WM'00 Conference, February 27-March 2, 2000, Tucson, AZ

TRANSITION OF FACILITIES AT HANFORD TO A STABLE, LOW COST STATE

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Abstract

The paper will explain the planning process, utilized at Hanford, to take both large and medium sized facilities from a stage of operational hold or standby condition to a cheap-to-keep condition. Cheap-to-keep is a minimum cost, safe, stable state allowing for significant surveillance and maintenance cost and risk reduction, while awaiting eventual decontamination and decommissioning (D&D), entombment, or even facility reuse. Although some papers have been presented in the past on projects such as Hanford's PUREX project, the intent of this paper is to emphasize how the pieces of the planning puzzle need to be utilized to ensure the needed integration of organizations including the Department of Energy (DOE) Field Office, DOE Headquarters, the contractors (including plant forces), the regulators, and other stakeholders, to arrive at a facility's interim and final closure position.

The paper will show how the "pilot" process at PUREX has evolved and served subsequent deactivations such as B-Plant and continues to be used to frame the DOE's deactivation strategy at other Hanford facilities such as the Plutonium Finishing Plant (PFP). Unique challenges (such as the integration of stabilization activities with deactivation) are expected at the PFP that may have implications for deactivation and closure of other plutonium facilities nationwide. In addition, the flexibility of Hanford's process for integrating the priority of smaller deactivations such as Building 327 with those of larger facilities such as PFP remains a challenge. These challenges must be met in order to assure DOE's overall goals of safe and cost effective site closures.

The paper will discuss the implications of focusing on end states and interim end points in the deactivation planning process and managing the budget and personnel to achieve these end points as a "project," not another phase of operations. In addition, the paper will describe the necessary reorganization or reengineering of plant forces to accomplish the work scope, and changes in the culture of managers and work force that must take place if the goals of the program are to be met in a cost-effective manner. Finally the lessons learned regarding the past projects and feedback loops that should be established also will be discussed.

Introduction

In early 1992, it was recognized by DOE and Westinghouse Hanford Company (WHC) management at the Plutonium-Uranium Extraction (PUREX) facility at the Hanford Site that there was no officially defined intermediate position between operations phase, standby phase, and D&D for nuclear facilities like PUREX. PUREX had been in the standby condition since 1990; plant tanks and piping still contained some process solutions. In late 1991 it was decided not to process the remaining fuel at Hanford. The shutdown of the facility was imminent. The concept of a "transition" or "deactivation" phase in a facility's life cycle, but short of complete D&D, needed to be grappled with. This was relatively new for DOE. Consequently, a new systematic deactivation planning process model was initially needed for the aging, terminated facilities across the DOE complex.

Development of the PUREX Transition Model

When the PUREX facility shutdown order was received in December 1992, plant managers began detailed planning for the actual physical steps that would be needed to bring the facility to a safe, very low-cost, low-maintenance deactivation status. This state is a state or condition that is safe and requiring low maintenance while decisions on D&D or entombment are properly through. Plants like PUREX may need to remain in this deactivated or transition state for 10 or more years. The initial effort was structured as a multi-disciplined project, and the first planning phase was completed in August 1994 with the publication of the *Purex/UO_3 Deactivation Management Plan* (PMP). Although useful as a comprehensive record, the initial PMP was unwieldy to review and revise, and did not contain predetermined end point criteria or specific end points. It could not be used as a true map of the transition project.

A "Red Team" of consultants was appointed to review the PUREX proposed program. It was deemed cumbersome, operations oriented, and expensive to implement with an undefined outcome. This led to a new strategy and the development of a second PMP. Along with this new PMP, an End Point Criteria Value Engineering Study was conducted jointly by representatives of DOE, contractor deactivation and decommissioning organizations, and PUREX personnel. This study (completed in 1994) arrived at a process for making deactivation decisions that could be applied flexibly to resolve deactivation issues and concerns. This process was a matrix-based approach to establishing deactivation end points; discreet plant conditions were identified and achieving them was managed as a project with clear schedules, resource allocations and management attention.

