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August 1994

RESTART OVERSIGHT ASSESSMENT OF HANFORD 242-A EVAPORATOR

Summary Report

U.S. Department of Energy
Office of Environment, Safety and Health
Office of Nuclear Safety
Washington D.C. 20585
HTF-242A-94-01

MASTER

OFFICE OF ENVIRONMENT, SAFETY AND HEALTH

Restart Oversight Assessment of Hanford 242-A Evaporator Summary of Report No. HTF-242A-94-01

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Restart Oversight Assessment of Hanford 242-A Evaporator

INTRODUCTION

This report summarizes a January 17–28, 1994, oversight assessment of restart activities for the 242-A Evaporator at the U.S. Department of Energy's (DOE's) Hanford Site about 25 miles northeast of Hanford, Washington. The assessment was conducted by qualified staff and consultants from the DOE Office of Environment, Safety and Health (EH). Its focus was the readiness of the facility for the resumption of safe operations, in particular those operations involved in the treatment and disposal of condensate from the evaporation of liquid radioactive waste, a key element of the tank waste remediation project administered by the DOE Richland Operations Office (DOE-RL).

Overall, the assessment yielded eight programmatic concerns, supported by 38 individual findings. Of the concerns, four have already been closed, and the other four have been resolved. Results pointed up strengths in management and engineering design, as well as effective support of facility training programs by the management and operating contractor, Westinghouse Hanford Company

(WHC). Weaknesses were evident, however, in conduct of operations, maintenance, and radiological practices. Furthermore, problems in the submittal and approval of Compliance Schedule Approvals—that is, WHC documentation of the status of compliance with DOE Orders—were indicative of a programmatic breakdown in the DOE Order compliance process. According to the results of this assessment, there are no safety and health issues that would preclude or delay restart of the evaporator.

BACKGROUND

Built in 1973 near the center of the Hanford Site, the 242-A Evaporator has become an integral part of the DOE program for the treatment and disposal of low-heat-generating liquid wastes. The facility was designed to concentrate such wastes, and thus to reduce the amounts to be stored and to make more storage space available. It began operation in 1977 with a projected useful life of 10 years. In 1989 it was shut down temporarily for resolution of a concern about compliance with the hazardous waste provisions of the Washington

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State Administrative Code, whose requirements are the state's equivalent of federal guidelines under the Resource Conservation and Recovery Act (RCRA). The concern in question related to the discharge of hazardous waste as process condensate via retention basins and a crib. RCRA explicitly prohibits the discharge of liquid hazardous wastes to landfill units such as cribs.

After the shutdown, various steps were taken to ready the facility for restart and safe operation. As part of a project to extend its useful life through the year 2000, the control room was modified, as were the monitoring control and vessel ventilation systems; a Raw Water Service Building was constructed; and additional support equipment was

provided. A Liquid Effluent Retention Facility (LERF) was also constructed as an interim step toward resolution of the RCRA waste concern. Full resolution should be achieved with completion of the Effluent Treatment Facility currently under construction. In addition, the facility's hazard designation was changed from "low hazard" to "moderate hazard," and its Safety Analysis Report was amended to reflect the safety envelope associated with the new classification. Finally, DOE and WHC conducted several Operational Readiness Reviews (ORRs) in preparation for returning the facility to service, and EH provided oversight of these restart preparations.

242-A Evaporator/PUREX Process Condensate Treatment Facility

242-A Evaporator Building

PROCESS DESCRIPTION

High- and low-level liquid radioactive wastes generated at Hanford are treated in the 242-A Evaporator. By a process of evaporation and concentration, the evaporator reduces the volume of the wastes and thereby the number of double-shell tanks required to store them.

Waste feed is pumped through an encased underground feed line to the Evaporator Building and then into the evaporator vessel for processing. The vessel, the process concentrate collection system, and associated piping and equipment provide primary confinement of the waste, and the Evaporator Building and its ventilation system provide secondary confinement of liquids and airborne particulates released inside the structure.

