procedures and training, poor communication, and ineffective DOE management and oversight. Because of this incident, the reactor was shut down on August 17, 1988. The K and L reactors were already in an outage status as part of normal operations.

In October 1988 DOE announced it would restart K reactor in December 1988 if required levels of safety and quality could be achieved by that time, but the restart date has been delayed several times for a number of reasons including change in operating contractor at the Savannah River Site. In June 1989, Westinghouse—the new operating contractor at SRS—proposed to restart K reactor in September 1990, with the restart of L reactor to follow in December 1990 and P reactor in March 1991.[2]

[1]See Ineffective Management and Oversight of DOE's P-reactor at Savannah River, S.C., Raises Safety Concern (GAO/T-RCED-88-68, Sept. 30, 1988) for a detailed description of the incident.

[2]On April 1, 1989, the Westinghouse Savannah River Company replaced E. I. du Pont de Nemours (DuPont) as the operating contractor at SRS. DuPont had built the facility in the early 1950s and operated it until that time.

In June 1989, Westinghouse submitted a Reactor Operations Management Plan to DOE that provided a restart plan for K reactor. Supplementary plans for L and P reactors were provided on July 31 and August 31, respectively. Although DOE gave Westinghouse interim approval to use the June 1989 plan as a management tool and as a basis for measuring progress, the plan had not been given final approval as of late March 1990. At that time Westinghouse was revising the plan to assess the schedule implications of restart work tasks added since June 1989. The new plan is to be finalized by mid-April, and DOE will announce a restart date by the latter part of April, according to Savannah River Project Office officials.

DOE estimates that about $2.1 billion of reactor-related costs will be incurred during the restart period fiscal years 1989-91 (see app. IV for more details on the cost estimate). This amount does not include the costs that will be incurred after restart to implement the planned agenda of further safety improvements that are to be completed in the late 1990s. DOE or Westinghouse may decide, on the basis of the results of ongoing studies and analyses, that some of the safety improvements originally planned for the long term need to be done before restart. If this occurs, the costs associated with restart could be higher.

DOE Management and Oversight

When the restart efforts began in late 1988, DOE's Savannah River Operations Office Manager was responsible for efforts to restart the reactors, along with all other operations at SRS. However, to provide a single management focus on the restart effort, the Secretary of Energy created a Savannah River Special Projects Office in mid-May 1989 to manage the reactor restart program. The Director of the new project office reports directly to the Assistant Secretary for Defense Programs, who is fully responsible and accountable for all operational programs and activities at SRS. Among other duties, the project office's mission is to direct, oversee, and verify government and contractor efforts to restart the reactors in a safe and timely manner.

At the same time, the Secretary also created an Office of Reactor Restart at headquarters that reports to the Assistant Secretary for Defense Programs. The mission of this new restart office is to provide coordination, independent technical review, and staff support to the Assistant Secretary in directing the safe and timely restart of the SRS reactors.

Between late 1988 and early 1990, the Secretary's Advisory Committee on Nuclear Facility Safety provided the Secretary with expert views and

recommendations on the reactor restart program. However, the Advisory Committee chairman told us in early March 1990 that the Committee, as directed by the Secretary, no longer had oversight of reactor restart but is focusing primarily on DOE's Rocky Flats facility. He said that reactor restart oversight is now being provided by the Defense Nuclear Facilities Safety Board—a new external, independent oversight board established by the Fiscal Year 1989 National Defense Authorization Act. The new Safety Board, comprised of five members, was confirmed by the Senate in October 1989.

Safety Board members told us in March 1990 that reactor restart is one of the Board's top priorities but that other problem DOE facilities—Rocky Flats, Hanford, and the Waste Isolation Pilot Plant—are also high priorities. However, Board members also told us that their work is being hampered by problems in hiring technically qualified full-time staff, who are also in demand by the Nuclear Regulatory Commission (NRC), DOE, and the commercial nuclear industry. Although the Safety Board is authorized to hire up to 100 full-time staff, as of early March 1990, the Board had hired only 1 technical staff member. The Safety Board chairman told us that hiring had progressed slowly due primarily to problems in meeting the administrative and position classification requirements of the Office of Personnel Management. At that time, the individual board members themselves were providing first line direction of technical consultants contracted to provide technical oversight for reactor restart at Savannah River and for nuclear safety issues at other DOE facilities.

Objectives, Scope, and Methodology

On September 30, 1988, the Senate Committee on Governmental Affairs and the House Environment, Energy and Natural Resources Subcommittee, Committee on Government Operations, held joint hearings on reactor operations at Savannah River, focusing on the attempt to restart P reactor in August 1988. During the hearings, DOE said that P reactor would be restarted within 30 to 45 days. The Chairmen asked that GAO review DOE's plans for restarting the reactors. Shortly thereafter, DOE announced that K reactor would be the first reactor restarted and that it would be restarted in December 1988 if required levels of safety and quality could be achieved by that time. We monitored DOE's restart activities; however, due to a major delay in the restart schedule and no restart plan, our primary review of DOE's restart efforts began in June 1989, when Westinghouse submitted a Reactor Operations Management Plan to DOE. On November 7, 1989, your offices asked that we provide our views on the safety culture at SRS and potential delays in the restart schedule.

In performing our work, we reviewed Westinghouse's restart plans; DOE's organization and oversight plans; reports on technical restart issues prepared by Westinghouse and DOE; reports on restart progress and problems prepared by DOE and Westinghouse; reports prepared by NUS Corporation, a nuclear services firm providing support services to DOE personnel at SRS; and other files and documents related to reactor restart.

