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AN UPDATE ON THE QUALITY ASSURANCE FOR THE WASTE VITRIFICATION PLANTS (U)

by

W. H. Caplinger, D. L. Shugars, and M. K. Carlson

Westinghouse Savannah River Company
Savannah River Site
Aiken, South Carolina 29808

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AN UPDATE ON THE QUALITY ASSURANCE FOR THE WASTE VITRIFICATION PLANTS

Wayne H. Caplinger
Manager, Hanford Waste Vitrification Plant Quality Assurance
Westinghouse Hanford Company
Richland, Washington

David L. Shugars
Manager, Quality Assurance
West Valley Demonstration Project
West Valley, New York

Michael K. Carlson
Manager, Waste Management Quality
Westinghouse Savannah River Company
Aiken, South Carolina

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ABSTRACT

Immobilization of high-level defense production wastes is an important step in environmental restoration. The best available technology for immobilization of this waste currently is by incorporation into borosilicate glass, i.e., vitrification.

Three U.S. sites are active in the design, construction, or operation of vitrification facilities. The status, facility description and Quality Assurance (QA) development for each facility was presented at the 1989 Energy Division Conference (ASQC 1989)(1). This paper presents the developments since that time. The West Valley Demonstration Project (WVDP) in northwestern New York State has demonstrated the technology. At the Savannah River Site (SRS) in South Carolina the Defense Waste Processing Facility (DWPF) has completed design, construction is essentially complete, and preparation for operation is underway. The Hanford Waste Vitrification Plant (HWVP) in Washington State is in initial Detailed Design.

The design, manufacture and construction of the facilities continues at WVDP. A novel modular structure has been developed, and installation is underway. After five years of prototype development and operation using non-radioactive materials, the full-scale melter was removed and examination for unanticipated damage is commencing. The results from this task will be important to demonstrate the melter has been designed adequately so as to operate safely throughout the life of the West Valley vitrification process. The WVDP also has revised its quality assurance program description (QAPD) for conformance with the requirements of DOE/RW-0214, Quality Assurance Requirements Document,(2) rather than with OGR/B-14, Quality Assurance Requirements for High-Level Waste Form Production (DOE-OCRWM 1988).(3)

The QAPD for the SRS based on DOE/RW-0214 requirements was submitted to U.S. Department of Energy-Headquarters (DOE-HQ) for review and approval. The DOE-HQ has conducted an audit of the DOE field office and will soon participate in audits of the operating contractor. The DWPF Program Management Team (PMT) is developing a formalized, phased startup program with a complimenting list of startup criteria defining programs and requirements which need to be in place and/or met before the initiation of each startup phase.

The HWVP Project reorganized into an Integrated Management Team (IMT) consisting of four contractors and the U.S. Department of Energy Richland Operations Office (DOE-RL). The newest member of the team is UE&C-Catalytic, Inc. (UCAT), whom the DOE selected as the general construction contractor in January 1990. The current HWVP Project QA Program is based on the requirements of ANSI/ASME NQA-1, "Quality Assurance Program Requirements for Nuclear Facilities (ANSI 1986)"(4) and the supplemental requirements of OGR/B-14, which has been in place since mid-February 1990. A major effort is currently underway to develop and qualify the HWVP QAPD in accordance with DOE/RW-0214.

INTRODUCTION

During Session B of the 1989 American Society for Quality Control Energy Conference (ASQC 1989), a report was presented on the history, status, and process characteristics for three of the vitrification sites in the United States. The WVDP has demonstrated vitrification technology since clean-up activities began in 1982, under the direction of the DOE. Its mission involves two phases: 1) process and vitrify the high-level waste and also decontaminate the facilities; and 2) ship the vitrified high-level waste to a federal geologic repository plus complete disposal of the low-level waste. Testing is essentially complete at WVDP and vitrification operations are scheduled to commence in October 1992. About 350 glass filled canisters, 0.61m (2 ft) diameter by 3m (10 ft) tall, will be produced.

A vitrification facility is also being designed and constructed at the SRS. Known as the DWPF, the design is complete and construction is virtually finished. The DWPF is larger than WVDP and capable of processing the 121 million liters (35 million gallons) of existing high-level waste at SRS, as well as future waste generation for 20 years after startup. The DWPF is a canyon-type facility with remote-handling capabilities where the feed will be treated and blended with other ingredients for eventual processing into borosilicate glass. The glass then will be poured into stainless steel canisters for subsequent transport to a federal repository. Radioactive startup of DWPF is scheduled for 1992.