Evaporation generates two product streams: (1) a liquid stream, or double-shell slurry, and (2) a process concentrate stream consisting of water vapor and a gaseous effluent. The slurry is transferred from the evaporator through encased underground piping to valve pits and is then distributed to double-shell tanks in the 200 East Area. The process concentrate stream is passed through one primary and two secondary condensers, where the water vapor and the gaseous effluent are separated. Then the gases are filtered out and released to the environment via the vessel vent exhaust system, and the water vapor is collected, passed through an ion exchange column, and ultimately discharged to the Liquid Effluent Retention Facility. Cooling water from the condensers is discharged to a holdup pond. The reboiler steam condensate is impounded in a basin and, on verification that the results of a radiological sampling of

the basin are within prescribed release limits, is released to a pond.

SAFETY ENVELOPE

A breach of containment is the most significant threat to the safe operation of the evaporator. Such an event could result from excessive process pressure or temperature, mechanical failure, corrosion, or the impact of a foreign object. The most serious breaching scenario is one in which a pump spray leak develops and causes wetting and subsequent failure of the process ventilation filters, and thereby the dispersal of airborne radioactive contaminants.

Engineered safeguards have been incorporated into facility and process design to prevent or mitigate a breaching event.

The evaporation process selected, however, is the most effective facility safeguard. Evaporation is accomplished by continuously circulating waste from an external feed tank through the evaporator, adding sufficient heat to keep the waste temperature at approximately 170°F, and maintain-

ing a vacuum on the system sufficient to induce boiling at this temperature. Thus, any process system leak would be inward, resulting in a loss of vacuum and an inhibition of continued boiling—the only exception being leaks near the discharges of the circulation and slurry pumps, where pressures are positive. Control of the rates of waste feed and slurry return flow is maintained by balancing heat input and condenser cooling to produce the temperature and vacuum conditions that are conducive to optimal boiling.

Process operating procedures define the limiting conditions for operation (LCOs), and operators are trained to keep the process within those limits. If the LCOs were exceeded, appropriate sensors and interlocks would be actuated to ensure against excessive pressure or temperature condi-

tions; that is, systems that add energy to the process—heaters and pumps, for example—would simply shut down. Such systems are “hard-wired” to the monitoring and control system, and thus are not subject to operator influence.

Aside from the inherent process safety features, the facility benefits from several engineered safeguards. Process containment involves three independent systems: primary containment is provided by the evaporator vessel and associated piping, normally operating under a partial vacuum; secondary containment, by the shielded hot cell that surrounds the process vessels and piping—these have sufficient internal volume to prevent release of the contents of the evaporator in the event of a catastrophic primary containment failure; and final containment, by the outer walls of the facility.

Evaporator Process Flow

Although there are only two ventilation zones—i.e., the hot side and the manned spaces—within the facility, there are three ventilation subzones in the manned space between the second and third containments. Under normal operating conditions, pressure differentials are maintained across each barrier to ensure that air leakage is always in a direction away from the control room toward the hot side.

The facility is designed to withstand the full range of potential accidents and abnormal operating events, including the loss of electrical power and the loss of instrument service air. A fire suppression system and a standby diesel generator are also available, although neither is vital to maintaining the safety envelope.

242-A Facility Layout

CHRONOLOGY OF RESTART READINESS ACTIVITY

In accordance with the superseded *Procedures for Restart of Reactors and Non-Reactor Nuclear Facilities*, dated February 26, 1992, restart of the 242-A Evaporator was designated a Type 3 restart, and thus became subject to approval by the cognizant program office, the DOE Office of Environmental Restoration and Waste Management (EM). (Because DOE 5480.31, *Startup and Restart of Nuclear Facilities*, dated September 15, 1993, had not yet been issued, it was not used as a basis for the initial restart readiness activities of the program office and operations office.) The Type 3 designation was the impetus for the series of review and oversight activities (see box, p. 7) elaborated in the following sections.