We visited the K reactor and observed restart activities in progress and interviewed DOE and Westinghouse officials responsible for reactor restart. We also interviewed NUS Corporation officials, the Chairman of DOE's Advisory Committee on Nuclear Facility Safety, and the members of the Defense Nuclear Facilities Safety Board. We reviewed the Advisory Committee's reports to the Secretary of Energy, attended public hearings held by the Advisory Committee at SRS on reactor restart, and attended briefings provided by DOE and Westinghouse to an Advisory Committee subcommittee on reactor restart. We reviewed reports of the Defense Nuclear Facilities Safety Board to the Secretary of Energy. We also discussed environmental issues with officials of the South Carolina Department of Health and Environmental Control.

We discussed the facts in this report with DOE staff who generally agreed with the accuracy of the information, and we incorporated their views where appropriate. As agreed with the requesters' offices, we did not obtain official agency comments on this report. Our review was conducted between June 1989 and December 1989 with information updated through March 1990, in accordance with generally accepted government auditing standards.

Potential Delays in the Restart Schedule

Many safety, operational, and management changes are scheduled to be completed by the fall of 1990, when Westinghouse has proposed the first reactor be restarted. For example, the Westinghouse plan for restarting K reactor is composed of 226 separate tasks. According to Westinghouse's monthly report on reactor operations dated December 1, 1989, the current work plans for restarting the reactors were progressing on schedule. However, there are a number of unresolved technical and environmental issues that will probably delay the restart schedule.

The technical issues that present potential delays in the schedule involve ultrasonic inspection of reactor vessels, reactor operator training, preparation of new technical specifications, and improving the reactors' ability to withstand an earthquake. Whether these issues result in schedule slippages hinges primarily on studies, assessments, and/or tests being conducted by DOE, Westinghouse, and/or the Defense Nuclear Facilities Safety Board.

The unresolved environmental issues center on legal questions raised under the National Environmental Policy Act and the Federal Water Pollution Control Act, popularly known as the Clean Water Act. Their resolution will involve the state of South Carolina, public interest groups, and the federal courts. The exact impact of these environmental issues on the restart schedule is unknown at this time; however, one issue concerning the construction of a cooling tower for K reactor—the subject of a recently announced lawsuit by two public interest groups—could delay the restart of K reactor for about 2 years.

We note that these technical and environmental issues may not be the only ones with the potential to delay reactor restart. In addition, at the time of our review, the resolution of these issues was not finalized, and definite estimates of the impact on the restart schedule were not available.

Ultrasonic Inspection of Reactor Vessels

Ultrasonic inspection is a state-of-the-art method for determining whether cracks exist in nuclear reactor vessels. During hearings in 1987 before the Senate Committee on Governmental Affairs, GAO stated that visual inspection—the primary method for inspecting SRS reactor vessels before September 1989—was not state-of-the-art and that ultrasonic testing would be an important step in enhancing the level of

safety for the reactors.[1] In a number of hearings since March 1987, we have continued to say that inspecting 100 percent of the accessible welds in the reactor vessel prior to restart would provide important baseline information about the condition of SRS' over 30-year-old reactor vessels.[2]

Westinghouse's June 1989 Reactor Operations Management Plan did not call for performing ultrasonic inspection of the K reactor vessel before restart. Westinghouse contended there was no technical basis to require ultrasonic inspection of the K reactor vessel before restart. Westinghouse's plan called for ultrasonically inspecting about 40 percent of the accessible welds in the P and L reactor vessels before restarting K reactor.[3] If no problems were found in P or L reactor, Westinghouse believed it could be reasonably and safely assumed that no problems existed in K reactor.[4] Under the Westinghouse plan, the K reactor vessel was to be ultrasonically inspected during planned outages after restart.

However, the DOE Advisory Committee, before ceasing its oversight of reactor restart, told the Secretary in December 1988 that the decision to not ultrasonically inspect the K reactor vessel before restart should be better explained and justified. The Chairman reiterated this concern during a September 1989 Committee meeting, stating that the justification still was not adequate. Later that same month DOE decided to require ultrasonic inspection of at least 40 percent of the accessible welds in K reactor before restart.

In early January 1990 the Acting Director of the Savannah River Special Projects Office directed Westinghouse to ultrasonically inspect as much as possible—up to 100 percent—of the accessible welds. The Acting

[1]Management and Safety Issues Concerning DOE's Production Reactors at Savannah River, S.C. (GAO/T-RCED-87-5, Mar. 12, 1987).

[2]To construct the vessels for the SRS reactors, large pieces of stainless steel were welded together. The welds and the areas around the welds that were heated during the welding process are susceptible to cracking and must be periodically inspected. Cracks found in the C reactor vessel at SRS forced its shutdown in 1985.

[3]Only 77 percent of the total weld length in the reactor vessel is accessible for ultrasonic inspection. The inspection plan calls for inspecting all accessible welds (and a 3-inch strip on either side of the weld) in two vertical top-to-bottom slices of the vessel wall, which together comprise one-third of the circumference of the vessel. Within these two vertical slices are located 100 percent of the vessel's accessible vertical welds and 33 percent of the accessible horizontal welds—or in total, 40 percent of all accessible welds in the vessel. The inspection plan requires all remaining accessible welds to be inspected within 5 years after restart.

[4]Inspection of the P reactor vessel occurred from mid-Sept. 1989 to late Oct. 1989. The inspection covered 40 percent of the accessible welds, and no cracks were found.

