THE INTEGRATION OF A PROPOSED ZONE CLOSURE APPROACH FOR THE PLUTONIUM FINISHING PLANT (PFP) DECOMMISSIONING AND THE PFP ZONE, HANFORD SITE, WASHINGTON

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ABSTRACT

The Plutonium Finishing Plant (PFP) and associated processing facilities are located in the 200 area of the Hanford Site in Eastern Washington. This area is part of what is now called the Central Plateau. In order to achieve closure of the contaminated facilities and waste sites at Hanford on the Central Plateau (CP), a geographic re-districting of the area into zones has been proposed in the recently published *Plan for Central Plateau Closure[1]*. One of the 22 zones proposed in the Central Plateau encompasses the PFP and ancillary facilities. Approximately eighty six buildings are included in the PFP Zone. This paper addresses the approach for the closure of the PFP Zone within the Central Plateau.

The PFP complex of buildings forms the bulk of the structures in the PFP Zone. For closure of the above-grade portion of structures within the PFP complex, the approach is to remove them to a state called "slab-on-grade" per the criteria contained in PFP End Point Criteria document and as documented in action memoranda. For below-grade portions of the structures (such as below-grade rooms, pipe trenches and underground ducts), the approach is to remove as much residual contamination as practicable and to fill the void spaces with clean fill material such as sand, grout, or controlled density fill. This approach will be modified as planning for the waste sites progresses to ensure that the actions of the PFP decommissioning projects do not negatively impact future planned actions under the CERCLA. Cribs, settling tanks, septic tanks and other miscellaneous below-grade void spaces will either be cleaned to the extent practicable and filled or will be covered with an environmental barrier as determined by further studies and CERCLA decision documents. Currently, between two and five environmental barriers are proposed to be placed over waste sites and remaining building slabs in the PFP Zone.

INTRODUCTION

The Central Plateau is located in the approximate center of the 560 square mile Hanford Site located in Southeastern Washington. The Plutonium Finishing Plant (PFP) and associated processing facilities including the Plutonium Isolation Building (231-Z) are located in the

Central Plateau. In order to achieve closure of the contaminated facilities and waste sites at Hanford on the Central Plateau, a geographic re-districting of the area into zones has been proposed (*Plan for Central Plateau Closure).* One of the zones encompasses the PFP complex and ancillary facilities.(See Figure 1). Approximately eighty six buildings are included in the PFP Zone. The closure strategies discussed for the Central Plateau are for discussion purposes. The strategy has not been approved by the required government agencies at this time, however, it does propose a common sense approach to a very complicated closure scenario which could be used as the basis for serious discussions with stakeholders on what it will take to close the Central Plateau. This proposed closure strategy for the Central Plateau will be discussed with stakeholders in the near future.

The Plan for Central Plateau Closure presents a proposed strategic approach to closing the Central Plateau by addressing contaminated sources and integrating closure of facilities within certain zones. The general approach that has been proposed is to divide the Central Plateau into 22 zones based on geography. The closure planning for each zone has been divided into "closure elements"; canyons, underground tanks, waste sites, structures and wells. This allows for a different approach to closing the Central Plateau by planning each closure zone as a separate project. The PFP area has been proposed as one of the 22 zones. A zone closure implementation plan is under discussion at this time.

The Plutonium Finishing Plant (PFP) is the major facility complex in the PFP Zone and is currently undergoing decommissioning and closure. The decontamination and decommissioning of PFP and its ancillary facilities will not disposition everything within the PFP Zone. Therefore, it is essential to integrate closure of the PFP facilities with remaining zone closure actions. For instance, the 231-Z Plutonium Isolation Facility and its associated waste sites will be dispositioned outside of the PFP complex Decontamination and Decommissioning. The decision document(s) resulting from the feasibility studies related to the PW-1 and PW-6 operable units will be key to the closure of the PFP Zone.

Although the ultimate closure decisions will depend on agreements made under the Hanford Federal Facility Agreement and Consent Order (HFFACO or Tri-Party Agreement (TPA)) and other appropriate requirements, the intent of the PFP Zone planning is to seek to acquire a balance between removal of contamination and mitigating further migration of contaminants through barrier placement and institutional controls which rely on long term stewardship. The agreements documented in the HFFACO reflect the CERCLA process.