Development of End Points

A fundamental premise of project management for deactivation is to identify when the deactivation project is complete. Just as the design specifications are essential to a construction project, specifying the end-points for the facility's spaces, systems, and major equipment is the key to identifying when a facility has been deactivated. End-point specifications for the entire facility are used during and/or after implementation:

- As input for scheduling and cost estimating.
- To create detailed work plans for each space and system in the facility.
- To document bases for performance-based contracting or out-sourcing of work, where practical to do so.
- To demonstrate conformance to agreements negotiated with third parties who have a legitimate stake in the condition of the facility after deactivation.
- To show compliance with both local and Federal regulations.

A consensus on the desired end-points is necessary to reduce scope, cost and schedule changes, and will ensure an improved level of satisfaction by all involved. This consensus involves participation by the decision-makers from DOE, the operating contractor, worker groups, the receiving organization, if different than the deactivating organization, and the stakeholders. A team approach, including the planners, doers, approvers, and regulators is necessary for success of the process.

Since identifying the end-points is an integral part of deriving the project work breakdown structure, schedule, and budget, end-point planning and specification must be initiated as soon as possible. Specifying end-conditions is the first part of the end-point planning process. Facility end-points are derived for plant areas, structures, systems, and equipment. Facility end-point specifications must be quantitative, where possible, and in all instances must be explicit.

Specifying and achieving end-points is a systematic, engineering method for progressing from an existing condition to a stated desired final set of conditions in which the facility is safe, shutdown and can be economically maintained and monitored. An end-point method is a way to translate broad mission statements into explicit goals and milestones that are readily understood by engineers and the crafts personnel who will perform the work. The method is a systematic process that can result in hundreds, to a thousand or more, explicitly stated conditions to be achieved. In the case of PUREX, this amounted to in excess of 3200 conditions.

The detailed specification and actual end-points achieved will undoubtedly vary from facility to facility across the DOE complex. Variations are expected because of the differences among facilities with respect to previous mission requirements, equipment and systems, containment, degree of contamination, ability to isolate the contamination, facility environs, projected ultimate disposition, and a host of other factors. Regardless of variations in conditions to be achieved, the methods used to decide and specify end-points are fundamentally similar.

Several guiding principles form the foundation of the end-point process:

(1) The decision to specify an end-point needs to be driven by, and clearly linked to, top-tier program objectives.

(2) End-point decisions are integrally linked to decisions (and constraints) on resources and methods. If a proposed end-point is not economically feasible, it will only be specified if mandated by law, applicable regulation, or formal agreement.

(3) End-point decisions may consider, but should not be driven by, decommissioning presumptions.

(4) Defense-in-depth as a fundamental safety approach will be used in determining the end-point condition of the deactivated facility. As applied here, defense-in-depth involves three layers of protection: elimination or mitigation of hazards, effective facility containment, and facility monitoring and control. In this context, the concept of reducing risk to acceptable levels can be applied.

(5) Successful end-point development requires "ownership" by all affected organizations, including the planners, the deactivation work force, and the receiving organization.

(6) Work teams in the field need clear, quantitative completion criteria. End-points must be established up front, must meet the completion criteria, and be practical and achievable.

(7) End-point development is an iterative process. Most end-point decisions can be made during the planning stages early in the project; however, some end-points will have to be revisited as deactivation proceeds (e.g., final contamination levels).

(8) A deactivation project is intended to be done in the short term. Therefore, it must be possible to achieve the objective with current knowledge. That is, a reasonable schedule would probably not allow for preliminary research as a prerequisite for activities to achieve an end-point.

These guidelines and possibly others need to be considered when selecting the end-point method, setting up criteria, and specifying detailed end-points. The use of a tailoring approach in the development of the facility end-points is appropriate to differentiate between complex facilities with process systems and/or significant hazards and those with relatively simple buildings that are not substantially contaminated and do not have complex equipment or systems.

