Update on Demolition Strategy and Progress at Hanford's Plutonium Finishing Plant-17161

Tom Bratvold, CH2M HILL Plateau Remediation Company, Richland, Washington

ABSTRACT

U.S. Department of Energy (DOE) contractor CH2M HILL Plateau Remediation Company (CH2M) is currently demolishing the Plutonium Finishing Plant (PFP). The facility is located on the Hanford Site and produced plutonium metal during the Cold War. Production was stopped in 1988, the facility was formally shut-down in 1996 and material processing completed in 2004. In November 2016, the project team, partnering with DOE-Richland Operations Office (DOE-RL) began demolition of the building. CH2M and DOE-RL will demolish PFP as a Hazardous Category II nuclear facility (HazCat II).

The PFP is considered one of the most hazardous buildings on the Hanford site; employees have performed some of the most hazardous work anywhere across the DOE Environmental Management complex. Since 2008, employees have removed much of the plutonium-processing infrastructure. Four main buildings make up the majority of the PFP complex. As of November 2016, one building is undergoing demolition, another is ready for demolition and, concurrently, demolition preparations continue in the remaining two buildings. That hazard mitigation work includes removing contaminated ventilation duct work, process lines and performing asbestos abatement.

To ensure safe and compliant demolition, CH2M employees researched, trained and deployed personal protective equipment never before used on the Hanford Site to complete some of the most hazardous demolition preparations. Project management commissioned the development of an air dispersion model that dictated ready-for-demolition criteria and established conservative demolition parameters. Management also sequenced project work to allow demolition to occur while demolition preparations continue a safe distance away in adjacent buildings.

This paper will allow CH2M and DOE-RL to share lessons learned and progress to date with other complex and hazardous projects across the DOE complex.

INTRODUCTION

PFP, also known as Z-Plant, operated from 1949 to 1989, and represented the final step in the plutonium production effort at Hanford. At this facility, plutonium was processed into solid, hockey-puck sized "buttons" and plutonium oxide powder that could then be safely shipped to the country's weapons production facilities. PFP produced nearly two-thirds of the nation's plutonium stockpile.

By December of 2009, containerized plutonium-bearing material stored at PFP was successfully stabilized, packaged, and shipped to the Department of Energy's Savannah River Site and to another Hanford on-site location. Ancillary building demolition began in 2012 with the removal of vaults that once held plutonium. Inside, demolition preparations were well underway. By November 2016, crews

completed some of the most hazardous work ever performed anywhere across the DOE complex, including:

- Size reducing two large, high holdup glove boxes. Contamination levels during size reduction activities require workers to wear pressurized suits and breathe supplied air.
- Preparing for demolition building 242-Z, a building left severely contaminated as a result of a 1976 explosion inside a glove box.
- Cleaning off the Plutonium Reclamation Facility (PRF) (in building 236-Z) canyon floor and decontaminating the canyon, left contaminated after years of chemical leaks and spills.

With these tasks complete, and demolition underway in the PRF and demolition preparations complete in 242-Z, crews have been deployed to focus on preparing the two remaining buildings for demolition which involves the critical path project: abating the remaining 10 percent of asbestos, removing the remaining 25 percent of process vacuum piping and 66 percent of ventilation ducting.

The safe, compliant demolition of PFP is necessary to protect human health and the environment, as well as reduce lifecycle costs for the Hanford Site.

HAZARDOUS DEMOLITION PREPARATIONS, INCLUDING NEW PROTECTIVE GEAR DEPLOYMENT

The primary personal protective equipment in use during much of the demolition preparations inside the PFP facilities are hooded powered air purifying respirators (PAPR) with filter cartridges appropriate for the task, anti-contamination clothing and at least two pairs of gloves.

As work progressed and increased in difficulty and hazard, management and crews deployed new personal protective equipment to increase safety and efficiency, particularly for the difficult and hazardous task of cleaning out 242-Z, the Americium Recovery Facility.