WHC Operational Readiness Review, November 1992

WHC conducted an ORR for the restart of the evaporator beginning in November 1992 and ending on May 7, 1993. The review involved more than 1500 lines of inquiry into facility performance and yielded 104 findings. An Operational Readiness Evaluation (ORE) team from EM was also present during February 8–12, 1993, to observe training

runs at the facility. On completion of the review, WHC declared its readiness to restart the facility, subject to the closure of outstanding prestart findings. To allow time for closure, the WHC Readiness Review Board and DOE-RL recommended that the ORE be postponed for approximately 4 weeks. This period was also used for further training of the operating crew and the closure of additional "punchlist" items.

DOE Operational Readiness Evaluation, June 1993

Over the period June 7–18, 1993, DOE Headquarters (EM) and DOE-RL conducted their first joint ORE of the 242-A Evaporator. The ORE team consisted of 11 individuals with expertise encompassing 17 programmatic areas, and it was supported by six advisors, three of whom were senior advisors. Activities of the team were as stipulated in the Operational Readiness Evaluation Plan for the 242-A Evaporator/Crystallizer.

Operational readiness was judged in terms of the achievement of various objectives broken down into four categories:

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- ♦ Plant and equipment (hardware) readiness
- ♦ Personnel readiness
- ♦ Management readiness
- ♦ Functional area and program readiness

The ORE resulted in 13 prestart findings and numerous poststart findings and observations. The team concluded that WHC would have to resolve all prestart findings before restarting the facility. It also recommended that WHC develop, before restart, a plan and schedule for resolving all poststart findings.

Representatives from EH monitored the activities of the ORE team. They concluded that WHC preparations for evaporator restart warranted further scrutiny and that DOE-RL would have to take steps to ensure that the contractor was indeed ready for restart.

Stand-down from Evaporator Operation, August 1993

On August 12, 1993, work at the Hanford Tank Farms, including the 242-A Evaporator, was placed on administrative hold by senior WHC management after a series of incidents indicative of less-than-adequate conduct of operations. (None of the incidents had occurred at the 242-A Evaporator.) This stand-down considerably delayed the evaporator restart efforts of DOE-RL and WHC. Organizational changes and the reassignment of personnel in these organizations contributed to a loss of continuity, which resulted in uncertainty as to the status of corrective actions and engendered new expectations.

DOE-RL Restart Review, November 1993

From November 29 to December 23, 1993, the DOE-RL Tank Operations Office conducted a separate restart review of the evaporator. Its objective was to verify that corrective actions agreed to before the stand-down—i.e., actions in response to ORE and other requirements—had been completed, and that the facility was prepared for resumption of the ORE. The review featured an evaluation of selected restart readiness documentation, and focused on four functional areas that

had been the source of deficiencies in previous assessments of the evaporator and the Tank Farm complex:

- ♦ The facility Safety Analysis Report (SAR) and the safety envelope
- ♦ Conduct of operations
- ♦ Industrial hygiene and occupational safety
- ♦ Emergency preparedness

Specific topics and programs in each area were sampled to determine the current status of evaporator programs, the purpose being to go beyond individual prestart punchlist items in the assessment of evaporator programs. Evaluations of the status of other issues and actions with a view to clearing the way for return of the ORE team were also conducted. These evaluations focused on environmental issues, the closure of prestart findings, planned corrective actions for poststart issues, and facility compliance with DOE 5480.31 (the Department's restart Order).

Results of the DOE-RL restart review revealed no safety-significant issues that would delay completion of the ORE. Accordingly, on January 4, 1994, DOE-RL formally requested that the ORE team resume its evaluation of evaporator restart. That request was granted, and the ORE follow-up visit was scheduled for January 17–27, 1994.

DOE Operational Readiness Evaluation, January 1994

During January 17–27, 1994, EM completed the ORE that had begun in June 1993. Since DOE 5480.31 had been issued in the intervening period, the team focused on resolution of the Core Requirements of that Order with the Criteria and Review Approaches (CRAs) used during the earlier visit.

Although noting that WHC had made substantial progress toward readiness status since the June 1993 evaluation, the EM team identified five prestart findings that would have to be closed before it could authorize restart. The ORE team leader and selected members of the team made a follow-up visit on March 21–23, 1994, to confirm the closure of these findings.

