LESSONS LEARNED FROM STARTUP OF THE SAVANNAH RIVER SITE E- AREA DISPOSAL VAULTS AND CURRENT OPERATIONAL STATUS

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ABSTRACT

Due to the changing nature of the Department of Energy (DOE) complex's activities, startup of new facilities has become an involved process, requiring that major changes be planned for when scheduling startup activities. During the course of the E-Area Vaults (EAV) startup, considerable changes in discipline of DOE operations occurred which will improve EAV operations, but many of which were unplanned and required quick implementation. This paper outlines the processes that the EAV startup team, including both Westinghouse Savannah River Company's (WSRC) team and the DOE-Savannah River's (DOE-SR) participants, used to accomplish activities involved in startup of a new nuclear facility within the DOE complex.

BACKGROUND AND VAULT CONSTRUCTION

Changes in social and political affairs have placed increased emphasis on concerns for the environment resulting in new laws, rules and regulations. Additionally, improvements made through technical research have had a great impact on analysis limits, with smaller and smaller concentrations of contaminants being able to be detected and evaluated. New and greater emphasis is placed on a well-rounded stewardship of personnel, natural resources and economy. This holds true for disposal of solid low-level radioactive waste (LLW) disposed at the DOE's Savannah River Site (SRS), as well. Engineered concrete disposal facilities constructed at the SRS are undergoing final readiness reviews to begin enhanced disposal.

The vaults in the E-Area were designed primarily for ease of handling, to reduce exposures during offloading, and to minimize contact of contaminants with the soil and groundwater. Two vault types are defined by the level of activity allowed within each structure. Wastes with low radiation rates (less than 200 mrem/hr at 5 cm (2 mSv/hr) from an unshielded container) are defined as Low Activity wastes at SRS. Wastes with radiation rates in excess of the 200 mrem/hr (2 mSv/hr) limit are considered Intermediate Activity wastes. Additionally, wastes containing more than 10 Curies ($3.7E^{+11}$Bq) per package of tritium, or in excess of 10 nCi/g ($3.7E^{+2}$Bq/g) concentration of transuranic radionuclides, are considered Intermediate Activity wastes. A separate vault type was designed and constructed for each of the two activity levels. Vaults will be built on an as-needed basis during the next 20 years.

Low Activity Waste Vault

The Low Activity Waste Vault was designed and constructed to be front-loaded by conventional means - standard fork lift trucks. The vault consists of a reinforced concrete structure which is 145 feet (44 m) wide by 648 feet (198 m) long and stands nominally 25 feet (7.6 m) high. Structure walls of 2 foot (0.6 m) thickness are mated to a 2.5 foot (0.8 m) thick slab and are capped by a 1.33 foot (0.4 m) thick roof supported by concrete bridge beams. The vault is divided into 12 individual cells, each with the capacity to hold approximately 1000 steel boxes with 4 X 4 X 6 foot (1.2x1.2x1.8 m) dimensions. It is constructed atop an engineered subsurface drain system similar to a French drain system. A roof drainage system collects and channels rainwater through gutters. Both the subsurface and the roof drainage systems drain to a common, clay-lined basin for sediment control and evaporation. An in-cell drain system collects any liquids which may find their way into the cells of the vault. Liquids will be collected in concrete catch basins so that they may be sampled.

Intermediate Activity Waste Vault

The Intermediate Activity Waste Vault was designed and constructed to be top-loaded using a mobile gantry crane and consists of two basic units. Seven Intermediate Level NonTritium (ILNT) cells are mated to a 2.5 foot (0.8 m) thick reinforced concrete slab. External dimensions of the unit are 189 feet (58 m) long, 48 feet (15 m) wide and 28 feet (9 m) deep. Wall thicknesses range from 1.5 to 2 feet (0.5 to 0.6 m) thick.

Two Intermediate Level Tritium (ILT) cells are mated to a similar concrete slab. External dimensions of this unit are 48 feet (15 m) wide, 60 feet (18 m) long and 28 feet (9 m) deep. One of the ILT cells has additional components added to accept specially packaged vessels containing tritium crucibles.