An example of a PUREX facility endpoint which eliminates/mitigates a hazard is, "Remove unattached combustible materials to reduce the fire hazard." An end point that involves effective facility containment is "Isolate/seal hood face." An end point that involves facility monitoring and control is "Isolate iodine monitor by closing valves." Development of a Safety Strategy

At the time of PUREX and UO_3 facility shutdown, each facility had an existing final safety analysis report (FSAR), based on plant operating needs, which contained the Operations Safety Requirements (OSRs, similar to Technical Specifications in the NRC/commercial nuclear arena), safety boundaries, safety conditions, and other control features. During the transition from operation to standby/shutdown condition, a revised version of the PUREX FSAR and an operation specifications document were written to cover expected activities that had not been documented and analyzed from a safety perspective during operations. A separate document was also created at PUREX in which each OSR was examined for its applicability to the operating mode and/or standby conditions. As the systems met their end points, the OSRs were formally eliminated. In addition, each deactivation task resulting from end point development and work planning/ scheduling was screened by the DOE-approved un-reviewed safety question (USQ) process, and a safety evaluation was prepared for every task falling outside previously analyzed safety criteria. The PUREX safety documentation strategy, a creative blend of existing safety documentation with new consideration of deactivation tasks, was put in place in late 1994.

Radiological protection of onsite and plant personnel was ensured in the transition process model through existing PUREX and UO3 plant Safety Analysis Reports (SARs), administration manuals, and radiological control manuals. These established and maintained radiation protection practices consistent with DOE-approved standards and well within federal exposure limits. The deactivation activities used the existing features of the facility and plant radiation protection program, which were evaluated for adequacy and found satisfactory.

Once the PUREX facility was downgraded from a Hazard Category 2 to a Hazard Category 3 nuclear facility after nuclear material de-inventory, many of the hazards had been removed from the plant and other hazards had been sealed, the FSAR no longer fit the facility. The plant condition and configuration described in the FSAR was no longer accurate, and the process description for operations did not apply at all. It therefore became necessary under DOE orders to prepare new safety documentation for the deactivated PUREX facility. During 1996, PUREX personnel prepared two interim safety basis (ISB) documents, one for the PUREX facility itself and one for the PUREX tunnels. However, even these documents and other documents that they referenced did not adequately reflect the actual end state conditions of the facility at the close of the deactivation project. New documents, known as basis for interim operations (BIO) documents, were written in 1997.

Development of a Modified Surveillance and Maintenance Strategy

The closeout of systems, equipment, and spaces resulted in "as-you-go" renovation of the Surveillance and Maintenance (S&M) activities performed in the facilities. It is crucial that the new organization which may take over the facility be integrated into the new program in such a way that its S&M procedures are developed and formatted to the new organization's specifications. This will minimize unnecessary duplication of effort after transition, and will ensure that S&M requirements are commensurate with the new system/equipment conditions.

Development of a Regulatory Strategy

A process to address and allow facility deactivation without going directly to facility closure was developed and implemented between 1993 and 1995. Agreements reached were documented in the Tri-Party Agreement for public review and acceptance. Because the PUREX deactivation project duration was lengthy (4 years), many interim agreements had to be negotiated with regulators. Resource Conservation and Recovery Act (RCRA), air permitting, National Environmental Policy Act (NEPA), National Historic Preservation Act (NHPA), and Clean Water Act issues resulting from PUREX shutdown and deactivation, such as tank permitting, were addressed by a series of face-to-face meetings among PUREX, DOE, state, and Environmental Protection Agency (EPA) personnel. Issues concerning nuclear and hazardous materials/chemicals and environmental monitoring were also addressed and documented through these cooperative meetings and videoconferences.

