U.S. Department of Energy
Office of River Protection
P.O. Box 450
Richland, Washington 99352

04-ESQ-026

Mr. J. P. Henschel, Project Director
Bechtel National, Inc.
2435 Stevens Center
Richland, Washington 99352

Dear Mr. Henschel:

CONTRACT NO. DE-AC27-01RV14136 – ASSESSMENT REPORT A-04-ESQ-RPP-WTP-003 – ASSESSMENT OF WASTE TREATMENT AND IMMOBILIZATION PLANT (WTP) CONTRACTOR COMPUTER SOFTWARE

This letter forwards the results of the U.S. Department of Energy, Office of River Protection assessment of Bechtel National, Inc. (BNI) control of safety computer software for the WTP during the period of February 17 – 23, 2004. The assessment team (Team) identified two Findings (Attachment 1) and made five Observations. Details of the assessment, including the Observations, are documented in the assessment report (Attachment 2).

The Team found BNI had a coherent program for the control of computer software that, with the exceptions of the Findings noted below, conformed to contractual requirements. The Team noted the following positive characteristics of the program:

- It was documented through a wide range of appropriate procedures;
- There was an aggressive and effective Quality Assurance assessment program;
- There was an established and effective supplier evaluation program;
- All personnel interviewed by the assessment team were knowledgeable;
- Bechtel Standard Computer Program technical sponsors at the Bechtel Corporate office were knowledgeable, and information was well-documented in manuals;
- The use of spreadsheets in design calculations was properly controlled; and
- There was an effective configuration management process.

The assessment team identified two Findings and made five Observations. The Findings were:

- The system for error notification from the GXQ code custodian (Fluor Hanford, Inc.) was not adequately implemented; and

- In certain instances, verification and validation (V&V) was conducted without the required pre-approved V&V plan.

The Observations discussed in Attachment 2 do not identify deficiencies, but represent experience-based Observations of the team members that BNI should consider as a source of information for improving its program. In addition to responding to the Findings, in accordance with the attached Notice of Finding, BNI should state the actions it intends to take as a result of the Observations.

If you have any questions, please contact me, or your staff may call Robert C. Barr, Director, Office of Environmental Safety and Quality, (509) 376-7851.

Sincerely,

Roy J. Schepens
Manager

ESQ:DWB

Attachments: (2)

cc w/attachs:
R. H. Lagdon, EH-31
L. D. Vaughan, EM-5
S. M. Hahn, RL
J. F. Schwier, RL

Notice of Finding

Section C, "Statement of Work," Standard 7, "Environment, Safety, Quality, and Health," of the Contract[1], defined Bechtel National, Inc.'s (BNI) (the Contractor) responsibilities under the Contract as they related to conventional non-radiological worker safety and health; radiological, nuclear, and process safety; environmental protection; and quality assurance.

Standard 7, Section (d) of the Contract required the Contractor to develop and implement an integrated, standards-based, safety management program to ensure that radiological, nuclear, and process safety requirements are defined, implemented, and maintained. The Contractor was required to conduct work in accordance with the Contractor-developed and U.S. Department of Energy (DOE)-approved Safety Requirements Document (SRD). The Contractor's SRD was defined in 24590-WTP-SRD-ESH-01-001-02, Revision 2h, dated June 25, 2003.

Standard 7, Section (e)(3) of the Contract required the Contractor to develop and implement a Quality Assurance (QA) program, supported by documentation that describes the overall implementation of QA requirements. The documentation shall identify the procedures, instructions, and manuals used to implement the Contractor's QA program within the Contractor's scope of work. For radiological, nuclear, and process safety, QA is to be conducted in accordance with 10 CFR 830.120. The Contractor's QA program was documented in 24590-WTP-QAM-QA-01-001, "Quality Assurance Manual (QAM)," Revision 4b, dated November 26, 2003.

During performance of an assessment of BNI's program for control of computer software, conducted February 17 through 23, 2004, at BNI's offices, DOE Office of River Protection (ORP) identified two Findings.

