

AUDIT  
REPORT

PROGRESS OF THE SPALLATION  
NEUTRON SOURCE PROJECT



NOVEMBER 2001

U.S. DEPARTMENT OF ENERGY  
OFFICE OF INSPECTOR GENERAL  
OFFICE OF AUDIT SERVICES



**DEPARTMENT OF ENERGY**  
Washington, DC 20585

November 19, 2001

MEMORANDUM FOR THE SECRETARY

FROM: Gregory H. Friedman (Signed)  
Inspector General

SUBJECT: INFORMATION: Audit Report on "Progress of the Spallation  
Neutron Source Project"

BACKGROUND

When completed, the Spallation Neutron Source (SNS) will be the world's foremost neutron-scattering facility. It will be an important scientific tool for basic research in materials science, life sciences, chemistry, solid state and nuclear physics, earth and environmental sciences, and engineering sciences. Approximately 1,000 to 2,000 users are expected to conduct research at the SNS facility each year. The facility is being built in Oak Ridge, Tennessee, as a partnership among six of the Department of Energy's national laboratories. The \$1.4 billion project, currently under construction, is scheduled for completion in June 2006.

Historically, schedule delays, cost overruns, and other management problems have plagued the Department's projects. Since the early 1990s, the Office of Inspector General has issued many reports critical of the Department's project management practices. To its credit, the Department recently began a series of project management reforms to address some of its long-standing problems. For example, to increase corporate oversight of the Department's projects, the Office of Engineering and Construction Management and project management support offices were established for the Office of Science, the Office of Defense Programs, and the Office of Environmental Management. Additionally, the Department established a new project management tracking and control system, a Chief Operating Officer's "Watch List" for troubled projects, and a new project management organization within the Office of Management, Budget and Evaluation. The Department's emphasis on project management was highlighted in a September 19, 2001, memorandum on this subject from the Deputy Secretary to the heads of headquarters elements. While we are encouraged by these steps, we believe that project management remains one of the Department's key challenges.

The objective of this audit was to determine whether the SNS Project was within technical scope, cost, and schedule.

RESULTS OF AUDIT

We determined that the SNS Project's technical scope was reduced to allow the cost and schedule components to be met. Contrary to original commitments, in June 2006, the anticipated completion date, the SNS Project will not:

- Have instruments to address all of the initially planned areas of science;
- Provide complete user facilities; and,
- Possess critical spare parts and equipment.

#### MANAGEMENT REACTION

The Office of Science disagreed with the audit finding and recommendations, and requested that the Office of Inspector General include its comments verbatim. We have done so, and also included our response to those comments, which may be found on pages 16 to 33.

It is important to emphasize that the Office of Inspector General recognizes the value of this facility to the Department and to the science community. We agree that once completed, as initially promised, the SNS may well be the best facility of its kind in the world. However, our concern is that as a result of the scope reductions made to the project at this stage, the facility will not deliver all of the intended leading-edge user facilities and capabilities nor cover all areas of science anticipated to meet the needs of the scientific community.

We also believe that the status of the SNS Project should be transparent to all interested parties. Specifically, the current Project Data Sheet, used to keep the Congress informed, should more realistically reflect the current plan for the project. As stated in the audit report, the Project Data Sheet does not include information that we believe to be critically important, such as the fact that only five of ten instruments originally planned are currently funded, and only three will be installed by June 2006. Nor does it state that operating funds will be used to install the other two instruments in lieu of project funds. Finally, the Project Data Sheet is substantively inconsistent with the Office of Science's own SNS report, which states that the instruments will be barely acceptable for user operation and will span many, but not all, of the scientific areas originally addressed.

Attachment

cc: Deputy Secretary  
Under Secretary for Energy, Science and Environment  
Acting Director, Office of Science  
Office of Management, Budget and Evaluation/CFO  
Principal Deputy Director, Office of Engineering and Construction Management

# PROGRESS OF THE SPALLATION NEUTRON SOURCE PROJECT

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# OVERVIEW

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## INTRODUCTION AND OBJECTIVE

The purpose of the Spallation Neutron Source (SNS) Project is to provide a next-generation spallation neutron source for neutron scattering and related research in broad areas of physical, chemical, materials, biological, and medical sciences. The \$1.4 billion project, currently under construction, was about 22 percent complete as of May 2001. The construction phase is scheduled for completion in June 2006. At that point, the research operations phase will begin with approximately two years of commissioning activities, which will include ramping up the intensity of the beam and testing the reliability of the research instruments. The annual post-construction operations budget is estimated at \$150 million for the next 40 years. Approximately 1,000 to 2,000 users are expected to conduct research at the SNS facility each year. Fiscal Year 2001 funding for the project was about \$278 million.

The SNS Project is being carried out as a multi-laboratory partnership, led by the SNS Project Office in Oak Ridge, Tennessee. A total of six Department laboratories are involved in various aspects of the SNS Project's design and construction. Oak Ridge National Laboratory (ORNL) is responsible for the design and construction of the liquid mercury target as well as for managing the overall project. Lawrence Berkeley National Laboratory is responsible for the front-end system, which includes an ion source, beam formation and control hardware, and low-energy beam transport and acceleration systems. Los Alamos National Laboratory is responsible for the linear accelerator, which continues the ion beam acceleration. Thomas Jefferson National Accelerator Facility is responsible for the superconducting cavities, which provide the remainder of the beam acceleration. Brookhaven National Laboratory is responsible for the accumulator ring structure, which bunches and intensifies the ion beam for delivery onto the mercury target to produce the neutron beams. Finally, Argonne National Laboratory is responsible for developing the neutron-scattering instrumentation and for working closely with ORNL to develop the experiment facilities.

In October 2000, the Department's Office of Science conducted its semi-annual review of the SNS Project's performance. The results of the review, issued in February 2001, stated that the architect engineer's initial Title I cost estimate of \$380 million for conventional facilities exceeded the baseline by approximately \$80 million. Conventional facilities include user facilities such as offices, laboratories, an auditorium, the cafeteria, and workshops that are required for the

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operation of the SNS facility. In addition, the potential uses of the SNS Project's contingency fund were much greater than originally estimated. Accordingly, SNS Project management was challenged to identify cost reduction measures to address these issues. The actions SNS Project management developed to address the potential cost growth led to our audit.

The objective of this audit was to determine whether the SNS Project was within technical scope, cost, and schedule.

## **CONCLUSIONS AND OBSERVATIONS**

The SNS Project's technical scope was reduced to allow the cost and schedule components to be met. Specifically, the July 2001 baseline did not provide for instruments to address the initially planned areas of science, complete user facilities, and critical spare parts to be available at the end of the construction project. This condition existed because the Department decided to meet the approved budget rather than ask Congress for additional funding. As a result of the scope reductions made to the project at this early stage, the SNS facility will not provide all of the intended leading-edge user facilities and capabilities to meet the needs of the scientific community at the end of the construction project. Also, the reliability of the SNS facility could be jeopardized.

The Office of Inspector General (OIG) recognizes that when completed as initially planned, the SNS may well be the best facility of its kind in the world. However, our concern is that as a result of the scope reductions made to date, it will not deliver all of the intended leading-edge user facilities and capabilities.

The current audit identified issues that management should consider when preparing its yearend assurance memorandum on internal controls.

Signed  
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Office of Inspector General

## TECHNICAL SCOPE REDUCTIONS

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### Technical Scope Was Reduced to Meet Cost and Schedule

The SNS Project's technical scope was reduced to allow the cost and schedule components to be met. Specifically, the project was not on track to provide instruments to address the initially planned areas of science, complete user facilities, and critical spare parts in June 2006.

#### Instruments

The instruments currently funded by the SNS Project will not address all of the initially planned areas of science, which were anticipated to be the most important for the facility. Specifically, the SNS Project has not funded any instruments for higher-energy dynamical studies. Instead, the Department plans to rely on groups external to the project to cover this area of science. According to Department officials, the instruments provided by the external groups will be funded through grants awarded by the Department's Office of Basic Energy Sciences to Pennsylvania State University and California Institute of Technology. Finally, the instruments funded by the SNS Project will not optimally address the following areas of science: atomic structures of single-crystal samples; internal stress and texture in engineering samples; and atomic-scale structures in liquids and amorphous materials.

Further, the initial suite of ten planned instruments will not be in place by June 2006. In fact, only five of the ten instruments have been funded, and only three of the five instruments are planned for complete installation by June 2006. Also, the three instruments that will be installed will lack certain capabilities because management decided to defer the procurement of analyzer crystals, detectors, and polarizing optics to the operations phase of the project. The Office of Science's May 2001 reviewers stated that "in their present configuration, these instruments will be barely acceptable for user operation."

In response to our draft report, management contended that the currently baselined instruments would be fully functional with performance that greatly exceeds that expected at the time the project was first approved. Specifically, management stated that the baselined instruments had been benchmarked against the best in the world. Management also contended that the initial suite of ten instruments was always described as a reference suite of instruments with the explicit statement that the final instrument selection would be made through consultation with the scientific community based on recommendations from expert advisory committees. Initially, this was reflected in the Project Data Sheet, sent to Congress to request funding, with the statement that the project would provide "approximately 10 instruments." The most recent Project Data Sheet, which has been

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approved by both the House and the Senate, refers to "fewer than 10 instruments" to reflect management's decision to emphasize the quality of instruments over their quantity.