Development of a Stakeholder Involvement Process

The PUREX/UO_3 deactivation project recognized very early that stakeholder involvement would be crucial to its success. Following DOE guidelines, the public involvement strategy was to involve DOE and contractor personnel (with employees viewed as key stakeholders), legislated authority structures such as state and federal regulators, the Defense Nuclear Facilities Safety Board (DNFSB), public advocates, advisory groups, Indian nations, and the general public. Any group affected by or able to affect the PUREX/UO_3 deactivation project was considered a stakeholder.

One initial action in the stakeholder involvement process was the establishment of a common information base from which interested parties could learn about the PUREX and UO_3 facilities, including their history and past missions, current status, condition, costs, and timetables. A number of historical reports, brochures, and fact sheets were prepared and distributed to more than a thousand stakeholders. The second draft PMP was made available to stakeholders, and comments received were incorporated into the final PMP issue in August 1994.

In other concurrent actions, facilitated meetings with regulators, facility tours, and numerous public meetings were conducted locally and along project nitric acid shipment routes. Innovative or "breakthrough" thinking was encouraged and fostered. It required risk-taking on the part of all parties, and resulted in extraordinary savings. One example of such thinking in the PUREX facility was the sale of slightly contaminated nitric acid to a company in the United Kingdom for reuse in their fuel processing plant. Nearly 250,000 gallons were disposed of in this fashion. This one innovative idea, a financial risk, resulted in the PUREX facility being able to close out several processing cells a year early, significantly reduced tank waste space, and eliminated unnecessary stack emissions. The early close out is estimated to have shortened the overall schedule 1.5 years and saved $100 million.

Development of a Management/Communications Structure

Conventional management structures established for normal nuclear facility operations were found to be too cumbersome and restrictive for large-scale deactivation projects like PUREX. Multi-level organizations with vertical communications and approval pathways simply could not provide timely decisions or issue resolution in the unfamiliar and often untested deactivation processes. Deactivation issues often required the direct involvement of a number of facility organization, which could be accommodated by the more conventional "matrix management" team concept. However, deactivation issues also often required direct involvement of numerous site-level and DOE Headquarters level organizations. Timely input from these organizations outside of the PUREX facility operations groups and outside of the site was essential, for example, in order to coordinate and ship the PUREX nitric acid off-site. It was clear that an innovative management structure with inherent rapid communications was needed.

Figure 1 represents the management structure utilized for the PUREX deactivation project. PUREX plant personnel, site interface and stakeholder personnel, and DOE Headquarters interface personnel teamed to lead the deactivation project. Decisions were reached and issues resolved jointly and with direct access to plant, site, and headquarters decision-makers without multiple levels of required management approval. Plant and site support organizations were made available to the deactivation project activity management as needed per prior agreements.