Director's letter to Westinghouse stated that "The amount of the UT [ultrasonic testing] should be maximized within the constraint of minimized schedule impacts." Westinghouse estimated that inspecting 100 percent of the accessible welds would take until April 25, 1990. In February 1990, DOE instructed Westinghouse to inspect as much as could be done by March 15, 1990. On March 8, 1990, Westinghouse had inspected 60 percent of the accessible welds and the inspection was halted at that point. No cracks were found.

Although the schedule impact of adding this inspection to the K reactor restart work was still being assessed in late March 1990, Westinghouse had preliminarily estimated that inspecting 40 percent of the accessible welds could delay restart of K reactor about 1.5 months. As of late March 1990, the Defense Nuclear Facilities Safety Board was still reviewing the question of whether inspecting less than 100 percent of the accessible welds is acceptable for restart. If the Safety Board were to recommend that 100 percent of the accessible welds be inspected before restart, such a requirement could result in additional schedule delays for all three reactors.

Training in Reactor Fundamentals May Be Inadequate

Under Westinghouse's training plan, the SRS reactor operators will not meet commercial industry standards for training in reactor fundamentals before the SRS reactors are restarted. According to the restart plan, reactor operator training is the key item that must be accomplished on time to restart the K and L reactors on schedule. If the current training plan is followed, Westinghouse and DOE management believe that training will not delay restart. However, if SRS reactor operators were required to meet commercial industry standards for reactor fundamentals knowledge before reactor restart, the training program would have to be expanded and could delay reactor restart.

In October 1989, the DOE Advisory Committee told the Secretary that the planned training for operators in reactor fundamentals is less than that provided to commercial reactor operators. Later, in February 1990, after oversight by the Advisory Board ceased, the Defense Nuclear Facilities Safety Board recommended to the Secretary that DOE

- identify differences between the qualifications of SRS reactor operators and those prescribed by NRC for commercial nuclear plants and, where differences exist, to identify supplemental measures taken to compensate for the differences;

- determine the current level of each reactor operator's qualifications and establish a training program that will achieve the knowledge prerequisite for restart; and
- accelerate implementation of a configuration management program to help ensure that the as-built drawings of safety-related systems are available to train reactor operators in procedures and discipline of operation.

As of March 22, 1990, DOE was still in the process of preparing a response to the recommendations of the new Safety Board. It is uncertain whether any of the Board's recommendations will result in changes in the training program that could delay restart of the reactors.

Restart Training Does Not Meet Commercial Industry Standards

As we stated in the September 1988 hearings on the P reactor start-up incident, the need for additional training for SRS reactor operators was identified as long ago as 1981 by a DOE task force that assessed the implications of the Three Mile Island accident. Also, in 1986 DOE's Office of Environment, Safety, and Health found that the knowledge of reactor operators and supervisors at SRS in reactor fundamentals such as thermodynamics, fundamental heat transfer, reactor kinetics, and operating characteristics was below the norm for commercial reactor operators and recommended upgrading that training.

According to the project office's Acting Director, the person in charge in the Savannah River reactor control rooms is the Control Room Supervisor. At the time of restart, Westinghouse will have 46 experienced SRS reactor operators who can serve as Control Room Supervisors. (Westinghouse will need 42 operators to operate all 3 reactors—14 for each reactor.) Before restart, these 46 operators will receive 116 hours of training in reactor fundamentals such as nuclear physics and reactor theory, mechanical components, process instrumentation, accident analysis, and radiation protection and health physics. However, to meet the commercial industry standards of the Institute for Nuclear Power Operations (INPO),[5] these 46 operators would need a total of 584 hours of training in

[5]In 1980 after the Three Mile Island nuclear accident, the nuclear industry established INPO to promote the highest levels of safety and reliability in plant operations. All nuclear utilities are INPO members and accept a form of peer review. INPO evaluates nuclear plants and establishes guidelines for plant operation, operator training, and other areas.

reactor fundamentals.[6] Westinghouse's current training plan does not call for any training in heat transfer and fluid flow, electrical science, print reading, chemistry, or material science before restart. If time permits, Westinghouse may provide some training in heat transfer and fluid flow, but that is uncertain at this point.

Westinghouse plans to compensate for the Control Room Supervisors' deficit in reactor fundamentals training by including a Shift Technical Engineer on each control room crew. Shift Technical Engineers have degrees in engineering and, according to DOE and Westinghouse, will possess all the knowledge in reactor fundamentals needed to satisfy INPO standards. At restart, these engineers will be qualified as Control Room Supervisors, except that they will still need 6 weeks of actual control room experience with the reactor operating at greater than 20 percent power. Until they meet the 6-week requirement, these engineers can function only as advisors in the control room.

According to the Chairman of the DOE Advisory Committee, the qualifications of the SRS Control Room Supervisors at the time of restart would not satisfy NRC standards. He said the Control Room Supervisor should possess both the operating experience and the knowledge in reactor fundamentals needed to independently reach informed judgments on how to respond to an emergency situation. The Control Room Supervisor should not have to rely on an advisor—the Shift Technical Engineer—to provide technical knowledge.

Additional Training Would Impact P and L Reactors' Restart Schedule

According to the project office's Acting Director, if SRS Control Room Supervisors were required to meet INPO guidelines on reactor fundamentals training before restart, it would be possible to meet this requirement for K reactor without much impact on the K reactor restart date. However, such a requirement could not be met for P and L reactors without a significant impact on their restart schedules.