We recognize that the currently funded instruments may outperform those available at the time the project was first approved. However, project funding included the estimated costs to build an initial suite of ten instruments and the associated research and development to design state-of-the-art components. The quantity and types of instruments were documented in the *SNS Conceptual Design Report*, which was validated by the Office of Energy Research in June 1997, and was an integral part of the basis for baseline approval in December 1997. Until April 2001, the baseline required that an initial suite of ten instruments would be funded.

Also, management stated that the decision to install five high-performance instruments rather than an initial suite of ten was due to advice from the scientific community. Our review disclosed that, while management obtained input from the user community in selecting the five instruments to be provided, the decision to provide only five instruments was based on budgetary constraints—not advice from the scientific community. In fact, the Office of Science October 2000 and May 2001 reviews showed that, due to budget constraints, project requirements were revised to require only five instruments to be funded, three of which would be installed. Also, the Office of Science recommended that management find savings throughout the project to restore the full scientific scope of ten best-in-class instruments to the extent possible. Further, the reviews stated that until the instruments are upgraded, they would not be the best-in-class instruments that were promised, and would not cover all of the areas of science originally planned.

Finally, we believe that the current Project Data Sheet should more realistically reflect the current plan for the project. For example, in the Project Data Sheet, the Department states that fewer than ten instruments will be provided, and there will be "no sacrifice in scientific capability" as a result of fewer instruments. The Project Data Sheet does not include information which we believe to be critically important, such as that only five instruments are currently funded and only three will be installed by June 2006. Nor does it state that operations funds will be used to install the other two instruments in lieu of project funds. Further, the Project Data Sheet is substantively inconsistent with the Office of Science's own report



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which states that the instruments would be barely acceptable for user operation and will span many, but not all, of the scientific areas originally addressed.

### User Facilities

The Department also reduced or eliminated some of the user facilities from the SNS Project. For instance, the Central Laboratory and Office Building, which was designed to be the main user facility, has undergone significant scope reductions. The reductions included eliminating the fifth floor conference area and leaving the auditorium, gallery, cafeteria, and second floor laboratories unfinished. By June 2006, these facilities will be structurally complete, but they will not be functional. Project officials stated that the facilities would be "uninhabitable," lacking drywall, lighting, heating, and air conditioning.

In response to the draft report, management stated that while the Central Laboratory and Office Building provides for future inclusion of an auditorium and cafeteria space, which are desirable enhancements, those facilities are not requirements for the operation of the facility or its scientific program. Also, management stated that the SNS baseline for user facilities contains all of the technical scope required to support operation of the scientific user program associated with the initial instrument suite. However, according to the Central Laboratory and Office Building scope of work, the auditorium and cafeteria are necessary to operate the SNS facility. Additionally, the Office of Science's May 2001 review determined that the lack of those facilities might prove to be an "unacceptable loss of functionality." Finally, funding for laboratories and equipment associated with the ten initially planned instruments was included in the total project cost.

### Spare Parts and Equipment

Further, the Department eliminated some of the SNS Project's critical spare parts and equipment from the baseline. In fact, all spare parts for the target system were eliminated. Some of the spare parts were reported as presenting a high technical or schedule risk since they require long procurement lead-times. For example, it would take 12 months to replace the target's inner plug system. Several other parts would require procurement lead-times from three to six months. Additionally, equipment for a facility designed to maintain and repair the linear accelerator cryomodules was eliminated from the project's construction phase.

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Management stated that the decision to reduce the spare parts inventory was based on an assessment of risk, incorporating input from advisory and review committees. Also, management stated that elimination of the spare parts would have no impact on the reliability or budget for the operating facility. Finally, management stated that the facility for the maintenance of linear accelerator cryomodules is not required for reliable facility operation since the capabilities are available off-site.

We disagree with management's contention that the spare parts and equipment were removed from the baseline, based on a risk assessment, with no impact on the reliability or budget for the operating facility. According to the October 2000 Office of Science report, the spare parts and equipment were removed from the baseline to ensure that the project remained within the approved project cost. The reviewers recommended that the spare parts be purchased during the early stages of operations. Also, while capabilities for maintenance and repair of the linear accelerator cryomodules will be available off-site, the facility is required to operate with minimal downtime due to the short duration of user visits. The downtime will not be minimal if equipment has to be sent off-site for maintenance and repair. Further, Departmental policy states that an initial complement of spare parts is to be included in the total project cost, and facilities should be furnished to make them operable per their original intent.

**Baseline Defined the Technical Scope, Cost, and Schedule of the Project**

The *Project Execution Plan* defines the specific requirements that form the project baseline. The Department approved the SNS Project baseline in December 1997. The *SNS Conceptual Design Report*, which was part of the basis for baseline approval in December 1997, stated that project funding included the estimated cost to build an initial suite of ten instruments and the associated research and development to design state-of-the-art components. The ten initially planned instruments covered the areas and types of science anticipated to be the most important for neutron-scattering research experiments. The instruments were to be installed and ready for commissioning at the time the proton beam is turned on in June 2006. The *SNS Project Design Manual*, which was derived from the *SNS Conceptual Design Report*, listed additional user requirements such as offices, laboratories, conference rooms, an auditorium, and a cafeteria. Project requirements also include critical spare parts to ensure beam reliability and availability.

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Until April 2001, the SNS Project baseline stated that the Department would construct an accelerator-based neutron-scattering facility, capable of delivering at least one megawatt of proton beam power on target. The facility was to include an initial suite of ten state-of-the-art instruments. In addition, the Central Laboratory and Office Building was to provide the office, laboratory, conference, food service, and shop space necessary to operate the SNS facility.

The SNS Project baseline was revised in April 2001, due to budget constraints, to fund only five instruments, three of which would be installed by June 2006. Also, certain user facilities were eliminated or descoped. Finally, critical spare parts and maintenance and repair equipment were deleted from the baseline. To reflect these changes, management submitted a Project Data Sheet that stated fewer than ten instruments would be provided with "no sacrifice in scientific capability."

**Technical Scope Was Reduced Rather Than Ask For Additional Funding**

The SNS Project's technical scope was reduced to allow the cost and schedule components to be met. This occurred because the Department decided to meet the approved budget rather than ask Congress for additional funds. The Department could have adjusted the total project cost when it determined that the amounts estimated for instruments and user facilities were understated and enhancements were made for the project. Instead, the Department reduced the technical scope to provide fewer instruments, leave some of the user facilities unfinished, and eliminate spare parts.

Estimate for Instruments Was Understated

The Department did not adjust the total project cost to account for underestimates in instrument costs. The Department estimated in May 1997 that the initial ten instruments would cost about \$55 million, which includes costs for construction as well as research and development. A review of the estimate performed by the Department's Office of Energy Research in June 1997 determined that the instruments would cost an additional \$40 million. An internal assessment conducted in March 1999 also found that the instrument budget was too low and recommended increasing the budget by \$40 million. In response, the Department increased the instrument budget to about \$116 million in July 1999 by transferring funds from other areas of the project. Finally, in March 2001, the instrument budget was reduced to about \$79 million to make more

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funds available for the project's contingency fund. As a result, the technical scope of instruments to be installed in June 2006 was reduced to stay within the revised budget.

Management did not agree that the cost estimate for instruments was understated. Instead, management contended that the original estimate was overtaken by subsequent advances in instrument technology and an explicit decision to emphasize quality over mere quantity. We agree that the cost of state-of-the-art instruments increased significantly in recent years, and we recognize the difficulty in estimating future costs of technological advances. However, the reductions in the number of instruments and their capabilities were due to budget constraints—not an increase in overall quality.

#### Estimate for User Facilities Was Understated

Also, the Department did not adjust the total project cost to account for underestimates in the cost of user facilities. The June 1997 Office of Energy Research review determined that the amount of space planned for user facilities may be inadequate. In particular, concerns were raised about the amount of space available for offices, instrument storage, long-term laboratory projects, ancillary equipment development, off-line testing, and maintenance. In response, SNS Project management undertook a detailed study to identify the amounts and types of space required for potential users. This study resulted in approximately 100,000 square feet of space being added to the planned facility. However, project costs were not increased to account for the added space.

Management agreed that the initial provision for support space was underestimated. However, it stated that the increase in space was accomplished through more efficient and cost-effective execution of the project. Our review, on the other hand, showed that other areas of the project, particularly instruments and spare parts, were adversely affected.

#### Facility Enhancements Were Made With Contingency Funds

Further, the Department did not adjust the total project cost when the decision was made to enhance the SNS facility. For example, management decided to enhance the project by building a superconducting linear accelerator capable of achieving higher beam

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power and improving beam flexibility and reliability without requiring major additional funding at some point in the future. Additionally, the ring and the target system were modified to handle a higher energy source and improve their capabilities. These enhancements, totaling \$54.7 million, were funded from the project's contingency fund which, in turn, resulted in reductions in instrument capabilities, descope user facilities, and elimination of spare parts and equipment.