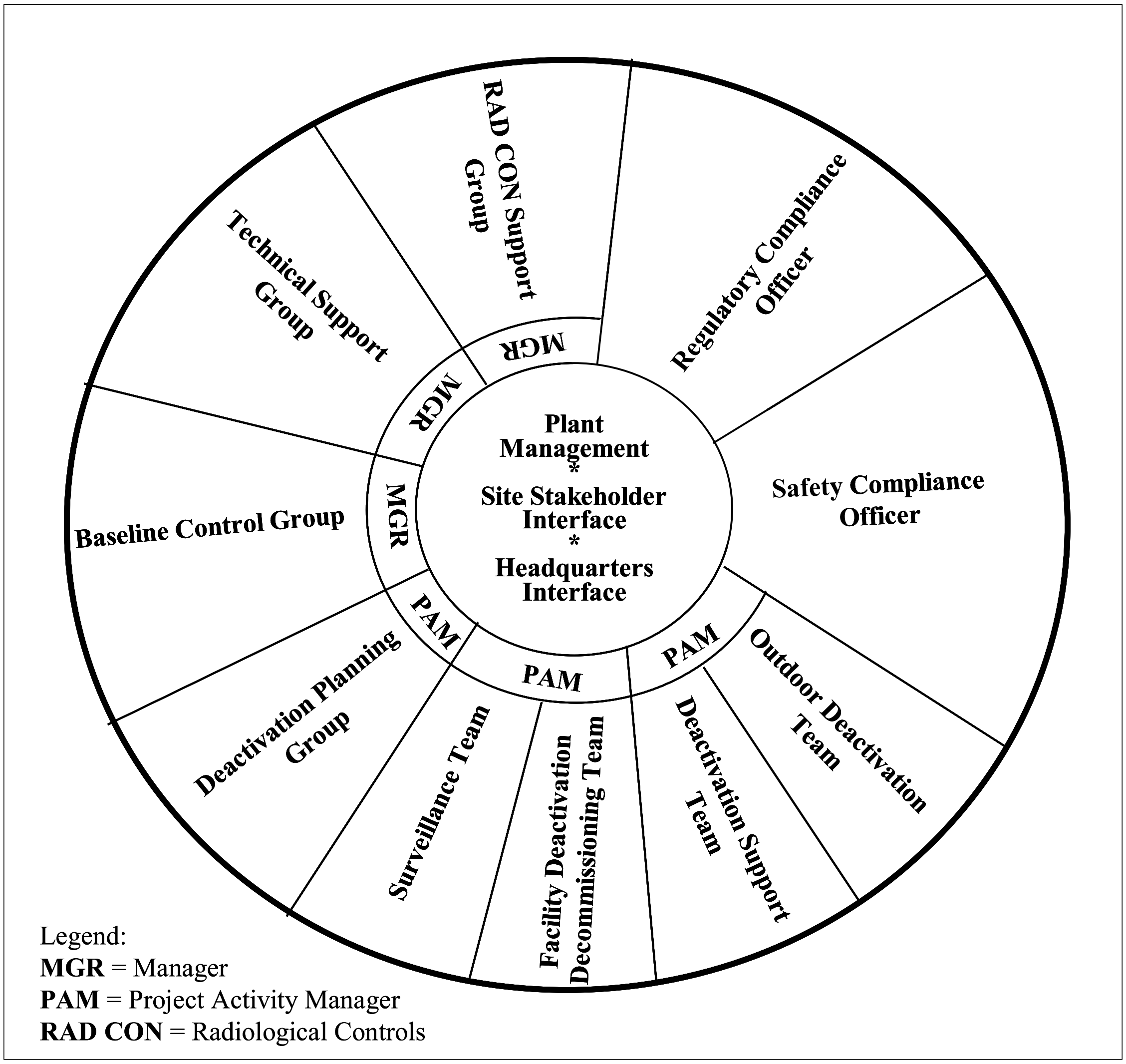

Figure 1. Transition Model Management/Communications Structure

Several advantages of this management/communications structure became apparent. Plant and site workers associated with the deactivation project initially were wary of a project which could result in their re-assignment to other work, or could make them vulnerable to a reduction in force. However, the commitment of the joint plant, site interface, and headquarters interface management team rapidly demonstrated to the workers the importance of the PUREX deactivation mission in a broader context. As issues were resolved by direct site or headquarters involvement, the workers and management became committed to the mission. As a result of worker commitment, innovative thinking was fostered throughout the deactivation process, and special expertise and assistance were more easily brought to bear on particular areas of need.

The deactivation of a facility of the magnitude of the PUREX facility cannot be economically achieved with a "conventional" operational management structure. To implement the PUREX PMP, a "re-engineered" plant management and work structure had to be developed. Re-engineering continues throughout the life of a deactivation project. It cannot be over-emphasized that front-end planning of all tasks and work scopes that go into all end points needs to be laid out in detail. Organized, well-identified work teams must then be identified, as well as their tasks, work plans, and the schedules to which they must work. The re-engineering allows for orderly accomplishment of all of the work, and also provides a practical schedule for the appropriate reduction of the work force. PUREX, in the standby mode, employed approximately 850 people. Orderly arrangement of work scope allowed for the placement of personnel elsewhere on site, allowed for the critical sharing of personnel, and a known schedule for release from the plant. The response of the work force was extraordinary. They approached their work as teams with professionalism and pride, knowing that the schedule eliminated the anxiety about the unknown, and allowed them to plan for future opportunities either on-site or off-site. The schedule also contributed heavily to the cost savings realized in the project, and defined defensible budget projections.