The Americium Recovery Facility contains the McCluskey Room, which was used to recover americium during the Cold War. The room is named after Harold McCluskey, who was injured in 1976 when a vessel inside a glove box burst and exposed him to radioactive material. McCluskey was 64 at the time and lived for 11 more years until he died from causes not related to the accident. As a result of the accident, employees in the room encountered airborne radioactivity, surface contamination and poor ventilation as they removed three remaining glove boxes, chemical lines and prepared chemical tanks for removal during demolition.

Recognizing the significant hazards, workers in 2013 traveled to a similarly contaminated Department of Energy site in Idaho and observed the use of advanced supplied air systems and protective suits, which they recommended for use at the PFP. The system and equipment observed at the Idaho site has been in use for approximately nine years.

Workers also developed procedures and training tailored for using the equipment at the Plutonium Finishing Plant. The equipment includes an abrasion-resistant suit that protects workers from surface contamination and chemicals. Workers also wore devices for communicating with each other and for monitoring air inside the suit. A dual-purpose air system will provide cool air for breathing and cool air throughout the suit for worker comfort, allowing them to work in the facility for longer periods of time. The suit is pressurized, which helps prevent workers from coming into contact with airborne contaminants.

After significant training during 2014, the technology was deployed inside the Americium Recovery Facility in September 2014. In 2015, a second team of employees, using the same equipment, began cutting apart and removing two large, highly contaminated glove boxes.

Figure 1: Employees developed a method to cut workers out of Level B suits by marking cut lines on the backside of the suits and applying tape over the cut lines prior to use keep the cut lines free of contamination. During doffing, a support crew cuts the back of the suit away from the worker, allowing the worker to step backward out of the suit.

During the use of the suits, PFP employees implemented new techniques to ensure maximum safety during use, including:

- Adding Kevlar protective padding to the belly and knee areas of the suits, to reduce the risk of puncturing the suits during the size reduction of glove boxes
- Using additional arm and leg sleeves to better protect against skin contamination as a result of doffing the suits.
- Developing a cut-out method for doffing the suit to better accommodate congested egress areas (Figure 1)

Right now, CH2M is considering adopting this technology for use in airlock and hot cell cleanout work at other Hanford projects.

OUTSIDE EXPERT GUIDANCE DURING DEMOLITION

CH2M is demolishing PFP as a HazCat II nuclear facility. However, to ensure employee and environmental safety, demolition is proceeding in a series of

consecutive phases, with each phase only containing enough contamination to be considered HazCat III. Although more than 20 tons of plutonium have been removed from the PFP as part of demolition preparations, the sheer volume of residual holdup throughout the former processing equipment has taken nearly 20 years to remediate to the point where demolition is possible.