In October 2000, the Department's Office of Science determined that the SNS Project's contingency fund had been used faster than originally anticipated. Accordingly, SNS Project management was directed to maintain the balance of the contingency fund at an adequate level. The contingency fund at that point was 20 percent of the total estimated cost to complete the project. The Office of Science was concerned that if all pending project change requests were approved, the contingency fund would fall to a dangerously low level of less than 10 percent. Accordingly, SNS Project management made scope reductions throughout the project to generate additional contingency funds. These actions included reducing the instrument budget, deleting the Central Laboratory and Office Building in its entirety and then adding it back without essential functions, and removing all of the target system spare parts as well as the linear accelerator cryomodule repair equipment from the baseline. The Office of Science considers the contingency level of about 25 percent, as of April 2001, to be adequate. It should be noted, however, that this contingency level was obtained at the expense of the project's technical requirements.

SNS Project management stated that they plan to use the contingency fund to acquire additional instruments, finish the Central Laboratory and Office Building, and procure critical spare parts and equipment if the money is available at the end of the project. Otherwise, they plan to use operating funds to acquire the items after the June 2006 completion date. However, Departmental guidance states that contingency funds are not to be used as a "slush fund" and should not be used to avoid making an accurate assessment of expected costs. The contingency fund is supposed to be reserved for unforeseen and unpredictable conditions or uncertainties that may develop during the life of the project. In this case, management knew the total project cost was understated and decided to use the contingency fund rather than adjust the total project cost. We are concerned that this course of action could result in even greater reductions in the project's

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technical scope between now and June 2006, as more unforeseen and unpredictable conditions develop. Further, Federal regulations and Departmental guidance prohibit the use of post-construction operating funds to finish line item construction projects.

Management stated that delivering maximum scientific performance within the approved budget was consistent with its responsibility for stewardship of public funds. It also stated that using contingency funds for project enhancements was an accepted part of value engineering. Further, management reported that the technical performance of the accelerator, the scope of conventional facilities, and the performance of instruments had all been increased as a result of design improvements and cost savings.

We agree that management should deliver maximum scientific performance within the approved budget using techniques such as value engineering. However, our review showed that the enhancements and current contingency level were obtained at the expense of the project's technical requirements. Departmental guidance allows for adjusting the baseline for bona fide changes such as substantial increases in capabilities or functions. However, the total project cost was not adjusted to reflect the enhancements.

We understand the Department's concern over requesting additional money for this project. However, the justification for the SNS Project was based on the need for neutron-scattering experiments to be conducted in a leading-edge user facility. It now appears that the total cost for providing the complete facility will be greater than \$1.4 billion. The General Accounting Office's report on the *National Ignition Facility* (GAO/REC-00-141, August 2000), found that project management was aware that the National Ignition Facility (NIF) would cost more than planned, but did not fully inform Congress. We believe it is important for the Department to apply the lessons learned from the NIF to the SNS Project. Other related OIG and General Accounting Office reviews are presented in Appendix 2 of this report.

### **Delivery of Leading-Edge Facility Is Questionable**

As a result of the scope reductions made to the project at this early stage, the facility will not deliver all of the intended leading-edge user facilities and capabilities nor cover all areas of science anticipated to meet the needs of the scientific community at the end of the construction project. Specifically, the facility will not be equipped to perform some of the experiments originally planned because the instruments needed to perform the experiments will not

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be completed on time. Additionally, the reliability of the SNS facility could be jeopardized if one of the critical spare parts deleted from the project is needed to replace a part that fails, or if repairs are needed for the linear accelerator cryomodules and the equipment required to make the repairs is not available.

Management did not agree with our conclusion regarding delivery of a leading-edge facility. Specifically, management contended that the SNS facility was enhanced and would provide more science than originally planned. We recognize that certain aspects of the SNS Project are exceeding requirements; however, the upgrades were added at the expense of some of the intended deliverables such as instruments, completed user facilities, and critical spare parts and equipment.

Finally, deferring the installation of research instruments, completion of the Central Laboratory and Office Building, and procurement of spare parts to the operations phase in order to stay within \$1.4 billion would place a strain on the operations budget, and could violate Federal and Departmental restrictions on the use of appropriated funds. United States Code Title 31 Section 1301 states that appropriated funds can only be used for their originally intended purpose. Also, Department of Energy Guide 430.1-1 prohibits the use of post-construction operating funds to finish line item construction projects.

## **RECOMMENDATIONS**

We recommend that the Manager, Oak Ridge Operations Office:

1. Adjust the baseline for the SNS Project to reflect the total project cost for providing:
  - a. State-of-the-art instruments to cover all of the initially planned areas of science;
  - b. Completed user facilities;
  - c. Spare parts and equipment; and,
  - d. Facility enhancements.
2. Use contingency funds only for unforeseen and unpredictable conditions or uncertainties, and not to enhance project capabilities or to adjust for known errors in cost estimates.

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3. Maintain the contingency fund at an adequate level without jeopardizing the project's technical requirements.
  4. Ensure that the project delivers approved project requirements on schedule as well as within cost.

## MANAGEMENT REACTION

Management disagreed with the basis for the report and the report's conclusions. Also, management non-concurred with the first recommendation and concurred with the other three recommendations, stating that the recommendations merely required following accepted project management practices, to which they believed they already adhered. Their initial comments, organized by recommendation, are as follows:

Recommendation 1: The current SNS baseline already meets, and generally exceeds, the minimum science mission requirements and the commitments made to Congress and Department management when the project was approved. The Department will ensure that future Project Data Sheets appropriately describe expectations for project design and performance. Additionally, if a baseline change is required, the Office of Science will request a Departmental decision from the Deputy Secretary.

Recommendation 2: Management has not and will not use contingency funds to enhance project capabilities beyond the scope approved by the Secretary of Energy in the *SNS Project Execution Plan* and described in the SNS Project Data Sheet.

Recommendation 3: The project currently has an adequate contingency level and will continue to do so.

Recommendation 4: The project is on track to deliver a facility that meets approved project requirements on schedule as well as within cost and will continue to do so.

Subsequent to the exit conference, management submitted an additional response to the draft report, and requested that it, along with their initial response, be included as appendices to the report. We have incorporated management's initial response throughout the report. Management's additional response and auditor comments are contained in Appendices 3 and 4.



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**AUDITOR COMMENTS**

Management's reaction was not responsive to the audit recommendations. Management did not indicate that any steps would be taken to address the audit concerns. Our initial comments, organized by recommendation, are as follows:

Recommendation 1: We do not agree that the SNS Project is on track to meet the approved project requirements. Not all of the instruments, user facilities, critical spare parts and equipment will be provided in June 2006. Also, as stated previously, we believe the current Project Data Sheet is inconsistent with the Office of Science's own findings regarding the acceptability of scientific instrumentation and user facilities.

Recommendation 2: We determined that contingency funds were used to increase the capabilities of the linear accelerator, ring, and target system. This, in turn, resulted in reductions in instrument capabilities and number, user facilities, and critical spare parts and equipment. We agree that management should deliver maximum scientific performance within the approved budget. However, contingency funds should not be used to enhance parts of the facility, or to adjust for known errors in cost estimates, at the expense of other project areas.

Recommendation 3: We acknowledge that the contingency level is considered adequate at this time. However, this level was obtained by eliminating instruments, user facilities, and critical spare parts and equipment.

Recommendation 4: We do not agree that the SNS Project is on track to meet all of the approved project requirements. The project will not provide instruments to address the initially planned areas of science, complete user facilities, and critical spare parts and equipment by June 2006.

## Appendix 1

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### SCOPE

The audit was performed from April 2, 2001, to August 3, 2001, at the Oak Ridge Operations Office (Operations Office) and the SNS Project Office in Oak Ridge, Tennessee. The scope of the audit included SNS Project activities from October 1994 through July 2001.

### METHODOLOGY

To accomplish the audit objective, we:

- Identified the SNS Project's technical scope, cost, and schedule;
- Evaluated the status of the technical scope, cost, and schedule;
- Reviewed Federal and Departmental regulations governing project management;
- Examined SNS Project documentation;
- Reviewed baseline changes;
- Analyzed the use of the contingency fund; and,
- Discussed SNS Project activities with Department and contractor personnel.

The audit was performed in accordance with generally accepted Government auditing standards for performance audits and included tests of internal controls and compliance with laws and regulations to the extent necessary to satisfy the audit objective. Accordingly, the audit included reviews of Operations Office and SNS Project Office project management activities. Because our review was limited, it would not necessarily have disclosed all internal control deficiencies that may have existed at the time of our audit. We did not conduct a reliability assessment of computer-processed data because only a very limited amount of computer-processed data was used during the audit. As part of our review, we evaluated the Operations Office's expectations and performance measures for the SNS Project. We determined that the Operations Office established performance measures for the SNS Project in accordance with the Government Performance and Results Act of 1993.

We held an exit conference with the Director, Office of Basic Energy Sciences, on October 25, 2001.