The key concept of barrier placement rather than a remove, treat, dispose scenario to waste sites and contamination areas within the zone probably bears most discussion in the future. There are arguments for barrier placement that show protection of human health and the environment. There are other arguments that removal of some or all of the contamination on the Central Plateau is the most protective of human health and the environment. The final decisions on the remedies for the Central Plateau will more than likely consist of a combination of remove, treat, dispose and barrier placement augmented by institutional controls.

PFP History

Plutonium production has been a key mission of the Hanford Site since World War II. PFP conducted the final step in plutonium metal production beginning in 1949 and throughout the Cold War.

The primary function of the PFP complex was to purify solutions containing plutonium from Hanford's nuclear fuel reprocessing facilities, and plutonium scrap from other DOE sites, and convert them into a solid form. The major former operating facilities at PFP are the 234-5Z and the Plutonium Reclamation Facilities. The solid forms were either a metal form similar to a hockey puck or a powder.

Both the plutonium metal and the plutonium powder were shipped to weapons fabrications facilities at other sites.

PFP's nuclear materials production mission ended in 1989, and much of the useable plutonium inventory was shipped to other sites. In 1996, the U.S. Department of Energy formally ordered a shutdown of the facility. Because the PFP processing line was abruptly halted in 1989, four metric tons of plutonium remained in the plant, encased in some seventeen metric tons of bulk material.

Plutonium is a toxic, radioactive element presenting a variety of potential hazards to Hanford workers, the environment and the public. Hazards include potential significant radiation exposure to workers (as they inspect and remotely handle the materials), the potential for contamination spread, and the potential risk of criticality.

Safely stabilizing and maintaining the volume and variety of plutonium forms has made PFP one of the highest risk and most technically challenging projects at Hanford. Because of these factors, PFP deactivation and decommissioning (D&D) is one of the site's highest cleanup priorities.

PFP Current Activities

The PFP complex is engaged in deactivation of process facilities including removal of plutonium residuals lodged in process gloveboxes, lines and pipes, and ducting. Since plutonium stabilization and packaging are completed, the PFP facility must be deactivated and dismantled in order to meet PFP's end point goals. This highly complex mission involves activities as diverse as:

- Removing remaining plutonium residuals from pipes and ductwork.
- Stabilizing and repackaging the recovered residuals, if needed.
- Removing chemical tanks and gloveboxes (compartments where radioactive and hazardous substances are handled remotely).
- Disconnecting and removing electrical lines.
- Dismantling the approximately 62 buildings in the complex.

Recovered plutonium residuals are being disposed as waste ultimately to the WIPP Facility in New Mexico, or they are being temporarily stored as materials to be dispositioned by DOE. In addition to recovered plutonium residuals, PFP is storing fuel pins and assemblies which will also be dispositioned via a path to be determined by DOE.

Containerization requirements vary depending upon the disposition pathway for the plutonium residuals. For instance, the plutonium oxide powder meeting the required standard is repackaged in heavy, triple-layered, stainless steel canisters that meet new DOE standards for 50-year storage and final disposal. These canisters can be safely stored in the PFP vaults until they are dispositioned by DOE.

Low purity residual material is placed in the Pipe and Go containers and will be shipped to the Waste Isolation Pilot Plant for disposal.

The PFP cleanup, which is projected to cost more than $1 billion, is scheduled to be completed in September 2009. At the end of the project, all above-ground structures will be deactivated and dismantled and the endpoint – a clean slab-on-grade state– will be achieved. PFP's mission will then shift from deactivation to long-term surveillance and maintenance as required in the Tri-Party Agreement.

Proposed PFP Zone Closure Approach

The PFP Zone is composed of buildings and waste sites within and without the PFP complex. The PFP complex of buildings is surrounded by a fence and most of the buildings and structures

discussed in the PFP Zone reside "inside the fence". Prior to the proposal to separate the Central Plateau into zones to facilitate an integrated closure of the plateau, the closure of the PFP complex was the subject of negotiations with the regulatory agencies: Washington Department of Ecology and U.S. Environmental Protection Agency. As a result of these negotiations, cleanup milestones were determined for the PFP complex under CERCLA as removal actions with a final Record of Decision (ROD) to be determined in conjunction with surrounding waste sites.