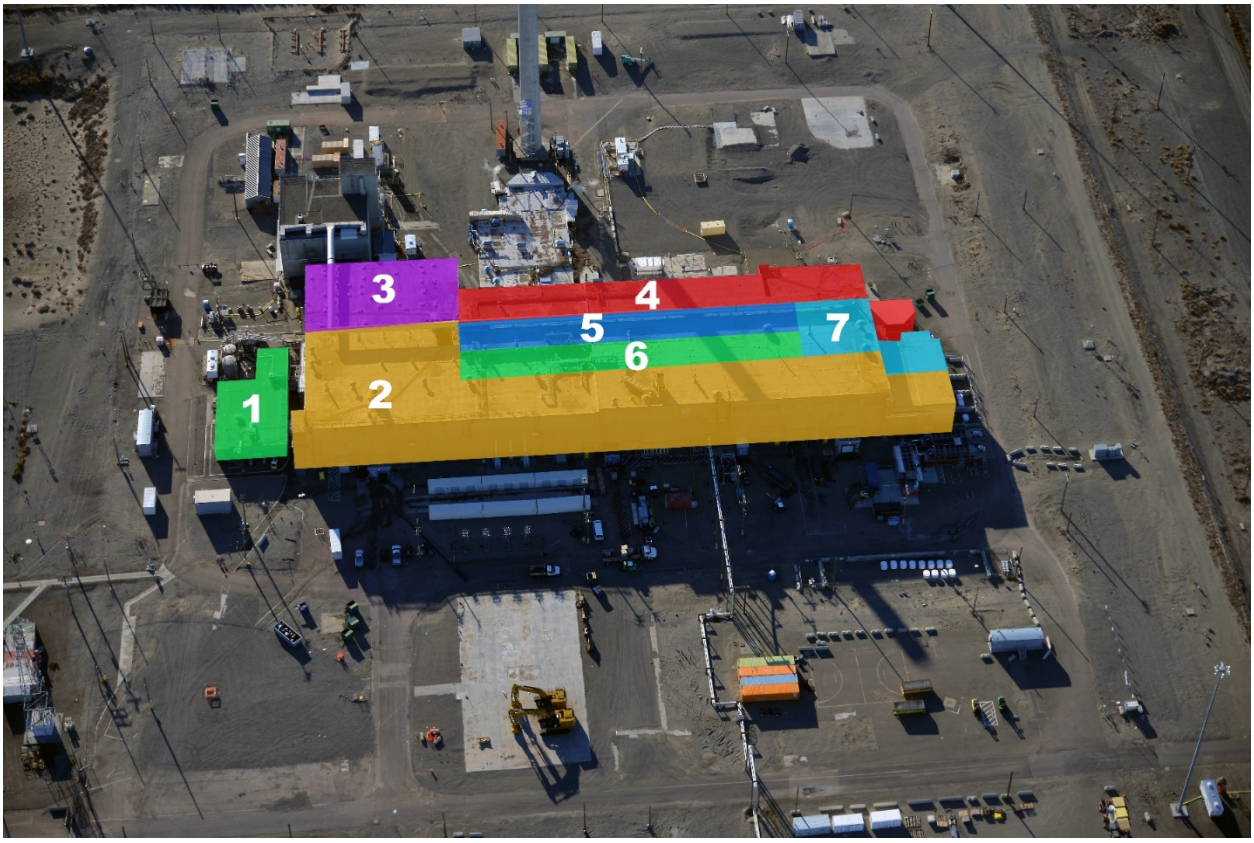

Figure 2: This illustration shows the seven zones and sequence for demolition of 234-5Z.

PFP project management contracted with a structural engineer (Joe Farrè) to guide the demolition of the facilities, based on structural engineering and characterization considerations. Demolition generally proceeds from the less hazardous to the more hazardous portions of the facilities. Demolition is occurring with high-reach type demolition equipment on a bay-by-bay, zone-by-zone basis (Figure 2). This approach allows the structure to be removed in mass segment while maintaining the structural integrity of the remaining building segments.