A-04-ESQ-RPP-RPPWTP-003-F01 – The system for error notification from the GXQ Code custodian (Fluor Hanford) was not implemented adequately.

Requirements:

a. QAM Policy Q-03.2, "Software Quality," states, "A software defect reporting and resolution system shall be implemented for software errors and failures to assure that problems are reported promptly to impacted organizations and to assure formal processing of problem resolutions."

Discussion:

Contrary to these requirements, BNI did not have an effective process for notification of errors from the code custodian for the GXQ code. BNI personnel told the assessment team it believed Fluor Federal Services (FFS) was the code custodian and would notify them of errors

[1] Contract No. DE-AC27-01RV14136, between U.S. Department of Energy and Bechtel National, Inc., dated December 11, 2000.

as the errors were identified. However, FFS personnel told the assessment team it had transferred responsibility for the GXQ code to Fluor Hanford, Inc. (FHI) in 1997. The cognizant FHI manager told the assessment team he knew BNI was a user of the code. However, FHI did not acknowledge a responsibility to inform BNI of errors in the code, such as those reported by other users.

A-04-ESQ-RPP-WTP-003-F02 – In certain instances, verification and validation (V&V) was conducted without the required pre-approved V&V plan.

Requirements:

QAM Policy Q-03.2, "Software Quality," Section 3.13, "Software Developed Not Using This Policy," states, "Identify the activities to be performed and documents required in order for the software to be placed under configuration management as a minimum, these activities include … test plans and test cases required to validate the software for acceptability."

Discussion:

The assessment team found objective evidence that an approved validation plan was used to test some software before approving it for use, but for other codes this evidence did not exist. In one instance, the personnel who performed the validation said they had not used a plan for the validation process. In other cases, BNI personnel said a plan was used, but it was not retained as a record. In these cases, BNI procedures required the plan be documented in the final V&V report. However, some final reports did not provide evidence that a plan was used during the validation process. Some deficiencies supporting this Finding are:

- There was no approved plan for V&V of the most recent version of SASSI 2000. Personnel who performed the validation testing stated they had not used a V&V plan.

- The RELEX V&V for phase II testing was performed without a V&V plan. The Plan was recreated and issued January 29, 2004, after the V&V was conducted in October and November of 2003.

- Waste Treatment and Immobilization Plant Engineering Baseline Process Performance Software was validated without an approved V&V plan. This was allowed by BNI procedures, but at the time of the assessment BNI was strengthening its procedures to comply with the QAM requirements for validation plans.

- The V&V plan for GXQ was not approved before the test.

ORP requests that BNI provide, within 30 days from the date of the letter that transmitted this Notice, a reply to the Findings above. The reply should include: 1) admission or denial of the Findings; 2) the causes of the Findings, if admitted, and if denied, the reason why; 3) the corrective steps that have been taken and the results achieved; 4) the corrective steps that will be

taken to avoid further Findings; and 5) the date when full compliance with the applicable commitments in your QAM will be achieved. Where good cause is shown, consideration will be given to extending the requested response time.

U.S. DEPARTMENT OF ENERGY
Office of River Protection
Environmental Safety and Quality

ASSESSMENT:	Control of Waste Treatment and Immobilization Plant Contractor Computer Software
REPORT:	A-04-ESQ-RPP-WTP-003
FACILITY:	Bechtel National, Inc.
LOCATION:	3000 George Washington Way Richland, Washington 99352
DATES:	February 17 – 24, 2004
ASSESSORS:	David H. Brown, DOE-ORP, Lead Assessor Shivaji S. Seth, DOE-RL Assessor Clifford A. Ashley, DOE-RL, Assessor Harry E. Bell, DOE-RL, Technical Participant Tino Maciuca, CH2M HILL Hanford Group, Inc., Assessor William Dey, Bechtel National, Inc., Assessor Subir Sen, DOE-EH, Contributor
APPROVED BY:	P. P. Carier, Verification and Confirmation Official