Of the 46 operators whom Westinghouse will consider qualified as Control Room Supervisors at restart, only 10 are degreed engineers with the knowledge of mathematics and physics that would be needed to complete all INPO-recommended training in reactor fundamentals before restart of K reactor. However, these 10 degreed operators presently are

[6]The INPO guidelines for commercial reactor operators call for a total of 650 hours of training in reactor fundamentals, but the curriculum has been adjusted by Westinghouse because the SRS reactors do not have turbines and do not produce electricity. Thus, Westinghouse maintains that 584 hours of training would provide training comparable to that recommended by INPO.

assigned to operating crews for the P, L, and K reactors. If all 10 were assigned to the K reactor operating crews, the P and L crews would be left without any Control Room Supervisors who could complete the INPO-recommended fundamentals training in time to meet the P and L restart schedules.

According to the Acting Director, if SRS Control Room Supervisors were required to meet INPO guidelines on reactor fundamentals training before restart, then the 10 degreed Control Room Supervisors would have to spend a significant additional portion of their time between now and restart in the classroom rather than in the reactor control room. According to the Acting Director, the benefits to be gained by spending this time in the control room are far greater than the benefits that would come from spending it in the classroom. He said that important pre-restart tests require control room crew participation and that it is important that these 10 degreed Control Room Supervisors be present because of their knowledge and because of their need to gain important hands-on experience. Furthermore, according to the Acting Director, the additional time spent in the classroom would hinder the development of the reactor control room teamwork that is needed for safe restart. The Acting Director's comments assume that restart activities would not be delayed to allow these Control Room Supervisors to spend additional time in the classroom and to be in the control room to participate in all restart activities.

According to the project office's Acting Director, Westinghouse has hired 44 degreed engineers to train as Control Room Supervisors, and by July 1990, these 44 engineers' knowledge of reactor fundamentals will be comparable with INPO standards. However, they cannot serve as Control Room Supervisors until they complete 6 weeks of actual experience with the reactor operating at greater than 20 percent power. Seventeen of the 44 have prior experience operating either commercial or naval reactors. In addition, according to the Acting Director, 11 former commercial or naval reactor operators, who are not degreed engineers, will complete training in July. These personnel will also possess the required fundamentals but will lack 6 weeks actual operating experience in SRS reactors.

Westinghouse's overall training program for reactor operations personnel does not meet commercial industry standards. (INPO reviews and accredits commercial industry training programs.) Westinghouse plans to have a training program that meets INPO's accreditation standards by 1992 (DOE has established a board to accredit the training programs)

with all personnel trained by 1995. Westinghouse has brought in about 30 training instructors and managers from other Westinghouse locations to support the upgrading effort.

Technical Specifications Could Impact Restart Schedule

An overall upgrade of the SRS technical specifications is underway to bring them up to the level required by NRC for commercial nuclear plants. For restart, DOE is requiring that Westinghouse rewrite and validate the technical bases for 11 technical specifications. At least 2 of the 11 have outstanding issues that could result in delays in the reactor operator training program—which in turn would delay restart.

A key tenet of safe operation of nuclear plants is that plants have to be operated within a well-defined envelope of safety. This envelope of safe operation is defined by the plant's technical specifications. Technical specifications formally document requirements related to safety limits, limiting conditions for operation, surveillance requirements, design features, and administrative controls.

For restart, DOE is requiring that Westinghouse rewrite and validate the bases for 11 technical specifications. Of the 11 to be rewritten and validated, DOE identified 10 in late 1988, and the DOE Project Office Director added 1 more in September 1989. All 10 identified in late 1988 have been rewritten and released by DOE for incorporation into the reactor operator training program; however, DOE has not given its final approval to any of the 10 technical specifications. Two of the 10 have some unresolved technical issues that could ultimately require changes in the reactor operator training program, which could delay restart. These two technical specifications relate to Process Water System leakage and detection.

Seismic Upgrading Still Being Discussed

According to Westinghouse's Reactor Operations Management Plan, two major systems for mitigating SRS reactor accidents—the emergency cooling system and the airborne activity confinement system—are not to be seismically upgraded before restart but will be upgraded in the longer term. However, the DOE Advisory Committee, before its oversight of reactor restart ended, raised questions about whether these systems should be upgraded prior to restart. DOE and Westinghouse are analyzing the Advisory Committee's concerns, and if a decision is made to upgrade one or both of those systems now, the restart schedule would be delayed. Furthermore, the new Safety Board is also reviewing seismic

issues, raising the possibility that additional seismic concerns could be surfaced.

According to Westinghouse, the seismic upgrades being made before restart will ensure that the reactors can be shut down safely and that core cooling can be maintained for at least 72 hours following a design basis earthquake—an earthquake of 0.2-g ground acceleration or about 6 on the Richter Scale.[7] The purpose of the emergency cooling system is to provide cooling water to prevent a fuel melting incident if the primary cooling system fails. The airborne activity confinement system is designed to filter a release of radioactive fission products in the event of a fuel melting incident. There is uncertainty whether these accident mitigation systems could still function after a design basis earthquake. Specifically, electrical power to the emergency cooling system could be disrupted, and the confinement system filters could become displaced, allowing radioactive fission products to escape into the atmosphere.

Westinghouse, however, contends that neither the emergency cooling system nor the confinement system needs to be seismically qualified before restart. Because the systems essential for safe reactor shutdown will be seismically qualified, Westinghouse concludes that these systems will not fail in the event of a design basis earthquake.[8] Therefore, Westinghouse further concludes that—because the essential shutdown systems would not fail—the reactor can be shut down before any fuel melting could occur. As a result, since the emergency cooling system and confinement system are only needed in the event of fuel melting, the disabling of these systems due to an earthquake is considered acceptable. However, Westinghouse does plan to seismically qualify both systems in the long-term seismic program to be completed after restart.