Specially designed reinforced, overlapping concrete tees are placed over the open active cell to provide radiation shielding. Sturdy metal raincovers are used to cover active and open cells except when loading operations are underway thus preventing accumulation of rainwater in the cells. The Intermediate Level Vaults have a subsurface drainage system very similar to the LAW vaults. Additionally, each cell has a liquid collection system. The cell floor has a layer of crusher run stone several inches thick which would allow any invasive fluid to flow freely to the cell sump. Provisions for sampling and pumpout are a part of the cell construction.

PROCESSES USED AND LESSONS LEARNED DURING THE PROGRAM DEVELOPMENT AND STARTUP PHASES

Like many other activities throughout the DOE complex, the EAV project was begun during a period when requirements were less formal than the present DOE philosophy. Most of the design and various administrative activities (such as National Environmental Policy Act documentation) were undertaken and brought to completion early in the process. These activities laid the foundation for all other activities that followed. By the time construction began, some changes were already occurring in many aspects of conduct throughout the

SRS. Some of the essential activities were prolonged because of concerns over changing policies and DOE's more disciplined approach.

A multi-disciplined Startup Team was formed soon after construction was fully underway, with a dedicated facility manager, to ensure all activities necessary for starting up the vaults were carried out. Startup engineers were selected based upon individuals' abilities to meet requirements set forth procedurally. A schedule was developed and maintained during the course of startup activities to track activities to completion which were required for operation of the vaults. Assignments from this schedule were made to individual team members, based upon the team members' individual disciplines, training, and experience. Weekly (and later, daily) meetings were held to update the status of assigned activities and to ensure that critical issues were raised to management's attention for resolution when necessary. A Startup Plan was prepared by the WSRC team and approved by WSRC management and DOE-SR.

Procedures and Training

Development of startup and operations procedures for the project began quite some time after the beginning of construction. Review of procedures for existing shallow land burial operations helped to identify areas where existing procedures could be revised and where additional procedures would have to be developed. Many administrative procedures for the existing shallow land burial operations did not meet the requirements in DOE's "Conduct of Operations" Order (DOE Order 5480.19) and had to be enhanced. Due to the large number of procedures being reviewed, the Startup Team developed an administrative system for tracking procedure development/revision, review, and approval. Almost all activities governing the administration of operations were caught up in DOE's and WSRC's program improvements (such as upgrade of the Unreviewed Safety Question Determination process, implementation of "Conduct of Operations," implementation of the new Radiological Controls manual, and implementation of new policies and DOE Order 5400.5 regarding radiological releases). Some procedures already written and in the approval cycle had to be recalled and revised to address requirements born of a more conservative approach. As a result of these changes, a higher degree of confidence has been established in the adequacy of the procedures and the procedure system.

Training programs for operations and maintenance began to take shape at about the same time as procedure preparation. Training programs were developed for the startup team, operations personnel, and engineering personnel. The startup team incorporated project specific and related fundamentals training in their weekly facility manager's meetings. This allowed the startup team, many of which had not been in waste operations for very long, to become more familiar with the specifics and bases of the SRS waste management program, the changes in related programs such as radiological controls, and even with specifics of understanding the project-specific schedule.

The operations training programs focused primarily upon the changes that would be made in facility operations. Job evaluations were performed by qualified training personnel to determine what specific training would be required. The identified training requirements were put into job-specific training matrices. Related health and safety operations are also included in the training requirements matrix. A graded approach was used in development of the training programs. Training for operations personnel includes:

- Classroom training on basic theory and operations of the EAV
- On-the-Job Training
- Job Performance Evaluations
- Drills on emergency preparedness procedures
- Core Radiation worker course qualifying the operators for work in radiation areas
- Testing on all classroom courses with a minimum passing score of 80 per cent.

All operations training is recurrent with assigned frequencies which do not exceed two years. An evaluation of the training process pertaining to the EAV will be conducted no later than six months after the startup of hot operations. Records of training and evaluation have been completed and are auditable. The training program for the EAV operations is in compliance with DOE's order on training (DOE Order 5480.20), but is not accredited.

Training for engineering personnel assigned as support during startup and operations is part of the sitewide program for consistently training engineering personnel in facility and site operations. The training for EAV engineering personnel included EAV-specific activities, but also focused on generic needs such as Unreviewed Safety Question Determinations, Process Hazards Reviews, Safety Analysis Report and Operational Safety Requirements knowledge, change control processes, and root cause analysis.

