Long-Term Surveillance Plan for the Parkersburg, West Virginia, Disposal Site

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1.0 Introduction

1.1 Purpose

This Long-Term Surveillance Plan (LTSP) is a technical plan that explains how the U.S. Department of Energy (DOE) will fulfill its responsibility for the custody and long-term care of the radioactive material storage area, formerly owned by AMAX, Inc., (AMAX) near Parkersburg, West Virginia. The LTSP describes the long-term surveillance and maintenance activities that are necessary to fulfill the requirements of the site ownership, which was conveyed to the DOE on March 4, 1994. DOE assumed ownership of the radioactive materials storage area (Parkersburg site) under the terms of Subtitle D, Section 151(c), of the Nuclear Waste Policy Act of 1982.

1.2 Background

The Parkersburg site is in Wood County, West Virginia, about 7 air miles (mi) (11 kilometers [km]) west-southwest of Parkersburg, the county seat, and is in the Lubeck magisterial district. Near the site are the villages of Washington and Lubeck about 1 mi (1.6 km) to the northeast and 3 mi (5 km) to the east-southeast, respectively. The center of the 15.16-acre (ac) (6.27-hectare [ha]) site containing the stabilization mound is about 2,000 feet (ft) (610 meters [m]) east of the Ohio River in Washington Bottom. The general location of the site is shown in Figure 1–1.

The site was developed in 1957 to produce high-grade zirconium metal for the Naval Reactor Program under an Atomic Energy Commission (AEC) contract. Zircon ore was processed until 1970, zirconium and hafnium metal sponge was produced until 1974, and experiments were conducted on baddeleyite ore in 1975 as concluding operations at the site. It is estimated by the U.S. Nuclear Regulatory Commission (NRC) that 2 million pounds (lb) (900,000 kilograms [kg]) of zircon ore, mainly from Nigeria, were processed at the AMAX-owned site. Residual soil contamination areas on the site were identified in 1977, and in 1978 several fires and explosions were caused by the uncovering of pyrophoric material on the site. Radiologic, geologic, and hydrologic studies of the site commissioned by AMAX resulted in a plan for remedial action provided in the "Stabilization Plan" (AMAX 1980). Remediation consisted of consolidating the waste material into one area and capping it with clay and topsoil; this was accomplished in the summer and fall of 1982. Details of the construction of the stabilization mound and of two additional ground water monitor wells installed on the site are in the *Stabilization Plan, Construction and Final Survey* (AMAX 1984).

1.3 Regulatory Requirements

Regulations that govern the transfer of ownership of the Parkersburg site to the DOE are solely in Subtitle D, Section 151(c), of the Nuclear Waste Policy Act of 1982 [42 U.S.C. 10171(c)]. The text of Subtitle D of the Act (enacted on January 7, 1982) is presented in Appendix A. General Federal license requirements under the Uranium Mill Tailings Radiation Control Act of 1978 do not apply to this site. Also, no State laws are applicable to the construction of the disposal cell at the site.

Figure 1–1. Location of Parkersburg, West Virginia, Site

2.0 Site Description and History

2.1 Site Location and Description

The Parkersburg site at 39° 15' N and 81° 41' W is in Washington Bottom, an area on the east bank of the Ohio River that contains both agricultural and industrial developments (Figure 1–1). The site is on two U.S. Geological Survey 1:24,000-scale topographic maps: the extreme south part of the Little Hocking, Ohio-West Virginia, and the extreme north part of the Lubeck, West Virginia-Ohio. Access to the site from downtown Parkersburg is shown in Table 2–1.

The L.B. Foster Company facility with several operating buildings, a water tower, soccer field, and foundations of former buildings is immediately west and north of the site. North of Foster Drive, agricultural and grazing land extends for about 2,500 ft (770 m) north to the industrial properties of General Electric Plastics and E.I. DuPont de Nemours Company. Land immediately to the east, south, and southwest of the site is used for grazing. Tracks of the Baltimore and Ohio (B&O) Railroad are about 250 to 300 ft (77 to 92 m) east of the site boundary, which they roughly parallel. Just east of the B&O Railroad tracks and south of Foster Drive is an electric power substation. South of the substation and directly east of the site are several buildings housing the insulation contracting and sales business of Nitro Industrial Coverings, Inc. Farther to the south and about 700 ft (215 m) southeast of the site are buildings that house the air separation plant of AGA Burdox, Inc., which produces oxygen and nitrogen. The large east-striking building housing the DuPont Blennerhassett Warehouse is only about 150 ft (46 m) south of the site.

