FACT SHEET
U. S. DEPARTMENT OF ENERGY
REMEDIAL ACTION PROJECT
NIAGARA FALLS STORAGE SITE
LEWISTON, NEW YORK

The U. S. Department of Energy (DOE) has completed a $40 million project to clean up radioactive materials and place them in safe, secure containment at the Niagara Falls Storage Site (former Lake Ontario Ordnance Works) in Lewiston, New York.

The former ordnance works site on Pletcher Road was used for the storage of radioactive residues connected with the Manhattan Project, the World War II effort to develop the world's first atomic weapon. During the late 1940s and early 1950s, additional radioactive materials connected with operations of the former Atomic Energy Commission were stored at the site.

Over the years, these materials were eroded or otherwise spread to other locations, both on and off the government-owned site. The DOE through its management contractor, Bechtel National, Inc., began cleaning up contaminated areas in 1982 and developing a waste containment facility on the site. Most of the construction work was performed by subcontractors from the Niagara Falls area.

Before remedial action began, some properties in the area were contaminated, residues from the site were eroding into a drainage ditch leading offsite, and levels of radioactive radon gas exceeded the allowable limit at a few locations on the site boundary. All of those conditions have been remedied, and radiation levels on and around the site are well within Federal standards.

In the past five years, DOE has cleaned about 25 vicinity properties, including more than three miles of a drainage canal, and numerous onsite locations. Additionally, residues stored in a 165-foot-high concrete tower were moved to the waste containment area to provide better control, and the tower was demolished and moved to the containment area.

Two types of materials are in storage at the site: slightly contaminated wastes and more highly radioactive residues. The residues are being stored on an interim basis. When applicable Environmental Protection Agency standards are developed, a final determination will be made for the long-term management of the residues.

Wastes from these activities were placed in the 10-acre containment area, which is an engineered facility that uses a natural underground clay layer, clay dike and cutoff walls and a clay cap to isolate the materials. This interim cap can be upgraded to a design life of 200 to 1,000 years by adding a thicker clay cover and a layer of riprap to act as an intrusion barrier.

An extensive monitoring program is in place to measure the integrity of the cap performance and to monitor air and groundwater for radioactivity. Monitoring conducted on and around the site since remedial action was completed has shown that all radiation levels are within DOE guidelines established for protection of the public. The results of this monitoring program are published in an annual report, which is available to the public.

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INTRODUCTION

The U.S. Department of Energy (DOE) has completed a major project to safely stabilize low-level radioactive materials at the Niagara Falls Storage Site, located approximately 10 miles north of the city of Niagara Falls and within the town of Lewiston, New York.

The 191-acre NFSS is a remnant of the 7,500-acre U.S. Army Lake Ontario Ordnance Works (LOOW), portions of which were used by the Manhattan Engineer District (MED) during World War II and the early years of the nation's atomic energy program. An aerial view of the site and its environs, taken some years ago, is shown in Figure 1.

Radioactive residues and materials were stored at and shipped to and from the LOOW, including the area that eventually became the NFSS. As a result of these operations, portions of the LOOW and the present NFSS became contaminated. Also, over the years, some of the radioactive materials stored at the NFSS were eroded by water and wind. Radioactive material migrated from storage locations to other on-site areas and to off-site vicinity properties, chiefly through drainage ditches.

The erosion and migration of contamination continued for several years, and environmental monitoring showed that concentrations of radon gas measured at some NFSS boundary locations exceeded federal standards.

In 1981 the U.S. Department of Energy selected Bechtel National, Inc. (BNI) as its project management contractor for remedial action at NFSS and similar sites around the country. Remedial action at NFSS began in 1982 and was conducted under the DOE Surplus Facilities Management Program (SFMP). Removal of the contaminated material from vicinity properties was funded under the Formerly Utilized Sites Remedial Action Program (FUSRAP).