A facility based on DWPF design and experience is being designed to vitrify the high-level waste at the Hanford Site. Located on the DOE site in south central Washington State, the HWVP will vitrify the high-level waste generated during defense production activities and currently located in the double-shell tanks. Detailed Design began earlier this year (1990), with construction forecasted to begin in July 1991. Radioactive operation is scheduled to begin in 1999.

WEST VALLEY DEMONSTRATION PROJECT

Between 1966 and 1972, Nuclear Fuel Services (NFS) carried out the reprocessing of 640 metric tons of commercially owned nuclear fuel at West Valley, New York. In 1976, NFS withdrew from the fuel reprocessing business and turned the site over to New York State. A DOE study in 1978 resulted in the allocation of responsibility between New York State and the DOE. Congress authorized DOE to carry out a high level nuclear waste management demonstration in 1980. Westinghouse Electric Corporation (WEC) was selected in 1981 as the prime operating contractor. Early in 1982, DOE, New York State, and WEC assembled their waste management teams and assumed operating control of the former reprocessing facility.

The primary objectives of the project are to demonstrate the safe solidification of high-level radioactive waste using the vitrification

process and cement stabilized low-level waste, and to develop technology for nuclear facility decommissioning.

To this end, WVDP has processed 1786 thousand liters (472 thousand gallons) of supernatant, passing it through ion-exchange columns to extract 137 Cs. The cesium is returned to the high-level waste storage tank while the extracted liquid is combined with Portland cement and poured into 269 liters (71 gallon) low-level waste drums. As of June 1990, 8,260 drums have been processed, each having a radiation reading on contact of less than 30 milliRad.

The design, manufacture, and construction of the facilities and equipment to be used in the vitrification process continue to be on schedule. During this past year, the Vitrification Building shell and supporting structures were completed. The process cell wall modules, which included preplaced mechanical and electrical penetrations, have been installed. Vitrification equipment such as the offgas system and mechanical jumpers are being manufactured. Design work for the melter, turntable, decontamination station, remote video system, and the welding system for the canister seal has been or is nearing completion.

The full-scale prototype melter was removed and currently is being disassembled to ascertain if unanticipated damage occurred during its five years of operation. The last run of this melter was conducted remotely during a 1 1/2-month period. The purpose of this run was to show that a glass product meeting the high-level waste acceptance specification requirements could be produced on a routine basis. The results of this run will become part of the glass qualification data.

Currently, the canister seal welds are being welded and tested. The welding is being performed using an autogenous gas tungsten arc process. This round of tests consist of dropping fully weighted canisters from a height of 10m (thirty-three feet). The canisters, which have been helium-leak tested before the drop test, are leak-tested again to verify the integrity of the canister and seal weld.

Technical exchanges are ongoing between WVDP, DWPF, and HWVP. Engineers meet periodically to discuss glass technology, melter design, remote handling and viewing, as well as the welding and decontamination of the canisters. The WVDP meets monthly with representatives (DOE and operating contractors) from each of the other facilities (Working Group on Waste Acceptance) to discuss regulations, share problems and concerns, and identify effective ways of implementing High-Level Waste QA Program requirements.

The QA Program for WVDP was updated this past year to incorporate the QA requirements of DOE/RW-0214, which superseded the previous QA requirements document OGR/B-14. The DOE/RW-0214 document is a result of combining the Civilian Radioactive Waste Management Program for production and repository requirements into one document. Changes were made to the WVDP QAPD as well as implementing procedures that dealt with software control, peer reviews, qualification of existing data,

and test control for High-Level waste form qualification. The revised WVDP QAPD's have been submitted to DOE-HQ for review.

The quality program at WVDP has not only been implemented and proven effective, but it has become a way of life. The WVDP Site is again a finalist for the Corporate George Westinghouse Total Quality Award. This pride in quality is evidenced by the results of various outside evaluations. Inspections are conducted on an ongoing basis by the DOE and Nuclear Regulatory Commission (NRC). It was concluded in the latest NRC audit that "nothing was identified that would suggest a near-term safety problem." Suggestions were offered that would improve the program and these suggestions are now being implemented. The DOE has given WVDP an "excellent" rating twice in the past 6 months. The DOE Tiger Team concluded that "WVDP was doing an excellent job in nuclear safety," and this information was passed to Congress by the Secretary of Energy.