The DOE Advisory Committee told the Secretary in October 1989 that the decision not to seismically qualify the emergency cooling system and confinement system before restart needed to be reevaluated. The Committee stated that this reevaluation should be done in light of the results

[7]An earthquake of 0.2-g is the maximum earthquake force that the SRS reactors are to be designed to successfully withstand. This maximum survivable earthquake is termed the design basis earthquake for the SRS reactors.

[8]The systems considered essential for safe shutdown are the primary process water system, the secondary cooling water system, the supplementary shutdown system, and the core monitoring system.

of the recently completed level 1 Probabilistic Risk Assessment (PRA).[9] According to the Advisory Committee chairman, the level 1 PRA results may be sufficient to make a final decision on seismic qualification, but it is possible that results of levels 2 and 3 may be needed to make the final decision. At present, the Defense Nuclear Facilities Safety Board is reviewing the PRA and seismic issues. According to the DOE Project Office Acting Director, if either the emergency cooling system or the confinement system filters had to be seismically qualified before restart, restart likely would be delayed.

Potential Environmental Constraints

Environmental issues that are still to be resolved also pose possible delays in the reactor restart schedule. If any significant environmental issues are identified in the environmental impact statement (EIS) presently being prepared by DOE, public interest groups could use such issues to seek an injunction against restart. Also, the reactor restart date could be delayed if DOE is required to build a cooling tower for the K reactor before restart is allowed.

In December 1988, public interest groups filed a lawsuit against DOE in federal court. The lawsuit contends that under the requirements of the National Environmental Policy Act (NEPA), DOE must prepare a new EIS before restarting the reactors. Under NEPA, major federal actions require an EIS. According to the lawsuit, restarting the reactors will constitute a major federal action because the reactors will have been shut down more than 1 year, will have undergone substantial renovations, and will continue to present outstanding environmental and safety questions. DOE maintains that the reactors have been in an "operating outage" status, not a shutdown status; therefore, an EIS is not required for restart.

Despite this contention, DOE began working on an EIS in early 1989 and subsequently announced it would be completed before restart. According to the Savannah River Project Office's weekly report dated March 26, 1990, the draft EIS should be issued for public comment by April 13, 1990. The best estimate for final completion of the EIS is between September 21 and October 5, 1990. According to the weekly report, there are two major unknowns that could delay the schedule for completing the EIS. First, the nature and scope of public comments could result in a time-consuming effort to address them, and second, reviews by the

[9]A PRA is usually done on three levels of scope, one building on the other. The levels are (1) analysis of plant design and operation, (2) examination of the physical processes of an accident and their effect on the reactor systems, and (3) analysis of the movement of radiation after an accident and its effect on public health.

Environmental Protection Agency (EPA) and the state of South Carolina could require more time than the schedule currently allows. Given these considerations, it appears very likely that the EIS process will not permit the K reactor to restart in September 1990, as currently proposed by Westinghouse.

In addition, the EIS could impact restart if it raises any issues that public interest groups could use to seek an injunction against restart of the reactors. Such issues could be raised on a number of fronts because the coverage of the EIS will be very broad. According to DOE's draft implementation plan, the EIS will address routine reactor operation, outages, design basis accidents, and the results of PRA analyses of severe accidents and related onsite personnel hazards. Among other technical issues, the EIS will address seismic risk, adequacy of the confinement system, adequacy of training, ultrasonic inspection of reactor vessels, and fire protection. The EIS also will analyze other issues such as water resources, air quality, wildlife areas, aquatic species, and waste management.

Another source of potential restart delay is the Clean Water Act. As described in a recent GAO report, under the Clean Water Act, the state of South Carolina issues the National Pollutant Discharge Elimination System (NPDES) permit for SRS.[10] Due to the restrictions on discharges of hot water from the reactors into onsite streams and wetlands, DOE and the state entered into a consent order in 1984, requiring that DOE build a cooling tower for the K reactor by the end of 1992, more than 2 years after the planned restart date. The consent order allows DOE to operate K reactor between now and the end of 1992 without a cooling tower but not thereafter. Although the NPDES permit expired in December 1988, renewal of the permit is expected during calendar year 1990. However, on March 22, 1990, two public interest groups—the Natural Resources Defense Council and the Energy Research Foundation—notified the Secretary of their intent to sue DOE to prevent the operation of K reactor before the cooling tower is completed. These groups stated that K reactor should not be operated without a cooling tower unless the President exempts the K reactor from Clean Water Act requirements on the basis of national security needs.

A lawsuit to prevent the operation of K reactor without a cooling tower could also be based on the environmental antidegradation policies of EPA

[10]Nuclear Health and Safety: Policy Implications of Funding DOE's K Reactor Cooling Tower Project (GAO/RCED-89-212, Sept. 27, 1989).

and the state. Following the shutdown of K reactor in April 1988, the vegetation in the stream system affected by K reactor's hot water discharges began recovering, and a viable aquatic system has been established. Restarting K reactor without a cooling tower would destroy the recovery made during the approximate 2.5-year shutdown.

DOE maintains that the antidegradation policies of EPA and the state would not apply to K reactor because the outage is for utility upgrades and no change in stream use has occurred. However, DOE officials recognize that the antidegradation policies could provide a basis for legal challenges that could postpone restart of K reactor until the cooling tower is completed.