Table 2–1. Route and Mileage to Parkersburg Site

Mileage	Route
0.0	Junction of State Highway 68 and U.S. Highway 50 in downtown Parkersburg. Proceed south on State Highway 68.
0.2	Start of bridge over Little Kanawha River.
3.0	Junction of State Highway 68 and State Highway 892 (DuPont Road). Turn right on DuPont Road.
6.15	Large facility of the E.I. DuPont de Nemours Company to right.
6.5	DuPont facility entrance to right.
6.8	Post Office for the village of Washington to left.
7.2	Entrance to the large General Electric Plastics facility to right.
7.7	Turn right (west) on Foster Drive (Secondary State Route No. 34/2).
7.8	About 150 ft (30 m) after crossing the tracks of the Baltimore and Ohio (B&O) Railroad, turn left (south) on the gravel site access right-of-way road that goes southward for about 750 ft (240 m), crosses two railroad tracks of the spur into the L.B. Foster Company, and ends near the northeast corner of the Parkersburg site.
7.95	Entrance gate in security fence surrounding the Parkersburg stabilization mound.

The Parkersburg site is in the unglaciated Allegheny Plateau section of the Appalachian Plateaus physiographic province. Although not glaciated, the site is at an elevation of about 630 ft (195 m) on a high terrace that formed from outwash material deposited by the Ohio River during early Wisconsinan glaciation about 65,000 to 75,000 years ago. Most of Washington Bottom consists of this high terrace surface situated about 60 ft (19 m) above the low water level of the Ohio River. West of the site is a narrow low terrace at an elevation of about 600 ft (180 m) that is adjacent to the Ohio River. This low

terrace formed from late Wisconsinan glacial outwash and is also part of Washington Bottom. About 700 to 1,000 ft (215 to 310 m) east of the site, just east of DuPont Road, low hills rise up abruptly about 200 ft (60 m) and border Washington Bottom. These hills are formed on bedrock of the Dunkard Group of Pennsylvanian and Permian age (Cardwell et al. 1968). Rocks of this group consist of a cyclic nonmarine sequence of sandstone, siltstone, shale, limestone, and coal. Some of the coal has been removed by strip mines (abandoned) scattered through the hills. Bedrock at the site beneath approximately 100 ft (30 m) of glacial outwash sand and gravel is also the Dunkard Group.

The site location in Washington Bottom at an elevation of about 630 ft (195 m) is higher than the highest recorded Ohio River floodwater level of 616.5 ft (187.9 m) in 1913 (NRC 1982). Because of the nearly flat terrain on the terraces of Washington Bottom, surface-water drainage in the area is poor in places, but generally is through small creeks and ditches that drain westward or southward into the Ohio River. Elevation over the 15.16-ac (6.14-ha) stabilization mound portion of the site property varies only about 30 ft (9 m) from about 644 ft (196 m) at the top of the stabilization mound to about 614 ft (187 m) in the drainage at the southwest corner of the property. Surface water at the site drains generally toward the south through an unnamed creek about 200 ft (61 m) east of the property and a ditch along the west property boundary. Both of these drainages empty into the south-flowing Ohio River within 1 mi (1.6 km) of the site.

Soils in the site area are generally classified as the Huntington-Ashton-Wheeling association according to the "Soil Survey of Wood and Wirt Counties, West Virginia" (Ellyson et al. 1970). These soils are deep, well-drained, silty, and occur on bottom lands and terraces along the Ohio River on level or gently sloping terrain. More specifically, soil at the site before the stabilization mound was constructed consisted of the Wheeling, Lakin, and Sciotoville series. Wheeling soil is deep, well-drained silt loam that is moderately permeable; it occurs in the west part of the site. Lakin soil is highly permeable loamy sand that developed on deep, sandy (possibly windblown sand) material on low ridges; it occurs in the central and southeast parts of the site. Sciotoville soil is a deep silt loam, moderately well drained, and of moderately low permeability; it occurs in a small area in the northeast part of the site.

The fenced area of the stabilization mound and most of the immediately adjacent area is open and grass-covered. Dense stands of trees are present along the unnamed south-draining creek that is east of the site, and trees are adjacent and south of a small section of the security fence along the south edge of the stabilization mound.