Executive Summary

Introduction

From February 17 to 23, 2004, the U.S. Department of Energy (DOE), Office of River Protection (ORP) assessed the implementation of the Waste Treatment and Immobilization Plant (WTP) Contractor's program for controlling computer software. The Contractor for the design and construction of the WTP is Bechtel National, Inc. The assessment team (Team) evaluated the control of safety software used in the design and analysis of safety systems, structures, and components. It also reviewed preparations the Contractor was making for development of instrument and control (I&C) system software. The Team used criteria, review, and approach documents (CRAD) provided by DOE Office of Assistant Secretary for Environmental Safety and Health to guide its review of the following areas:

Verification and Validation (V&V)
Software Design Descriptions
Software Requirements Descriptions
User Documentation
Software Quality Assurance
Software Procurement
Software Problem Reporting and Corrective Actions
Software Configuration Management

Significant Conclusions and Issues

The Team found the Contractor had a coherent program for the control of computer software that, with the exception of the two Findings noted below, conformed to both the BNI contract and the CRADs. It noted the following positive characteristics of the program:

- It was documented through a wide range of appropriate procedures;
- There was an aggressive and effective Quality Assurance (QA) assessment program;
- There was an established and effective supplier evaluation program;
- All personnel interviewed by the assessment team were knowledgeable;
- Bechtel Standard Computer Program technical sponsors at the Bechtel Corporate office were knowledgeable, and information was well-documented in manuals;
- The use of spreadsheets in design calculations was properly controlled; and
- There was an effective configuration management process.

The Team identified two Findings:

- The system for error notification from the GXQ code custodian (Fluor Hanford, Inc.) was not adequately implemented. Contractor personnel believed that Fluor Government Group (FGG) would notify them of code errors, but FGG was no longer the code custodian. The new custodian (since 1997) did not have a process for notifying users of newly identified errors; and
- In certain instances, V&V was conducted without a pre-approved V&V plan.

In addition to these Findings, the Team identified several issues that it classified as Observations. Observations are issues based on experience of the Team. However, ORP may still request a response from the Contractor on Observations. The Observations were:

- The Contractor should consider linking the training requirements in project plans to the authorized users lists maintained by Information Technology;
- The Contractor should consider requiring engineers to retain computer-generated spreadsheet cell formulas as part of the record of engineering calculations;
- The Contractor should consider revising the V&V documentation for PIPE-FLO by either performing a more complete test or evaluating and adopting the vendor's test;
- The Contractor should consider specifying an analytical process for determining the safety consequences of loss or damage to data. This would aid in accurately classifying databases and in specifying appropriate controls; and
- The Contractor should consider formally evaluating the readiness of its organization and process for the major task of developing safety I&C software.

Table of Contents

List of Acronyms

ASL	Approved Suppliers List
BNI	Bechtel National, Inc.
BSAP	Bechtel Standard Application Programs
CAR	Corrective Action Report
CIO	Chief Information Officer
CIS	Component Information System Database
COTS	Commercial-Off-the-Shelf
CRAD	Criteria, Review, and Approach Document
DNFSB	Defense Nuclear Facilities Safety Board
FGG	Fluor Government Group
FHI	Fluor Hanford, Inc.
I&C	Instrumentation and Control
IT	Information Technology
LIMS	Laboratory Information Management System
OCRWM	DOE Office of Civilian Radioactive Waste Management
ORP	Office of River Protection
PPS	Project Program Sponsor
QAM	BNI *Quality Assurance Manual*
QAS	Quality-Affecting Software
RM	Responsible Manager
SDD	Software Design Description
SIPD	Standards Identification Process Database
SRD	Software Requirements Description
SRS	System Requirements Specification
WEBPPS	WTP Engineering Baseline Process Performance Software
WTP	Waste Treatment and Immobilization Plant

Control of Waste Treatment and Immobilization Plant Contractor Computer Software for the Period of February 17 - 23, 2004

