

RECENT DEACTIVATION ACTIVITIES AT THE OAK RIDGE NATIONAL LABORATORY

LEON DUQUELLA
DOE-Oak Ridge Operations

ABSTRACT

This paper discusses the recent deactivation activities that have taken place at the Oak Ridge National Laboratory (ORNL) in the past few years. Nuclear research has been ongoing at the ORNL for the past 50 years. Many of the research facilities have reached the end of their useful life and are in need of specialized work activities to place them in a safe and environmentally sound condition prior to transfer to either the Environmental Restoration Program (EM-40) for decontamination, dismantlement and decommissioning (D&D) or to an alternate user. This paper discusses the status of several facilities that have undergone the deactivation process, including turn-over items, such as post deactivation surveillance and maintenance (S&M) and controls, safeguards and security and others. A brief history and description of these facilities prior to deactivation will also be presented. Deactivation has been defined as the process of placing a facility in a safe and stable condition that is both protective of workers, the public and the environment, and minimizes the long-term cost of S&M until decommissioning is complete. Specific deactivation activities can include: 1) removal, isolation, mitigation, and/or stabilization of high hazards and/or high risks to personnel or the environment; 2) removal and/or consolidation of remaining radioactive/hazardous and special nuclear material or wastes; 3) characterization of radioactive/hazardous material contamination; 4) removal of systems or equipment related to the operating mission; and 5) maintenance of adequate utilities and security for the building/structure and establishment of safety control envelopes. The objective of deactivation is to reduce risks and therefore the out-year S&M required for the care of these facilities, and to prepare the facility for decommissioning and final disposition.

BACKGROUND

The Oak Ridge National Laboratory (ORNL), originally known as Clinton Laboratories, was established in 1943 to carry out the pilot-scale production and separation of plutonium for the World War II Manhattan Project. After the war, ORNL's mission was expanded to focus on nuclear science and the development of nuclear energy for peaceful uses, including production of radioisotopes for biological research and for other purposes. As a result, several facilities were constructed in the 1950's and 1960's to house this new effort. These facilities operated continuously for 30 to 40 years until it was determined that there was no further need for their operation. As these facilities reached the end of their useful life, it became obvious that they were in need for specialized work activities that would place them in a safe and environmentally sound condition prior to transfer to the Environmental Restoration Program for decontamination and decommissioning (D&D). For this purpose, the Nuclear Materials Facility Stabilization Program (NMFS) was established. NMFS would be responsible for overseeing the completion of these specialized activities and, after completion, the transfer into the Environmental Restoration Program. Deactivation has been defined as the process of placing a facility in a safe and stable condition that is both protective of workers, the public and the environment, and minimizes the long term cost of surveillance and maintenance (S&M) until decommissioning is complete. Specific deactivation activities can include: 1) removal, isolation, mitigation and/or stabilization of high hazards and/or high risks to personnel or the environment; 2) removal and/or consolidation of remaining radioactive/hazardous and special nuclear materials or wastes; 3) characterization of radioactive/hazardous contamination; 4) removal of systems or equipment related to the operating mission; and 5) maintenance of adequate utilities and security for the building/structure and establishment of safety control envelopes. The objective of deactivation is to reduce risks and therefore the out-year S&M and to prepare the facility for decommissioning and final disposition. ORNL Facilities that have recently completed the deactivation process are as follows: 1) Alpha Powder Facility, Building 3028; 2) Source Development Laboratory, Building 3029; 3) Radioisotope Production Lab-C, Building 3030; 4) Radioisotope Production Lab-D, Building 3031; 5) Radioisotope Production Lab-E, Building 3032; 6) Radioactive Gas Processing Facility, Building 3033, and Actinide Fabrication Facility, Building 3033A; 7) Radioisotope Area Services, Building 3034; 8) Tritium Target Facility, Building 7025, and 9) Integrated Process Demonstration Facility, Building 7602. These facilities have reached minimum S&M and have been transferred to the Environmental Restoration Program.