Climate at the Parkersburg site is humid and continental, as inferred from data from the nearby town of Parkersburg (Ellyson et al. 1970). Annual average precipitation is approximately 40 in (100 cm). Heaviest rainfall is in June, July, and August; and lightest precipitation is in September, October, and November. Annual average snowfall is about 24 in. (60 cm). Winter is usually moderated by warm air that flows up along the Ohio River Valley. However, cold and snow can occasionally be severe, as experienced during January 1994 when 40 in. (100 cm) of snow fell. Large diurnal temperature differences are rare—the average daily temperature range is between 15 and 20° F (8 and 11° C). The lowest average temperature of 33° F (0° C) is in January and the highest average temperature of 75° F (22° C) is in July. Highest temperatures in summer usually reach into the upper 90s° F (35-38° C) and lowest winter temperatures are about 0° F (-18° C). Prevailing winds are from the southwest. Fog commonly occurs along the Ohio River bottom at night and early morning in the summer and fall.

No prior notification or permission is necessary for access to the Parkersburg site; however, personnel working on site are advised to inform the L.B. Foster Company (which leases land north and

west of the site from AMAX) of their presence on or adjacent to the site. Personnel should either call the L.B. Foster Company at (304) 863-3316 or check in at the company office building about 500 ft (150 m) north of the site.

The boundary of the roughly pentagonal-shaped 15.16-ac (6.14-ha) site property that contains the stabilization mound is shown in Plate 1, which is from a site survey conducted in the spring of 1995. A legal description of the site property is given in Appendix B, which contains the description as stated in the General Warranty Deed of AMAX Land Transfer for Tract 101 on July 8, 1993. This boundary description differs from the May 1987 description by AMAX in its license application to the NRC mainly in that the azimuth directions have changed slightly reflecting the resurvey in the spring of 1993 by the U.S. Army Corps of Engineers (COE). Tract 101 is held as fee simple property by the DOE. Also given in Appendix B is the legal description of Tract 101E, which is the 20-foot-wide permanent access road easement through AMAX-owned property from Foster Drive to the DOE-owned Tract 101 that contains the stabilization mound. Tract 101E contains approximately 0.34 ac (0.13 ha) and is shown in Plate 1.

The stabilization mound area is enclosed by a 6-ft (1.8-m) high security fence, which has one entrance gate and four walk gates (Plate 2). All the gates are locked. Keys to the locks are held by the DOE–Grand Junction Projects Office (GJPO) Project Manager and the Rust Geotech Long-Term Surveillance and Maintenance (LTSM) Project Manager (Table 2–2).

The fence around the stabilization mound was constructed in late 1982 and set inside the property boundary by a distance that varies from 15 to 100 ft (4.6 to 30 m). The galvanized security fence is approximately 2,900 ft (890 m) long, is of chain-link construction, and is topped with three stands of barbed wire. The entrance gate near the northeast corner of the site property is a 16-ft (5-m) wide double gate. The four walk gates (about 3-ft [0.9-m] wide) are located at the west end of the north fence, midway along the west fence, at the south end of the west fence, and at the east end of the south fence (Plate 2).

Fifteen warning signs are posted on the security fence around the site to inform the public of the function and ownership of the site and that trespassing is forbidden (Section 3.3.2). The signs are spaced no more than 200 ft (61 m) apart around the site security fence. Because the site is in an active industrial and agricultural area, human intrusion/vandalism could become a problem. Scheduled site inspections (Section 4.1.1) will monitor the effectiveness of these security measures. The DOE 24-hour telephone number on the warning signs (Section 3.3.2) provides an additional security measure.

Table 2–2. Parkersburg Site Key Holders

Title and (current contact)	Telephone	Address
DOE–GJPO Project Manager (Joe Virgona)	(970) 248-6006	U.S. Department of Energy 2597 B 3/4 Road Grand Junction, CO 81503
Rust Geotech LTSM Project Manager (David Scheuerman)	(970) 248-6140	Rust Geotech 2597 B 3/4 Road Grand Junction, CO 81503

2.2 Site History

In 1957, the Carborundum Company built a facility to produce high-grade zirconium metal by processing zircon ore ($ZrSiO_4$), which came mainly from Nigeria. The site of the processing facility included the present area of the stabilization mound and adjacent areas to the west and to the north as far as Foster Drive. The high-grade zirconium metal was produced under an AEC contract for use in the construction of nuclear reactors for the U.S. Navy. The designed capacity for this plant was 600 tons (544 tonnes) of zirconium annually and was an expansion from the company's smaller pilot zirconium-processing facility in Akron, New York.