Assessment Purpose and Scope

The assessment team compared the Contractor's processes for the control of design and analysis software to the criteria specified in U.S. Department of Energy Office of Assistant Secretary for Environmental Safety and Health Criteria, Review, and Approach Document (CRAD) 4.2.4.1, Revision 3, "Assessment Criteria and Guidelines for Determining the Adequacy of Software Used in the Safety Analysis and Design of Defense Nuclear Facilities" and the Contractor's Quality Assurance Manual[1]. The CRAD was prepared in response to Defense Nuclear Facilities Safety Board recommendation 2002-1, "Quality Assurance for Safety Software at Department of Energy Defense Nuclear Facilities." The assessment team also reviewed preparations the Contractor was making to develop instrumentation and control (I&C) software, although none had been developed at the time of the assessment.

Significant Observations and Conclusions

Software Requirements Description (SRD)

The Contractor had locally developed very little design and analysis software, although it used some codes that were developed by their corporate organization. Codes provided by the Bechtel corporate organization were called Bechtel Standard Computer Programs (BSCP). Proprietary BSCPs were originally developed years ago, but were still widely used by Bechtel projects and subsidiaries. The Bechtel corporate office had procedures for maintaining these codes, but the codes predated a requirement to have a unique software requirements description document. However, the assessors found the requirements for these codes were adequately documented. (Assessment Note A-04-ESQ-RPPWTP-003-10)

One locally developed spreadsheet named Waste Treatment and Immobilization plant (WTP) Engineering Baseline Process Performance Software was documented in a manner similar to applications. It contained macros and cell formulas, and it was approved for repetitive use. For this situation, Contractor procedures did not require an SRD even though the spreadsheet was functioning as an application. However, the assessors found documentation of the design requirements in other documents. Contractor personnel said they were in the process of strengthening the procedure for routines and macros. (Assessment Note A-04-ESQ-RPPWTP-003-10)

[1] 24590-WTP-QAM-QA-01-001, Revision 4b, *Quality Assurance Manual*

Software Design Description

The codes evaluated by the assessors were either commercial-off-the-shelf (COTS) or legacy codes. COTS software did not require a separately maintained Software Design Description. For legacy codes, the assessors found adequate documentation of the system design in Bechtel documents. (Assessment Note A-04-ESQ-RPPWTP-003-11)

User Documentation

User documents described the hardware and software platform requirements, input and output specifications, user interaction with the software, and potential problems and errors, along with appropriate user responses. The Relex Reference Manual, in particular, contained detailed, illustrated instructions and tutorials. (Assessment note A-04-ESQ-RPPWTP-003-01)

Training requirements for the various codes were stated in project plans. Training requirements were based upon the complexity of the software, its intended uses, and the knowledge and experience of the approved users. Although a list of current "approved" users was available from the Information Technology (IT) organization for each of the software applications reviewed, a list of "qualified" users was only maintained for GXQ. There was no connection between the authorized users list maintained by IT and the training requirements documented in project plans. This issue was documented in Observation A-04-ESQ-WTP-003-O01. (Assessment note A-04-ESQ-RPPWTP-003-01)

Software Verification and Validation

The Contractor and the Bechtel corporate office conducted verification and validation activities for design and analysis software. However, some testing was conducted without pre-approved Verification and Validation (V&V) test plans. For example, the test of the most recent release of the code named SASSI 2000 was conducted without a V&V test plan. In other cases, the Contractor may have had test plans, but they were unable to provide documentation of the test plan to the assessment team. This issue was documented in assessment Finding A-04-ESQ-RPP-WTP-003-F02. (Assessment note A-04-ESQ-RPPWTP-003-08)

There were weaknesses in the validation testing for the PIPE FLO Professional code. The assessors concluded the Contractor should either perform a more complete test or evaluate and adopt the vendor's test. This issue was documented in Observation A-04-ESQ-RPP-WTP-003-O03. (Assessment note A-04-ESQ-RPPWTP-003-12)

There was evidence that other Contractor V&V activities were appropriately rigorous. For example, when offsite personnel were to run codes originally tested on computers at Richland, Washington, the Contractor physically shipped the computers to the offsite location where the work was to be performed. This was done to assure safety software was subject to V&V testing on platforms and operating systems in the same environment in which it would be used.