Startup Checkout Testing

Facility checkout testing in readiness for startup is complete. Checkout activities included:

- Examination of construction documentation
- Examination of vault structures
- Operation and testing of ancillary equipment
- Simulation of operations activities.

Prior to turnover from the construction and project management organizations, detailed checkout procedures were written for each vault and its associated equipment. For each vault, the checkout consisted of three distinct parts. First, construction records were examined for completeness and adherence to standards specified in project specifications and prints. These records included records such as work package completion, walkdown of as-built drawings, and review of quality documentation for cement and rebar placements. Second, a thorough examination of the vault structures' physical attributes and fixed ancillary equipment was conducted. Third, operation of mobile ancillary equipment such as fork lifts and the gantry crane, including simulation of waste form placement, was performed in the specified vault type. Separate procedures were written and utilized for the testing of mobile ancillary equipment such as diesel generators and sump pumps, as well as checkout of the fork lifts and the gantry crane against the project's specifications.

Monitoring Construction Progress

Construction progress is directed and monitored in a tiered approach. Bechtel Savannah River, Incorporated, the SRS onsite construction organization, and the Project

Management Team monitors progress on construction activities on a daily basis as a part of normal construction management practices. Additionally, WSRC's Waste Management Quality Assurance organization surveillance of construction work assists in identifying problems at an early enough stage to mitigate or correct them in a more expeditious manner. Startup team members are also engaged in monitoring construction activities on a daily basis. The close communication between the operations organizations and the construction organizations was to ensure that a quality product was handed over at the end of the project, but more importantly, the communication ensured that the product would be a useful one that would achieve the present goals of the operations organization.

The project experienced a large increase in the estimated cost near the end. Detailed investigations were performed by the project management organization to determine the causes of the cost increase and the reasons for not identifying the increase sooner to upper management. Identified causes are those that can be seen carrying out many DOE projects. Changes in requirements and expectations were coming more quickly than they could be implemented by the present team. Changes in funding strategies (operating versus capital monies) caused the project management to constantly change schedules and financial baselines, in order to meet the required completion dates, without time enough to adequately review the effect on the overall project. Changes in design teams left open questions concerning some of the design bases, potentially causing an additional level of conservatism in the design. Reorganizations within both WSRC and DOE left some questions as to the expectations of individuals on the project. All these contributing causes highlight the need to maintain a staff whose priorities are routinely communicated.

Safety Programs

The safety programs enhanced during EAV startup focus primarily, but not exclusively, on three areas - Radiological Safety, Industrial Safety, and Emergency Preparedness. These programs, in large measure, take root from the Safety Analysis Report (SAR) and the EAV's Addendum to the SAR. Each of these programs had to be formally proceduralized and implemented.

A radiological program exists which includes classroom and practical training, labeling of controlled areas, and clearly posted entry requirements for controlled areas. Recent changes to the radiological program were stimulated by the new DOE Radiological Control Manual. WSRC, and in particular, the EAV, are implementing appropriate adjustments to their procedures and programs. The main thrust of these changes is in placing a greater emphasis on achievement of ALARA goals. During the time period in which EAV startup activities were performed, the radiological program in all of E-Area and Solid Waste Management underwent substantial changes. New postings were implemented across the site, and particularly around the present shallow land burial operation. Respiratory protection requirements and protective clothing requirements were made more clear. Radiological Work Permits were beginning to be used in Solid Waste Management activities. Facility Health Protection inspectors underwent increased training. Additionally, requirements were placed regarding specifics in the implementation of a structured ALARA program. All these changes were also incorporated into the EAV procedures and program at the same time, and sometimes earlier, as they were incorporated into the shallow land burial operations.

Industrial safety is implemented through procedures, initial facility safety inspections, routine inspections and management participation and encouragement in safety meetings. Additionally, all personnel receive OSHA specified training. The facility inspections include observation of labeling and identification of hazards, noise control requirements, safety rules postings, hazard communication requirements, facility hazards identification, housekeeping, heat stress management, and industrial hygiene. Results of the inspections are assessed, dispositioned and corrected as required. Specific inspections that were conducted at the EAV by qualified inspectors included noise levels while diesel generators were running, habitability during fork lift operations in LAW cells, lighting in the LAW cells, requirements for confined space entries in the ILT and ILNT cells, egress ease and postings from LAW cells and the long-lived waste storage building adjacent to the ILT and ILNT cells, and roll-up door safety requirements at the LAW cells.