The zirconium and hafnium (a constituent in the zircon ore) processing method used at the Parkersburg facility was developed by W.J. Kroll for the U.S. Bureau of Mines. Zircon ore is first converted to zircon carbonitride and hafnium carbonitride by mixing it with graphite or coke and fusing the mixture. The carbonitrides are chlorinated in a furnace, and the gaseous chlorides of zirconium ($ZrCl_4$, zirconium tetrachloride) and hafnium are collected in a condenser. The zirconium and hafnium chlorides are reduced to their respective metals using the Kroll method, which involves reacting the chlorides with magnesium metal under pressure. In addition to the magnesium chloride produced in this reaction, another waste product that can become pyrophoric under certain conditions is "sidewall material." The final product, zirconium sponge, contains about 2 percent hafnium and is used in non-nuclear applications. Reactor-grade zirconium (contains about 0.3 percent hafnium) is produced by dissolving zirconium sponge using methyl isobutyl ketone and the hafnium is solvent extracted to hafnium thiocyanate. The resulting zirconium sponge is crushed, compacted into electrodes, and vacuum melted to ingots.

From 1959 to 1962, the Carborundum Company processed Nigerian zirconium ore under AEC surveillance and under several licenses. In addition to zirconium, this ore contained about 3 percent hafnium oxide, up to 8 percent thorium (ThO_2), and about 2 percent uranium oxide (U_3O_8) (NRC 1982). All the ore and the residual materials were stored in drums on the site. The use of this highly radioactive Nigerian ore ended in April 1962, and until January 1964, plant operations were limited to reprocessing and upgrading the zirconium oxide and sponge inventory. In January 1964, plant operations switched to processing Australian zirconium ore, which contained low levels of radioactivity compared to the Nigerian ore.

From June 1965 to May 1967, the site facility was operated under the name of Carborundum Metals Climax, Inc., which was a joint venture of Carborundum Metals Company Division and AMAX Specialty Metals Co., Inc. In May 1967, AMAX (a totally owned division of American Metals Climax, Inc.) became the sole owner of the facility. By 1968, some of the drums containing the radioactive Nigerian ore and residual materials had deteriorated and spilled on the soils in the storage area. High radioactivity in the contaminated soils exceeded approved levels and it became necessary to move the soils and drums from the site. In September 1968, approximately 3,000 drums of zirconium ore, residual material, and soil were transported from the site to the AEC low-level radioactive waste site at Maxey Flats, near Morehead, Kentucky.

In late 1969, AMAX began purchasing zirconium tetrachloride and discontinued processing zirconium ore. Production of zirconium and hafnium metal sponge continued until November 1974 when all production at the site ended. In November 1974, AMAX obtained a license from the NRC to conduct laboratory-scale experiments on baddeleyite ore (ZrO_2), which contained less than 0.5 percent total thorium and uranium. Test material and process residuals were contained in one building. The tests were concluded in late 1975 and all remaining baddeleyite ore and its process materials were transported to Northern Abrasives, a site in Ontario, Canada.

In March 1977, AMAX sold the 375-ac (152 ha) property (only 125 ac [51 ha] of which had been involved with the zirconium-processing operations) and buildings to the L.B. Foster Company, a steel pipe manufacturing business. In September and October 1977, site inspections by the NRC associated with the closeout of AMAX's baddeleyite license found areas of residual soil contamination associated with Nigerian ore processing. The following cleanup program resulted in 70 drums of contaminated soil, which were transported to an NRC-approved disposal site in late 1977. During building construction activities by L.B.Foster Company in March 1978, a backhoe excavation encountered pyrophoric waste material that caused several fires and explosions. Investigation of the causes of the explosions determined that AMAX had not adequately terminated its license with the NRC. As a result, AMAX repurchased the property from L.B. Foster Company and began radiological, geological, and hydrological surveys to evaluate the site for cleanup. The first surveys completed were a radiological assessment of the site conducted from July through October 1978 (ATCOR, Inc. 1978) and an aerial radiological survey flown in August 1978 (EG&G, Inc. 1979). During 1979, AMAX leased part of the property found to be free of radiological contamination back to L.B. Foster Company and its pipe manufacturing operations resumed in late 1979 in buildings to the northwest of the present stabilization mound.