Software Configuration Management

The Contractor established and effectively implemented a software configuration management process that met the CRAD criteria stated above. Listings of all approved elements of the WTP project software baseline were maintained in approved, issued documents. Procedures reviewed by the assessors that controlled the identification and management of software components and products during all phases of use were understood and followed by WTP personnel. (Assessment note A-04-ESQ-RPPWTP-003-05)

Software installation processes were documented in project IT procedures and software-specific installation plans. Software was installed on individual workstations by the IT department or the Engineering Automation group. Software residing on network servers was made available to approved users. Access to the software was controlled through the use of passwords, restricted-access shared folders, and hardware keys. (Assessment note A-04-ESQ-RPPWTP-003-01)

Software Quality Assurance

The Contractor established an effective quality assurance program for safety software. It implemented established requirements through an appropriate and complete set of procedures, and personnel generally followed the procedures. The Contractor documented quality assurance issues through a system of corrective action reports that required analysis, corrective action, tracking, and closure. A vigorous assessment program identified and obtained timely resolution to meaningful issues. (Assessment note A-04-ESQ-RPPWTP-003-03)

Software Procurements

The Contractor established and effectively implemented the process for evaluation and qualification of vendors of software for WTP Project. The approved suppliers list (ASL) contained the information related to the vendor, items and services supplied, applicable quality assurance requirements, qualification status, and any restrictions resulting from the evaluation performed. The Contractor performed follow-up surveys and annual re-evaluations to include and retain suppliers on the ASL. (Assessment note A-04-ESQ-RPPWTP-003-02)

Software Problem Reporting and Corrective Action

The Contractor developed and implemented procedures for software problem reporting and corrective action for software errors and failures. Organizational responsibilities for reporting issues and implementing corrective actions were identified and the processes were properly documented. Contractual specifications required vendors to notify the Contractor of newly-discovered errors in codes. However, the assessment team found the process for notification of errors for the GXQ code was not effectively implemented. (Assessment note A-04-ESQ-RPPWTP-003-04)

GXQ was used to calculate either a maximum normalized air concentration (X/Q) or an atmospheric dispersion coefficient (X/Q') based on Hanford Site-specific joint frequency data. The Contractor believed that Fluor Government Group (FGG) would notify them if errors were discovered in the code, but FGG had transferred custody of the code to Fluor Hanford, Inc. (FHI). FHI did not have a process for notifying the Contractor of newly discovered errors in GXQ. This issue was documented in assessment Finding A-04-ESQ-RPP-WTP-003-F01. (Assessment note A-04-ESQ-RPPWTP-003-04)

Software Configuration Management

The Contractor established and effectively implemented a software configuration management process that met the CRAD criteria. The Contractor maintained listings of all approved elements of the WTP project software baseline in approved, issued documents and procedures. Procedures controlled the identification and management of software components and products during all phases of use. Procedures were understood and generally followed by WTP personnel. (Assessment note A-04-ESQ-RPPWTP-003-05)

Control of Calculational Software

The Contractor had an appropriate procedure for using calculation software, such as spreadsheets, in design calculations. The engineering activities evaluated by the assessors complied with the procedures. However, the Contractor did not always retain as a record of the calculation the actual spreadsheet cell formulas from the spreadsheet. This was not a requirement, but it is a good practice recommended by NQA-1. This issue is documented in Observation A-04-ESQ-RPP-WTP-003-O02. (Assessment note A-04-ESQ-RPPWTP-003-6)