CHRONOLOGY**Restart Readiness Review and Oversight Activities for the 242-A Evaporator****1993**

WHC Operational Readiness Review	Nov. 1992–May 7
EM Operational Readiness Evaluation team visit to observe training runs of 242-A Evaporator/Crystallizer	Feb. 8–12
EM Operational Readiness Evaluation*	June 7–18
Stand-down from evaporator operation	Aug. 12
RL restart review	Nov. 29–Dec. 23

1994

EM Operational Readiness Evaluation*	Jan. 17–28
EM follow-up to Operational Readiness Evaluation*	March 21–23

* Concurrent with an EH oversight assessment

EH OVERSIGHT ASSESSMENT

An EH team conducted an oversight assessment of the 242-A Evaporator over January 17–28, 1994, and a follow-up visit on March 21–23. The primary objective of this assessment was independent assurance of the safety of resumption of evaporator operation following the extended outage as well as oversight of the ongoing EM Operational Readiness Evaluation. The assessment encompassed several functional areas: conduct of operations, maintenance, engineering and configuration management, safety analysis, worker safety and health, training and qualification, management and oversight, and closure activities. It also involved a review of prestart findings identified during the June 1993 restart oversight assessment.

Overall, the assessment yielded eight programmatic concerns (see box), supported by 38 individual findings. Of the concerns, four have already been closed, and the other four have been resolved. Furthermore, closure has been verified for all prestart findings and concerns identified in the June 1993 oversight assessment and in EM's Operational Readiness Evaluation.

Conduct of Operations

Operations at the 242-A Evaporator, for the most part, were conducted by trained and certified operators in accordance with approved procedures. The more significant findings identified by the assessment team pertained to procedural consistency

and configuration control, procedure use, management oversight, and facility status. Judging from the results of this assessment, there are no safety and health issues that would preclude or delay restart of the evaporator.

The team assessed a variety of ongoing operations at the evaporator, including surveillance testing, alarm response, shift turnovers, and emergency drill performance. It found that operators exhibited a good working knowledge of conduct of operations. However, WHC had not prepared a conduct-of-operations implementation plan in accordance with the requirements of DOE 5480.19, *Conduct of Operations Requirements for DOE Facilities*. Once alerted to this condition, WHC performed a complete reassessment of that Order's applicability matrix and recommended a course of action to resolve any discrepancies.

With few exceptions, procedures for normal operation, alarm response, operational safety requirement (OSR) surveillance, and emergency response contained an appropriate level of detail and appeared to be sufficient for their stated purpose. Furthermore, operating personnel were knowledgeable regarding procedural requirements and operational response characteristics. Certain procedural inconsistencies, however, were evident. In the "review" section of several functional test procedures, for example, the Shift Manager was directed to review and evaluate the tests for acceptability and to document this by signature within one working day. However, these functional test procedures contained neither guidance as to which steps were critical nor clear statements of acceptance criteria. The lack of clearly defined acceptance criteria in surveillance procedures, in conjunction with the one-working-day review requirement, could lead to operation outside the design basis for periods exceeding the allowed action times. To correct this condition, WHC has revised the OSR surveillance procedures to clearly delineate acceptance criteria.

Maintenance

Overall, the maintenance program met the intent of DOE 4330.4A, *Maintenance Management Program*, and provided reasonable assurance that systems important to the protection of the environment, workers, and the public were reliable and maintained in a state of readiness. The material condition of the 242-A Evaporator was very good.

WHC management had implemented a matrixed maintenance organization that was more responsive to the needs of the facility. The work control system consisted of a series of administrative control procedures ensuring that critical maintenance activities were accomplished promptly and correctly. Corrective maintenance activities at the facility were controlled by reviewed and approved procedures, and facility personnel carried out major repair activities in accordance with these procedures. However, the assessment revealed a persistent problem of reliability with the radiation monitors associated with the AP and AW Tank Farms. Several of the annunciators associated with these monitors were in an alarm state, and operations personnel reported a high frequency of false high-radiation alarms. Among the operators interviewed, there was a general feeling that insufficient resources had been committed to resolve the problem. WHC affirmed that actions stipulated in its Waste Tank Operations Integrated Upgrade Plan of Action would resolve this problem.