HANFORD WASTE VITRIFICATION PLANT PROJECT

Among the major events regarding the HWVP Project since September 1989 were the following: the announcement of UCAT as the general contractor; reorganization of the HWVP participants into an IMT; and the initiation of definitive design. The DOE announced the selection of UCAT in January 1990. A construction and maintenance service company, UCAT is a subsidiary of United Engineers & Constructors International, Inc. and currently is performing maintenance and modifications at more than 15 nuclear power plants and more than 15 operating process plants. United Engineers & Constructors was formed in 1928 and became a wholly-owned subsidiary of Raytheon Company in 1969. Raytheon Company is a diversified science and technology based organization with current annual sales in excess of $8 billion.

Definitive design for HWVP was officially initiated in January 1990 by the architect/engineer (A/E) Fluor Daniel, Inc. (Fluor) of Irvine, California. The design to date has focused primarily on planning, support utilities, and structures. It is being conducted in accordance with OGR/B-14 (DOE-OCRWM 1988) requirements; however, not all systems receive OGR/B-14 coverage. Only those systems "important to waste acceptance process activities (WAPA)" must comply with OGR/B-14. The design has not matured sufficiently to conclusively identify all specific items and components "important to WAPA." Until this can be completed, 15 systems that are considered in their entirety to be under the WAPA umbrella have been identified.

During the fall of 1989, the HWVP Project reorganized into the IMT approach. The IMT purpose was to increase efficiency through elimination of redundancy, provide cost avoidance, and cause the contractors to focus on their respective tasks and functions. Westinghouse Hanford Company (WHC), in its role as Project manager, was reduced in the area of engineering and technical overviews, and expanded in its QA oversight and overall QA coordination. The A/E, Fluor's, role became focused on design and design verification, with WHC QA assuming the independent auditing of Fluor as well as selected QA technical surveillances. The

role of the technology contractor, Pacific Northwest Laboratory [PNL (operated for DOE by Battelle Memorial Institute)], changed only slightly and continues under the direction of the WHC HWVP Technology Group. The WHC QA continues to conduct independent audits and surveillances plus an involvement in PNL procedures and test plans. As mentioned above, UCAT became the General Contractor with construction responsibility including procurement of processing equipment. The WHC provides QA audits and overview of UCAT, and will perform Title III inspections.

Before IMT, the Project was a collection of DOE contractors, each with nearly a full range of functions. The IMT visualizes the Team as a functioning entity, i.e., with a Project Manager (WHC) function, an Engineering function (FD), a construction function (UCAT), and a Research & Development function (PNL and WHC). The central QA group (WHC) provides overall guidance, approvals, and independent verification. However, each function retains certain QA activities. For the IMT to succeed, it is vital that each functioning organization performs in the best, long-range interests of the overall Project, and that cooperation be paramount. It is also recognized that the IMT needs increased definition of responsibilities and planning, and the Project (including DOE-RL) has moved to document these.

The principal recent QA development at HWVP was the implementation of OGR/B-14 (DOE-OCRWM 1988) requirements. An Implementation Plan was prepared in December 1989, describing the seven major steps to achieve compliance. The steps included the following: identification of the applicable criteria for each contractor, revision of the Quality Assurance Plan (QAP), procedure preparation, training, and QA surveillance. The resources were committed and the Project participants were in compliance by mid-February 1990. To achieve compliance in this short period, only those procedures needed to support current work activities were prepared and implemented. Each participant prepared a schedule of additional procedures needed to support forecasted future work. Additional procedures have been prepared per this schedule. During this period DOE/RW-0214 was approved by DOE-HQ to replace OGR/B-14 and conversion from OGR/B-14 to DOE/RW-0214 by HWVP participants is expected during 1990. Any new procedures are being prepared with this in mind.