NFSS PRIOR TO INTERIM REMEDIAL ACTION

The condition of the NFSS prior to the start of interim remedial actions is illustrated in Figure 2. Radioactive residues were stored in various locations on the site; there were widespread areas of contaminated soil; several on-site and off-site drainage areas were contaminated; and a number of vicinity properties were thought to be contaminated (this had not yet been confirmed by radiological investigations).

Residues

Several different types of residues were stored at the NFSS. During the war, the residues had been code-named: K-65, L-30, L-50, F-32, and R-10. Though they made up only about 6 percent of the volume of contaminated materials at the NFSS, the residues accounted for about 99 percent of the radioactivity.

The K-65 residues were the most radioactive, averaging about 520,000 pCi/g. Because of this and the fact that they had been stored in a 165-ft tall renovated water tower, the K-65s presented the biggest challenge in the remedial action. The L-30, L-50, F-32, and R-10 residues and materials known as the Middlesex sands were less radioactive and were stored in various buildings and on the ground at the NFSS. The locations of the residues prior to remedial action are shown in Figure 2.

Contaminated On-site Areas

Several distinct areas of contaminated soil were present on the site (Figure 2). The R-10 storage area covered over 37,000 yd^2 and the other areas shown in Figure 2 covered approximately 165,000 yd^2.

On-Site and Off-Site Drainage Ditches

The two major drainage ditches that flowed off of the site were also contaminated. The larger Central Ditch begins on-site and flows north approximately 3-1/2 miles to its confluence with Fourmile Creek