Databases Controlling Information with Nuclear Safety Implications

The Contractor was following its procedures to manage and control databases that had safety implications. However, the Contractor did not classify some databases as "quality-affecting software" even though they contained information used in the design of safety systems. Databases were classified for control using a simple checklist, but the checklist and associated procedure did not specify an analytical process for identifying the consequences of errors in the databases. The assessors did not consider this a finding because the Contractor still had procedures for identifying and controlling databases with safety implications. However, the Contractor would improve the control of databases by specifying an analysis for identifying the consequences of errors in databases. This issue was documented in Observation A-04-ESQ-RPP-WTP-003-O04. (Assessment note A-04-ESQ-RPPWTP-003-07)

Development of Instrumentation and Control Software

The Contractor was following its established requirements and procedures towards developing system requirements specifications (SRS) for its safety I&C software. In particular, as work proceeded to completely define the set of software requirements, the Contractor was developing functional specifications and design guides to ensure that all system-level safety requirements were adequately captured.

The Team agreed with Contractor managers who said they should:

- Provide more specific requirements and guidance for software safety analysis;
- Ensure that software is designed and implemented to minimize the introduction of defects; and
- Ensure that software is designed and implemented to maximize the detection and removal of defects before the software is placed into service.

This is important because software cannot be tested exhaustively to certify its safe behavior before deployment. The Contractor managers said they were aware of the importance and the need for providing appropriate requirements to ensure that software safety is addressed consistently throughout the software life cycle. They said they intended to modify the applicable procedure and guidance to accomplish this objective. (Assessment note A-04-ESQ-RPPWTP-003-09)

The Contractor performed independent reviews of SRS development activities, such as the preparation of software functional specifications, in accordance with the governing software project plans. However, two of the older software project plans did not identify project-specific independent reviews. Contractor managers said they planned to upgrade the older project plans to include the documents and other products that will be subject to independent review and verification. (Assessment note A-04-ESQ-RPPWTP-003-09)

Development of I&C software for the WTP will be a major undertaking for the Contractor. In preparation for this, the assessors believe the Contractor would benefit from an assessment of its own process maturity. There are a variety of methods available for this, including that provided by the Software Engineering Institute Capability Maturity Model. This issue is documented in Observation A-04-ESQ-RPP-WTP-003-O05. (Assessment note A-04-ESQ-RPPWTP-003-09)

List of Items Opened, Closed, and Discussed

Opened

A-04-ESQ-RPP-WTP-003-F01	Finding	The system for error notification from the GXQ code custodian (Fluor

		Hanford, Inc.) was not adequately implemented.
A-04-ESQ-RPP-WTP-003-F02	Finding	In certain instances, verification and validation was conducted without the required pre-approved V&V plan.
A-04-ESQ-RPP-WTP-003-O01	Observation	The Contractor should consider linking the training requirements in project plans to the authorized users lists maintained by IT.
A-04-ESQ-RPP-WTP-003-O02	Observation	The Contractor should consider requiring engineers to retain computer-generated spreadsheet cell formulas as part of the record of engineering calculations.
A-04-ESQ-RPP-WTP-003-O03	Observation	The Contractor should consider revising the V&V documentation for PIPE-FLO by either performing a more complete test or evaluating and adopting the vendor's test.
A-04-ESQ-RPP-WTP-003-O04	Observation	The Contractor should consider specifying an analytical process for determining the safety consequences of loss or damage to data. This would aid in accurately classifying databases and in specifying appropriate controls.

A-04-ESQ-RPP-WTP-003-O05	Observation	The Contractor should consider formally evaluating the readiness of its organization and process for the major task of developing safety I&C software.