In general, decisions were made to remove structures within the PFP complex to "slab-on-grade" per the criteria contained in the PFP End Point Criteria document and as evaluated in the Above Grade Engineering Evaluation/Cost Analysis (EE/CA) for PFP. Structures not currently covered by this end point criteria document, such as Tank 241-Z-361, will be remediated (sludge removed and dispositioned) per the EE/CA and Action Memorandum pending on the tank, or the tank will be included in the planned CERCLA evaluations for the PW operable units which are currently being written to remediate soils in the vicinity of PFP

For the below grade portions of the PFP complex, the agencies have agreed to evaluate this area in an EE/CA. Limited below-grade remediation is anticipated with follow on actions completed in conjunction with overall zone remediation. In the Central Plateau closure planning, barriers are proposed for much of the PFP Zone after the buildings have been removed to slab.

In order to facilitate barrier placement void spaces (such as below-grade rooms, pipes trenches, underground ducts etc.) may be filled with void filling material such as sand, grout, or controlled density fill. Cribs, settling tanks, septic tanks and other miscellaneous below-grade void spaces will likewise be filled as required to prevent possible subsidence.

The closure approach will evaluate and implement as appropriate, for the PFP Zone removal, treatment and disposal of the waste, however, it is anticipated that surface barriers will be necessary to achieve remedial action objectives. The purpose of a cover system is to control moisture and percolation, promote surface water runoff, minimize erosion, prevent direct exposure to the waste, control gas emissions and odors, prevent occurrence of disease vectors and other nuisances, and meet aesthetic and other end-use purposes. Cover systems are intended to remain in place and maintain their function for an extended period of time.

The type of covers proposed for the PFP zone are alternative cover systems, such as evapotranspiration (ET) cover systems. These types of systems are increasingly being considered and used at sites where waste will be left in place and contained. Conventional cover systems use low-permeability barrier layers, such as compacted clay, geomembranes, or geosynthetic clay liners, to minimize percolation. Regulation under the Resource Conservation and Recovery Act (RCRA) for the design and construction of cover systems are based on using a barrier layer.

Under RCRA, an alternative design, such as an ET cover, can be proposed in lieu of a RCRA barrier if it can be shown to provide equivalent performance. The Environmental Protection Agency (EPA) has issued guidance for the minimum design of these alternative cover systems. ET cover systems use one or more vegetative soil layers to retain water near the surface until it is either evaporated from the soil surface or transpired through vegetation. These cover systems

rely on the water storage capacity of the soil layer rather than on the low permeability of the materials to minimize percolation. ET cover systems are designed to use the natural hydrological processes at the site, which include water storage capacity of the soil, precipitation, surface runoff, infiltration, and evapotranspiration.

Work in recent years has shown that the ET type of barrier has very desirable characteristics for an arid region like Hanford. Some advantages of ET barriers are: they are simpler and cheaper to construct; they are not susceptible to desiccation cracking of the clays contained in the standard RCRA designs; they don't rely on manmade materials that will eventual degrade over time; they are self-healing and not as susceptible to creating preferential flow pathways as multilayer designs when subjected to subsidence and/or tectonic movement; they are designed to act as a 'sponge' for wet years or events, then evaporate and transpire water back into the atmosphere; and they can be designed to prevent plant root and animal and human intrusion with the installation of a biointrusion layer under the ET barrier.

Extensive work has been conducted to demonstrate the effectiveness of ET barriers. The work to date has demonstrated good long term performance. As a result of this work, EPA is changing guidance to support ET barriers for waste sites in arid western states.

Two environmental barriers are proposed to be placed over waste sites and remaining building slabs in the PFP Zone. The first barrier, the 231-Z Barrier, will encompass the 231-Z complex and waste sites. This barrier will start at the northern edge of the PFP Zone and extend south to the northern edge of the PFP protected area. The 231-Z Barrier will extend east to the eastern boundary of the PFP Zone and west past the 216-Z-16 waste site.

