U.S. Department of Energy
Office of Inspector General
Office of Audit Services

Audit Report

Quality Assurance Standards for the Integrated Control Network at the Hanford Site's Waste Treatment Plant

DOE/IG-0764 May 2007

Department of Energy
Washington, DC 20585

May 4, 2007

MEMORANDUM FOR THE SECRETARY

FROM: Gregory H. Friedman
Inspector General

SUBJECT: INFORMATION: Audit Report on "Quality Assurance Standards for the Integrated Control Network at the Hanford Site's Waste Treatment Plant"

BACKGROUND

In one of the largest and most important of its environmental remediation projects, the Department of Energy is constructing a Waste Treatment Plant at its Hanford, Washington site. The $12.2 billion Plant is designed to treat and prepare for disposal 53 million gallons of radioactive and chemically hazardous waste. In December 2000, the Department awarded a contract to Bechtel National, Inc. (Bechtel National) to design, build, and commission the Plant to immobilize radioactive waste into a stable form of glass. Under current plans, the resulting high-level waste is to be disposed of in the Office of Civilian Radioactive Waste Management's geologic repository.

Because of the nature of the waste stream, the Waste Treatment Plant has been designated a Category II nuclear facility. As such, it must meet quality assurance standards for nuclear facilities, which significantly exceed those required for commercial facilities and equipment. The Plant design called for the installation of a computerized integrated control network to monitor the operation of a number of key processes. In November 2001, Bechtel National awarded a subcontract to procure the control system, an essential component of the integrated network. This system provides central communications for the Plant's pumps, valves, and instruments, and the interfaces for operators to control Plant activities. The objective of the audit was to determine if the integrated control network met appropriate quality assurance standards.

RESULTS OF AUDIT

The Waste Treatment Plant control system acquired by the Department did not meet applicable quality assurance standards--specifically, those required for "an activity affecting the immobilization of radioactive high-level waste." Bechtel National's specifications, which were approved by the Department, required the installation of a control system that met quality assurance standards for nuclear facilities, or equivalent standards. Yet, Bechtel National failed to impose parallel requirements on the subcontractor which supplied the control system. As a result, the system does not meet the stringent procedures, plans, specifications, or work practices associated with nuclear quality standards. Under the circumstances, we concluded that the Department cannot be sure that the Plant's current system is suitable for processing nuclear waste.

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In examining these issues, we noted a number of problems in the process used by Bechtel National to procure the control system. Specifically, Bechtel National had not:

- Performed a supplier evaluation to ensure that the subcontractor used appropriate quality assurance standards given the system's functions;

- Clearly set forth quality assurance standards to be applied during the procurement process; and,

- Consistently defined quality levels that were to be used for the Plant.

We concluded, as well, that Department officials had not taken necessary steps to assure that Bechtel National's actions regarding the control system were consistent with Agency quality assurance standards. In fact, the Department was unaware of the nuclear quality assurance standards issue prior to our review.

The Department needs to address concerns that the control system will not perform as needed and that quality assurance shortcomings could potentially impact the operation of other Waste Treatment Plant systems. These issues could significantly impact the schedule, cost and safety of the project. Depending on the results of further testing, the Department may have to commit substantial additional resources to either enhance the existing control system to ensure that it meets the appropriate quality assurance standards, or procure a new control system specifically designed to meet such standards.

The audit also disclosed that there was confusion within the Department as to whether its recently adopted quality assurance standards for safety software applied to the Plant's integrated control network. In Fiscal Year 2005, the Department issued Order 414.1C, *Quality Assurance*. Under the Order, safety software development is to meet the quality assurance standards for nuclear facilities, or equivalent standards, utilizing a graded approach, rather than the standards followed for commercial materials. To date, neither the Department nor Bechtel National has determined whether the internal control network's functions comprise safety software as defined by the Order. Toward the end of our audit, we were informed that the Department was undertaking a number of actions to review the applicability of Order 414.1C, *Quality Assurance*, to the integrated control network as well as to other systems at the Waste Treatment Plant.

