Buildings 771 and 774 Closeout Briefing Summary

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Briefing Summary Revision Number
Rev 0 (12/05)

Approximate Location
Northing: 751,000 (approximate center of 771), 751,050 (approximate center of 774)
Easting: 2,083,800 (approximate center of 771), 2,084,100 (approximate center of 774)
Location Relationship to other Site areas: Buildings 771 and 774 were built into a slope immediately north of the former Buildings 776/777 and south of North Walnut Creek.

Historical Information
(For a detailed history on Buildings 771 and 774, see References 1 and 2; the following section relies heavily on language used in References 1 and 2). In addition the link below has many interesting photos from the production era in Building 771.
http://192.149.55.183/HAER/base/771.htm
The HAER reference in the link is part of the Historical American Engineering Record which can be found on the www.rfets.gov homepage under Historical Information.

Building 771
Building 771 (B771) construction began in 1951 and operations began in May, 1953. The original designation for B771 was Plant C or 71. After quite a few years the designation changed to 771 just like the original Plant A or 44 became B444 as more and more buildings were added to the site. The original building was a two-story structure built into the side of a hill with most of three sides covered by earth (see Figure 1, page 7). The fourth side, facing north, provided the main entrance to the building.

Original building operations included:
- plutonium (Pu) foundry, fabrication, and assembly operations;
- Pu recovery;
- Pu special recovery;
- Pu chemistry;
- Pu metallurgy research; and,
- analytical laboratory operations.

The foundry operations consisted of casting Pu metal into forms that could be fabricated for assembly into nuclear warhead components. In 1957 these operations were transferred to B776/777 after a fire caused major damage to 771 (see Figure 2, page 8, for 771 fire damage).

Pu recovery operations processed a variety of Pu-bearing residues to recover as much Pu as was economically feasible. Significant quantities of americium (Am) were also recovered (enough so that for a time Rocky Flats supplied manufacturers of commercial smoke detectors with Am). In 1958 an incinerator began operations so that Pu-bearing combustibles could be burned in order to recover Pu from the incinerator ash.

Special recovery operations processed scrap metal and oxide residues containing elements and isotopes that could have otherwise contaminated or diluted the Pu production stream. Pu

chemistry R&D groups developed new methods for recovering, separating, and purifying actinides from acidic streams. The Pu metallurgy group assisted agencies and plant production with weapon design. Liquid and solid samples were analyzed by the analytical laboratory for Pu, Am, uranium, neptunium, and other radioactive isotopes.

The first shipments of Pu arrived in 1953 from the Hanford site in Richland, Washington in the form of plutonium nitrate liquid. By about 1959, theses shipments diminished and the majority of B771 feed material resulted from site return weapon components. Site returns were "units" that had been in the "field" (read: military nuclear weapons systems) for some time and were "retired" due to their age or other issues. The nuclear weapons were disassembled at another site and the Pu/U primary cores (a.k.a. "pits") were sent back to Rocky Flats for reprocessing (recovery of Pu/U).

The primary recovery operations involved both liquid and solid Pu-containing materials. The liquid materials were typically very acidic in nature and their corrosive nature caused numerous problems with production equipment. As a result, there were a large number of liquid leaks throughout the processing areas of B771 during its operational lifetime. These continual leaks and other contamination events caused problems which existed throughout the life of the building. An example of another contamination event was a fire in 1957 which caused extensive damage and contaminated a large area of 771.

Although 771 continued to have operational difficulties throughout its lifetime, its "replacement" fared worse. In 1968 Building 371 was conceived as a larger and safer facility to replace 771. 371 would feature automated processes to keep workers distance from the hazards of Pu processing. In 1980 construction of 371 was finally completed after many years of design and construction delays. At that point Pu operations in 771 were discontinued and cleanup operations began. However, due to the inadequate design of Pu processing operations in 371, 771 Pu operations were re-started later in 1980. 371 never achieved the goal of replacing the operations in 771. The hands-on processes used in 771 were superior to the automated systems installed in 371.

On June 6, 1989, agents from the FBI, Department of Justice, and EPA enforcement agents raided the site to conduct an investigation into alleged environmental crimes. This operation was termed "Operation Desert Glow". Part of their investigation was into the alleged practice of illegal incineration activities in 771. After 1989, 771 operations never re-started. However, when the plant was shut down in 1989, it was not shut down in a safe, controlled fashion. As a result, Pu solutions remained in process piping, tanks, and four-liter plastic bottles stored in gloveboxes. The continued storage led to increased safety risks due to deteriorating conditions, which led a DOE working group in 1994 to declare 771 the most dangerous Pu facility in the DOE weapons complex. After 1994, remedial actions began to correct the safety problems associated with the long-term storage of Pu in 771. Tank draining activities began in 1996 and were followed in 1998 by "tap & drain" of 771's vast network of process piping.