The requirements and responsibilities for preventive maintenance of the facility and its supporting systems and subsystems were found to be delineated in approved procedures. However, deficiencies were evident in the conduct and documentation of preventive maintenance for some facility systems. To correct this condition, WHC revised its preventive-maintenance procedures and developed a program for training managers on the proper methods of filling out and reviewing preventive-maintenance data sheets.

Engineering and Configuration Management

The engineering organization was found to effectively administer the facility design and modification control function. Engineering personnel were familiar with the design control process and knowledgeable of the systems and activities for which they are responsible. The recent establishment of cognizant system engineers for the 242-A Evaporator was deemed a "good practice," one that would improve overall plant design controls and practices. Engineering practices were generally controlled by approved procedures. Modifications were designed to acceptable specifications, and design backlogs were not excessive. Post-modification test requirements were specified for each modification,

STATUS OF CONCERNS

The requirements of DOE 5480.19, <i>Conduct of Operations Requirements for DOE Facilities</i> , have not been fully satisfied, nor have requests for exemption from compliance been fully justified.	CLOSED*
Westinghouse Hanford Company has not established all formal procedures required for the conduct of facility operations.	CLOSED*
Maintenance on the AP and AW Tank Farm radiation monitors does not ensure their accuracy and thus their suitability for the support of facility operations.	RESOLVED
The unreviewed-safety-question determination process does not include all activities that could impact the authorization basis.	CLOSED*
The operational safety requirements do not address all the requirements and systems necessary to protect the health and safety of the worker.	CLOSED*
Poor radiological protection practices were evident in the performance of a facility radiological control drill.	RESOLVED
Some aspects of the facility training program are deficient in scope and applicability.	RESOLVED
The management programs in place at the facility do not comply fully with the requirements of DOE Orders in the areas of self-assessment, surveillance, lessons learned, trending, and performance measurement.	RESOLVED

* Prestart Concern

and they provided reasonable assurance of the correctness and operational readiness of the modification. Drawings reflecting the as-built facility were available, and outstanding Engineering Change Notices affecting system configuration were reflected on the design drawings. Although drawings were usually revised within 30 days of sign-off on the Engineering Change Notice (indicating that the work had been completed), inordinate delays in the sign-off process had increased the time between completion of the work and revision of the drawing. WHC agreed to take steps to reduce this delay.

The configuration of temporary modifications was controlled by reviewed and approved procedures. However, extensions of temporary modifications beyond the prescribed 90 days were not subject to the requirements of unreviewed-safety-question (USQ) determination—that is, determination that the safety consequences of physical or procedural changes in the facility do not invalidate the assumptions of the facility safety analyses. To correct this problem, WHC revised its procedures to encompass application of the USQ determination process to the extension of temporary modifications.

Safety Analysis

The SAR and supporting documentation had been prepared in accordance with existing guidance, the accident analyses were bounding, and cognizant engineers were aware of the SAR's requirements. Weaknesses existed, however, in the control of operational safety requirements, in the USQ determination process, and in maintenance of the authorization basis for the facility.

Although the quality of the USQ determination process had shown steady improvement, the threshold for implementation of that process did not ensure appropriate review and approval of all proposed changes and activities that could impact the authorization basis. For example, WHC did not apply the process to interpretations of operational safety requirements contained in facility standing orders. To correct this condition, WHC arranged for its Plant Review Committee to look into this issue and committed to screening future interpretations of operational safety requirements to ensure that unreviewed safety questions are addressed.

Typical of deficiencies was the fact that there were no specific operational safety requirements or surveillances associated with the cathodic protection system, which is defined in the SAR as Safety Class 2. Even though preventive maintenance on the system was extensive—three discrete checks were performed bimonthly and annually—there was no routine operator surveillance or tracking of cumulative system downtime. Without adequate surveillance, maintenance of the cathodic protection system as a Safety Class 2 system cannot be ensured. To address this deficiency, WHC prepared OSR surveillance procedures and acceptance criteria for safety-related portions of the cathodic protection system.