Development of a Transition Process

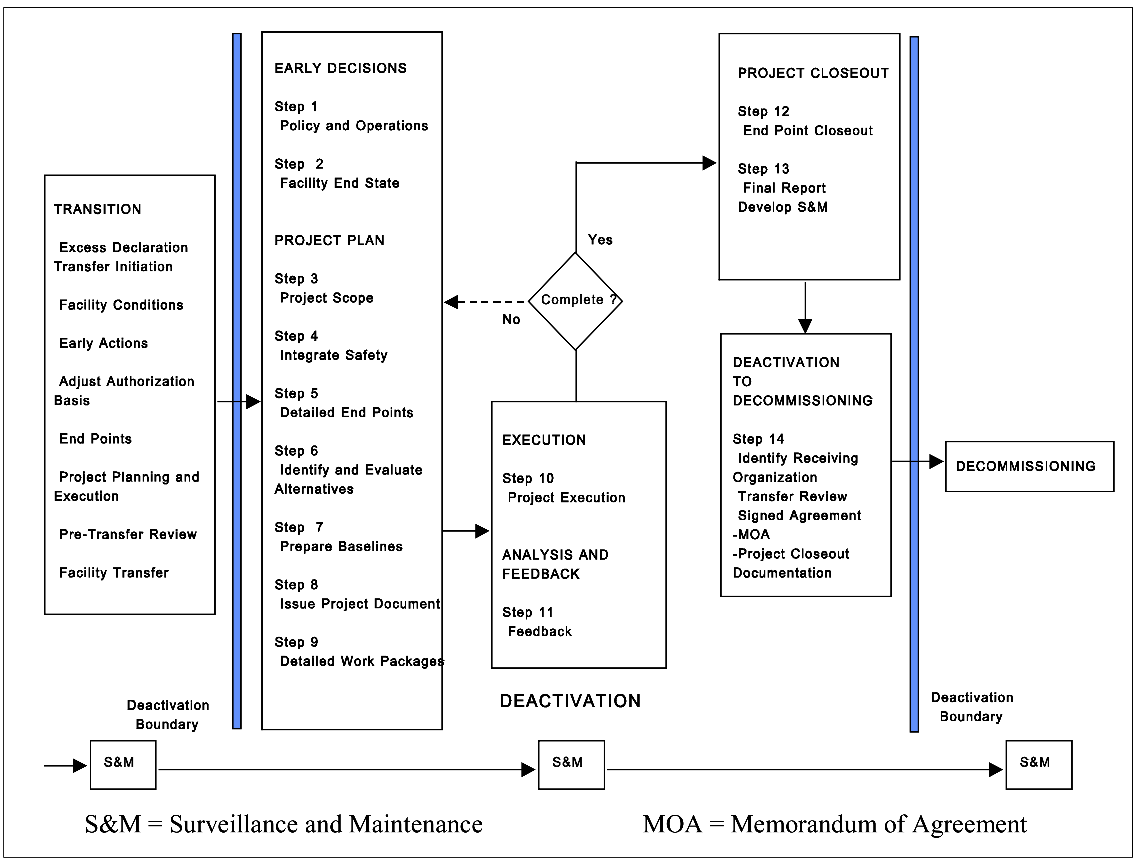

Figure 2. Purex Transition Model

Deactivation activities intensified at PUREX during 1995, 1996, and 1997, despite the many required endpoint, baseline, and schedule revisions. The deactivation project at the UO3 facility was completed in February 1995, and the PUREX facility deactivation project was completed in May 1997. The process model resulting from the completion of these projects is summarized above in Figure 2. This model served as the basis for a number of deactivation projects that are either in progress or in planning stages.