Closed

None

Discussed

None

Signatures

David H. Brown, DOE-ORP
Assessment Team Leader

Dr. Shvaji S. Seth, DOE-RL
Assistant Assessment Team Leader

Clifford A. Ashley, DOE-RL
Assessor

Harry E. Bell, DOE-RL
Technical Participant

Constantin Maciuca, CH2M Hill Hanford Group, Inc.
Assessor

William C. Dey, Bechtel National, Inc.
Assessor

Dr. Subir Sen, DOE-EH
Contributor

Appendix A

Team Member Biographies

David H. Brown, Assessment Team Leader – Mr. Brown has been leading and participating in quality assurance assessments for 17 years. Several of these have included or been focused on computer software quality assurance. He has been certified as a Lead Auditor in accordance with the requirements of NQA-1, *Quality Assurance Program Requirements for Nuclear Facilities*, since June, 1987. Mr. Brown holds a baccalaureate degree in nuclear science from the State University of New York, Maritime College (1971). He received formal training in computer software quality assurance from the Pacific Northwest National Laboratory in 1992. He participated in development of the following DOE directives and documents:

- The DOE response to DNFSB Recommendation 2002-1, *Quality Assurance for Safety Software at Department of Energy Defense Nuclear Facilities*.
- CRAD 4.2.3.1, *Criteria and Guidelines for the Assessment of Safety System Software and Firmware at Defense Nuclear Facilities*
- CRAD 4.2.4.1, *Assessment Criteria and Guidelines for Determining the Adequacy of Software Used in the Safety Analysis and Design of Defense Nuclear Facilities*
- DOE-STD-1172-2003, *Safety Software Quality Assurance Functional Area Qualification Standard*

Dr. Shivaji S. (Shiv) Seth, Assistant Assessment Team Leader – Dr. Seth is Senior Technical Advisor for Nuclear Safety at the DOE Richland Operations Office. He has reviewed the nuclear safety authorization basis and the operational safety of several nuclear facilities at the Hanford site, including those where safety software is deployed both in safety systems and in analyzing facility safety. As a member of a DOE team responding to DNFSB Recommendation 2002-1, Dr. Seth was a contributor to the development of the DOE qualification standard for software engineers and the CRADs for safety software assessments.

Prior to joining DOE in 1996, Dr. Seth managed and guided safety and systems engineering projects at the MITRE Corporation in support of the USNRC and DNFSB. He was the principal investigator of a major project for the USNRC for developing the guidelines, technical basis, and research needs for high-integrity (safety) software in nuclear power plant safety systems. This work (NUREG/CR-6263) has been cited as a resource in various USNRC Regulatory Guides.

Dr. Seth's 35 years of work in the nuclear field also includes nuclear reactor core design and analysis, optimization of the reactor fuel cycle, and safety and probabilistic risk analyses. These involved considerable programming and use of computers. His experience at a national laboratory includes planning and analyzing reactor critical experiments for investigating the design and safety of fast reactors and supervising reactor operations. These involved the use of digital instrumentation and control systems.

Dr. Seth holds Master's and Doctor's degrees in nuclear engineering from the Massachusetts Institute of Technology, Cambridge, Massachusetts, and has authored over 80 technical publications.

Clifford A. Ashley, Assessor – Mr. Ashley has been leading and participating in quality assurance assessments and surveillances during the last 13 years for the US DOE. This includes

nine years experience as a DOE Facility Representative, as well as service as subject matter expert and various quality assurance positions with the New Production Reactor Project and the Tank Waste Remediation System Project. Several assessments included or were focused on computer software quality assurance.

During 1979 to 1981, Mr. Ashley's primary responsibility was to program a HP-1000 computer to record and extract critical test data from DOD sidewinder missile servomechanisms.

Mr. Ashley holds a baccalaureate degree in electrical engineering from Washington State University (1975), and a Master of Science degree in Electrical Engineering from North Dakota State University (1976).

Harry E. Bell, Technical Participant – Mr. Bell was involved in a variety of computer programming projects in a research setting at the Oregon's Albany Research Center from 1982 to 1988. As a result, he contributed to a number of publications in the areas of thermodynamics and metallurgical processing. He was also a computer programmer analyst at the Portland District of the Army Corps of Engineers from 1988 to 1991.