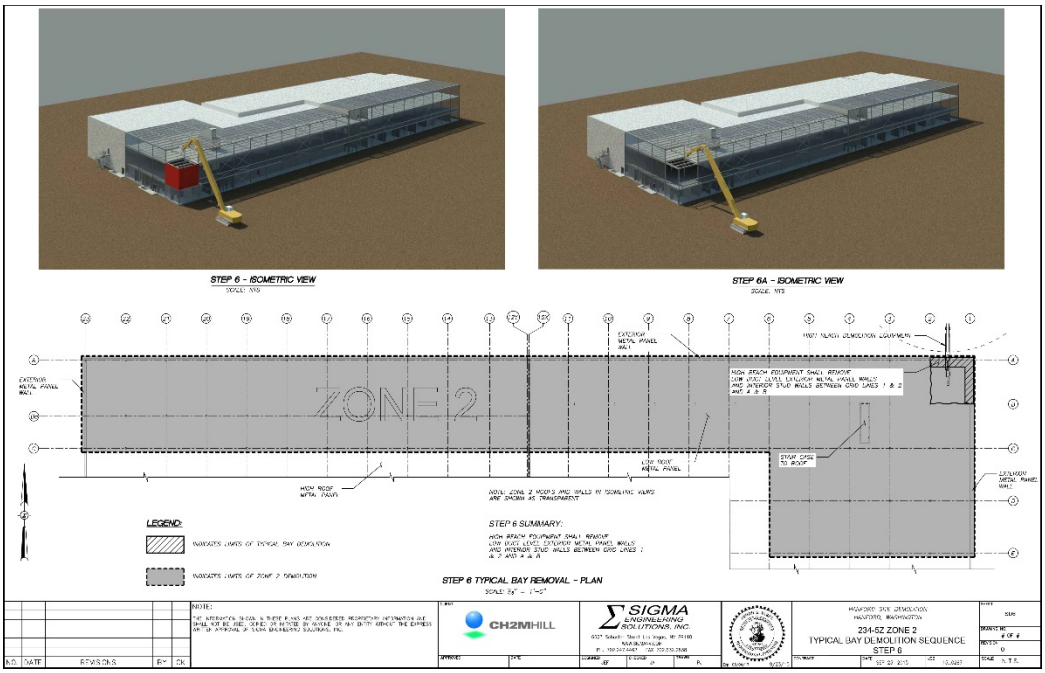

Figure 3: Example of structural engineering drawings that will guide demolition.

The engineer provided the project with detailed day-by-day demolition plans, identifying what walls, beams and others structures are to be removed that shift or day (Figure 3). Crews are briefing to those plans at the start of each work day.

A detailed air dispersion model will also guide demolition preparations and execution. The project contracted Dr. Bruce Napier with Pacific Northwest National Laboratories to develop the model.[1] Dr. Napier is a world-renowned expert in air dispersion modeling; the model he developed factored in:

- Residual contamination levels in the building,
- The types of demolition activities (whether it be cutting, crunching, etc.),
- Historical weather patterns on each day of demolition (the model assumes that on any given day of demolition, the weather for that day will be the worst weather for that day for the last six years)
- Wind patterns and building wake effects created as sections of the building are demolished

By law (10CFR 835), the project is required to post an Airborne Radioactivity Area (ARA) at a concentration of 1 DAC (Derived Air Concentration) or at an exposure level of 12 DAC-hr in a week. The CH2M Radiological Control Manual recommends posting an ARA at 20 percent of a DAC; PFP has an approved Technical Equivalency Determination (TED) stating the project will post outdoor areas in support of the PRF demolition at 30 percent of a DAC.

The air dispersion model indicates that for the entire demolition, airborne

[1] B.A. Napier, J.P. Rishel and E.I. Mart, "Air Dispersion Modeling of Radioactive Releases During Proposed PFP Complex Demolition Activities: A Report to CH2M HILL Plateau Remediation Company;" Pacific Northwest National Laboratory; PNNL-20173 Rev. 4 (October 2016).

radioactivity levels requiring posting and control will be contained well within established airborne radioactivity area boundaries.

The conservative model also indicates that during demolition of the 236-Z main process cell (canyon) exposure levels could approach 1 DAC-hour/week at the Material Balance Area boundary fence line of the PFP. Averaged over a 40-hour work week, that equates to a concentration of 2.5 percent of a DAC. In other words, under worst case conditions, concentrations at the PFP fence line may be at a factor of 10 times below posting and control requirements during canyon demolition. In terms of dose for our source term, an exposure level of 1 DAC-hr equates to 7.2 µSv (0.72 mrem) received over a 50 year period. For comparison, the Nuclear Regulatory Commission quantifies the amount of radiation exposure we receive, on average, from "background" radiation is 3.1 mSv/year (310 mrem/year) or approximately 60 µSv/week (6 mrem/week).