Worker Safety and Health

The worker safety and industrial hygiene programs at the facility had been implemented in accordance with DOE requirements and guidance. The occupational safety and health policy was comprehensive, the responsibilities of the various levels of management were defined, and occupational safety and health program training was provided. Furthermore, a radiological protection program in the form of procedures, training, and facilities was

in place to support facility operation. However, poor radiological practices observed during a hazardous and radioactive waste spill drill indicated a need for improvement in program implementation. For example, response actions were slow, and anticontamination clothing worn in the simulated surface contamination area was incorrect. WHC agreed to continue drills in this area with a view to upgrading personnel performance.

Training and Qualification

The training program provided certified and qualified personnel for the operation and support of the 242-A Evaporator. The certification process, records, and documentation were particularly good. Administrative procedures, lesson plans, and instruction—all attested to the effectiveness of facility training, particularly the Evaporator Operator Training Program. Personnel were trained to levels commensurate with their responsibilities, and they were aware of their responsibilities, constraints, and required interactions. Training programs were administered in accordance with reviewed and approved procedures and, according to the results of interviews with WHC training management, were well funded. Moreover, plans had been formulated for increased staffing of the Operator Training Department to better serve the needs of facility personnel. However, the Tank Farm managers—that is, management personnel at levels above Shift Manager—did not normally receive facility-level training (e.g., training on facility design, training on safety systems and their bases). Advised of this deficiency, WHC committed to developing a plan for certifying Tank Farm Operations Managers.

Management and DOE Oversight

Surveillances by WHC management helped to ensure that waste tank operations facilities met administrative, housekeeping, and safety requirements. Execution of the surveillances, however, was inconsistent. For example, procedures required that the Facility Manager or a representative perform a surveillance of one facility per week on a rotating basis, so that each facility was inspected at least once a month. Data sheets indicated that the last such documented surveillance was in June 1993. WHC management was in the process of

updating the surveillance program to focus more attention on aspects of conduct of operations. New surveillance checklists and rotating schedules had been developed, but procedures had not yet been formalized. The new program will include an effective protocol for monitoring and measuring progress toward conduct-of-operations goals.

The EH team also determined that WHC had not fully established several major management programs at the evaporator. Lacking, for example, were formal management self-assessment or lessons-learned programs. There were also no formalized goals and objectives, or associated performance

measurement system, and no formal procedure for establishing trends in Occurrence Report data. In response to this deficiency, WHC initiated the development and implementation of management programs in these areas.

Finally, the EH team concluded that reviews performed according to a revised ORE plan implemented during EM's ongoing Operational Readiness Evaluation were effective in determining facility restart readiness. The reviews, focusing on occupational health and safety, industrial hygiene, and environmental protection, were particularly comprehensive and well conducted.

GLOSSARY

Authorization basis

Those aspects of the facility design basis and operational requirements deemed important to safety and therefore relied upon by DOE to authorize the operation of a nuclear facility.

Closure

The condition existing when corrective action in response to a concern has been implemented and its implementation has been verified by DOE's Office of Environment, Safety and Health.

Concern

A condition that, if left uncorrected, could have an adverse impact on the health and well-being of nuclear facility workers or the general public. A concern is derived from one or more "findings."

Containment

The combination of systems, structures, and components of a nuclear facility that are required to contain radioactive and chemically hazardous materials and thus preclude emissions thereof during normal, abnormal, and accident conditions.

Design basis

The set of requirements, some of which are important to safety, that bound the design of systems, structures, and components of a nuclear facility.

Finding

A documented nonconformity with nuclear safety requirements or performance standards.

Interlock

An electrical connection that permits the automatic activation of a control system at a particular setpoint in order to maintain a safe process configuration.

Lessons-learned program

A program by which information derived from investigations of nuclear occurrences is made available to nuclear facility operators and is incorporated into personnel training and facility procedures.

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