IAEA-SM-359/P. 19

THE DECOMMISSIONING OF THE BARNWELL NUCLEAR FUEL PLANT

J. MCNEIL
Life Cycle Engineering,
North Charleston, South Carolina, United States of America

Abstract

The decommissioning of the Barnwell Nuclear Fuel Plant is nearing completion. The owner's objective is to terminate the plant radioactive material license associated with natural uranium and transuranic contamination at the plant. The property is being released for commercial-industrial uses, with radiation exposure from residual radioactivity not to exceed 0.15 millisieverts per year. Historical site assessments have been performed and the plant characterized for residual radioactivity. The decommissioning of the uranium hexafluoride building was completed in April, 1999. Most challenging from a radiological control standpoint is the laboratory building that contained sixteen labs with a total of 37 glove boxes, many of which had seen transuranics. Other facilities being decommissioned include the separations building and the 300,000-gallon underground high-level waste tanks. This decommissioning in many ways is the most significant project of this type yet undertaken in South Carolina. Many innovations have been made to reduce the time and costs associated with the project.

The Barnwell Nuclear Fuel Plant

The BNFP lies approximately six miles west of Barnwell, South Carolina. The plant is owned by Allied-General Nuclear Services (AGNS). The plant property, mostly wooded, comprises 1632 acres.

The plant was built in the early 1970s to process spent nuclear fuel from commercial power reactors. It was never used for this purpose. It was tested using natural uranium as a surrogate material from 1976 through 1983. Research and development work using plutonium and other transuranics was also performed at the plant.

In 1983, the plant was shut down and partially decontaminated. But significant radioactive contamination remained inside much of the processing equipment and inside gloveboxes and fume hoods located in the laboratory building. Some facility surfaces also remained contaminated.

Planning the Decommissioning

In August of 1997, AGNS proceeded with planning to decommission the plant, which would result in termination of the possession-only radioactive material license issued by the South Carolina Department of Health and Environmental Control (SCDHEC). A contractor team was brought in for this purpose. Its members were U S ENERGY Corporation of Aiken, SC and Life Cycle Engineering of Charleston, SC.