Clean Water Act restrictions could also affect the restart dates of P and L reactors. South Carolina's environmental regulations implementing the act prohibit the fish kills caused by L and P reactors' hot water discharges. During outages, fish reenter the areas affected by the discharges, and when the reactors restart, the discharges sometimes kill large numbers of fish the size of fingerlings or smaller. DOE maintains the impact on the fish population is minimal.

State officials have told DOE that the fish kills must be eliminated to receive an NPDES permit. DOE has informed South Carolina that this would require constructing cooling towers and has taken the position that as long as a balanced biological community is maintained, the fish kills do not violate the Clean Water Act. DOE has submitted a preliminary list of options to reduce the fish kills—such as modifying the cooling lakes—but the state rejected the preliminary list. DOE is evaluating other possible options. However, even if the state agrees to one of DOE's options, public interest groups could file lawsuits challenging any operation of the reactors without cooling towers.

Safety Culture Changes Needed

Safe operation of a nuclear reactor requires a very disciplined and focused attitude toward safety. Both DOE and Westinghouse have recognized that the safety philosophy at SRS needs improvement. While we found a number of examples of a continuing complacent attitude toward safety among contractor employees, we recognize that fully achieving the desired change in attitudes will take time—even beyond the time of restart.

Positive steps have been taken to improve the safety attitude, and Westinghouse, with input from DOE, has prepared a management policy statement outlining a strategy for changing the reactor operations safety culture. However, DOE has not required that Westinghouse prepare an implementation plan with specific tasks and milestones for achieving the culture change objectives. Such a plan would provide a clear focus on exactly how the problem is being addressed, and by pulling together all the needed actions in one document, emphasize to SRS employees the importance DOE and Westinghouse place on safety culture change. Further, the plan would demonstrate the close link a good safety attitude has with all activities and changes being made at SRS. Such an implementation plan needs to contain measurement indicators that will provide a continuing basis for gauging the effectiveness of cultural change initiatives at Savannah River.

Further, DOE personnel and contractors at other DOE locations also have problems with safety attitude, and while actions are underway or planned, there is no comprehensive plan that would lay out these activities or measurement indicators to help DOE assess whether attitudes are changing.

Safety Culture in the Commercial Nuclear Industry

Over the years—especially after the Three Mile Island nuclear accident—the operating practices and procedures in commercial nuclear plants have evolved into a way of doing business sometimes referred to as "safety culture." The nuclear industry recognizes that the safe operation of nuclear reactors requires a special mindset and attitude toward nuclear safety. Although DOE is not regulated by NRC which regulates the commercial nuclear industry, it has adopted the regulations that relate to its facilities and NRC's overall philosophy towards safety.

The importance NRC places on safety culture can be demonstrated in its order in 1987 to shut down the Philadelphia Electric Company's Peach Bottom Atomic Power Station. It was found that a root cause of the problems at Peach Bottom was the failure of management and operating

personnel to adapt over the years to changing nuclear requirements. In other words, the safety culture at Peach Bottom had not kept pace with the rest of the industry. Because of the importance of the safety culture problems, NRC required Philadelphia Electric to include an extensive corrective action plan for changing the safety culture as part of its restart plan.

As defined by NRC, nuclear safety culture is a prevailing condition in which each employee is always focused on improving safety, is aware of what can go wrong, feels personally accountable for safe operation, and takes pride and "ownership" in the plant. Safety culture is a disciplined, crisp approach to operations by a highly trained staff who are confident but not complacent, follow good procedures, and practice good teamwork and effective communications. Safety culture is an insistence on a sound technical basis for actions and a rigorous self-assessment of problems.

SRS Safety Culture Problems

The P reactor start-up incident in August 1988 pointed to, among other things, problems with the safety culture at SRS. We found that Westinghouse has taken some steps to change the culture, including upgrading training and bringing some new employees to SRS with experience working in commercial and Navy nuclear facilities that have a strong safety emphasis.

In the September 1988 hearings on the P reactor startup incident, we pointed out that the reactor operating staff continued the start-up process even though unexplained anomalies were occurring. The DOE Advisory Committee told the Secretary in December 1988 that the P reactor event had revealed "very poor operating practices" and raised a concern about the "lack of vigilant safety awareness." The Advisory Committee commented that bringing about changes in attitudes was critical to a sound program for restarting the reactors. According to the Acting Director of DOE's Office of Reactor Restart, the safety culture problems in SRS reactor operations developed because the personnel at SRS for many years did not keep up with evolving commercial nuclear requirements and practices. In an update of its views concerning reactor restart, the Advisory Committee told the Secretary in October 1989 that continuing procedural errors and reporting problems indicated that an emphasis on safety of operations was not yet pervasive at Savannah River.

In our review, we found several examples that demonstrate the continuing effects of the old culture. For example, according to the DOE project office staff member responsible for oversight of maintenance activities, Westinghouse's first-line maintenance supervisors should regularly make unannounced visits to job sites to observe maintenance personnel performing assigned tasks. Announced visits establish an artificial environment where a supervisor cannot obtain the best information on how well procedures are being followed and the work is being done. The DOE staff member found, however, that some supervisors did not visit jobs in progress, because they fear that maintenance personnel will think they are spying on them or because they believe such visits are unnecessary because maintenance personnel know what they are doing.