Building 774

Initial construction of Building 774 (774) was completed in 1953. Several expansion projects were completed throughout the operational lifetime of 774. 774 was designed to treat the liquid process wastes generated in 771. As nuclear warhead component production increased, 774 began processing wastes for additional operations and buildings. 774 processed wastes such as:

- radioactive acidic wastes;

- radioactive caustic wastes;
- radioactive organic wastes;
- radioactive waste oils and sludges; and,
- non-radioactive waste photographic solutions.

The goal of the waste treatment processes in 774 was to reduce liquid radioactive wastes and convert them into a form suitable for transport off-site for storage and disposal. In general, wastes were either piped directly into 774 or transferred in drums, containers, or other types of packaging. The wastes entered a series of interconnected tanks designed to treat acidic, caustic and radioactive wastes and separate relatively low-level radioactive effluent from contaminated solids or sludges. Each of the four processes used in the first stage process in 774 were tailored to meet certain characteristics of the wastes. The wastes may have passed through one or more of these first stage processes before entry into the next stage of operation. The four first stage processes included:

- neutralization and filtration of acidic wastes containing large quantities of metal ions or chloride ions;
- batch neutralization, precipitation, and filtration of acidic wastes containing only small quantities of metal ions or basic wastes containing large quantities of undissolved solids;
- continuous radioactive decontamination of neutral and caustic wastes; and,
- solidification of aqueous wastes containing complexing agents, certain radioactive isotopes, or hazardous chemicals that were undesirable in the regular waste system.

The second stage of the operations included two separate radioactive waste decontamination processes. The benefit of segregating the wastes was better utilization of the waste storage ponds based on whether or not the wastes met standards for radioactive and/or chemical contamination. The two processes were:

- batch precipitation to remove radioactive materials from wastes containing both radioactive and chemical contaminants in excess of standards; and,
- continuous precipitation to remove radioactive materials from wastes meeting the standards for chemical but not radioactive contaminants.

The slurry from both these second stage processes was held in a slurry tank until it was processed by vacuum filtration to separate the solids from the liquid. The separated solids were mixed with a solidifying agents and packaged for shipment and disposal at WIPP as transuranic-mixed waste (radioactive, >100 nanoCuries/gram, and hazardous).

The role of 774 diminished when the new process waste treatment facility opened in Building 374. The waste product from 374 was primarily “saltcrete” which had its own history of difficulties.

As a result of the many years of radioactive waste processing, 774 became a highly contaminated facility over time. It suffered from some of the same radioactive contamination woes as experienced by its sister building, 771.

Pre-remediation Characterization Data

(Again portions of this section heavily rely on References 1, 2, and 3)

Both 771 and 774 had a wide variety of contaminants of concern (COCs) present inside the buildings, in outside ancillary structures, and under building contamination (UBC) locations. Large areas of both buildings contained equipment and portions of the building structures which

were categorized as TRU waste (>100 nanocuries of Pu activity per gram of waste) due to years of accumulated actinide contamination. Due to the complex actinide recovery and waste processing operations in these two buildings, many different COCs were present as follows:

- radionuclides such as Pu, Am, and U isotopes (many locations which exceeded wildlife worker action levels, WRW ALs);
- metals such as Ag, As, Ba, Be, Cr, Cu, Mn, Ni, Pb, Sr, and Zn (many locations which exceeded WRW ALs as well as ecological screening levels, ESLs);
- VOCs such as chlorinated solvents, acetone, toluene, and benzyl alcohol; and,
- SVOCs/PCBs such as anthracenes, pyrenes, phthalates, nathenes, fluoranthenes, and aroclor-type PCBs.

Remedial Actions Taken

Both 771 and 774 were built into a hillside and both buildings were razed during remedial actions. 771, 774, and their associated infrastructure were removed as various categories of waste. Those portions of the reinforced concrete building structures which were deeper than 6 feet below final grade were left in place if the residual contamination was less than 7 nCi/g Pu averaged across the remaining concrete slab thickness.

The following is a summary of the waste volumes by categories generated during remediation:

- TRU – 2,066 cubic meters to WIPP disposal site in New Mexico;
- TRM (TRU mixed) – 648 cubic meters to WIPP;
- LLW (low level waste, <100 nCi/g) – 35,000 cubic meters to NTS in Nevada or Envirocare in Utah;
- Asphalt (most disposed as LLW) – 1,861 tons to either NTS, Envirocare, or if free-release to local sanitary landfill;
- Asbestos (most disposed as LLW) – 1,780 tons to either NTS, Envirocare or if free-release to local sanitary landfill;
- Non-routine sanitary waste – 2,152 tons to local sanitary landfill;
- Recycle for use as fill – 3,047 tons of concrete; and,
- Re-use – 193 tons of steel to off-site vendor.

In order to establish the final land configuration for the demolished buildings, the following quantities of backfill were used:

- Soil – about 120,000 tons;
- Free-release concrete – about 3,000 tons; and,
- Flowable fill – about 1,850 tons.