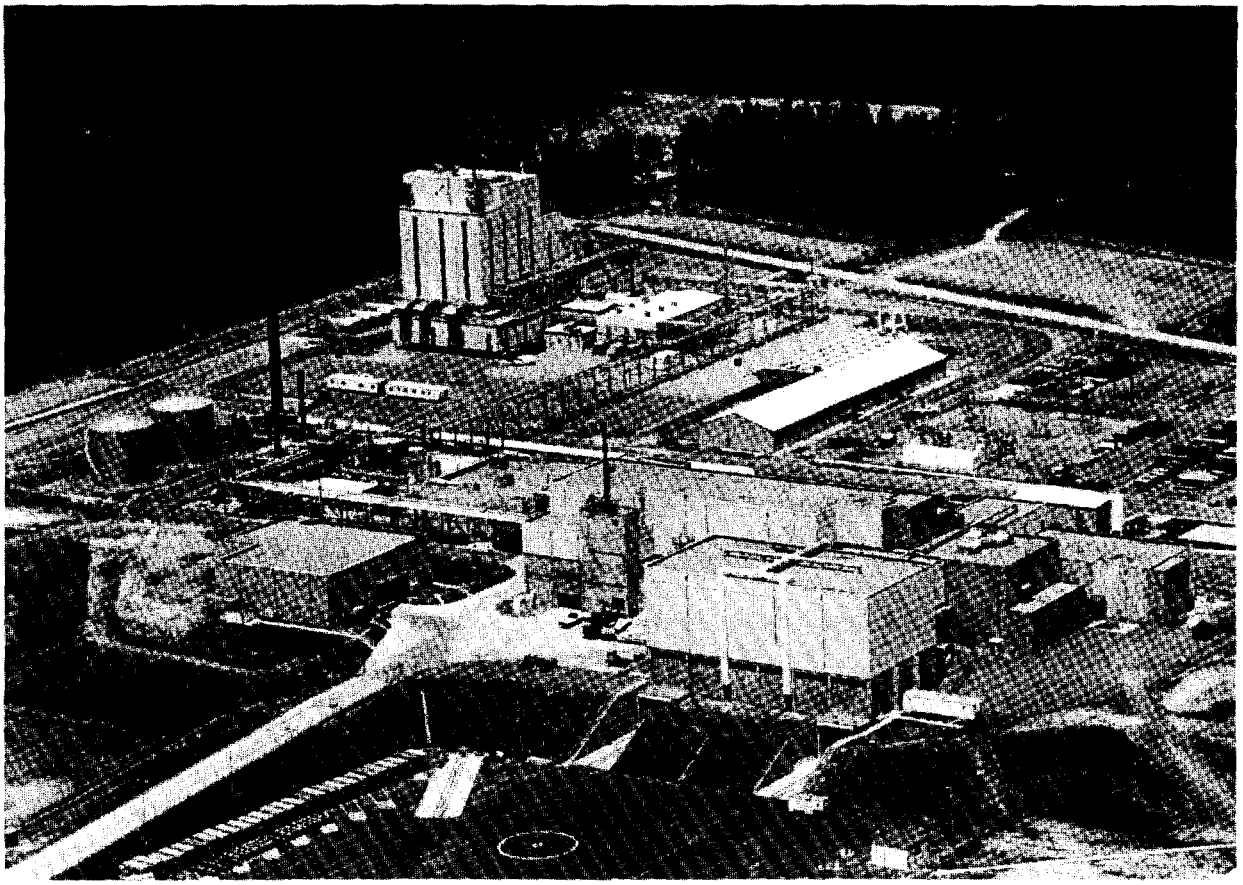

Figure 1. The Barnwell Nuclear Fuel Plant. *The cluster of buildings in the right foreground — the Separations Facility, the Fuel Receiving and Storage Facility, the Plutonium Nitrate Loading Station, and the Hot and Cold Laboratory Area — formed the heart of the plant.*

The team developed a planning strategy based on its experience with planning the decommissioning of the Heavy Water Components Test Reactor at the Savannah River Site and on the experience of key team members with the nuclear decommissioning of the Charleston (South Carolina) Naval Shipyard. Elements included:

- Release of the property for commercial-industrial uses with no restrictions other than limitation to such uses.

- Dividing the plant into five distinctly different areas for planning purposes. These included the uranium hexafluoride facility, the laboratory building, the separations building and the high-level waste tank facility, along with a fifth area comprised of the remaining parts of the plant.

- Beginning with a detailed historical site assessment of each area.

- Performing detailed characterization to determine the extent of the radioactive contamination.

- Developing site-specific cleanup guidelines using the RESRAD and RESRADBUILD residual radioactivity computer codes to ensure that the regulator's cleanup limits were achieved.

- Preparing a decommissioning plan for each of the five different plant areas.

These tasks were completed over a period of approximately six months.

Historical Site Assessments

The historical site assessments followed guidance in *the Multi-Agency Radiation Site Survey and Investigation Manual (MARSSIM).* They began with review of the records. Inspections and walkdowns of the various facilities followed. Photographs were taken in each area. Team members interviewed key former employees. Technicians took radiological scoping surveys to help identify needed characterization.

The team documented the assessments in five separate reports. These were designed to clearly lay out information about each area in a usable fashion. They included descriptions of the facilities and how they were used, along with explanations of the processes that were utilized during the plant testing phase. Summaries of plant radiological data and that data generated during radiological scoping surveys appeared in the reports, as well as recommendations for characterization. Team members briefed the regulator on the results of the assessments.

Characterization of the Plant

Among the techniques employed were: (1) detailed sample and analysis plans, (2) alpha and beta-gamma scan measurements, (3) microR/h and microRem/h meter surveys of facility surfaces and equipment, (4) laboratory analysis of smears and material samples, (5) opening equipment for internal surveys and (6) in-situ gamma spectroscopy of installed equipment.

The in-situ gamma spectroscopy made use of the Canberra ISOCS system. This technique proved to be especially important in characterization of sealed glove boxes and for equipment in the Separations Building. The characterization program was completed in approximately four months.

Developing the Decommissioning Plans

During early discussions with the regulator, the team outlined the planned use of the RESRAD and RESRADBUILD computer codes to derive the cleanup guidelines. The team proposed the scenarios to be used in the computer modeling for different areas of the plant and obtained SCDHEC agreement. Later, SCDHEC reviewed the calculation results and concurred on the resulting cleanup guidelines.

The team completed the five decommissioning plans over a period of approximately four months. Decommissioning plans which covered piping contaminated with natural uranium incorporated an innovative approach for determining that internal contamination levels fell below the cleanup guidelines. Utilizing correlations between external contact dose rates and surface contamination levels inside the piping, this approach made it practical to determine with a simple external scan survey whether piping and ventilation ducts met the cleanup guidelines.

Accomplishing the Decommissioning Work

The first facility completed was the Uranium Hexafluoride Building. This eight-story steel-frame structure was contaminated in 1976 and 1977 with natural uranium that had been used for testing plant systems. The decontamination and decommissioning of this structure began in June of 1998 and was completed ten months later. The approach followed incorporated several innovative features, such as the use of external dose rate surveys of piping to determine whether the cleanup guidelines were achieved. The work was accomplished by small crews of radiological control technicians.

The laboratory building proved to be the most challenging facility from a radiological controls standpoint. One large glove box contained pilot plant equipment heavily contaminated with plutonium. Working inside a specially-designed containment tent, workers carefully dismantled the equipment and the glove box itself. Most of the TRU waste associated with the project came from this one glove box.

The biggest surprise associated with the decommissioning involved the 300,000-gallon underground high-level waste tanks. Two of the three tanks were known to be contaminated with natural uranium and were expected to contain a small quantity of water. Instead one tank was found to contain some 5000 gallons of organic and aqueous mixed waste, with a high concentration of uranium. The other tank was found to be floating. Rainwater had infiltrated the concrete tank vault, filling the space around the tank and approximately 70,000 gallons of water had entered the tank itself. Altogether some 100,000 gallons of radioactive liquid waste in the plant was processed by evaporation.