Today ORNL it is the oldest national laboratory on its original site, site of the world's oldest nuclear reactor, and home to the Department of Energy's largest and most diversified multi program laboratory. There are still as many as 25 large facilities that are going through the Deactivation Process and are scheduled to be transferred to the Environmental Restoration program in the next few years.

Following is a narrative of several facilities that have undergone the deactivation process at the ORNL. All of these facilities are now in a safe shut down mode and were transferred into the Environmental Restoration Program. They are currently waiting for D&D.

Alpha Powder Facility, Building 3028

Building 3028 was constructed in 1950 as part of the Isotopes Program. It originally housed the I-131 processing facility and a four story ion-exchange column separation facility for Pm-147. Several changes were made to the structure and function of the facility, including curium source fabrication and Xe-133 and Mo-99 production. The building is a four-story steel frame structure covered by corrugated aluminum siding. The first level contains the processing cells and the three upper levels contain laboratories for the production of the various isotopes. The floor area of the building is 4,000 square feet. The facility housed 7 hot cells, four of which have 2 feet of water contained in steel tanks for neutron shielding.

Following approximately 40 years of operations, the facility was classified as surplus and many of the process systems were abandoned in place. General housekeeping was not maintained and the structural integrity of the building was allowed to lapse. A Hazard Screening was completed on the facility and the only non-industrial hazard identified was residual surface radioactive contamination. The hazard level classification for the facility is RADIOLOGICAL. Hazardous materials identified were lead-based paint used as wall covering throughout the building; asbestos floor tiles used as floor covering; asbestos lagging, used as pipe lagging, PCBs in electrical devices and transformers; lead shielding used in cell walls, doors, and windows; mineral oil used in one of the cells; crank case oil and freon refrigerant used in the Chilled Water compressor. The Deactivation End Points were not established prior to beginning the activity. The building structure and roof were inspected and found to be in generally good condition. The building exterior and roof have been cocooned to prevent air in-leakage and provide effective containment for the building. The general areas were decontaminated to remove transferrable contamination from access-required spaces. Hot cell manipulator boots and isolation bags were typically removed and replaced and the manipulator arms were bagged as a precaution. Viewing windows and shielding tanks were drained and abandoned in place. All service lines and systems have been deactivated and all drains have been plugged.

Deactivation activities continued with the removal of miscellaneous items abandoned when the facility was no longer in use. The Air Alpha Monitoring System, which consisted of 8 Continuous Alpha Air Monitors (CAAM), was removed. The individual CAAMs were considered to be contaminated from the process activities performed prior to deactivation. All storage cabinets, desks, file cabinets and miscellaneous office materials were removed from the building, and some were released for reuse. Some asbestos material was removed in accordance with safety work permits and plant and equipment asbestos removal procedures. The asbestos floor tiles are not intended to be removed until facility decontamination and decommissioning. Lead-based paint exists throughout the building as wall covering, although the areas that were peeling and flaking have been repaired. The Process Off-Gas system remains in operation to provide negative pressure contamination control to several hot cells. The Liquid Low Level Waste System and the process drain system have been isolated, drained and abandoned in place. Drains in individual cells have been plugged. Both systems remain highly contaminated from earlier process activities. All electrical services, with the exception of lighting, have been disconnected or de-energized at the main breaker box. The fire protection system was drained

and isolated from the fire main header. All other utilities systems such as steam, HVAC, building exhaust system, potable water, natural gas, and plant air, have been de-energized, isolated, drained, and abandoned in place. The facility housed an elevator and some overhead cranes. This equipment has also been de-energized, drained of oil, and abandoned in place. There were no systems considered to be mothballed.

Building 3028 was now ready to be transferred from NMFS (EM-60) to the Environmental Restoration Program (EM-40) by a Memorandum of Agreement (MOA). EM-40 would agree to accept the building as is at the time of the transfer. The MOA documents the requirements agreed upon between EM-40 and EM-60. The signed MOA indicates acceptance by EM-40 that the criteria outlined in the MOA have been completed satisfactorily, with the exception of a post transition punch list, and that the level of deactivation is acceptable for transition into the EM-40 Program. The items on the post-transition punch list will be finished using EM-60 funding after deactivation is complete. The details of how the punch list items will be completed would be addressed in the MOA.