To address the concerns raised during our audit, we recommended that senior Environmental Management officials conduct necessary tests to ensure that the control system for the integrated control network at the Waste Treatment Plant meets appropriate quality assurance standards; place significantly greater attention on the administration of the Bechtel National contract with emphasis on a review of Bechtel National's procurement system; and, determine if and the extent to which Departmental Order 414.1C applies to the integrated control network.

MANAGEMENT REACTION

Management, in responding to a draft of this report, indicated that it was reviewing Bechtel National's engineering judgments regarding (1) the quality assurance

classification of the control system for integrated control network and (2) whether the system will meet Office of Civilian Radioactive Waste Management's waste acceptance requirements for the repository. It further stated that Bechtel National will be required to ensure that the integrated control network meets recently imposed nuclear safety and quality assurance standards.

The actions proposed by management are responsive to our recommendations. Management's comments and our detailed response are summarized in the body of the report.

Attachment

cc: Deputy Secretary
Acting Under Secretary of Energy
Assistant Secretary, Office of Environmental Management
Chief of Staff
Manager, Office of River Protection

REPORT ON QUALITY ASSURANCE STANDARDS FOR THE INTEGRATED CONTROL NETWORK AT THE HANFORD SITE'S WASTE TREATMENT PLANT

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STANDARDS FOR THE INTEGRATED CONTROL NETWORK AT THE WASTE TREATMENT PLANT

Background

In November 2001, Bechtel National issued a purchase order to procure a control system for the integrated control network at the Waste Treatment Plant (Plant). The integrated control network is an automated system that monitors the quality and safety of systems and processes of the Plant. The control system, which is a critical component of the integrated control network, monitors the status of pumps, mixers, and flow rates of the waste through the treatment process. Bechtel National identified the integrated control network as affecting the quality of immobilized high-level radioactive waste.

Departmental Orders require the establishment of quality assurance programs over systems and operations. Bechtel National, in implementing the Department's quality assurance directives, concluded that the control system needed to meet quality assurance standards for nuclear facilities or equivalent because it affected the quality of immobilized high-level waste.

Application of Quality Assurance Standards

The control system ultimately procured by Bechtel National did not meet the required quality assurance standards. When Bechtel National issued the Request for Proposal, the specification required that the control system meet quality assurance standards for nuclear facilities. However, after the bids were received and the proposals evaluated, it was determined that none of the proposers had a system that could meet quality assurance standards for nuclear facilities, or equivalent standards. During the acquisition period, a change was being implemented in Bechtel National’s quality assurance process which permitted the acquisition of certain systems from commercial suppliers. This change in procurement requirements was approved by the Department. Based on the contractor's interpretation of the revised requirements, Bechtel National awarded the control system contract to a commercial supplier. Bechtel National did not seek other avenues to acquire software which met nuclear facility standards, or equivalent internationally recognized standards.

Although Bechtel National's revised quality assurance procedures allowed commercial materials in certain operations, the procurement of a commercial control system did not satisfy the requirement that items and services affecting the quality of immobilized high-level waste meet nuclear facility quality assurance standards. This higher standard was necessary to satisfy the Office of Civilian Radioactive Waste Management's (OCRWM) quality assurance requirements for disposing of immobilized high-level waste in its proposed geologic repository.

Procurement Practices

Inadequate Federal contract administration practices and weaknesses in Bechtel National's procurement process contributed to numerous problems in the procurement of the control system. Specifically, the Department failed to adequately monitor Bechtel National's procurement of the control system as shown by its approval of the contract award for a system that did not meet applicable quality standards. We found no evidence during our review that indicated the Department raised questions about the suitability of the commercial grade control system for the Plant's function of producing immobilized high-level waste.