Emergency preparedness procedures were substantially upgraded and implemented. Due to the reorganization separating Solid Waste management from Liquid Waste management, the Solid Waste Program had to develop specific procedures and drill scenarios, and identify Emergency Response Organization personnel for implementation of emergency preparedness requirements. Emergency preparedness procedures which were developed provide guidance and direction for establishing and maintaining a state of readiness. Classroom training includes appropriate responses to the various emergency classifications. Drills were conducted during the startup and operational readiness review stages of the facility which included a medical emergency at the facility (which is remotely located from the administration building), a simulated fire at the storage facility, and evacuation of the entire facility to the area's rally point. Operations facility personnel, including the operators and emergency coordinators, carried out the scenarios as prepared by the startup team and the Emergency Preparedness organizations. The drills were monitored by personnel which routinely assess emergency preparedness and were critiqued. Lessons learned from the drills were reviewed by management and operations personnel.

Security

E-Area is located deep within the confines of the SRS and thus enjoys the protection of controlled entry at the site boundaries. However, government -owned property within E-Area is required to be protected. Additionally, disposal of classified waste in the EAV required that DOE approve this specific disposal methodology. These requirements called for the security program at the EAV to be revised and enhanced. Security education for all personnel is by classroom training and monthly updates and reminders in scheduled meetings. Additionally, with access controlled at the SRS boundary, E-Area utilizes the challenge system as its main security defense, as do many small areas onsite. An enhanced lock and key control program for the facility is being implemented. Access into radiological areas is restricted to those with the need to be in the area through implementation of the radiological work permit program, whose main goal is ALARA, but secondly provides a security function.

Waste Management Program Implementation

The SRS Waste Management program implementation is dynamic. Changing priorities have caused a shift from high output production to a measured and disciplined control of processes. Waste is finally beginning to be viewed as another product, with specifications to be met by those generating the waste. The EAV facility will put the SRS in a position where waste is managed to meet the specific performance criteria set forth in DOE Order 5820.2A. These specific criteria include:

- an exposure to any member of the public from all pathways, not to exceed 25 mrem/yr
- an exposure to any member of the public via a groundwater pathway, not to exceed 4 mrem/yr
- an exposure to any inadvertent intruder after loss of institutional control which will not exceed 100 mrem/yr for continuous exposure or 500 mrem/yr for a single acute exposure.

While a Performance Assessment is underway to provide assurance that waste disposed in the EAV meet the above criteria, Waste Acceptance Criteria were developed from:

- simplified, yet conservative, analyses similar to the methodology in the Performance Assessment,
- DOE Order 5820.2A, "Radioactive Waste Management," requirements
- assumptions used in the Safety Analysis Report addendum for the facility
- assumptions used in the Hazard Class assessment
- criticality analyses performed for the vaults
- standard practices in commercial waste management.

The advent of a detailed Waste Acceptance Criteria is one facet of a significant implementation program. Due to the recent dynamic nature of DOE Order requirements, the Waste Acceptance Criteria itself is dynamic. Although the radioactive waste management order has not changed since 1988, orders involving safety analyses, operational safety requirements, and hazard class determination have changed. These, too, provide the operational basis for the EAV facility, and are an intricate part of the bases for the Waste Acceptance Criteria.

Implementation of the Certification program required by DOE Order 5820.2A will represent a significant achievement in the SRS waste management program. Due to the many generators onsite (SRS has approximately 40 generators, along with 10 offsite generators), implementation of the program was scheduled to be a phased approach. While initial phases have been delayed due to various reasons, the final date for implementation remains the same. This activity represents the single, most cooperative effort underway between waste management and the other generating organizations. One of the most valuable lessons learned from the startup effort has been in this area. That is, that constant communication with generators is imperative. Generators must understand the reasons behind the waste acceptance criteria in order to place adequate priority on implementing the changes in their programs, as well as to implement the details of the requirements.