For Building 3028, there are no Post-Transition Punch List items identified. There are no regulatory requirements nor stakeholder commitments.

The Post-Deactivation Surveillance and Maintenance (S&M) plan for Building 3028 covers activities associated with the interior spaces, operational and mothballed systems, and external areas related to the facility. The specific objectives of the S&M Program for this facility is as follows: 1) ensure adequate containment of contamination; 2) Provide physical safety and security control; 3) Maintain the facility in a manner that will minimize potential hazards to the public; and 4) Provide a mechanism for the identification and compliance with applicable environmental, health and safety requirements. The S&M activities associated with Building 3028 include the following type of activities; 1) walkdown and inspections for structural integrity, safety, radioactive contamination, and hazardous material conditions; 2) general housekeeping of the interior and exterior of the building and needed; and 3) Maintenance activities required to maintain the security and safety envelope of the facility.

Source Development Laboratory, Building 3029

Building 3029 was constructed in 1952 and originally contained a system of remotely operated barricades and a small manipulator cell. The facility was built as part of the Isotopes Program. It is a single story steel frame structure covered with corrugated aluminum siding. The building covers 3,000 square feet and a total volume of 33,000 cubic feet of free space. The isotopes originally handled in the facility were Ir-192 and small Co-60 sources, Cs-137, and Sr-90. A hazard screening was performed on the facility, and the facility was classified as INDUSTRIAL, with no unacceptable, non-standard industrial hazards/actions/situations present in the facility. Two laboratory type hoods were located in the southwest corner of the operating area which were converted to operate as gloveboxes in the early 1980s. Hot drains were provided in both laboratory hoods and were connected to the Liquid Low Level Waste system. One of the

drains leaked and allowed the spread of alpha contamination to the area below the hood. The laboratory hoods were continuously exhausted through a HEPA filter to the local building ventilation system. The effluent air was piped to the roof of the building where it was pulled by a roof fan through two mounted HEPA filters and then discharged from a short stack above the building's roof. There were also two gloveboxes that were highly contaminated due to process activities. There also was a structure named the Cobalt Garden which was used for storage and irradiation. The facility was subterranean, 6 square feet, and 8.5 feet deep. The facility was capable of irradiation doses of up to 1.5 million rem/hr. It consisted of 92 stationary stainless steel tubes surrounding a 1 foot square, 7 feet long irradiation plug. All of the tubes were covered with 22 inches of lead shot at the top. The Cobalt Garden plenum, into which the tubes project, was cooled by a stream of air which was discharged to the Process Off-Gas system. The effluent air from the Cobalt Garden was then scrubbed and HEPA filtered at the Stack 3039 prior to discharge.

Deactivation end points were not established for this facility. Deactivation work similar to the deactivation work completed in Building 3019 was started. In the Cobalt Garden, all of the cobalt sources, with the exception of two, were removed. The remaining sources could not be removed and were abandoned in place. The tubes associated with the remaining sources have been capped at the top. The total curie content for the sources is less than 10 curies. No mothballed systems are associated with Building 3029. There were no regulatory requirements nor stakeholder commitments. No post-transition punch list items were identified for Building 3029.

Radioisotope Production Labs C, D, and E; Buildings 3030, 3031, and 3032

The Production Labs were constructed in 1950 as part of the Isotopes Program. The buildings contain facilities that were used for storage, purification, and processing and dispensing of a wide variety of radioisotopes. These isotopes were processed primarily from irradiated targets from the High Flux Isotope Reactor, the Oak Ridge Research Reactor, and the 86-in. Cyclotron. The one-story buildings were steel framed structures covered by corrugated aluminum siding. Each had a floor area of 825 square feet. Two of the production labs had manipulator type hot cells and laboratory type hoods. All high-level work was conducted in the hot cells. Those two buildings operated at a slightly negative pressure relative to the outside atmosphere. The third building was converted to house mostly offices. No high-level work was conducted in the building, which operates at atmospheric pressure. A Hazard Analysis was not conducted at these facilities because it was deemed unnecessary.