We noted that Bechtel National had not (1) performed a supplier evaluation; (2) clearly set forth quality assurance standards to be followed; (3) consistently applied quality assurance requirements; and, (4) appropriately documented key elements in the procurement process.

Supplier Evaluation

Bechtel National did not perform an evaluation of the control system supplier whose system could affect the quality of waste generated by the Plant. In so doing, Bechtel National incurred the risk of significant cost and schedule overruns in the event the integrated control network failed to perform as intended. A supplier evaluation ensures the application of a graded approach to the quality criteria adhered to by the supplier. Bechtel National's failure to perform the supplier evaluation conflicted with the Department's quality assurance requirements.

Bid Selection

Also, we found no evidence to indicate that the individuals involved in selecting the subcontractor were aware that bidders needed to meet quality assurance standards applicable to nuclear facilities. This may have occurred, in part, because Bechtel National repeatedly revised documents supporting the acquisition which obscured the requirement that nuclear facility standards needed to be applied for the system.

Consistent Application of Quality Requirements

Program and procurement personnel involved in the acquisition, in addition, appear not to have understood that if the network, as a whole, must meet nuclear standards, then component parts of the network -- including the control system – must also meet these standards. Currently, Bechtel National applies only commercial

quality assurance standards to the control system, a key component and base layer of the integrated control network, even though the network as a whole is required to meet the higher quality assurance standards applicable to nuclear facilities.

Procurement Files

Other weaknesses were noted in Bechtel National's procurement process. For example, under the procurement requirement, the subcontractor of the control system was to provide a representation concerning quality assurance matters. We found that this document was erroneously completed by a Bechtel National employee. Therefore, Bechtel National had no formal commitment by the subcontractor to meet applicable quality program requirements as specified in the engineering specification and purchase order. In addition, many key procurement documents were undated, limiting our ability to develop a timeline of the sequence of events. The timeline would have assisted us in determining of weaknesses in the procurement system.

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Additional Requirements

The Department revised its standard for safety software in 2005. Based on this revision, the Department mandated that "software that performs a control function necessary to provide adequate protection from nuclear facility or radiological hazards" must meet quality assurance standards for nuclear facilities, or an equivalent standard. However, the Department has not yet determined whether the control system software must meet quality assurance requirements for safety software.

Although the control system is not the Plant's primary safety system, it provides central communications for the Plant's pumps, valves, and instruments, and the interfaces for operators to control Plant activities, activities associated with the control of nuclear hazards. For example, the autosampling control system, a component of the integrated control network, is designed to limit personnel exposure and maintains alarm and draining capabilities in the event of a malfunction. According to a Departmental software quality assurance official, working with the Office of Inspector General on this review, functions performed by the integrated control network comprise safety software as defined in the Directive. Other quality assurance officials stated that further review is necessary before they could conclusively determine whether the Directive applies to functions of the integrated control network. Given the findings in this report, the quality assurance

standards applicable to the control system need to be examined from both an immobilized waste and a safety software perspective.

Effect

The Department is at risk that the control system will not perform as needed thereby impacting the schedule, cost and safety of the $12 billion project. Additionally, the Department spent more than $13 million for the control system that was not acceptable for high-level waste immobilization operations of the Plant. Depending on the results of further testing of the system, the Department may be required to spend additional resources to either ensure that the control system meets the appropriate quality assurance standards, or to procure another control system that meets those standards.

RECOMMENDATIONS

We recommend that the Assistant Secretary for Environmental Management:

1. Ensure that the integrated control network for the Plant meets appropriate quality assurance standards for its immobilization of high-level waste functions;

2. Determine whether the quality assurance requirements for safety software apply to the integrated control network; and,

3. Direct the Office of River Protection to provide more stringent oversight of Bechtel National's procurement process, including a review of the adequacy of Bechtel National's procurement system.