Enhancements to the Transition Model at B Plant

Since deactivation projects will continue at DOE's Hanford facilities and at other DOE field sites as more facilities and sites move toward closure activities, it is imperative that lessons learned from deactivation experiences are communicated and applied. Each deactivation project will be unique because each facility is unique, but the similarities within the range of facility complexity will yield valuable enhancements to the transition model as each project is completed.

The Hanford B-Plant deactivation is a good example of the timely application of lessons learned. A number of enhancements were made to the transition model implemented during the PUREX deactivation project. These enhancements involved extensive streamlining and tailoring of the transition model's processes, and involved integration of safety management principles and objectives into the project.

From the very start of the B-Plant deactivation project, streamlining was applied. The B-Plant project management team itself wasted no time in planning and re-engineering using the lessons from PUREX. Transition of the B-Plant within a three-year period required maximum personnel flexibility and the innovative organizational approaches, such as reengineering and self-directed teams, to meet the demanding and changing need for resources. The project team organization more closely aligned resources to the facilities and projects they supported, and utilized self-directed project and facility teams to accomplish work more effectively and efficiently.

An accelerated three-year time frame for accomplishment of the deactivation was established as an objective, improving on the more drawn-out time frame experienced during the PUREX deactivation. The final facility end state and the specific end points were established early in the B-Plant deactivation project through the use of DOE deactivation guidance which was not available at the time of the PUREX deactivation planning. The baseline of the B-Plant deactivation project was developed from the start with the accelerated time frame in view, and included activity-based cost estimates. Planning and scheduling tools from PUREX deactivation were streamlined, and a more adaptable software package was utilized. Fully developed, integrated, resource-loaded schedules were then implemented using these tools, which avoided work delays and some duplication that plagued the PUREX project. A short, high-level project management plan was developed, which was found to be a better tool for setting overall deactivation strategy for B-Plant. Sub-plans dealing with various issues such as regulatory compliance, safety strategy, and stakeholder involvement, were then issued as supporting or ancillary documents. Each sub-plan was then more easily revised and more quickly implemented.

B-Plant deactivation project management was also able to implement Integrated Safety Management (ISM) strategies from DOE guidance which had not existed. This resulted in greatly enhanced worker, public, and environmental protection during deactivation activities by implementation of fundamental policies that guide the safe accomplishment of deactivation work. One direct enhancement of the safety strategy development for B-Plant was the development of a BIO prior to the start of the deactivation project, rather than the long and complex evolution of the PUREX BIOs.

Enhancements to the Transition Model at Other Hanford Facilities

Other Hanford facilities, such as the 324 and 327 Buildings and the Fast Flux Test Facility (FFTF), present similar deactivation challenges as other DOE radio logically contaminated buildings that will be deactivated in the future. These projects have continued to build on the lessons learned from previous and ongoing deactivation projects, and contribute to the knowledge base for future facility deactivation.

The 324 and 327 Buildings PMP has been prepared in the same manner as the B-Plant PMP, with the supporting appendices providing the detailed documentation for application and implementation of the PMP strategies, as well as the detailed schedule and cost data. However, the project scope is divided into three discreet sub-projects. The PMP also describes several future deactivation sub-projects and incorporates these on the overall schedule well in advance of the commencement of these sub-projects.

Challenges/Enhancements to the Transition Model

The facility transitions and deactivation projects being planned now vary greatly in complexity and final end state. Many of these planned transitions result from the need to shrink the footprint of DOE facilities throughout the United States and deactivate entire DOE sites. Therefore, many challenges face the deactivation teams of the future, and the deactivation planning tools will out of necessity evolve to meet these new challenges. Some of these challenges are obvious now:

- Different End States

  Facilities like Building 771 at Rocky Flats and PFP at Hanford have "brown field" end states, meaning that the facilities will be completely removed down a slab at ground level. The PUREX and B-Plant transition models left the facilities standing after deactivation. A different facility end state does not preclude the use of the deactivation project management tools already developed, such as the method for end point development. However, it does require carefulapplication of these methods and tools, since the project objectives and end points may differ from those encountered before.