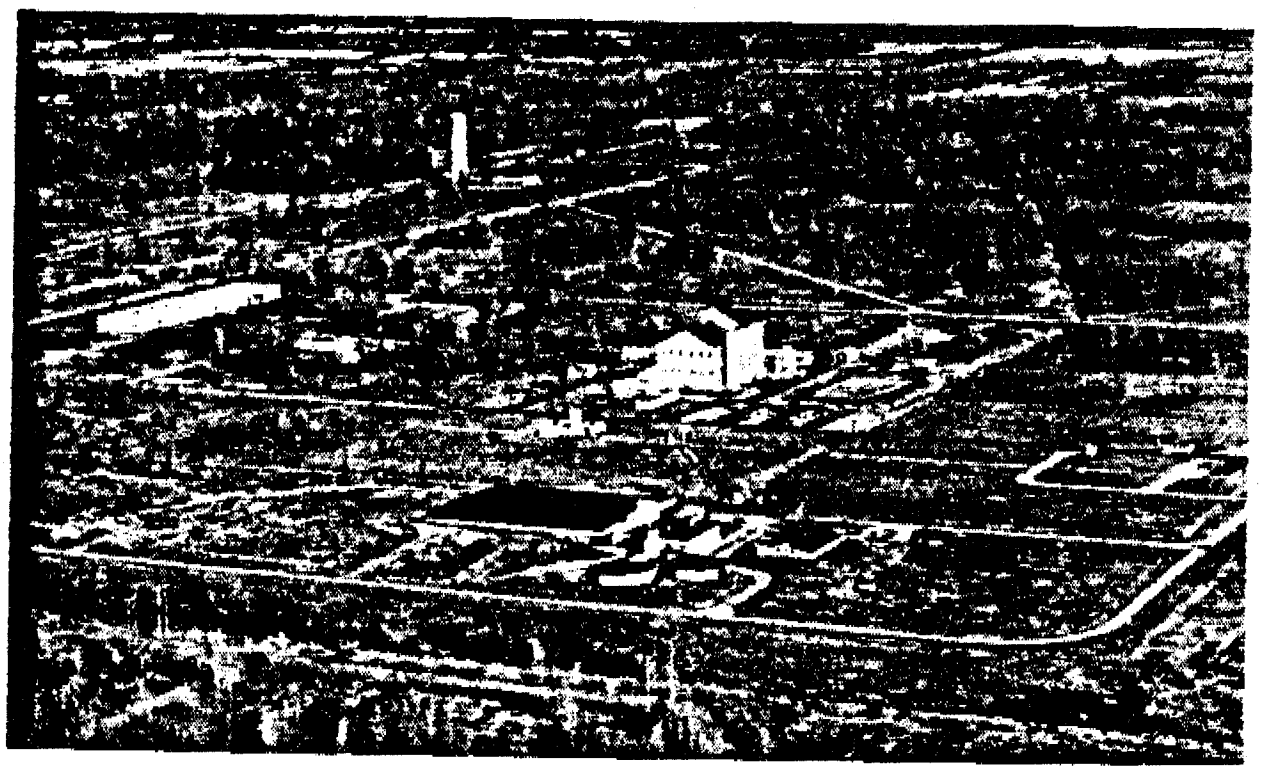

FIGURE 1 - AERIAL VIEW OF NFSS BEFORE REMEDIAL ACTION

View looking northeast. Building 434, also known as the Tower, in which the K-65 residues were stored, is in the top background. The R-10 and Building 411 area, which became the Waste Containment Area, is in the foreground.