## Appendix 2

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### **Related Office of Inspector General and General Accounting Office Reviews**

This review concerned the progress of the SNS Project regarding technical scope, cost, and schedule. Prior Office of Inspector General and General Accounting Office reviews related to the SNS Project and other large-scale science projects include those listed below:

*Audit of the Management of the Spallation Neutron Source Project*, (ER-L-00-04, May 2000). The SNS Project had addressed the results of selected prior audits and reviews and had closed 93 percent of the recommendations.

*Laboratory Research: State of Tennessee Exempts DOE's Spallation Neutron Source Project From Sales and Use Taxes*, (GAO/RCED-00-99R, March 2000). The SNS Project was exempted from all sales and use taxes imposed by the State of Tennessee. As a result, it would cost no more, from a sales and use tax perspective, to construct the SNS Project in Tennessee than at any of the other collaborating laboratories.

*Laboratory Research: Sales & Use Tax Costs to Build DOE's Spallation Neutron Source Project*, (GAO/RCED-00-33R, November 1999). The cost of sales and use taxes to build the project in Tennessee would be more than if the project were built in New York, where virtually no sales and use taxes would be incurred.

*Challenges Exist in Managing the Spallation Neutron Source Project*, (GAO/T-RCED-99-103, March 1999). Concerns were raised about SNS Project leadership, cost scheduling and the Department's project management structure. Coupled with the Department's history of not successfully completing large projects on time and within budget, the SNS Project was deemed a significant management challenge and continued close oversight was suggested.

*Summary Audit Report on Lessons Learned from the Superconducting Super Collider Project*, (DOE/IG-0389, April 1996). Instruments for a new facility are difficult to estimate due to rapidly evolving technology. Therefore, a phased approach to baselining instruments was recommended. Specifically, the facility should be baselined first with an allowance for instruments. Scientific instrumentation costs should not be baselined until later when better information is available.

## Appendix 3

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### Additional Management and Auditor Comments

The Acting Director, Office of Science, provided additional comments to the audit report on October 29, 2001. A summary of management comments and auditor responses follow. Management's response is included in its entirety in Appendix 4.

*Management asserts that the audit is seriously flawed because it fails to audit against the SNS Project Execution Plan and the Project Data Sheets. Management contends that the Project Execution Plan and the annual submission to Congress represent the internal control document and the external reporting document for the SNS Project.*

We used the *SNS Project Execution Plans* as well as the Project Data Sheets as criteria in our audit. Further, as stated in the report, the *SNS Conceptual Design Report* was part of the basis for baseline approval in December 1997. The *SNS Conceptual Design Report* is referred to in the *Project Execution Plan*. Our report points out that the SNS Project baseline included certain deliverables that were reduced in April 2001, due to budget constraints. The report also includes reference to management's submittal of the Project Data Sheet that stated fewer than ten instruments would be provided with no sacrifice in scientific capability. However, as noted in our report, we believe that the Project Data Sheet should more realistically reflect the current plan for the project. We revised the report to note that the *Project Execution Plan* defines the specific requirements that form the project baseline.

*Management stated that the audit report references statements from a variety of documents, some of which were never approved by the Department, were superceded and were merely advisory. Management contended that some of the statements in the report were simply inaccurate. The report fails to convey to the reader how, why, and when important decisions were made to address the evolution in technology available for incorporation into the SNS Project and in user needs. The cost related to the issues raised in the report is at most a few percent of the total project cost and is inconsistent with the sweeping generalizations in the Conclusions and Observations section of the report's Overview.*

First, the reviews were approved by the Department and contain the statements placed in the report. Management cites the semiannual project management reviews as merely advisory while at the same time uses them to support its statement that the SNS Project is meeting all technical, cost, and schedule requirements. A detailed response to each of management's concerns about the reviews is provided in this appendix.

Second, audit evidence contradicts management's statement that they approached the project to make important decisions to address the evolution in technology. The evidence shows that facility enhancements were made by using the contingency fund. Later, when the balance of the contingency fund was questioned, the Department reduced the technical scope of the project to provide fewer instruments, leave some of the user facilities unfinished, and eliminate spare parts. Further, evolution in technology did not drive the decisions concerning the instruments. In fact, the current SNS Project Director wrote a memorandum to the OIG in June 2001 that states "the overall project cost constraints led to a decision to reduce the instrument budget in the fall of 2000."

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Third, the cost of the issues raised in our report is not the point of the audit report and is not used to support our overall conclusion. Our point is that the July 2001 baseline did not provide for instruments to address the initially planned areas of science, complete user facilities, and critical spare parts to be available at the end of the construction project. This happened because the Department chose to reduce the project's technical scope in order to meet the approved budget rather than ask Congress for additional funding.

*Management contends that the SNS Project is meeting or exceeding all technical, cost, and schedule requirements. Management cites the May 2001 Office of Science review as evidence that "the Project was found to be on track and well positioned to meet its technical, cost, and schedule objectives."*

Our audit showed that as of July 2001, the SNS Project's technical scope was reduced in order to meet the cost and schedule requirements. Thus, while cost and schedule milestones may be met in a technical sense, the project's scope, as currently envisioned, will be inconsistent with the Department's original commitment. Further, the May 2001 review stated that "overall, the Committee judged the SNS project is making satisfactory progress and should be able to meet its Level 0 Baseline objectives: Total Project Cost of \$1,411.7 million; project completion date of June 2006; and greater than or equal to 1 megawatt proton beam power on target." It is important to note that the review's comment addresses the Level 0 Baseline deliverables. The review also commented on areas of concern in the project. For example, the reviewers concluded that the instruments in the current baseline will be barely acceptable for user operation in their present configuration, and that the elimination of user facilities might prove to be an unacceptable loss of functionality for the SNS facility.

*Management stated that the current scope of the SNS Project substantially exceeds the commitments made when the baseline was approved. Management cited the accelerator design, more space for staff and users, target system, and instrument performance as examples of improved deliverables. The SNS facility will be the world's best neutron scattering facility by a substantial margin. Management further stated that changes to the project were made in partnership with the user community, including Congress. Stretch goals along the way were deemed not achievable and difficult decisions had to be made; however, all the customers and stakeholders were involved in the process.*

We recognize that certain aspects of the SNS Project are exceeding requirements; however, the upgrades were added at the expense of basic deliverables such as instruments, completed user facilities, and critical spare parts and equipment. Also, the additional space for staff and users was added because, as noted in our report, the initial estimate for user facilities was understated. Our report states that the June 1997 Office of Energy Research review determined that the amount of space planned for user facilities may be inadequate. A further study resulted in approximately 100,000 square feet of space being added to the planned facility. However, project costs were not increased to account for this added space. Also, instrument performance was always intended to be delivered at the state-of-the-art level. Specifically, project funding included the estimated costs to build an initial suite of ten instruments and the associated research and development to design state-of-the-art components.

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We recognize the value of this facility to the Department and we agree that once completed as initially promised, the SNS facility may be the best in the world. However, our concern is that as a result of the scope reductions made to the project at this early stage, the facility will not deliver all of the intended leading-edge user facilities and capabilities nor cover all areas of science anticipated to meet the needs of the scientific user community at the end of the construction project. Specifically, the facility will not be equipped to perform some of the experiments originally planned because the instruments needed to perform the experiments will not be completed on time. Finally, the reliability of the facility could be jeopardized if one of the critical spare parts deleted from the project is needed to replace a part that fails.

Congress should be fully informed of the status of the project. Specifically, we believe that the current Project Data Sheet should more realistically reflect the current plan for the project. As stated in the report, the Project Data Sheet does not include information which we believe to be critically important, such as only five instruments are currently funded and only three will be installed by June 2006. Nor does it state that operating funds will be used to install the other two instruments in lieu of project funds. The Project Data Sheet is substantively inconsistent with the Office of Science's own report which states that the instruments will be barely acceptable for user operation and will span many, but not all, of the scientific areas originally addressed.

Further, our review disclosed that, while management obtained input from the user community in selecting the five instruments to be provided, the decision to provide only five instruments was based on budgetary constraints—not advice from the scientific user community. The Office of Science October 2000 and May 2001 reviews support this conclusion. In particular, the reviews state that due to budget constraints, project requirements were revised to require only five instruments to be funded, three of which would be installed. The Office of Science recommended that management find savings throughout the project to restore the full scientific scope of ten best-in-class instruments to the extent possible.

Overall, providing instruments to address the initially planned areas of science, completed user facilities, and critical spare parts at the end of the construction project are not considered "stretch goals." Rather, as noted by the Deputy Secretary's memorandum dated September 19, 2001, the Department should be held accountable for delivering projects within the full scope that was proposed to Congress.

*Management's most serious concern with the report is that it implies that increasing the total project cost is the correct response to the circumstances. Management stated that this is in direct contradiction of Secretarial policy that major projects should be managed to meet cost, schedule, and mission objectives.*

We agree that major projects should be managed to meet cost, schedule, and mission objectives within the full scope that was proposed to Congress. Our report points out that the total cost of providing the completed facility will be greater than \$1.4 billion. Therefore, we recommended that the total project cost be revised to reflect the cost of the instruments to cover all of the initially planned areas of science, completed user facilities, spare parts and equipment, and facility enhancements.