The E-Area Vaults team, which is comprised of personnel from WSRC operations, engineering, maintenance, and quality assurance organizations, as well as DOE-SR, contributed greatly to the SRS Waste Acceptance Criteria. The startup team provided the function of incorporating all the many requirements and limits from various sources into a meaningful and encompassing document. Many times the conservatism of the limits were questioned, however, developing the basis for each requirement aided in explaining the reasons to reviewers.

Aside from limits on radionuclide concentrations and quantities, the Waste Acceptance Criteria outline prohibitions on waste accepted at the EAV. The EAV facility will not accept hazardous or mixed waste, or transuranic waste. Specifics on container sizes and equipment limitations are outlined in the Waste Acceptance Criteria, as well.

Another significant accomplishment in the Waste Management Program is the development of a computer database to assist in maintaining an accurate inventory in each cell of each vault within the limits prescribed by the Waste Acceptance Criteria. This program is known as the Waste Information Tracking System, or WITS. Information is entered into the system by qualified facility personnel from disposal records received from certified generators. Once all the required information is entered, the information is checked against a table of acceptance parameters within the program, and the waste form is accepted if no limits or restrictions have been exceeded. The program is auditable, provides concise tracking, and a variety of reports. Future plans are to provide certified generators access to the system for inputting preliminary disposal record information.

Additionally, Solid Waste management will be upgrading the inspection program waste containers go through prior to disposal. In addition to biennial audits of the generator's program, each container and shipment will be further inspected to ensure that all appropriate documentation is with the containers. The checks within the computer system WITS will be most significant in assuring that limits defined in the WAC are upheld.

Development of an EAV Addendum to the present Safety Analysis Report for Solid Waste management operations was required. During EAV startup, a new Order was published which set forth further guidelines on approval of Safety Analysis Reports for DOE facilities. While it had been planned that the Field Office would approve the addendum to the SAR, it was now required that the SAR be approved by DOE-HQ. A team of reviewers was developed at the Savannah River Field Office which included specialists in facility safety and specialists in waste management. DOE-HQ provided reviewers for the team at DOE-SR. After WSRC had developed the SAR addendum and had resolved all internal comments, the addendum was provided for DOE final review. The review process provided an excellent overview due to the various specialties of the reviewers, however, extra time was required for the review due to the many mission and transition priorities across the entire SRS. Agreement also had to be made as to the scope of the addendum and its relation to the entire SAR for all solid waste operations.

Perhaps the most substantial change in the entire waste management program is the reorganization of personnel within the Environmental Restoration and Waste Management areas to further emphasize the commitment to meeting requirements of the solid waste management programs. DOE-SR had reorganized prior to construction getting underway on the EAV to allow more focus on individual areas. This included developing division level management for each

of four areas: High-Level Waste management, Solid Waste management, Environmental Restoration management, and management of the Defense Waste Processing Facility. WSRC reorganized during construction and startup of the EAV, and while this presented some immediate problems in the approval of certain tasks, it has certainly proven to be an overall step forward. Increased management attention was required due to the many projects, including EAV, which would have to be constructed to meet regulatory commitments for the management of solid waste streams such as low-level waste, hazardous waste, mixed waste, sanitary waste, and transuranic waste. Because of the increasing detail of regulatory oversight and oversight within DOE and the contractor's organization, day-to-day management of waste management operations was an integral part of the reorganization.

Refinements in Startup Requirements

During the period of EAV startup, both DOE and WSRC developed more formal guidance and requirements for startup of facilities. This was in part due to the more disciplined approach by DOE and its contractors, and in part due to the increased oversight by the Defense Nuclear Facilities Safety Board which is the main external oversight for DOE nuclear operations. Recommendations made by the board during the startup and restart of other major nuclear facilities both onsite and within the complex were considered during the startup of EAV. During this time, DOE-Headquarters developed specific levels of authority for restart or startup. Although this did not have a major effect on the EAV, since it is a non-reactor nuclear facility and is a low nuclear hazard facility, it did have the potential to have a major schedule impact on startup. DOE-HQ has approved the facility to be started up by the Savannah River Field Office Manager, with constant communication between DOE-SR and DOE-HQ Program Office.

Additionally, WSRC has begun development of a manual which sets forth guidelines on startup of facilities. This will aid in assuring consistency in requirements for startup of all SRS facilities.