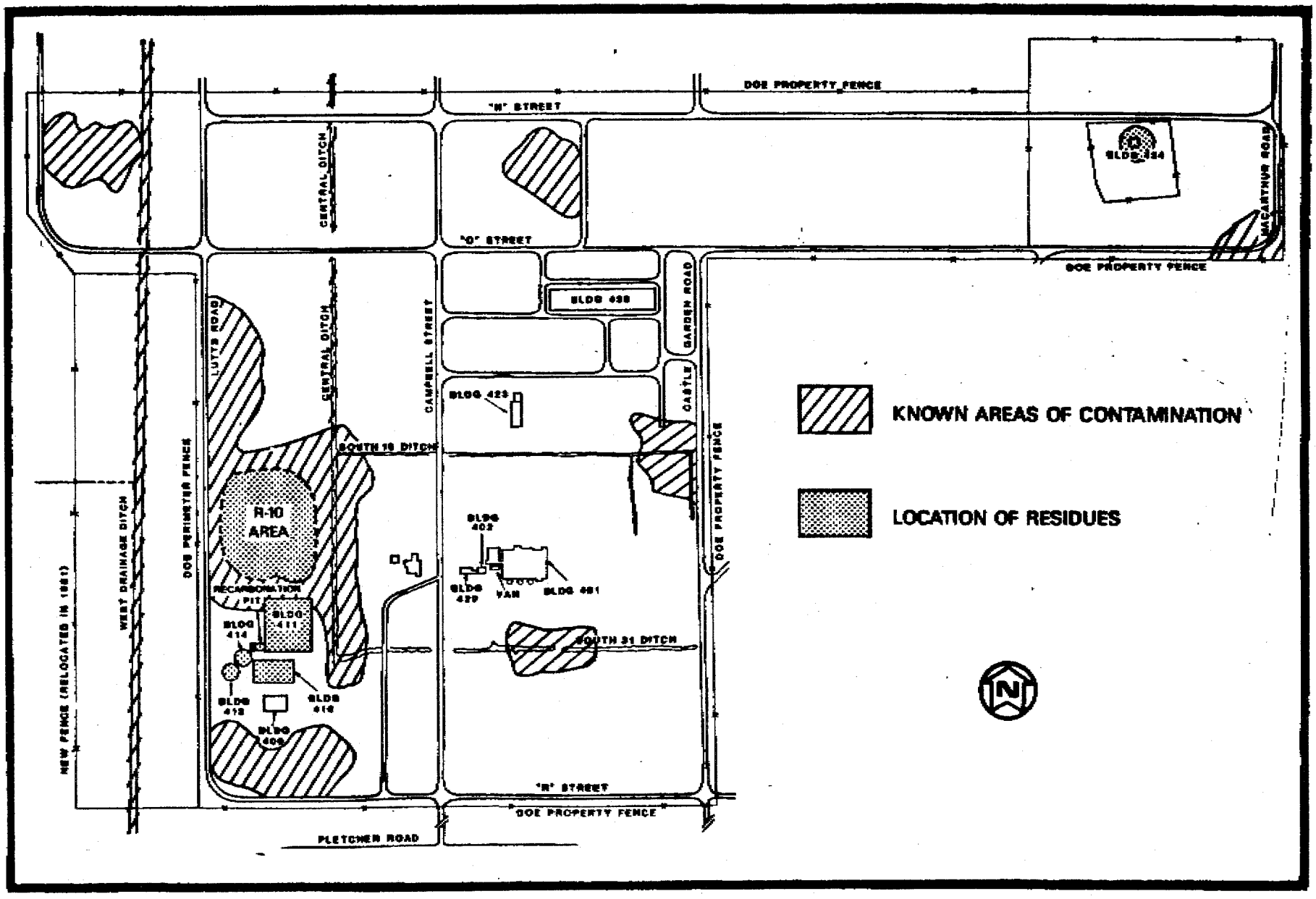

FIGURE 2 THE NFSS PRIOR TO INTERIM REMEDIAL ACTIONS

northwest of the site. The West Ditch begins at a point west and south of the site and flows northward for approximately 4,500 ft, intersecting with the Central Ditch north of the site.

Vicinity Properties

Because the NFSS covered only 191 acres of the approximately 1,500 acres originally utilized for shipment, storage, and burial of radioactive materials, several contaminated properties that were once federally owned are now privately owned.

INTERIM REMEDIAL ACTIONS

The objectives of the interim remedial action were to:

-- Provide surveillance and maintenance of the site as necessary to maintain public safety and reduce impact on the public, the environment, and on-site personnel to as low as reasonably achievable.

-- Clean up contaminated areas on-site, the off-site ditches, and the vicinity properties and develop an interim waste containment facility for the contaminated materials.

-- Perform the necessary environmental, geological, engineering, and other studies as required to support the decision-making process for eventual long-term disposition of the site.

-- Select, in accordance with the National Environmental Policy Act (NEPA) process, a preferred alternative for long-range disposition of the wastes and residues at the site and implement the remedial action program required to accomplish the selected alternative.

The remedial action at the NFSS is interim remedial action. The DOE decision regarding long-term disposition of the site was announced in the Record of Decision on August 27, 1986 in accordance with the NEPA process and after all technical, environmental, safety, and other impacts of the reasonable alternatives were evaluated in an Environmental Impact Statement (EIS). The decision-making process provided opportunities for members of the public and local communities to become informed about the alternatives and to contribute to the DOE decision.

Interim remedial action at NFSS began in 1982 and was completed in 1986. The progress of the remedial action is described below, year-by-year. However, these descriptions are very general, and it is important to stress that extensive investigations, studies, and analyses were required to plan and execute the remedial actions. For example, to precisely locate and define the extent of contaminated areas, radiological characterizations were performed. These characterizations also determined the depths of contamination and just how contaminated the materials were. Extensive laboratory analyses were necessary to identify the types of materials and levels of radioactivity. Geological studies were performed to define the strata underneath the site. Comprehensive environmental monitoring activities and health and safety measures were in place at all times to ensure the protection of workers, the environment, and the public. These and other activities contributed to the success of the remedial actions described below.

Remedial Actions - 1982

The immediate priorities at NFSS were to stabilize the R-10 residues to halt erosion and migration of contamination and to upgrade and seal two buildings to reduce emissions of radon gas from the residues stored in them. An area around the R-10 pile was cleared and approximately 16,000 yd^3 of contaminated soil were placed there. A clay dike and cutoff wall were constructed around the pile, and the cutoff wall was keyed into underlying clay to prevent lateral migration of

contamination. The top of the pile was covered with a synthetic liner to prevent runoff between work seasons. The upgrading and sealing of Buildings 413 and 414 reduced radon emissions to essentially background levels.

Remedial Actions - 1983

The primary activity during 1983 was the continued development of the waste containment area. The roof of Building 411 was removed and other preparations were also made for the transfer, dewatering, and consolidation of residues. Openings and pipes into Building 410 also were sealed to prepare that building for water storage during residue transfer operations in Building 411.