In addition, in September 1989 Westinghouse personnel found that someone had tampered with and disabled a safety alarm in the P reactor because it was annoying. The purpose of the alarm is to alert reactor operations personnel if the pumps malfunction that circulate process water for reactor cooling. During the course of a DOE investigation, the individual directly responsible for the incident identified himself and voluntarily resigned from Westinghouse. However, as outlined in the investigation report, this did not ensure resolution of the incident. The DOE investigative team found reluctance and unwillingness on the part of some Westinghouse employees to provide information associated with the incident either to their supervisor and management or to the investigative team. The team concluded, on the basis of statements by the individual who silenced the alarm, that about five other plant personnel had knowledge of the tampering incident. The team also observed weaknesses in the technical knowledge and training of plant staff and significant weaknesses in plant staff attitudes toward safety alarms. From interviews with plant personnel, the team found an attitude that the silenced alarm was not important, but rather a "nuisance" alarm. The team found that many personnel responsible for responding to alarms "do not pursue the reason for the alarm as much as they try to silence the alarm."

Furthermore, in September 1989 the DOE project office reviewed an assessment of corrective actions taken by Westinghouse following four recent reactor incidents.[1] The project office reported that during its

[1]These four incidents involved thermal shield water overflow (part of a shield system that absorbs heat and protects against the escape of radiation), disassembly basin overflow (water basin used to cool irradiated assemblies), inadvertent start-up of a cooling water pump, and inadvertent draining of 2 feet of water from the reactor vessel.

review of these incidents some Westinghouse managers claimed the failure to comply with procedures was "defensible" and "insignificant." This attitude toward noncompliance with procedures exemplifies the need for a change in the safety culture.

On the basis of its assessment of the corrective actions taken after these four incidents, the project office concluded that Westinghouse had not implemented effective measures to prevent recurrence of the incidents by failing to provide (1) clear written guidance, (2) specific solutions to problems, and (3) continuing diligent oversight to ensure that policies were being enforced. This demonstrates that management must ensure not only that new procedures are written effectively, but also that there is systematic followup to ensure that new procedures are being implemented.

Another recent incident highlighted how good communication is essential to improving the safety culture. In this case, Westinghouse determined that existing controls on weld rods—metal weld material—were inadequate, opening the possibility that maintenance personnel could use improper material to make welds on safety-related equipment. According to DOE's project office, Westinghouse developed informal verbal restrictions to prevent maintenance personnel from making any welds on systems related to safety. These restrictions were to take effect on July 1, 1989.

However, DOE project office personnel discovered in October 1989 that maintenance supervisors and craftsmen were unaware of any welding restrictions. According to the project office, the failure to communicate the restriction on welding to the maintenance supervisors and craftsmen resulted because the verbal restriction was not followed up with formal documentation. A stop work order was issued on October 5, 1989, prohibiting maintenance personnel from welding on any reactor safety system.

Culture Change Is Underway

DOE and Westinghouse both recognize that the safety culture still requires more change and that such a change cannot be achieved overnight. We believe positive steps are being taken to change the reactor operations safety culture. However, as the Advisory Committee told the Secretary in late October 1989, the inability or unwillingness of persons from the old culture to accept the need for change could undermine the effectiveness of operational improvements.

In January 1990, Westinghouse, with input from DOE project office personnel, prepared a management policy statement referred to as a "White Paper," outlining a strategy for changing the safety culture in reactor operations. It described the culture change activities already being implemented as part of the June 1989 Reactor Operations Management Plan, as well as other initiatives that were implemented or planned for implementation after issuance of the management plan. Efforts currently underway include upgrading of the training and procedures as outlined in the management plan. Westinghouse's efforts also include other activities such as bringing in new people who have worked in the type of safety culture environment that is needed at SRS.

For example, on November 10, 1989, Westinghouse announced major personnel changes, which placed individuals with commercial nuclear industry experience in key reactor management positions. A primary objective was to strengthen the sense of plant ownership—a key ingredient in the NRC's definition of safety culture. These changes included the establishment of a Station Manager responsible for the day-to-day operations and facilities of K, L, and P reactor plants, with the Plant Managers reporting to him. The reorganization also replaced the P and K reactor Plant Managers, replaced the L reactor Assistant Plant Manager, and replaced the Training and Procedures Manager. According to Westinghouse, all of these positions were filled by personnel with extensive commercial nuclear experience.

Safety culture change at SRS will also entail a fundamental change in the way reactor operations personnel have operated in the past. For example, the philosophy of the former contractor, DuPont, was that reactor operators should follow procedures in a rote fashion. This contrasts with the philosophy of the commercial industry, which is that while operators should follow procedure, they should also rely on training-based judgments. Both DOE and Westinghouse want the commercial industry philosophy to become the one used at SRS.

Westinghouse's White Paper is a good first step, but more needs to be done. DOE does plan to evaluate the status of safety culture—and Westinghouse's commitment to it—at the time of restart. However, DOE's criteria for evaluating safety culture do not require that Westinghouse prepare an implementation plan. Without such a plan, we believe it will be difficult for DOE to ensure that all needed actions are being taken and accomplished in a timely way. A comprehensive implementation plan would identify the specific tasks contributing to the needed change in safety culture, milestones for their accomplishment, and measurement

indicators, which will provide a continuing basis for assessing the effectiveness of the cultural change initiatives. Further, the Director of the Office of Reactor Restart at DOE headquarters told us that while he reviewed the White Paper, he saw no need for DOE to approve it. We believe that DOE's review and approval would ensure that an implementation plan is comprehensive and contains indicators to measure whether the safety culture initiatives are effective.