Demolition of PRF is expected to take around 12 weeks with more than half of that set aside for the canyon.

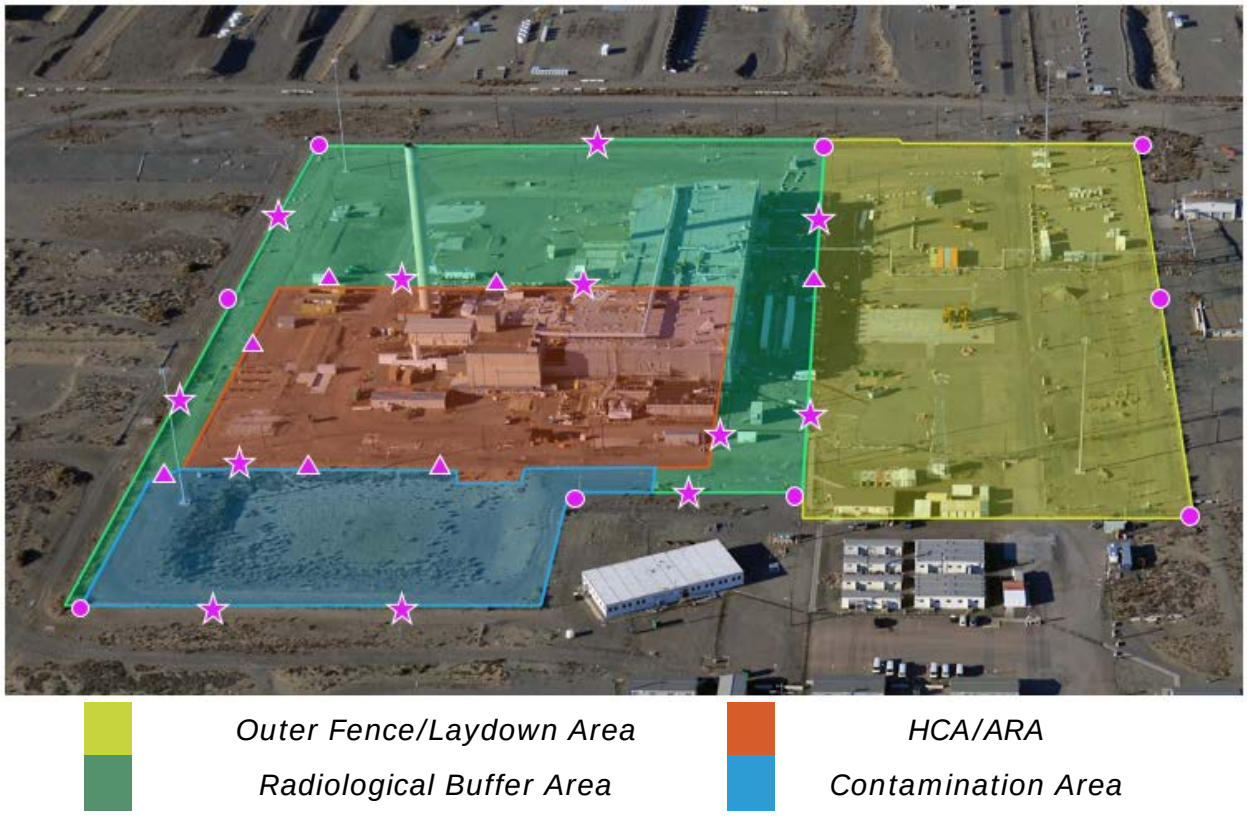

Figure 4: An air monitoring map during PRF demolition shows the location of CAMs (triangles), air samplers (circles) and cookie sheets (stars).

During demolition, a robust monitoring system is in place with continuous monitoring for airborne radioactivity and contamination at not only the posted boundaries, but outside the trailers around the PFP complex and well beyond the facility borders to provide negative data for nearby facilities and employees (Figure 4).