The second barrier, the 234-5Z Barrier, is proposed to encompass the 234-5Z complex and waste sites. The 234-5Z Barrier will start at the PFP protected area loop road (between 270-Z and 234-5Z) and extend south to the end of the PFP Zone. The 234-5Z Barrier will extend west past the 216-Z-12 waste site. The eastern boundary of the 234-5Z Barrier will follow Camden Ave south past the 216-Z-21 waste site and then jog to the west and follow the eastern edge of the 261-Z-1D waste site. The east and west edges of the 234-5Z Barrier do not tie into other barriers. At this point in the zone planning, 69 acres or 57% of the zone is proposed to be covered by barriers.

Of the approximately 86 buildings in the PFP Zone, 62 will be transitioned to slab-on-grade by the PFP Decommissioning Project. The remaining support structures will be transitioned as a follow-on project. The 241-Z waste tanks will be remediated by the PFP Decommissioning Project. The 241-Z-361 Waste Settling Tank will be remediated as a follow-on project (sludge removed and dispositioned). All other waste tanks (216-Z-8 and septic tanks) may be dispositioned in place via isolation and void filling pending future planning for waste sites closure.

Assumptions

Major assumptions regarding barrier placement over the PFP complex and zone area depend upon feasibility studies and decision documents per the CERCLA process. Meetings are planned to discuss this approach with interested parties. Stakeholder involvement will occur as CERCLA

evaluations are performed such as feasibility studies, and as stakeholders are asked to provide input.

PFP Zone Closure Issues

Several issues that could pose potential problems for the PFP zone closure approach are listed below:

- Several waste sites located near PFP received waste containing carbon tetrachloride and plutonium. Containment and interim actions are underway to remove carbontetrachloride from the soil column and the groundwater beneath PFP.
- The scope of the PFP zone closure is large and involves integration with on-going decommissioning activities at the PFP complex. There are as many as 282 closure elements in the PFP Zone including 1 treatment, storage, and disposal permit, 86 buildings, 40 waste sites and 155 wells.
- Surface Barrier Life- The expected design life of the surface closure barrier is estimated to be 1000 years. The long half life of TRU constituents is a matter of continuing discussion.
- Surface Barrier Maintenance- Responsibilities for oversight and maintenance barriers is will be determined as planning proceeds.
- Gas Generation- Effects on gases generated by plutonium contaminated soils and sanitary drain fields is under discussion.
- Sub Surface Voids- Subsurface voids created by the large ductwork, waste-water clay and metal piping, sanitary water and electrical conduit and the waste transfer lines interspersed at PFP will require careful planning and logistical support. The proposed barriers will require a lot of material and the transportation of the material to support construction actives.

Regulatory Strategy

Closure activities within the PFP zone will be conducted under CERCLA with the exception of two RCRA TSD units (241-Z TSD and Glovebox HA-20MB). The TSD units will be closed according to approved RCRA closure plans which will be integrated with the CERCLA activities. CERCLA activities in the zone will involve non-time-critical removal actions for the facilities and remedial actions of the waste sites.

The PFP Zone CERCLA closure will consider EPA's nine CERCLA evaluation criteria, defined in EPA/540/G 89/004 to address the statutory requirements and the technical and policy considerations important for selecting removal/remedial alternatives. These criteria serve as the basis for conducting detailed and comparative analyses and for the subsequent selection of appropriate removal/remedial actions, as required. In general, the 9 criteria ensure overall protection of human health and the environment, compliance with ARARs, implementation feasibility, and acceptance by the State and community.
CERCLA non-time-critical removal actions are planned for above grade and below grade structures as specified in the Tri-Party Agreement milestones for PFP. An engineering evaluation/cost analysis (EE/CA) will be completed for each proposed removal action. There are

four EE/CA's planned or in progress for the PFP zone closure at this time; above grade structures, subgrade structures, building 232-Z, and settling tank Z-361.