Operational Readiness Reviews

WSRC has performed an Operational Readiness Review (ORR) for the EAV, thoroughly assessing the programs, personnel, records and procedures for construction, startup and operations. The Operational Readiness Review was based on previous requirements set forth in site-specific requirements documents and implements the requirements contained in DOE Orders regarding startup of facilities. Operational Readiness Reviews have been implemented at SRS for several years, however, they have become increasingly detailed, and more formally documented. WSRC had previously developed a sitewide manual for performance of ORR's to ensure that the same thought and planning processes are consistent for both reactors and major nuclear facilities and smaller nonreactor nuclear facilities such as the EAV. This manual was one of the prime references for development of the EAV Operational Readiness Review Plan.

WSRC's Environmental Restoration and Waste Management (ER&WM) Division contains a specific organization to manage conduct of operational readiness reviews for the various startups and restarts within ER&WM. This organization operates independently of the four operating programs within ER&WM and contains personnel trained in various site and Order requirements. Personnel are trained specifically in the conduct of ORR's. An Operational Readiness Review Board, which contains most of its members from outside the Solid Waste program, reviews assessments of individual modules in the plan and reports on the adequacy of the programs.

The Startup Team has been responsible for answering any findings, observations, or exceptions documented by WSRC's ORR team. Closure of these is required before startup of the EAV.

DOE-SR is also performing an Operational Readiness Evaluation, which will consist mainly of an evaluation of WSRC's ORR, but will also independently evaluate some aspects of the EAV program. This activity is managed independently of the DOE-SR Solid Waste management organization to ensure that no conflicts exist with regard to safe startup and schedule constraints. The DOE-SR ORE team is also made up of multi-disciplined team members, each focusing on areas within their specific experience or abilities.

STATUS OF CURRENT AND PLANNED VAULT OPERATIONS

Construction has been completed on the Intermediate Activity Waste vault, and the first four cells of the Low Activity Waste vault. The E-Area Vaults are ready to begin hot operations. A small number of remaining administrative activities remain regarding DOE approval of the security plan. Implementation of the Waste Certification program, required for waste generators as outlined in DOE Order 5820.2A, is the remaining challenge in beginning waste disposal in the vaults. Certification of the first generator is expected to occur some time in April 1993. An increasing number of priority activities within SRS generators' programs have caused this activity to be delayed.

In order to assure that operators remain trained, procedures remain up-to-date, and equipment is properly maintained, WSRC has developed a program to maintain readiness. Simulated operations activities have begun to keep operations personnel acclimated to new procedural requirements and job tasks.

Completion of DOE-SR's Operational Readiness Evaluation (ORE) remains an open item. This activity was begun in late January. After completion of the ORE and closure of any findings which may result, the vaults will begin disposal of radioactive waste. This is scheduled to be completed by April 30, 1993.

DISPOSAL VOLUME AND COST

Each LAW vault will provide approximately 1.7 million cubic feet (48,000 cubic meters) of disposal space. Total construction costs of the first vault is projected to be 20 million dollars and combined with annual operating costs, an estimate of $19/cubic foot is expected.

Eight of the nine cells of the Intermediate Activity Vaults provide slightly more than 200,000 cubic feet (5660 cubic meters) of disposal space. The ninth cell is modified to accept special cylinders with a limited use. The construction costs for the intermediate activity vaults was 13 million dollars, and combined with annual operating costs, an estimate of $75/cubic foot is expected.

SUMMARY OF LESSONS LEARNED

The DOE complex is in a constantly changing environment, with increasing emphasis being placed on management of wastes and a disciplined conduct of operations throughout all activities. It is imperative that program managers and facility managers in charge of facilities going through startup activities or restart activities recognize that this change is a part of the process of managing their programs, and that their programs be designed to allow for and manage this change.

Specifically, new changes which have come about during the last two years in the DOE complex deal with:

- Conduct of Operations
- Radiological Controls
- Safety Analysis processes
- Operational Readiness Reviews
- Startup Requirements

It is also imperative that constant and open communications lines be in place, and a good working relationship be established, between the Headquarters organizations, the Field Office organizations, and the Contractor organizations. In the case of Waste Management areas, coordination with generating facilities also requires significant planning and effort.