MANAGEMENT REACTION

Management stated that it is evaluating Bechtel National's judgments made at the time of the procurement regarding the appropriate quality assurance classification of the integrated control network. Management indicated that it planned to provide more rigorous oversight of Bechtel National's procurement process and is initiating a review of Bechtel National's procurement system. Management also stated that it had initiated a separate review of both its and Bechtel National's quality assurance programs to determine whether appropriate quality assurance standards are implemented and whether systemic issues exist that need to be addressed. Finally, Management indicated that it will direct Bechtel national to ensure that the integrated control network meets current contractual nuclear safety and quality assurance standards.

As background, management indicated that during the 2000-2001 timeframe, it encouraged Bechtel National to move from a compliance philosophy based on process control to a sampling strategy in order to confirm the quality of the waste product. Management thought that by moving towards a sampling strategy it would significantly reduce the amount of equipment categorized as affecting the quality of immobilized high-level waste. In September 2002, the Department directed Bechtel National to apply the sampling strategy, increasing the likelihood that the integrated control network would no longer be classified as waste quality affecting.

Based on the Department's direction, Bechtel National reclassified the integrated control network from affecting the quality of high-level waste to "To Be Determined." Management acknowledged that a non-conservative approach accepting cost and schedule risk drove the decision to purchase the control system as commercial material. Management also stated that Bechtel National developed a recovery plan in the 2001 timeframe, although not documented, in the event the control system was later determined to have a function essential to the high-level waste form function.

Management acknowledged that it is still not certain whether component systems of the integrated control network are currently waste quality affecting. Additionally, management stated that it did not believe the internal control network comprise safety software, as defined by the Department's Directive.

AUDITOR RESPONSE

As stated in the body of the report, the procurement of the control system as commercial material did not meet the quality assurance standards required for an activity affecting the quality of the Plant's immobilization of high-level waste at the time of procurement. While changes to Bechtel National's quality assurance procedures allowed the use of commercial materials for non-safety systems, the revised procedures still required that items and services affecting the quality of immobilized high-level waste meet quality assurance standards for nuclear facilities. Further, although Bechtel National reclassified the waste affecting function of the system as "To Be Determined" in 2001, the company subsequently identified components of the integrated control network in its 2004 Determination of Immobilized High-Level Waste Product Quality-Affecting Items and Activities list. As such, the control system procurement should have been subject to nuclear quality assurance standards since the procured control system was and continues to be identified as a key component of the control network.

Further, we are concerned that the Department has not reviewed the control system for compliance with the Departmental Directive on safety software. Establishing the appropriate quality assurance level for the software is important because the integrated control network provides central communications for the Plant. For example, the autosampling control system, a component of the integrated control network, controls an alarm function and draining capability in response to a malfunction.

Despite our disagreement on certain points, the actions initiated or planned by Management, if fully implemented, are responsive to concerns raised in the report.

Appendix 1

OBJECTIVE

The objective of this audit was to determine if the integrated control network met appropriate quality assurance standards.

SCOPE

We conducted the audit from April 2006 to March 2007. The scope of the audit covered the Waste Treatment Plant's integrated control network.

METHODOLOGY

To accomplish the audit objective, we:

- Relied on technical assistance and analyses provided by a software quality assurance expert from the Department of Energy's (Department) Office of Environmental Management;
- Obtained and reviewed planning, quality control, and procurement documents for the Waste Treatment Plant;
- Researched Federal and Departmental regulations;
- Analyzed and assessed Bechtel National, Inc.'s (Bechtel National) internal controls over its procurement of the integrated control network;
- Analyzed the Bechtel National contract with the Office of River Protection; and,
- Interviewed key personnel in the Office of Environmental Management, Office of Price-Anderson Enforcement, Office of River Protection, and Bechtel National.

The audit was conducted 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. We assessed performance measures established under the Government Performance and Results Act of 1993 related to the Office of River Protection's Waste Treatment Plant at the Hanford Site. 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 limited amount of computer-processed data was used during the audit.

We held an exit conference with management on March 1, 2007.

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