The Production Labs were deactivated in a similar fashion as Building 3028. There were no mothballed systems and no post-transition punch list items. All deactivation activities were completed prior to transfer to EM-40.

Radioactive Gas Processing Facility, Building 3033 and Actinide Fabrication Facility, Building 3033A

Buildings 3033 and 3033A are steel-frame structures covered by corrugated aluminum siding that were constructed in the late 1950's to process C-14, Kr-85 and H-3. The single story facilities have a total floor area of 1442 square feet. The tritium and krypton production facilities were housed in Building 3033. The krypton process cell consisted of a composite shielded enclosure made of steel, lead and concrete. Part of the enclosure housed the in-process storage tanks and was made of stacked 4 inch thick lead bricks. The krypton feed gas was located inside a 1 inch thick steel plate enclosure, located outside of the building. Process components in the enclosure were connected with 3/8 inch copper tubing shielded by 1 inch lead. Each of the enclosures was connected to the isotopes area cell ventilation system. Tritium was handled in a hood inside the tritium room. The hood was connected to the cell ventilation system and maintained at negative pressure. Building 3033A was used to house and contain the facilities for the production, loading, welding, and decontamination of neutron dosimeter materials as well as the weighing and packaging of milligram to gram quantities of actinide materials for research applications. The building did not contain a hot cell and was used only for low level radioactive operations. C-14 was also processed at 3033A, but in the early 1980's, the C-14 processing area was decontaminated and decommissioned. The area was then converted to storage. A detailed hazard analysis was performed and an inspection of the roof and exterior walls was completed. The roof had been replaced in 1980 and was in good shape, the walls were cocooned with polyurethane foam to seal the building. The process did not generate any liquid wastes so there was no connection to the liquid waste system.

The buildings were deactivated in a similar fashion than Building 3028. Two systems were placed in mothballs; the tritium hoods, and the krypton enclosure. The following deactivation activities were performed in the tritium hoods: 1) pumped down and purged the system to remove free tritium; 2) cut out all uranium traps and dispose of them; 3) All monitors removed; 4) ventilation remains on hoods; 5) all other equipment remains in the hoods; 6) all service lines were identified, labeled, and tagged; and 7) access to the area was secured. The following deactivation activities were performed in the krypton enclosure: 1) pumped down and purged the system to remove free krypton; 2) removed external cylinder and disposal; 3) ventilation on enclosure remains; 4) all other equipment remains in the enclosure; 5) all service lines were identified, labeled and tagged; and 6) access to the area was secured. There were no post-transition punch list items. All deactivation activities were completed prior to transfer to EM-40.

Radioisotope Area Services, Building 3034

Building 3034 is a steel frame structure covered by corrugated aluminum siding. The single story facility has a floor area of 825 square feet. The building housed the electrical distribution system for the isotopes area, served as a storage area and as a stores drop point for supplies for the isotopes facilities, and office space. No radioactive operations were ever performed in the building. No pre-deactivation hazard analysis was performed. Deactivation activities similar to

those performed on Building 3029 were completed. All electrical services for the building, with the exception of lighting, were disconnected or de-energized at the main breaker box. The electrical distribution system for the remainder of the isotopes area remains in use. There were no mothballed systems and no post-transition punch list items. All deactivation activities were completed prior to transfer to EM-40.

Tritium Target Facility, Building 7025

Building 7025, which was a Tennessee Valley Authority surplus building, was installed in 1968 to house a tritium target fabrication system. The facility is a prefabricated metal-sided building with a total floor area of 590 square feet. Tritium target fabrication equipment was housed in a 26 foot long stainless steel hood. A high vacuum evaporator system was used in the building for the preparation of uranium and thorium targets. The vacuum evaporator was operated in a HEPA filter hood for contamination control. Only bench-top quantities of uranium and thorium were handled. Except for mass spectrometric analysis, all tritium process activities were conducted in the stainless steel tritium hood. The tritium hood contained a hot sink for use in decontaminating process equipment. The hot sink drained to a 1500 liter underground storage tank, which was pumped to a liquid low level waste system truck for disposal as necessary during the operational period of the building.