DEFENSE WASTE PROCESSING FACILITY

The DWPF is a three-story, reinforced-concrete structure similar to the existing canyon-type facilities at the SRS. The Chemical Process Cell (CPC) is located in the center of the building. It is designed for remote operation and maintenance. Within this cell is a line of ten 37,805 liter (10,000-gallon) tanks and other equipment. Pumps, agitators, and condensers are mounted on the tank tops. Tanks are precisely "located" in this canyon by trunnion buttons extending from the tanks to trunnion guides mounted on the canyon walls. This allows remotely removable pipes (jumpers) to be installed and connects equipment to precisely located wall nozzles. All tanks, pumps, agitators,

condensers, heating coils, and equipment frames can be removed by a remotely controlled crane.

The DWPF contains both remote and hands-on decontamination and maintenance facilities where equipment can be repaired. The second and third floors contain electrical, instrument, and cold feed facilities. A mezzanine between the first and second floor, adjacent to the CPC, contains sampling and analytical facilities.

Some of the existing waste at SRS has been processed and is ready to feed to the DWPF. Low-level radioactive liquid waste resulting from the preparation of waste for the DWPF provided the first radioactive feed to the new SRS Saltstone Facility on June 12, 1990. The first three runs resulted in processing 106 thousand liters (28 thousand gallons) of feed into grout, the permanent waste form.

The DWPF is approximately 98% mechanically complete with 85% of checkout and run-in completed. The recently formalized DWPF startup test program follows checkout and run-in of individual equipment. The startup program is divided into four phases, with operations quality assurance program implementation increasing proportional to need as the startup program progresses. In support of this, a list of all (including QA) programmatic and program implementation requirements for the various phases of startup are being developed. The phases of startup are described briefly below.

In the integrated water runs the objective is to use water as the operating fluid to obtain basic operability information on the performance of systems and process steps. Performance of process monitoring and support equipment will also be evaluated. Integrated water runs are scheduled to start in late September 1990.

During cold chemical runs, chemicals will be introduced into process equipment to simulate future radioactive feed. Performance of equipment, systems and process will be monitored and assessed as part of the startup program. This will be the first exposure of process equipment to corrosion/erosion environments.

For the waste form qualification runs, the objective is to verify, using simulated waste, that the DWPF process produces a product that will be acceptable to the repository. The waste form compliance plan describes the product requirements from the waste acceptance preliminary specifications and the general plan for meeting them. Results of the waste form qualification runs will be documented in test reports, and acceptance of the process and product will be through waste form qualification reports. Included in prerequisites for qualification runs are implementation of Westinghouse Savannah River Company (WSRC) QA procedures and the DWPF QAPD.

Prior to radioactive operation, readiness of equipment, documentation and personnel will be thoroughly documented and demonstrated. Product acceptance testing will initially be documented in waste form

qualification reports to validate correlations with previous cold qualification runs. If no significant problems are encountered during the first three phases of startup, operation with radioactive material could start in late 1992.

The startup test program administration is modeled after preoperational tests which have been employed successfully in commercial nuclear power plants. The primary quality assurance requirements applicable to administration of the program are from WSRC QA procedures. A startup test program plan describes authorization and organization of the DWPF Startup Department. The plan outlines a preliminary test index, creation of the Joint Test Group (JTG), the basis for test plans and test procedures.

The JTG is composed of members from WSRC Engineering and Projects Division, Savannah River Laboratory, Department of Energy, Waste Management Programs Quality Department (WMPQ), and the DWPF Operating and Technical Departments. WMPQ, as part of the JTG, approves test procedures and test reports. WMPQ personnel perform normal oversight activities on startup test program activities in support of the DWPF PMT through surveillances and inspections. Additional requirements imposed on startup activities by the QAPD are included in inspection criteria and surveillance scopes.

A major SRS milestone was reached in April 1990 with the issuance of the Operating Contractor QA Manual based on NQA-1 (ANSI 1986). Much of the design, manufacture, and construction of the DWPF was conducted to industrial standards, but in 1988 a new Operating Contractor, Westinghouse (WEC), was selected by DOE. The Westinghouse Savannah River Company contract included compliance to NQA-1 (ANSI 1986). DWPF PMT personnel are revising QA implementing procedures to conform within the WSRC QA Manual.

The DWPF completed Revision 5 of their QAPD to respond to Revision 2 of DOE/RW-0214 (DOE-OCRWM 1988). The QAPD and DOE/RW-0214 are expected to continue going through iterations.

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