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*Management was concerned about the report's statements regarding the use of contingency funds. Management contended that the report states that contingency funds should not be used for project enhancements, including investments that facilitate future upgrades, and that this implies that improving project performance within the approved budget is not permitted.*

The report's recommendation regarding the use of contingency funds must be put in the context in which the funds were being used. For example, the enhancements, which totaled at least \$54.7 million, were made from the contingency fund, which in turn, resulted in reductions in instrument capabilities, descoped user facilities, and elimination of spare parts and equipment. The Department could have adjusted the total project cost when it made enhancements to the facility and when it determined that amounts estimated for instruments and user facilities were understated. Departmental project management guidance states that the baseline can be revised for bona fide changes such as increases in capability of a facility. The guidance also states that the contingency fund should not be used in lieu of making an accurate assessment of expected costs. In this case, the technical scope of the project was reduced in lieu of asking for additional funding.

*Finally, management stated that cost challenges must first be managed by keeping increases to the minimum while still meeting requirements. Unavoidable increases in cost would be managed by looking for offsets in areas of lower priority or use of contingency. An increase in total project cost would be warranted only if these avenues were exhausted or could not be pursued without harm to project performance. Management closed by stating that it was their responsibility to optimize scientific performance within the approved baseline and to do otherwise would not be consistent with responsible stewardship of public funds.*

We agree that cost challenges must be managed by keeping increases to a minimum while still meeting requirements. However, parts of the SNS facility were enhanced at the expense of basic deliverables that were part of the Department's commitment. The descoping actions have rendered the instruments barely acceptable for user operation and will span many, but not all, of the scientific areas originally addressed. The lack of certain user facilities may pose an unacceptable loss of functionality. The Department should deliver the SNS Project within the full scope that was proposed to Congress, and to do otherwise would be inconsistent with responsible stewardship of public funds.

Management also expressed concern about the following statements in the report. Our response to each of their concerns follows.

1. *The SNS Project is within cost and schedule.*

*Audit Report*

*Page 2 states "The SNS Project was not within technical scope, cost and schedule."*

*Management Comment*

*While the report contains many criticisms relating to technical scope, there is no basis for the conclusion that SNS is not within cost and schedule. In fact, SNS is on schedule and is currently projected to be complete several months early. The cost performance index is currently 1.01 and the*

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*contingency level is over 20 percent of remaining commitments. The May 2001 DOE review concluded that "the project was found to be on track and well positioned to meet its technical, cost and schedule objectives." Based on this conclusion, the cost performance index, the quarterly reviews, monthly reports, and weekly teleconferences with project management, the DOE management concludes that the project is within technical scope, cost, and schedule.*

#### Auditor Response

The audit disclosed that the July 2001 baseline for the SNS Project did not provide for several of the key scientific and logistical features that were included in the initial baseline. Thus, while cost and schedule milestones may be met in a technical sense, the project's scope, as currently envisioned, will be inconsistent with the Department's original commitment. The July 2001 baseline did not provide for instruments to address the initially planned areas of science, complete user facilities, and critical spare parts to be available at the end of the construction project. In essence, the project's technical scope was reduced to allow the cost and schedule components to be met.

Further, although the May 2001 Office of Science review stated that "the project was found to be on track and well positioned to meet its technical, cost, and schedule objectives," the overall conclusion was referring to the Level 0 Baseline deliverable of 1 megawatt of proton beam power on target, for \$1.4 billion in June 2006. The review also raised several concerns. Specifically, the review states, "The Committee noted that the scope of the first three instruments has been downgraded to meet budgetary constraints. Although this is recoverable at a later stage, the Committee is concerned that, in their present configuration, these instruments will be barely acceptable for user operation. Resources should be redirected as necessary to bring the powder diffractometer to a state of design comparable with that of the other four instruments. The goal should be to have all five instruments ready for neutrons at, or shortly after, the SNS Operational Readiness Review." The review also states "...some of the scope reduction items may resurface on the project as unacceptable loss of functionality (i.e., auditorium, cafeteria, furniture, and casework) when these issues are revisited at a later date."

2. *The 1997 initial estimate for instruments was not understated.*

#### Audit Report

*Page 7 states "A review of the estimate performed by the Department's Office of Energy Research in June 1997 determined that the instruments would cost an additional \$40 million."*

#### Management Comment

*The Department's review of June 1997 did not determine that the instruments would cost an additional \$40 million. In the June 1997 DOE Review (a comprehensive review of the SNS Conceptual Design), the committee's report stated:*

- *"They [the SNS Project] have developed a reference set of spectrometers adequate for costing purposes and have presented a credible cost estimate."*
- *"This set of instruments was chosen in order to allow costs to be estimated and should not be viewed as the set that will actually be built by the project."*



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- *"Our conclusion is that the budget requested for construction of 10 instruments on day 1 (\$45.6 million) is adequate and that sufficient contingency has been included."*

*In its own estimate of project costs, the committee's report did not increase instrument construction cost beyond the level estimated by the project. That is, they agreed with the \$45.6 million figure. DOE accepted the conclusions of this review, which were valid at the time they were made.*

#### Auditor Response

The review does state that the budget requested for construction of an initial set of instruments is adequate and that the instruments should not be viewed as the set that will actually be built. However, it also states "...the committee strongly recommends a substantial increase in the budget for instrumentation R&D, from less than \$10 million to about \$50 million." The report was clarified to note that we included both construction and research and development costs for the instruments.

3. *Project plans were always based on phased installation of instruments, not on delivery of all planned instruments at the time of Critical Decision 4.*

#### Audit Report

*Page 6 states that the ten instruments envisaged in the SNS Conceptual Design Report "were to be installed and ready for commissioning at the time the proton beam is turned on in June 2006."*

#### Management Comment

*The plan for instrument installation has always involved phased installation and commissioning due to the logistics of installation in an eighteen-month window with two overhead cranes. The definition of the Instrument Systems Complete Project Acceptance Test contained in Appendix B of the Project Execution Plan in place at the time ten instruments were in the baseline (Project Execution Plan Appendix B, October 1, 1999) states: "Milestone is defined as the completion of the ORR [Operational Readiness Review] for 5 installed instruments and the confirmation of the completed procurement of the remaining 5 instruments." This milestone has since been updated through the formal change control process to reflect the current plans for instruments. Had the audit been done against the established DOE approved baselines this error in the OIG report would not have occurred. The change control process is well defined, and the Project Execution Plan is changed as warranted when baselines change.*

#### Auditor Response

The SNS Conceptual Design Report was part of the basis for the initial baseline approval. According to the SNS Conceptual Design Report, "operations will begin with construction of the target operating at 60 Hz and ten neutron scattering instruments. These first ten instruments will span the types of science anticipated to be most important for this facility. They are expected to be installed and ready for commissioning at the time the source turns on and should be ready to begin a scientific program within a matter of months after that. It is expected that additional instruments will be installed at a rate of one to two per year after that." We agree that the Project Execution Plan dated October 1, 1999, reduced the commitment to five instruments installed and five procured. This milestone has since been reduced

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again to require the procurement of five instruments, only three of which will be installed. However, we do not agree with management's contention that these reductions are not a sacrifice in scientific capability.

4. *Instrument beam optics have not been deferred.*

Audit Report

*Page 3 of the report states "Also, the three instruments that will be installed will lack certain capabilities because management decided to defer the procurement of analyzer crystals, detectors, and optics."*

Management Comment

*Neutron beam optics have not been deferred in the referenced instruments because doing so would adversely impact beam intensity (and hence, instrument performance).*

Auditor Response

The report does not state that "neutron beam optics" had been deferred. The report refers to the deferral of the "polarizing optics" associated with the liquids reflectometer as reported to the OIG by the SNS Instrument Systems Senior Team Leader. The report was updated to use the specific term "polarizing optics."

5. *Instrument scope has not been reduced to address potential cost growth in Conventional Facilities.*

Audit Report

*Page 1 of the report states that the "initial Title I cost estimate of \$380 million for conventional facilities exceeded the baseline by approximately \$80 million."*

Management Comment

*Early identification of potential cost increases allowed the project to address the cost drivers in facility design. The current project baseline for conventional facilities, which provides for all the required conventional facilities to support operation of the SNS, stands at \$310.7 million. The modest cost growth since the fall of 2000 (approximately \$7.2 M) was easily accommodated by using contingency and has not impacted funds available for instrumentation. The project has adjusted instrument scope to reflect the cost of Best-in-Class instruments and the overall budget for the project. This error is an example of the OIG auditing against preliminary and, in this case, invalid information. Some of the \$80 million increase in conventional facilities had to do with over design, such as using stainless steel reinforcement bars in cases where carbon steel was adequate or bad design such as placing a utility building in a location that required long runs of utility lines or excessive wall thickness.*

Auditor Response

The report does not state that the instrument scope had been reduced to address potential cost growth in conventional facilities. The report states "the instrument budget was reduced to about \$79 million to make more funds available for the project's contingency fund" (See Report Page 7). Project

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documentation showed the initial conventional facilities Title I estimate was \$380.2 million; however, the October 2000 baseline was only \$300.3 million. The Department's Office of Science October 2000 review noted that fact and raised concerns about the potential use of contingency. In December 2000, the reviewers stated that SNS management had developed a number of actions to address the potential cost growth. These included: returning the scientific instrument budget to near its conceptual design level; reducing the amount of office and laboratory space; and reducing the size and capabilities of several conventional facilities. Also, the SNS Instrument Systems Senior Team Leader reported in an SNS Project publication, dated Spring 2001, that "the funds removed from the instrument budget were placed in the project contingency fund. This was needed to raise the contingency to an acceptable amount in light of a higher than anticipated cost estimate for the conventional construction and recognition of the need for additional funds to support the buildup and training of SNS staff to operate the accelerator systems." Further, the SNS Project Director stated in a letter to the OIG dated June 13, 2001, that ". . . overall project cost constraints led to a decision to reduce the instrument budget . . ." Accordingly, the reduction in instrument scope was driven by a need to increase contingency, partially due to potential conventional facility cost increases—not to accommodate state-of-the-art instruments.