The CERCLA approach to the footprint resulting from the removal actions determined by the action memoranda for the PFP complex is being developed in accordance with Section 8 of the TPA Action Plan. For PFP transition milestones, there is included a portion of the "disposition phase" for key facilities., The approach to key facilities is described in the TPA Action Plan, Section 7.2.2, Operable Unit Scoping Activity, and Section 8, Facility Decommissioning Process. The agreements in the TPA action plan allow for the PFP footprint to be eventually scoped into an operable unit and analyzed appropriately within a RI/FS.

For removal actions within the PFP complex, each action will proceed according to a selected alternative that is documented in an Action Memorandum issued following regulatory agency approval. The removal actions will be implemented and documented through Removal Action Work Plans (RAWPs). The RAWPs will be prepared to establish the methods for removal and disposal of the building(s)/waste, the controls and limits necessary for environmental compliance, and any other supporting functions associated with implementation of the recommended removal actions.

Closure via CERCLA remedial actions is planned for PFP Zone waste sites (cribs, ditches, drains, reverse wells and unplanned release sites). These waste sites are catalogued in the Hanford Waste Information Data System (WIDS) database. Remedial Investigation and Feasibility Studies(RI/FS) will be conducted and each waste site will be evaluated within the context of an operable unit and its associated RI/FS. There are approximately 45 waste sites, 86 buildings, and 70 underground lines in the PFP zone located in eight to nine operable units at this time. These operable units are: 200-CW-5, 200-LW-2, 200-PW-1, 200-PW-6, 200-IS-1, 200-SC-1, 200-ST-1and 200-UR-1.

After the RI/FS is reviewed by stakeholders and accepted and approved by the regulators, Records of Decision are expected to be issued applicable to these units. Remedial action objectives will consider land use, contaminants of potential concern, potential applicable or relevant and appropriate requirements, and exposure pathways. Remedial actions for all waste sites will proceed according to a Record of Decision addressing each waste site.

Because the PFP Zone actions include CERCLA evaluations from several different operable units for remedial actions as well as several major removal actions, an integrating management plan for consolidating the decision documents from all of the CERCLA actions in the Zone will be developed. The concept of a zone closure implementation plan was developed for this purpose. This implementation plan will act as a type of project management tool that will integrate such items as field activities from several decision documents, barrier design and installation, cross-zone work elements and waste handling and infrastructure logistics coordination. Later, the information gathered during implementation of the actions will be used to verify closure of the zone.

CONCLUSION

The Plutonium Finishing Plant (PFP) and associated processing facilities are located in the 200 area of the Hanford Site in Eastern Washington. This area is part of what is now called the Central Plateau. In order to achieve closure of the contaminated facilities and waste sites at Hanford on the Central Plateau (CP), a geographic re-districting of the area into zones has been proposed in the recently published *Plan for Central Plateau Closure*. One of the 22 zones proposed in the Central Plateau encompasses the PFP and ancillary facilities. Approximately eighty six buildings are included in the PFP Zone. This paper addresses the approach for the closure of the PFP Zone within the Central Plateau and its integration with the on-going decontamination and decommissioning of the PFP complex.

The PFP complex of buildings forms the bulk of the structures in the PFP Zone. For the decontamination and decommissioning of the above-grade portion of structures within the PFP complex, the approach is to remove them to a state called "slab-on-grade" per the criteria contained in PFP End Point Criteria document and as documented in action memoranda. Some of these slabs will be capped. For below-grade portions of the structures (such as below-grade rooms, pipe trenches and underground ducts), the current PFP approach is to remove as much residual contamination as practicable and to fill the void spaces with fill material such as sand, grout, or controlled density fill. Cribs, settling tanks, septic tanks and other miscellaneous below-grade void spaces will either be cleaned to the extent practicable and filled or will be covered with an environmental barrier. The exact nature of what will be left behind and capped, the number of caps, and the extent of caps will be determined by further studies and negotiations with agencies.

REFERENCES

1. *Plan for Central Plateau Closure*, Fluor Hanford, September 2004, CP-22319.
2. Ibid.
3. Above Grade EE/CA, 2004.
4. *Plan for Central Plateau Closure*, Fluor Hanford, September 2004, CP-22319.