The final grade was established using the backfill materials then erosion control matting was added to the hillside and the area was revegetated with hydromulch containing native seed species. The revegetation was completed in the late summer/early fall of 2004. Before and after photos of 771/774 can be seen in Figures 3 and 4 (pages 9 & 10).

Post-remediation Remaining Contamination

The state and federal regulators gave the site permission to leave plutonium-contaminated walls and foundation slabs in place deeper than 6 feet from final grade as long as the contamination did not exceed 7nCi/g Pu averaged over the thickness (volume) of the slab or wall. Locations where the Pu-contamination was above 6 feet below final grade were either decontaminated to free-release levels (basically no Pu contamination) or were removed as low-level waste for shipment to a low-level radioactive disposal site – either Envirocare in Utah or the Nevada Test Site. The

site estimates that 771 and 774 each contain about 1.6 grams of buried Pu spread throughout the remaining foundations. The decision to allow Pu contamination to remain in building foundations deeper than 6 feet below final grade was not without some controversy. Some members of the local communities supported this decision while others did not. The decision to allow residual Pu contamination in buried foundations also applied to Building 371.

As a separate issue, a post-remediation problem arose from the B771 area in November 2004. Surface water monitoring stations in North Walnut Creek recorded Am activity well above regulatory levels. The Am contamination migrated downstream to terminal Pond A-4 which was scheduled for a normal release offsite. Am levels in A-4 were reported at 0.6 pCi/liter which was 4 times the maximum allowed regulatory limit of 0.15 pCi/l (same standard for both Pu and Am). At the time of the scheduled release A-4 contained approximately 25 million gallons of water. The site traced the source of the Am contamination to a manhole near the northwest corner of B771. The manhole had several pipes running into it from B771. The piping was removed and the contamination path was disrupted. The site had to bring in a portable treatment system to treat the 25 million gallons of water in A-4. The treatment successfully lowered the Am activity to well below the 0.15 pCi/l Am limit so the water could be discharged offsite. By eliminating the Am source the Am activity in North Walnut Creek returned to "normal" values well below the regulatory limit.

Potential Exposure Pathways to Remaining Contamination

There are several potential exposure pathways to remaining contamination in the 771/774 area. The Am problem affecting surface water in the previous section is a good example. Since Pu-contaminated slabs were left deeper than 6 feet below final grade in both buildings, erosion of the soil cover could eventually expose contaminated material to surface water. The contamination could then be mobilized into surface water and eventually reach North Walnut Creek and the A-series ponds (A-1 through A-4, which is the terminal pond). In addition to a potential surface water pathway, groundwater contaminated with carbon tetrachloride from a source directly south of 771 is moving downgradient (north) towards 771 and could surface as a seep where 771 is located.

Long-term Stewardship Controls

The 771/774 area will remain as part of the DOE-retained lands after closure and will be monitored for evidence of water contamination. Although it has been well-established that Pu and Am are very immobile in groundwater, at the request of the local communities, the site and regulators agreed to install three groundwater monitoring wells downgradient of 771 between its former location and North Walnut Creek (a short distance). These wells are intended to provide additional confirmation that indeed the Pu and Am contamination in the 771/774 buried slabs is not migrating in groundwater toward North Walnut Creek. Groundwater monitoring wells are also located to monitor the extent of the carbon tetrachloride plume as it migrates through the 771/774 area.

Surface water monitoring locations will be maintained in North Walnut Creek to monitor the quality of water arising from the 771/774 area as well as other former plutonium processing buildings in the drainage.

Notes

None at this time.

Document references

1. Decommissioning Closeout Report, 771 Closure Project, Revision 1, May 2005 (document path, CERCLA AR# pending)
2. Historic American Engineering Record, Rocky Flats Plant (document path, DOE RFETS home page/historical information/HAER database)
3. ER RSOP Notification and Closeout Report IHSS Group 700-4 (document path, CERCLA AR# pending)

Figure 1. Aerial view of 771 in 1969 looking to south

Note: As can be seen 771 was built into a hillside; 774 is the smaller complex to the left (east) of 771. This photo also shows Buildings 776, 777, and 707 located to the south (towards the top of photo) of 771.

Figure 2. View of filter plenums damaged from fire in 771(9/16/57)
Note: the filter plenums were used to filter glovebox and process equipment atmospheres to remove Pu prior to exhausting to outside air. Some Pu escaped from 771 when the filter plenums were severely damaged by the fire.

Figure 3. View of 771/774 complex in early 1990's looking south

Figure 4. View looking south from August 2005 showing completed remediation of 771/774 at approximately the same location as Figure 3. Note: new wetlands have been added to the area and at the top of the slope one can see railroad cars being loaded with low level radioactive debris waste from the demolition of B776/777. These specialized railroad cars will carry the debris waste to the low-level radioactive waste disposal site, Envirocare of Utah.