Mr. Bell is currently acting as Hanford's program manager for unclassified cyber security. He remains a computer programming aficionado and maintains proficiency in FORTRAN and assembly languages. Through his private company, Bell Software and Services, Inc., he has written and marketed a technical stock analysis application, PickStock.

Mr. Bell holds a masters degree in chemical engineering from Oregon State University (1987) and is currently registered in Washington as a professional engineer qualified in chemical engineering.

Dr. Subir K. Sen, Contributor – Currently with the DOE's Office of Environment, Safety and Health, Office of Quality Assurance Programs (EH-31), Dr. Sen has significant experience in the use and development of design and analysis computer software for commercial nuclear power plants and DOE nuclear facilities. Dr. Sen has participated in design review and preparation of safety evaluation reports for a number of DOE facilities where computer software was used extensively, such as the Hanford Spent Nuclear Fuel Project and Savannah River Site's F&H Canyons' seismic vulnerability study. He has participated in and led independent assessment and inspection teams that conducted safety analysis reviews, studied ES&H vulnerabilities of DOE's nuclear material storage facilities, and conducted inspections of nuclear D&D operational activities and functioning of essential safety systems. Dr. Sen was the project manager for the DOE sponsored and completed software KBERT that analyzes the ex-facility and in-facility consequence of an accident involving radioactive materials.

Dr. Sen had significant involvement in DOE's response to DNFSB's Recommendation 2002-1. Dr. Sen participated in the development of the DOE implementation plan, in development of the software functional area qualification standard, and in the preparation of the two criteria, requirements, and approach documents used in DOE software quality assurance assessments.

During his 24 years of industrial and research experience, Dr. Sen led engineering teams in the design and analysis of nuclear and fossil power plants, in the use and validation of commercial software, and in the development of computer programs for design and research work.

Dr. Sen holds MS and D.Sc. degrees in structural engineering from Washington University in St. Louis. He is a member of the American Society of Civil Engineers and the Earthquake Engineering Research Institute. He is also a registered professional engineer. He has published in many technical journals and is trained in ISO 9000.

William C. (Bill) Dey, Assessor – Mr. Dey is a Senior Quality Assurance Engineer with Bechtel National, Inc., and has participated in computer software quality assurance audits, both internal and external to Bechtel. His 12 years of experience in the commercial nuclear industry includes assessment and repair of irradiated fuel elements, fuel performance analysis and reporting, cost estimating, preparation of proposals and contracts, and development of software tools to support these activities.

Mr. Dey holds a baccalaureate degree in chemical engineering from Oregon State University (1985).

Constantin (Tino) Maciuca, Assessor – Mr. Maciuca is a Senior Quality Assurance Engineer with CH2M HILL Hanford Group, Inc., (CH2M HILL) and has over 20 years experience in nuclear quality assurance. This includes development and implementation of quality systems using standards and regulations applicable to nuclear facilities and radioactive waste management. It also includes participation in quality assurance assessments and audits. He has been certified as Lead Auditor in accordance with the requirements of ASME NQA-1 since January of 1999 and successfully completed the Lead Auditor training in accordance with provisions of DOE/RW-0333P, Office of Civilian Radioactive Waste Management Quality Assurance Requirements Document (2001).

Mr. Maciuca's 33 years of work in the nuclear field also includes thermal-hydraulic experiments and analytical studies in support of the nuclear reactor fuel design and safety, and the development of the software quality assurance documentation for Columbia University – Heat Transfer Research Facility (New York, 1992).

Mr. Maciuca has extensive experience in audit and assessment of computer software as an employee of BNFL, Ltd., and CH2M HILL. Among other software oversight activities, he has participated in and led oversight of safety software used in development of the Final Safety Analysis Report and the Documented Safety Analysis for the Hanford Tank Farms.

Mr. Maciuca holds a baccalaureate degree in mechanical engineering from Bucharest Polytechnic University, Romania (1970), and he authored over 25 technical publications and reports.

Appendix B

Assessment Notes