6. *Accelerator downtime for cryomodule repair can be minimized without having an onsite facility.*

Audit Report

*Page 5 states "equipment for a facility designed to maintain and repair the linear accelerator cryomodules was eliminated from the project's construction phase." Page 6 states, "while capabilities for maintenance and repair of the linear accelerator cryomodules will be available off-site, the facility is required to operate with minimal downtime due to the short duration of user visits. The downtime will not be minimal if equipment has to be sent off-site for maintenance and repair."*

Management Comment

*Downtime is not dictated by the location of the maintenance and repair facilities, but can best be minimized by having sufficient spares in place at SNS. The project has these spare components within its scope. During SNS operation, it is anticipated that some repair work will be done off-site, but it will not be on the critical path in determining downtime.*

Auditor Response

The statement management is referring to concerns the lack of linear accelerator cryomodule maintenance and repair equipment—not spare parts. Project management reported that in the absence of the equipment, all cryomodules needing repair must be sent off-site. Accordingly, management stated that the turn around time on repairs would be longer than if the capabilities were available on-site. Project management also stated that in order to minimize downtime it was possible to bypass the affected cryomodule and run the linac at reduced power. However, management reported that some of the capabilities of the machine would be sacrificed. A review of the project change requests as of October 29, 2001, showed that the equipment had not been added back into the baseline. Further, we question the inclusion of the equipment in the original baseline if there was no effect on downtime.

7. *The March 1999 internal assessment did not recommend increasing the instrument budget by \$40 million.*

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### Audit Report

Page 7 states "An internal assessment conducted in March 1999 also found that the instrument budget was too low and recommended increasing the instrument budget by \$40 million."

### Management Comment

The internal assessment referenced in the OIG report was one done by a new management team just before they took charge of the project in April 1999. It is not clear why the OIG is auditing against a document prepared by people who were not yet part of the project and which did not have then and never has had any standing within the project or DOE. Nevertheless, this assessment report, (April 13, 1999) does not contain any mention of an instrument cost increase, much less recommendation to add \$40 million to the project instrument budget. The new management team merely pledged that "In full operation the SNS facility will meet or exceed its performance goals and deliver pulsed neutron beams of unprecedented power and reliability to a world-class instrument suite." In July 1999, the new project team did propose, and DOE accepted a Level 1 (SC level) baseline that included an instrument budget (exclusive of R&D) of \$97.3 million that would provide for "up to eleven instruments" of world-class caliber yet to be identified or designed. The \$40 million increase was taken from cost savings found in other areas of the project. Incidentally, they did not find it necessary to propose a substantial increase to the instrument R&D budget. The \$40 million increase eventually had to be relaxed to a \$15 million increase due to competing demands elsewhere in the project. At this stage, there was no specific technical scope tied to this money since the instruments had yet to be designed.

### Auditor Response

The internal assessment, dated March 25, 1999, was prepared by an internal representative (SNS Instrument Systems Senior Team Leader) and an external representative (National Institute of Science and Technology). This assessment did appear to have significant standing within the project and DOE considering the fact that SNS project management used the assessment as the basis to increase the instrument construction budget to \$97.3 million. The internal assessment stated that the original instrument budget of \$45.6 million could build the instrument set referred to in the *SNS Conceptual Design Report*. However, the report continued that the instruments would be far from state-of-the-art, and so would not make optimal use of the neutrons produced by SNS. The internal assessment stated that rough estimates indicated "an additional \$40 million plus contingency would be required to optimize this particular set of instruments." The audit disclosed that the \$40 million increase eventually had to be reduced to increase project contingency. We disagree with management's assertion that no technical scope was tied to that money. Instrument concepts had already been identified, in conjunction with the user community, to address the initially planned areas of science.

8. An auditorium and cafeteria were not part of the initial project requirements.

### Audit Report

Page 6 states, in reference to the *SNS Conceptual Design Report*, "Project requirements also include offices, laboratories, conference rooms, an auditorium, a cafeteria, and ..."

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Management Comment

*The SNS Conceptual Design Report did not go into the level of detail to specify a requirement for an auditorium or a cafeteria; they are not even mentioned. Although it was never approved by DOE as a baseline document, the SNS Project Design Manual (1998) explicitly stated that an auditorium and cafeteria were outside the scope of the SNS Project.*

Auditor Response

The project requirements for an auditorium and a cafeteria were not made in reference to the *SNS Conceptual Design Report*. Those facilities were listed as user requirements in the *SNS Project Design Manual*, which was derived from the *SNS Conceptual Design Report*. The *SNS Project Design Manual* was reported as the design basis for the SNS Project. Appendix B of the *Project Execution Plan*, dated October 7, 1998, stated that the *SNS Project Design Manual* defined the facility requirements, design concepts, construction plans, and operational capabilities to be provided upon completion of the facility. The *SNS Project Design Manual* was listed as a document approved for use project-wide until September 2001. According to the *SNS Project Design Manual*, the SNS Project was relying on the Joint Institute of Neutron Sciences (funded by the State of Tennessee) to provide these facilities. SNS project management added these facilities to the SNS Project baseline in April 2000; however, due to the upgrades in other areas of the project, the scope of those facilities has been reduced. The Department's May 2001 Office of Science review found that the elimination of facilities such as the auditorium, cafeteria, furniture, and casework might prove to be an unacceptable loss of functionality. The report was revised to include reference to the *SNS Project Design Manual*.

9. *The Project is in compliance with Departmental policy on spare parts.*

Audit Report

*Page 2 states that the July 2001 project baseline "does not provide...critical spare parts to be available at the end of the construction project." Page 6 states "Departmental policy states that an initial complement of spare parts is to be included in the total project cost."*

Management Comment

*The current project baseline does contain a budget for an initial complement of spares. The exact amount will evolve as the design is completed and the detailed needs are identified, but the spares budget currently stands at \$6 million. There were no "critical" spares identified in the OIG report that are not contained in the project baseline.*

Auditor Response

The report only refers to the elimination of target system spare parts, which were removed from the baseline in March 2001. According to project documentation and interviews with project management, some of those parts were considered "critical" to the operation of the facility due to a high schedule or technical risk. A review of the project change requests as of October 29, 2001, showed that the spare parts had not been added back into the baseline.

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10. The June 1997 DOE Review of the SNS Conceptual Design Report concluded that user facilities were generally adequate.

Audit Report

Page 8 states "The June 1997 Office of Energy Research Review determined that the amount of space planned for user facilities was inadequate."

Management Comment

At the least, this is a gross distortion of facts. The June 1997 Review found that space for the user facilities was reasonably adequate.

In regard to the conventional facilities, the June 1997 DOE Review report stated: "The facilities and services seem to be adequate for the SNS based on the conceptual requirements for the proton source, linac, accumulator ring, target, research instruments, and support facilities."

In regard to the experiment systems, the June 1997 DOE Review report stated: "As discussed elsewhere, the committee recommends a relatively small addition of laboratory space, which likely adds about \$1 million to conventional facility cost [of roughly \$300 million]."

Auditor Response

Although the June 1997 review did make the statements mentioned by management, they also stated that "While the instrument hall appears to be of sufficient size, the committee is concerned that office and lab space may have been seriously underestimated." The reviewers also raised concerns about the amount of space available for offices, instrument storage, long-term laboratory projects, ancillary equipment development, off-line testing, and maintenance. The March 1999 internal assessment also reported that the amount of office and lab space may be seriously inadequate and recommended that the amount of office, laboratory, and storage space available to both visiting researchers and SNS staff be increased. The audit report was revised to state that the space "may be" inadequate. Also, as stated in our report, a further study resulted in approximately 100,000 square feet of space being added to the planned facility.

11. The Office of Science has always been (and remains) committed to meeting the TPC.

Audit Report

The report makes a direct implication that DOE management deliberately understated the total project cost estimate. Page 9 states "In this case, management knew the total project cost was understated." On page 10, the report states "Department officials knew that the National Ignition Facility (NIF) would cost more than planned, but pushed the unrealistic figure in the belief that Congress would not fund the project at a higher cost. We believe that it is important for the Department to apply the lessons learned from the NIF to the SNS Project."