The dike and cutoff wall surrounding the R-10 pile were extended southward to enclose Buildings 410, 411, 413, and 414. Portions of the west and south walls were left open to allow for clean water drainage and future access for placing contaminated materials. Like the section constructed in 1982, the extended cutoff wall was keyed into underlying clay.

Several on-site contaminated areas were decontaminated, as well as approximately 4,800 ft of the West Ditch and approximately 6,900 ft of the Central Ditch. Roughly 54,000 yd^3 of contaminated material were excavated and placed in the waste containment area.

Remedial Actions - 1984

In 1984 the south dike of the waste containment facility was completed, forming the final segment of the cutoff wall; Building 410 and the upper portion of Building 415 were demolished, clearing the way for final development of the southern portion of the containment area; and the interim cap was placed over the northern portion, or about 40 percent, of the waste containment area

Decontamination was performed on several vicinity properties, some contaminated on-site areas, and more of the Central Ditch. The contaminated soil excavated from these areas totaled approximately 27,900 yd^3. In addition, Building 411 was transformed into a storage facility for the L-30, F-32, and K-65 residues. The former were relocated between bays in the building and were dewatered to make room for the K-65 residues.

The removal and transfer of the K-65 residues was by far the most difficult undertaking during the entire period of remedial actions at NFSS. About 4,000 cubic yards of these residues had been placed in a 165-ft tall silo-shaped concrete tower during the 1950s. Most of the residues were placed in the bottom of the tower, but some were located in an upper domed area. The residues were difficult to access because of the height of the tower, the thickness of the concrete, and the large quantities of radon they emitted, which required workers to be dressed in respirator-equipped protective clothing.

The residues were removed by a hydraulic mining unit that formed a slurry mixture of residues and water. The mining unit was suspended in the center of the tower by a crane and was lowered as the operation progressed. The unit was remotely operated, and a remote control TV camera inside the tower helped for guiding operations. The slurry was then pumped through a pipeline to Building 411.

Remedial Actions - 1985

In 1985 the last of the K-65 residues were removed from the bottom of the tower by mechanical means, and the building was demolished. Its rubble and the contaminated soil surrounding the building were moved to the waste containment area. The 10 remaining contaminated vicinity properties were decontaminated, producing 6,300 cubic yards of soil, and cleanup of on-site areas produced 11,000 cubic yards.

The major portion of the interim cap over the containment area was completed,

leaving open only the section over Building 411 for final placement of contaminated soil prior to closure in 1986.

Water treatment was a major activity during 1985. Approximately 4 million gallons of highly contaminated water had been generated, mainly as a result of the hydraulic mining activity. In 1984 and through the first half of 1985, the Oak Ridge National Laboratory developed a treatment process to meet the stringent State of New York Department of Environmental Conservation criteria governing release of the water via the Central Ditch. By the end of 1985 approximately 3 million gallons had been released in accordance with these criteria.

Remedial Actions - 1986

The few remaining contaminated areas on- and off-site were cleaned up in 1986. The contaminated materials were placed in the waste containment facility, and the final portion of the interim cap was completed. These activities completed the interim remedial actions at the NFSS.

THE DOE RECORD OF DECISION

The DOE Record of Decision on the long-term disposition of the NFSS was issued in August 1986. For the radioactive wastes at the NFSS, DOE selected long-term, in-place management consistent with the guidance provided in the EPA regulation for uranium mill tailings (40 CFR 192). For the radioactive residues at the site, DOE intends to provide for long-term, in-place management consistent with future applicable EPA guidance. If future analyses show that in-place management cannot comply with EPA guidance, another disposal option will be developed that complies with EPA guidance and is environmentally acceptable.

Interim Waste Containment Facility

The main product of the interim remedial actions at the NFSS is the containment facility, which has a 25 to 50-year design life, but which can be upgraded to a design life of 200 to 1000 years. A passive design was used for the facility, i.e., naturally occurring materials were utilized, the need for maintenance and surveillance has been minimized, and the necessity for long-term institutional controls has been eliminated.