The seven CAMs at the posted ARA boundary are set to alarm at 8 DAC-hrs, which is the same alarm set point inside the facility in our non-ARA locations. Nine Fixed Air Samplers (FAS) located around the PFP fence line, and an additional five FAS are located throughout the trailers at PFP and three additional FAS outside PFP borders. “Cookie sheets” are also placed with the FAS (additional ones are also placed at various locations). These cookie sheets provide a flat surface for the radiological control technicians to verify no removable/transferrable contamination. All air sample filters will be changed out twice per day during demolition activities, along with the cookie sheets being surveyed.

Air sampling and monitoring data to date has demonstrated the air dispersion model to be conservative, as expected.

SAFE, EFFICIENT PARALLEL WORK

To advance demolition preparations in PRF, the project deployed five crews in that facility, starting in the summer of 2016. As demolition began, those crews were redeployed to prepare the remaining two structures for demolition, 234-5Z and 291-Z.

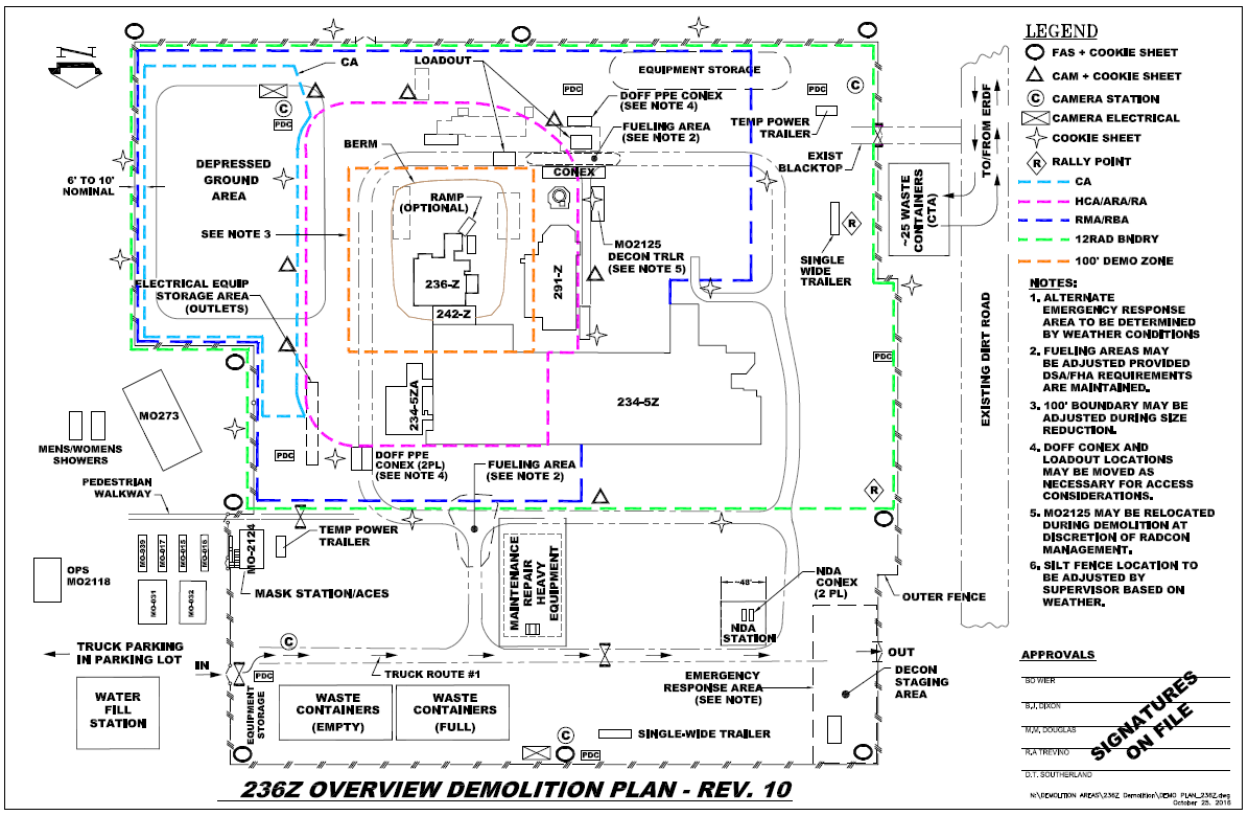

Figure 5: Work inside 234-5Z occurs outside the demolition zone while demolition occurs at 236-Z.