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Management Comment

*It is not clear why NIF is mentioned. This is not an audit of NIF. If the OIG insists on this statement with respect to NIF, it should be reviewed by NNSA, and NNSA should be allowed to comment. The implication with respect to the SNS is both groundless and offensive. Indeed, the actions taken by Project and DOE management to adjust the elements of the project scope to maximize the science capability within the TPC (and criticized by this report) are direct evidence of the commitment to cost control. However, as a matter of fact, we have involved NIF management in the SNS review process to learn what we can from NIF. Furthermore, Congress has imposed many tough requirements that have been met. See, for example, the requirements in the House Report (Report 106-253, pp 113-114) that accompanied the FY 2000 Energy and Water Development Appropriations Act. This project has been an open book from the start. GAO, OMB, OSTP have all been observers in the DOE review process. Congress was briefed regularly by DOE and the contractor. The OIG also ignores that the TPC has been increased three times over the original contractor CDR estimate. Each such increase was based on sound analysis by DOE management, proposed and accepted by OMB, submitted to Congress in the President's budget, and accepted by Congress in its annual appropriations bills.*

Auditor Response

NIF is mentioned in the report to show a trend in the Department's project management philosophy. Although we agree that management should deliver maximum scientific performance within the approved budget using techniques such as value engineering, our review showed that the enhancements and current contingency level were obtained at the expense of the project's technical requirements. Department guidance allows for adjusting the baseline for bona fide changes. However, in this case, the total project cost was not adjusted to reflect the enhancements.

We are aware that the total project cost has increased over the original SNS Conceptual Design Report amount three times. The first increase was due to project management's implementation of some of the June 1997 Department of Energy Research SNS Conceptual Design Review recommendations. The other two increases extended the schedule due to funding shortfalls. Thus, none of the increases were due to analyses performed on the effects of making project enhancements.

12. The SNS has always managed contingency properly.

Audit Report

*On page 9, the report makes the direct implication that DOE management deliberately mismanaged contingency. "Departmental guidance states that contingency funds are not to be used as a "slush fund" and should not be used to avoid making an accurate assessment of expected costs."*

Management Comment

*This implication is both groundless and offensive. The Project has a contingency management process that is defined in the Project Execution Plan and was used to govern the baseline changes referenced in the report. Again, the OIG fails to use the approved baseline documents and processes in their audit choosing instead to bolster their case with inflammatory language that has no basis in fact.*

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Auditor Response

The report's comments regarding the use of contingency funds must be put in the context in which the funds were being used. For example, the enhancements, which totaled at least \$54.7 million, were made from the contingency fund, which in turn, resulted in reductions in instrument capabilities, descoped user facilities, and elimination of spare parts and equipment. The Department could have adjusted the total project cost when it made enhancements to the facility and when it determined that amounts estimated for instruments and user facilities were understated. Departmental project management guidance states that the baseline can be revised for bona fide changes such as increases in capability of a facility. The guidance also states that the contingency fund should not be used in lieu of making an accurate assessment of expected costs. In this case, the technical scope of the project was reduced in lieu of asking for additional funding. Finally, Department guidance cautioned against using the contingency fund as a "slush fund." Use of the Department's guidance in our report was not meant to be inflammatory.





Department of Energy  
Washington, DC 20585

MEMORANDUM FOR GREGORY F. FRIDMAN  
INSPECTOR GENERAL

FROM: JAMES F. DECKER  
ACTING DIRECTOR  
OFFICE OF SCIENCE

A handwritten signature in black ink, appearing to read "J. Decker", written over the typed name and title.

SUBJECT: Summary of Management Response to the Draft IG Audit  
Report on the Spallation Neutron Source (SNS) Project.

As previously discussed, we are submitting the attached Summary of Management Response and request that you include it as Appendix A in the final Audit Report on the SNS Project.

We request that the original Management Response in the Audit Report be included as Appendix B.

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### Summary of Management Response<sup>1</sup>

Because of our strong disagreement with the findings and recommendations from this audit, management has specifically requested that this response be included as an appendix to the report.

The Audit Report "Progress of the Spallation Neutron Source Project" is seriously flawed, because it fails to audit against the SNS Project Execution Plan (PEP), the document formally recognized by the Department to define and control the official Project baselines. The SNS Project Data Sheet, which is the budget document submitted annually to Congress, summarizes the current budget status and addresses substantive changes in the project baselines that occur from year to year. Thus, the PEP and the annual submission to Congress represent, respectively, the internal control document and the external reporting document for the SNS Project.

In lieu of using these documents, the Report references statements and often fragments of statements abstracted from a variety of documents, some of which had never been approved by the Department, some of which were long superceded, and some of which were merely advisory to the Department such as the reports of the semiannual project management reviews. And some of the statements in the Report are simply incorrect.<sup>2</sup> The result is a confusing and distorted picture of the SNS Project, which fails to convey to the reader how, why, and when important decisions were made to address the evolution in technology available for incorporation into the SNS Project and in user needs. Furthermore, the cost related to the issues raised in the Report is at most a few percent of the Total Project Cost, which is inconsistent with the sweeping generalizations in the Conclusions and Observations section of the Report's Overview.

The SNS Project is meeting or exceeding all technical, cost, and schedule requirements. This has been confirmed by numerous recent assessments performed by the SNS Project, the Department staff, and external review committees. Indeed, the May 2001 "Lehman review"<sup>3</sup> concluded that "the Project was found to be on track and well positioned to meet its technical, cost, and schedule objectives." The next such review, planned for November 6 – 8, 2001, will again examine the project's technical, cost, and schedule status. This review report should be available by early January 2002.

The current scope of the SNS Project substantially exceeds the initial commitments made when Critical Decision 2 (Baseline) was approved (December 23, 1997) in a number of ways. Some of the more important of these are:

- The accelerator design is more robust and provides for higher beam power.
- The conventional facilities provides more space for staff and users.
- The target system provides more, higher performance neutron beamlines.
- The instrument performance significantly exceeds that in the Conceptual Design Report, due to improved instrument technology and better overall facility performance.

Because informed, thoughtful decisions were made all during the life of this project, the SNS facility will unquestionably be the world's best neutron scattering facility by a substantial margin. Already it is the envy of the international scientific community. All of the changes to the SNS Project were made in partnership with the user community – the ultimate customer of this facility – and were communicated to other stakeholders (including the Congress) in a regular, open manner. Sometimes stretch goals along the way were deemed not achievable, sometimes difficult decisions had to be made; however, all the customers and stakeholders were involved throughout the process.

Perhaps the most serious concern with the IG Report is that it implies that increasing the Total Project Cost (TPC) is the correct response to all but a limited set of possible circumstances. This is in direct contradiction of Secretarial policy that major Projects should be managed to meet cost, schedule, and mission objectives. Furthermore, the IG Report's statement that contingency funds should not be used for Project enhancements, including investments that facilitate future upgrades, implies that improving Project performance within the approved budget (an accepted part of Value Engineering required by OMB Circular A-131) is not permitted.

Cost challenges, such as those that arose in the fall of 2000, must first be managed by keeping increases to the minimum while still meeting requirements. This was the main element of solving the difficulties relating to conventional facilities discussed in the report. Unavoidable increases in cost would then be managed by looking for offsets in areas of lower priority or through the judicious use of contingency. An increase in TPC would be warranted only if these avenues were exhausted or could not be pursued without harm to Project performance.

We believe it is our responsibility to optimize scientific performance within the approved baseline and to do otherwise would not be consistent with responsible stewardship of public funds.

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<sup>1</sup>The entire Management Response to the initial draft IG Report of August 9, 2001 is contained in Appendix B. This is the response referenced in numerous places in the final IG Report. [*The OIG has incorporated management's initial response throughout the body of the report. Management's additional response and auditor comments are contained in Appendices 3 and 4.*]

<sup>2</sup>A compendium of inaccuracies follows this summary.

<sup>3</sup>A "Lehman review" is a comprehensive (technical, cost, schedule, and management) review periodically performed on all large Office of Science (SC) projects by committees of independent experts organized by SC's Division of Construction Management Support and chaired by its Director, Daniel Lehman. These experts are drawn from a wide variety of national laboratories, academia, foreign research institutions, and other Federal agencies. These experts provide counsel to DOE management in their report. The review is used by DOE management to make decisions regarding the project in the context of all other responsibilities and obligations.

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**Examples of  
Inaccuracies in IG Report on SNS Project**

**1. The SNS project is within cost and schedule.**

IG Report

Page 2 states “The SNS Project was not within technical scope, cost and schedule.”

Fact

While the report contains many criticisms relating to technical scope, there is no basis for the conclusion that SNS is not within cost and schedule. In fact, SNS is on schedule and is currently projected to be complete several months early. The cost performance index is currently 1.01 and the contingency level is over 20 percent of remaining commitments. The May 2001 DOE Review (“Lehman review”) report concluded that “the project was found to be on track and well positioned to meet its technical, cost, and schedule objectives.” Based on this conclusion, the cost performance index, the quarterly reviews, monthly reports, and weekly teleconferences with project management, the DOE management concludes that the project is within technical scope, cost, and schedule.

**2. The 1997 initial estimate for instruments was not understated.**

IG Report

Page 7 states “A review of the estimate performed by the Department’s Office of Energy Research in June 1997 determined that the instruments would cost an additional \$40 million.”