A naturally occurring stratum of highly impermeable gray clay forms the bottom of the facility. The sides of the facility consist of an above-grade dike embedded in the top of a subsurface cutoff wall, which is keyed into the gray clay bottom. This provides a continuous barrier to radionuclide migration into both groundwater and surface water.

The containment facility is covered with a cap designed to minimize water infiltration, radon emanation, erosion, and frost heave damage. A 3-ft-thick layer of clay is the main component of the interim cap. Eighteen inches of topsoil cover the clay layer, and a turf cover minimizes erosion and frost heave damage to the clay. The cap is sloped to enhance natural drainage away from the facility.

The interim cap can be upgraded to a design life of 200 to 1000 years by adding a thicker clay cover and a layer of riprap to act as a barrier to intrusion into the waste by plant roots, animals, or humans. It is possible that additional barriers will be constructed over Building 411.

To ensure that the waste containment facility would function effectively, studies and tests were performed before and during construction. The studies analyzed both the short- and long-term potential for contaminant migration given the hydrogeologic conditions of the site and the properties of the interim cap. The studies took into account such

uncertainties as hydraulic conductivity, adsorption coefficient, and boundary conditions, and evaluated the selected cap design under representative geologic and climatic conditions. The results of the studies showed that, even in worst-case scenarios, the maximum distance a contaminant would migrate from the containment facility over a period of 1,000 years would be less than 100 feet.

Environmental Monitoring

The DOE environmental monitoring program at the NFSS, begun in 1981, measures radon gas concentrations in air, radium and uranium concentrations in surface water and groundwater, and external gamma radiation levels. DOE summarizes the monitoring data and prepares an annual environmental monitoring report for the NFSS. The report for 1986 demonstrated that the site meets DOE guidelines and recognized radiation protection standards.

Monitoring After Closure

The completed containment facility is also being monitored using surface and subsurface techniques to ensure that undesirable trends in the physical condition or performance of the facility are detected early so that timely corrective actions can be taken. Surface monitoring will consist of topographic surveys, walkover surveys, and aerial photography. For the topographic survey, a grid will be established on the cap and evaluations made twice each year for a period of 5 years. Walkover surveys will be conducted to detect settlement, cracking, or other undesirable conditions. Aerial mapping will document changes in the surface contours of the facility; infrared photography will be used to identify stressed areas in the vegetation as well as surficial moisture differentials, thereby permitting location and delineation of saturated areas indicative of localized subsidence and ponding. Subsurface conditions will be monitored by means of a series of monitoring wells installed around the facility and by a system of vibrating wire pressure transducers (VWPTs) and pneumatic pressure transducers (PPTs) installed in the cap of the facility. Experience with these instruments in dam and tunnel construction indicated that they were well suited to this application. A pressure increase measured by these instruments can indicate an increase in the height of saturation above them. Pressure increases that occur rapidly within the first year after closure will indicate a newly formed permeable condition nearby, whereas a slow increase in pressure at one or more stations with a steady decrease in pressure at others will indicate equalization of the water contained within the facility at closure. The instruments are expected to stabilize within a year after closure. In addition to pressure changes, the VWPTs will measure temperature to monitor potential changes in the form of the wastes. Any evidence of an apparent breach in the containment facility will be documented and remedial action undertaken if required. The use of external and internal monitoring techniques will facilitate documentation and evaluation of potential or actual migration of radionuclides from the facility in time for repairs to be made and waste to be reconfined before contamination reaches the site boundary. Use of these techniques will also document the adequacy of the design and construction.

CONCLUSION

The cost to complete the NFSS project through the installation of the interim cap was approximately $41 million. Depending on the EPA requirements for upgrading the facility for long-term storage, the final cap could cost approximately $14 million more. Through installation of the interim cap, the project lasted approximately 5 years, during which more than 250,000 cubic yards of contaminated material were cleaned up and stored in the waste containment area, making the NFSS the largest completed decontamination project of its type in the U.S.