- Facility Complexity and Activities

  Facilities like F-Canyon Facilities at Savannah River and PFP at Hanford are faced with much more complex transition phases than ever before because stabilization operations must proceed in certain sections of the facility while deactivation projects must be planned and implemented in other sections. These situations are fairly easily incorporated into the systematic deactivation planning methods already developed and utilized, but new applications of existing methods require careful consideration and attention to detail. Also, some facilities or sections of facilities will be making the transition from stable deactivated states to decommissioning and dismantlement activities. This will require systematic planning, engineering, safety/hazards, and requirements analyses which will be somewhat different that those previously completed.

Smaller, less complex facilities may not require the full application of the transition model or its processes. Tailored approaches will be needed, within the guidelines of DOE and site policy guidelines, which are commensurate with the facility complexity and required end state. Prioritization will be needed at the program level to ensure that smaller, less complicated and less hazardous facilities are not forgotten in the overall deactivation strategy.

- Facility Safety Bases and ISMS

  The safety basis of a facility changes during deactivation, and the process of changing the safety documentation of that facility must also have the flexibility to change. Complete revision of existing safety basis documentation is not usually cost-effective. Deactivation project management should utilize existing safety bases if possible, and change it to meet the changing facility objectives. Also, incorporation of ISMS principles must be improved in future deactivation activities.

- Funding

  Limited funding severely impacts transition and deactivation schedules, and complicates the application of the evolving transition model to DOE facilities. Creative strategies such as Requirements Based Surveillance and Maintenance (RBSM) can be utilized to avoid cost expenditures on some activities so that those resources can be re-allocated to deactivation.

Capturing Lessons Learned

Hanford site management is actively providing feedback to EM management as deactivation projects like 324 and 327 Buildings and PFP proceed from planning to and through implementation. Lessons learned through these projects are being incorporated into policy guidance such as DOE O 430.1A, LIFE CYCLE ASSET MANAGEMENT and its implementation guides for transition and deactivation. The lessons learned are continuously being evaluated for applicability to other DOE site/facility deactivation, and provide excellent verification checks and improvement suggestions for policies.

A practical Deactivation Handbook has been published, and is being revised and updated, as a direct result of the deactivation experiences at Hanford, Savannah River, Idaho, Oak Ridge, Mound, and Rocky Flats. Hanford and Savannah River site management have documented site-specific guidance on surplus facilities deactivation and have made it available to DOE field site and Headquarters personnel.

These and other deactivation policy, guidance, and information resources are available for complex-wide use through the National Facility Deactivation Initiative (NFDI) Program. NFDI is a partnership between DOE Field Offices and the Office of Nuclear Material and Facility Stabilization established to reduce risks and costs through accelerated facility deactivation.

Summary

The evolution of DOE facilities from full-scale operations to standby to deactivation has begun, and in the last five years several major nuclear facilities have been deactivated. A growing number of facilities are becoming engaged in the deactivation planning process as a result of site and facility closure activities. It needs to be emphasized that deactivation is not complete D&D, but only a "limbo" state. Eventual decisions on especially large canyons and reactor complexes need to be made. In some cases, entombment may be utilized. At the time of final decision, an infusion of money will be required. Standards, guidelines, good practices, and handbooks are now available for general use, and these are continuously being improved through deactivation activities. Software and hardware tools are now being made available through the NFDI Program to aid deactivation project personnel.

The initial "pilot" deactivation project processes at the Hanford PUREX facility have evolved to a systematic process that is currently serving subsequent deactivations such as the Hanford B-Plant, Building 771 at Rocky Flats, and the Hanford PFP. Unique challenges continue to arise as complex facilities simultaneously stabilize materials, de-inventory facilities, and plan for deactivations. The flexibility of Hanford's transition model is being challenged as each new deactivation project begins, and the model continues to be fundamentally sound, yet adaptable to emerging and changing deactivation project needs.