The project established conservative demolition boundaries during the demolition of PRF to simultaneous work in adjacent structures (Figure 5). The demolition

boundaries do not factor in protection of walls and roofs of those adjacent buildings. Work in 234-5Z will not occur when demolition is occurring in 236-Z. The size, however, of 234-5Z allows work in the western-most portion of the building outside the 236-Z demolition zone.

Many of the facility and worker support functions for PFP were located in the demolition zone for 236-Z; those have been relocated well outside the demolition zone to allow access during demolition.

SUMMARY

Demolition of PFP will progress from 236-Z and through 242-Z (Figure 6). In spring 2017, demolition of 234-5Z is expected to begin. Demolition of that facility and 291-Z will be done in parallel where possible. Building demolition is expected to be complete in July 2017, with demobilization activities continuing through September 2017.

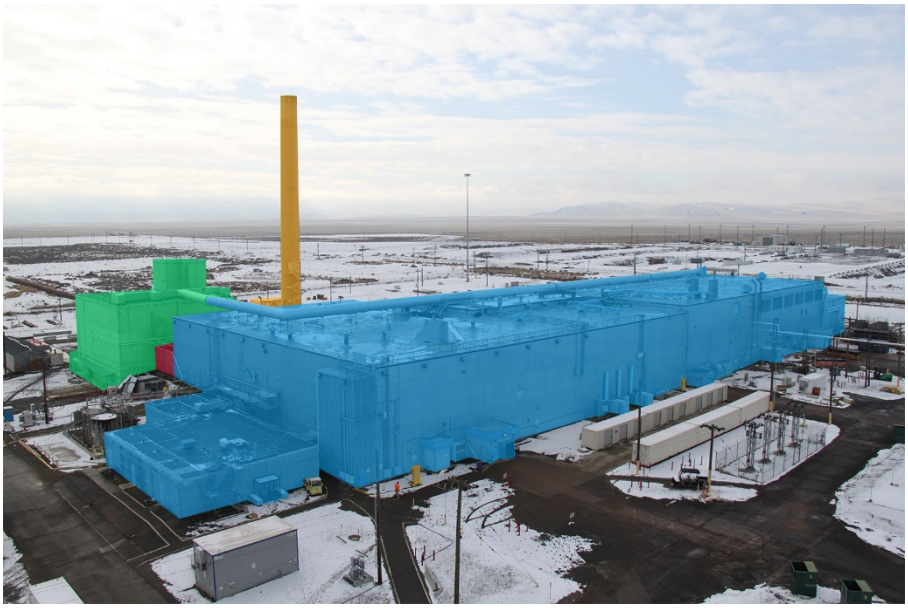

Figure 6: Demolition Sequence

1 *Plutonium Reclamation Facility (236-Z)*

2 *Americium Recovery Facility (242-Z)*

3 *Plutonium Finishing Plant (234-5Z)*

4 *Ventilation Stack and Fan House (291-Z)*

All buildings will be demolished to their concrete slabs, with trenches and tunnels grouted or backfilled for stability CH2M is currently in discussions with DOE to remove the concrete slabs associated with the most contaminated buildings (236-Z and 242-Z) while demolition equipment and crews are mobilized.

The work to prepare PFP for demolition required some of the most hazardous deactivation work ever performed within the DOE complex. With that work complete, the focus is now the safe and compliant demolition of the facility, removing a hazard on the Hanford Site.