The facility was deactivated in a similar fashion as Building 3028. Based on the SARUP screening document, the facility was classified as RADIOLOGICAL. The 1500 liter underground tank was emptied prior to deactivation, and was assumed to be contaminated. The tank was filled with grout to prevent the accumulation of groundwater. There was an independent alpha hood that was disassembled and removed from the facility. All process equipment and debris were removed from the tritium hood, which was decontaminated to remove transferrable contamination from the surfaces. The exhaust system for the hood remains in place to prevent spread of tritium contamination to the remainder of the building. There were no mothballed systems and no post-transition punch list items. All deactivation activities were completed prior to transfer to EM-40.

Integrated Process Demonstration Facility, Building 7602

This building is physically connected to the Robotics and Remote Systems Lab, which is an active facility. The two buildings are separated by a partial block wall, which does not extend completely to the ceiling of the high bay area. Building 7602 is a 15,841 square feet concrete block and steel frame structure. It has three floors. It contains three pits that collect any liquids coming from leaks. Depleted and natural uranium are the only radioactive contaminants present in the facility. Building 7602 was constructed in 1963 as a reactor fueling building for the Experimental Gas-Cooled Reactor. The reactor was never fueled and no nuclear fuel was ever handled at that location. The Building was declared surplus in 1994 and deactivation began shortly thereafter with Nuclear Energy funding (NE). Unlike other surplus facilities at ORNL, actions to deactivate Building 7602 and place it in a safe stable condition were initiated

promptly. The facility management had made significant progress in reducing the building's inventory of uranium oxide. Consequently, the facility did not experience an extended period of neglect, and was in good condition prior to deactivation. The entire building was a radiological buffer area containing designated contamination areas, high contamination areas, and radiation areas. All areas of the building contained large amounts of process equipment and large quantities of radioactive and hazardous materials. The Feed House consisted of two chambers holding uranium oxide and a chute used to feed uranium oxide powder to the dissolver. Prior to deactivation, the Feed House contained 95 Kg of uranium oxide powder. There was a continuous rotary dissolver which dissolved the uranium powder with nitric acid to make uranyl nitrate solutions. These solutions were delivered to the Centrifugal Contactor Test, which was a solvent extraction system used to develop processes for uranium fuel recycling. Depleted uranium was used in these tests. There were two other solvent extraction systems and a uranium product evaporation system. Other process systems in the facility included an organic treatment system, a dissolver off-gas system, a liquid waste treatment system, and a chemical makeup system. The only bulk quantities of hazardous chemicals present were a collection of miscellaneous chemicals in small containers. The facility was also contaminated with hexavalent chromium on the floors, and was suspected of possessing asbestos insulation. When the facility was placed in Asafe standby@ immediately prior to the initiation of deactivation activities, the facility contained 30,178 liters of uranyl, and 1,900 liters of nitric acid. A total of 3,346 liters of organic solvent was also present before deactivation.

During the deactivation process, all quantities of hazardous and radioactive materials have been removed. The uranium oxide powder was sent to Waste Management for disposal, and all tanks and process piping have been drained. The feed system and all other process systems have been shut down, isolated and abandoned in place. A section of the roof that experienced leaking problems was replaced. The safety showers and eye wash stations were the only systems to be mothballed. They were administratively tagged out of service, but the piping remains on them. The rest of the facility was deactivated in a similar fashion as Building 3028. All deactivation activities were completed prior to transfer to EM-40. The Building 7602 is in sound physical condition and does not possess inordinately high contamination levels. These attributes make the facility a promising candidate for reuse, either by another DOE Program, or by private industry.

CONCLUSION

It has become clear that something needs to be done with the former research facilities that have outlived their usefulness and mission. An inordinate amount of funding is targeted toward keeping these facilities in a low-risk mode by paying for the S&M of these facilities well into the next century. The deactivation process has been proven to work very well in reducing those costs to the point where it becomes feasible to continue to fund the minimum S&M until final disposition of the facility. We have seen the deactivation work done on a wide variety of facilities, research labs, production facilities, and specialized structures. In all cases, the deactivation process was completed and a significant reduction in S&M was achieved.

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