Fact

The Department’s review of June 1997 did not determine that the instruments would cost an additional \$40 million.

In the June 1997 DOE Review (a comprehensive review of the SNS Conceptual Design), the committee’s report stated:

- “They [the SNS Project] have developed a reference set of spectrometers adequate for costing purposes and have presented a credible cost estimate.”
- “This set of instruments was chosen in order to allow costs to be estimated and should not be viewed as the set that will actually be built by the project.”
- “Our conclusion is that the budget requested for construction of 10 instruments on day 1 (\$45.6 million) is adequate and that sufficient contingency has been included.”

In its own estimate of project costs, the committee’s report did not increase instrument construction cost beyond the level estimated by the project. That is, they agreed with the \$45.6 million figure. DOE accepted the conclusions of this review, which were valid at the time they were made.

**3. Project plans were always based on phased installation of instruments, not on delivery of all planned instruments at the time of Critical Decision 4.**

IG Report

The report states that the ten instruments envisaged in the Conceptual Design Report “were to be installed and ready for commissioning at the time the proton beam is turned on in June 2006”. (page 6)

Fact

The plan for instrument installation has always involved phased installation and commissioning due to the logistics of installation in an eighteen month window with two overhead cranes. The definition of the Instrument Systems Complete Project Acceptance Test contained in Appendix B of the Project Execution Plan in place at the time ten instruments were in the baseline (PEP Appendix B, October 1, 1999) states: “Milestone is defined as the completion of the ORR [Operational Readiness Review] for 5 installed instruments and the confirmation of the completed procurement of the remaining 5 instruments.” This milestone has since been updated through the formal change control process to reflect the current plans for instruments. Had the audit been done against the established DOE approved baselines this error in the IG report would not have occurred. The change control process is well defined, and the PEP is changed as warranted when baselines change.

**4. Instrument beam optics have not been deferred.**

IG Report

The report states that “Also, the three instruments that will be installed will lack certain capabilities because management decided to defer the procurement of analyzer crystals, detectors, and optics.” (page 3)

Fact

Neutron beam optics have not been deferred in the referenced instruments because doing so would adversely impact beam intensity (and, hence, instrument performance).

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**5. Instrument scope has not been reduced to address potential cost growth in Conventional Facilities.**

IG Report

The report states that “initial Title I cost estimate of \$380 million for conventional facilities exceeded the baseline by approximately \$80 million.” (page 1)

Fact

Early identification of potential cost increases allowed the project to address the cost drivers in facility design. The current project baseline for conventional facilities, which provides for all the required conventional facilities to support operation of the SNS, stands at \$310.7 million. The modest cost growth since the fall of 2000 (approximately \$7.2 M) was easily accommodated by using contingency and has not impacted funds available for instrumentation. The project has adjusted instrument scope to reflect the cost of Best-in-Class instruments and the overall budget for the project. This error is an example of the IG auditing against preliminary and, in this case, invalid information. Some of the \$80 million increase in conventional facilities had to do with over design, such as using stainless steel reinforcement bars in cases where carbon steel was adequate or bad design such as placing a utility building in location that required long runs of utility lines or excessive wall thickness.

**6. Accelerator downtime for cryomodule repair can be minimized without having an onsite facility.**

IG Report

Page 5 states “equipment for a facility designed to maintain and repair the linear accelerator cryomodules was eliminated from the project’s construction phase.” Page 6 states “while capabilities for maintenance and repair of the linear accelerator cryomodules will be available off-site, the facility is required to operate with minimal downtime due to the short duration of user visits. The downtime will not be minimal if equipment has to be sent off-site for maintenance and repair.”

Fact

Downtime is not dictated by the location of the maintenance and repair facilities, but can best be minimized by having sufficient spares in place at SNS. The project has these spare components within its scope. During SNS operation, it is anticipated that some repair work will be done off-site, but it will not be on the critical path in determining downtime.

**7. The March 1999 internal assessment did not recommend increasing the instrument budget by \$40 million.**

IG Report

Page 7 states “An internal assessment conducted in March 1999 also found that the instrument budget was too low and recommended increasing the instrument budget by \$40 million.”

Fact

The internal assessment referenced in the IG report was one done by a new management team led by David Moncton just before they took charge of the project in April 1999. It is not clear why the IG is auditing against a document prepared by people who were not yet part of the project and which did not have then and never has had any standing within the project or DOE. Nevertheless, this assessment report (April 13, 1999) does not contain any mention of an instrument cost increase, much less recommendation to add \$40 million to the project instrument budget. The new management team merely pledged that, “In full operation the SNS facility will meet or exceed its performance goals and deliver pulsed neutron beams of unprecedented power and reliability to a world-class instrument suite.”

In July 1999, the Moncton-led project team did propose, and DOE accepted a Level 1 (SC level) baseline that included an instrument budget (exclusive of R&D) of \$97.3 million that would provide for “up to eleven instruments” of world-class caliber yet to be identified or designed. The \$40 million increase was taken from cost savings found in other areas of the project. Incidentally, they did not find it necessary to propose a substantial increase to the instrument R&D budget. The \$40 million increase eventually had to be relaxed to a \$15 million increase due to competing demands elsewhere in the project. At this stage, there was no specific technical scope tied to this money since the instruments had yet to be designed.

**8. An auditorium and cafeteria were not part of the initial project requirements.**

IG Report

Page 6 states, in reference to the *SNS Project Conceptual Design*, “Project requirements also include offices, laboratories, conference rooms, an auditorium, a cafeteria, and .....”

Fact

The *SNS Project Conceptual Design* did not go into the level of detail to specify a requirement for an auditorium or a cafeteria; they are not even mentioned. Although it was never approved by DOE as a baseline document, the *SNS Project Design Manual* (1998) explicitly stated that an auditorium and cafeteria were outside the scope of the SNS project.

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**9. The Project is in compliance with Departmental policy on spare parts.**

IG Report

Page 2 states that the July 2001 project baseline “does not provide ... critical spare parts to be available at the end of the construction project”. Page 6 states “Departmental policy states that an initial complement of spare parts is to be included in total project cost”.

Fact

The current project baseline does contain a budget for an initial complement of spares. The exact amount will evolve as the design is completed and the detailed needs are identified, but the spares budget currently stands at \$6 million. There were no “critical” spares identified in the IG report that are not contained in the project baseline.

**10. The June 1997 DOE Review of the SNS Conceptual Design concluded that user facilities were generally adequate.**

IG Report

Page 8 states “The June 1997 Office of Energy Research Review determined that the amount of space planned for user facilities was inadequate.”

Fact

At the least, this is a gross distortion of facts. The June 1997 Review found that space for the user facilities was reasonably adequate.

In regard to the conventional facilities, the June 1997 DOE Review report stated: “The facilities and services seem to be adequate for the SNS based on the conceptual requirements for the proton source, linac, accumulator ring, target, research instruments, and support facilities.”

In regard to the experiment systems, the June 1997 DOE Review report stated: “As discussed elsewhere, the committee recommends a relatively small addition of laboratory space, which likely adds about \$1 million to conventional facility cost [of roughly \$300 million].”

**11. The Office of Science has always been (and remains) committed to meeting the TPC.**

IG Report

The report makes a direct implication that DOE management deliberately understated the total project cost estimate. Page 9 states “In this case, management knew the total project cost was understated”. On page 10, the report states “Department officials knew that the National Ignition Facility (NIF) would cost more than planned, but pushed the unrealistic figure in the belief that Congress would not fund the project at a higher cost. We believe that it is important for the Department to apply the lessons learned from the NIF to the SNS Project.”

Fact

It is not clear why NIF is mentioned. This is not an audit of NIF. If the IG insists on this statement with respect to NIF, it should be reviewed by NNSA, and NNSA should be allowed to comment. The implication with respect to the SNS is both groundless and offensive. Indeed, the actions taken by Project and DOE management to adjust elements of the project scope to maximize the science capability within the TPC (and criticized by this report) are direct evidence of the commitment to cost control. However, as a matter of fact, we have involved NIF management in the SNS review process to learn what we can from NIF. Furthermore, Congress has imposed many tough requirements that have been met. See, for example, the requirements in the House Report (Report 106-253, pp 113-114) that accompanied the FY 2000 Energy and Water Development Appropriations Act. This project has been an open book from the start. GAO, OMB, OSTP have all been observers in the Lehman review process. Congress was briefed regularly by DOE and by the contractor. The IG also ignores that the TPC has been increased three times over the original contractor CDR estimate. Each such increase was based on sound analysis by DOE management, proposed and accepted by OMB, submitted to Congress in the President’s budget, and accepted by Congress in its annual appropriations bills.

**12. The SNS has always managed contingency properly.**

IG Report

On page 9, the report makes the direct implication that DOE management deliberately mismanaged contingency. “Departmental guidance states that contingency funds are not to be used as a “slush fund” and should not be used to avoid making an accurate assessment of expected costs.”

Fact

This implication is both groundless and offensive. The Project has a contingency management process that is defined in the PEP and was used to govern the baseline changes referenced in the report. Again the IG fails to use the approved baseline documents and processes in their audit choosing instead to bolster their case with inflammatory language that has no basis in fact.

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