Safety Culture as an Award Fee Consideration

Once Westinghouse develops a formal implementation plan for improving the safety culture, DOE could use the plan, along with other factors, to establish criteria for determining the amount of the award fee that Westinghouse should receive for its performance in ensuring safe reactor operations at SRS. Similar to contracts for the operation of other DOE facilities, the contract for operating SRS makes Westinghouse eligible for an award fee. DOE uses award fees to encourage contractors to work effectively and improve the quality of performance.

DOE evaluates Westinghouse's performance over a 6-month period to determine whether the contractor should receive an award fee. An award fee would be in addition to reimbursements of the contractor's costs and base fees, if any, provided for in the contract. The evaluation period in effect at the time of our review was to end on March 31, 1990, with the next evaluation period covering April through October 1990.

According to the SRS Award Fee Determination Plan, Westinghouse is eligible to earn an award fee for achieving specified goals in certain special performance areas. One area is the safety and quality of reactor operations, which focuses on the quality and timely completion of training and emergency preparedness measures used to strengthen safety of operations and other measures used to strengthen fire protection, health physics, and internal oversight.

Each special performance area is evaluated by a DOE performance evaluation committee. The chairman of the committee that evaluates the safety and quality of reactor operations said that a comprehensive plan for implementing the safety culture change could assist his committee in evaluating Westinghouse's safety performance.

Safety Culture Changes May Be Needed by DOE Employees and Other Contractors

Problems with safety culture are not limited to the Savannah River Site. GAO and other groups, such as the National Academy of Sciences and DOE's Advisory Committee on Nuclear Facility Safety, have described a complacent attitude toward safety not only by employees at Savannah River, but also by DOE personnel in general and contractors at other locations. We, for example, have identified a number of safety problems at DOE facilities and have described a DOE management structure that emphasizes production over safety and relies heavily on contractor judgments about safety. This attitude has contributed to the numerous safety problems being raised at most of DOE's nuclear facilities, which in the case of Rocky Flats in Colorado has led to its continued shutdown.

DOE is trying to instill a new attitude throughout DOE and its contractors toward safe operations of DOE's nuclear facilities. To begin to change the culture within its own organization, DOE is taking actions such as hiring more technical staff with commercial industry backgrounds and starting to reorganize its management structure. However, as we pointed out in our January 30, 1990, report on DOE's reorganization of its safety management function, it may be difficult to hire the technical staff DOE needs, and the reorganization is not being put into place in a timely way.

Another Secretary of Energy initiative directed, in part, at culture change is the Tiger Teams. These teams are special task forces composed of DOE employees that assess a facility's performance in the environmental, safety, and health (ES&H) areas. In February 1990, DOE released a preliminary analysis of trends in its Tiger Team assessments.[2] Some of the overall concerns were that 50 percent of the facilities lack sufficient oversight by DOE operations offices or area offices responsible for contractor activities and 50 percent of the facilities did not know ES&H authorities and responsibilities and did not have an adequate ES&H program. Further, the press release describing the assessments stated that

"67 percent of the facilities had problems communicating ES&H policy and objectives to all levels of the organization, which has resulted in a lack of or slowness of culture change."

The press release stated more broadly that "The preliminary analysis of the results of the assessments indicates trends which may prove endemic to DOE facilities."

[2]This analysis was based on assessments at Rocky Flats Plant in Colorado, Feed Materials Production Center in Ohio, West Valley Demonstration Project in New York, Y-12 Plant in Tennessee, Pantex Plant in Texas, and Mound Plant in Ohio.

The Secretary of Energy has acknowledged that DOE staff need to change their attitude toward safety, and the Tiger Team assessments demonstrate that there is still work to be done. According to the Under Secretary of Energy, DOE will not be able to competently manage its facilities unless such a change in attitude is accomplished. However, while there are many activities ongoing as a result of the Tiger Team assessments and other initiatives relating to changing safety culture, there is no specific plan that describes the various efforts in a comprehensive strategy for instilling attitude change throughout DOE, nor measurement indicators to provide a basis for DOE to judge whether attitudes are changing.

SRS Reactor Operations Budget, Fiscal Years 1989-91

Dollars in millions				
Reactor budget	**1989**	**1990**	**1991**	**Total[a]**
Operating costs				
Westinghouse reactor restart	$357.2	$531.6	$652.6	**$1,541.4**
Raw materials	65.0	76.0	80.5	**221.5**
Savannah River—DOE	40.9	28.1	31.0	**100.0**
Subtotal	**463.1**	**635.7**	**764.1**	**1,862.9**
Capital equipment	12.2	15.5	15.0	**42.7**
General plant projects	3.2	6.6	6.7	**16.5**
Construction line items	35.3	36.3	125.9	**197.5**
Total	**$513.8**	**$694.1**	**$911.7**	**$2,119.6**

[a]These costs do not include reactor safety improvement projects that will be implemented after restart as part of a long-term program to be completed in the late 1990s For example, Factory Mutual and Professional Loss Control told DOE in 1986 that fire protection needed significant improvement. Limited improvements are being made before restart, but DOE plans to spend an additional $115 million on fire protection improvements that are to be completed in 1996 According to Westinghouse's restart plan, new authorizations for such projects through fiscal year 1992 will amount to $638 million. Line item projects include reactor spray systems, replacement of the flood control pumps, emergency diesel generator replacement and upgrades, and a charge/discharge machine training simulator.

As provided by the Savannah River Restart Special Projects Office, the costs for fiscal year 1989 are actual. The costs for fiscal years 1990 and 1991 are preliminary budget estimates.

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