In addition to the initial site studies, AMAX started in 1979 a comprehensive series of technical studies to develop a stabilization plan. Soil test pits and two monitor wells (MW–1 and MW–2) were installed in June 1980 as part of the evaluation of the hydrogeology of the AMAX site completed in August 1980 (Williams and Associates 1980). A geotechnical investigation report (Woodward-Clyde Consultants 1980) completed in September 1980 located borrow material, recommended placement and compaction procedures for earthwork in stabilization mound construction, and presented tests of topsoil material in the area. The radiological survey conducted in 1980 by Chem-Nuclear Systems, Inc., identified an unrestricted area in which the radiation dose levels were above the acceptable limits of 10 CFR 20.105 (NRC regulations for licensed facilities). This survey was presented in the report completed in September 1980 entitled *Radiological Assessment and Stabilization Scenarios* (Chem-Nuclear Systems, Inc. 1980). With these technical study report results, AMAX proposed a site stabilization plan to the NRC in September 1980 (AMAX 1980). The stabilization plan proposed to consolidate the waste site into one area (which had previously been occupied by the zirconium processing operations), protect public health, and restore much of the property to unrestricted use. The consolidated waste material would be capped with clay and protective topsoil so that radionuclide leaching would be minimized, radon emissions would be reduced, erosion and dispersion would be prevented, and the potential for contact with pyrophoric wastes would be eliminated.

In April 1982, the NRC completed an *Environmental Impact Appraisal* (NRC 1982), which evaluated the environmental impact of the proposed stabilization plan. This document determined that preparation of an environmental impact statement for the proposed action was not necessary. Also, in the document the NRC gave its approval with certain provisions for the proposed stabilization plan. The *Environmental Impact Appraisal* was submitted to the EPA for its review and concurrence, but the EPA declined to review the document.

In June 1981, AMAX applied to the NRC for a source material license. In June 1982, after the NRC's completion of the *Environmental Impact Appraisal,* the NRC granted AMAX a license authorizing "the collection, stabilization, and storage of the contaminated soil and rubble which is present at and adjacent to the AMAX site." After receipt of the license, AMAX proceeded with stabilization of the site from July to November 1982. During construction of the stabilization mound, Chem-Nuclear Systems, Inc., provided radiological data. Two additional monitor wells (MW–3 and MW–4) were installed in the fall of 1982 during the stabilization mound construction. Details of the radiologically contaminated

material removed and of the construction of the stabilization mound where it was placed are in the *Stabilization Plan, Construction and Final Survey* prepared by AMAX in March 1984 (AMAX 1984). In late 1983, some minor post-construction adjustments were made to the stabilization mound and adjacent area to facilitate water drainage away from the mound. These adjustments included regrading the slope between the railroad spur and the north edge of the stabilization mound, installing a 120-ft (37-m) section of 42-inch (in) (108-centimeter [cm]) diameter steel culvert at the north end of the west drainage ditch, installing a 50-ft (15-m) section of 60-in (152-cm) diameter steel culvert under the ramp over the west drainage ditch, regrading the banks of the west drainage ditch, and constructing a drainage (perimeter ditch) furrow along the west side of the stabilization mound (AMAX 1984).

The NRC requested that the Oak Ridge Associated Universities Radiological Site Assessment Program conduct a survey to evaluate the effectiveness of remedial action at the AMAX property. This study was completed as a *Radiological Survey of the AMAX Site* and issued in January 1985 (Frame and Berger 1985). Objectives of the survey were to evaluate the adequacy and accuracy of the soil sampling and analytical techniques used by Chem-Nuclear Systems, Inc., evaluate the effectiveness of decontamination operations, and determine the radiological status of the site following cleanup, backfilling, and stabilization mound construction.

Among the requirements of the license issued by the NRC to AMAX were a stipulation that biannual inspections of the stabilization mound be conducted and a report submitted to the NRC. In addition, water samples will be obtained from the four monitor wells and analyzed for gross alpha and gross beta. The first inspection occurred in December 1982, and two inspections per year have occurred subsequently during most years through 1993. All inspections and sampling, except the initial sampling in 1982, have been completed by personnel of the West Virginia Department of Health. All water-sample results for alpha and beta activity have been below the NRC license criteria of 15 picoCuries per liter (pCi/L) for gross alpha and 50 pCi/L for gross beta.

In January 1986, AMAX requested that its contract license be amended to delete the area outside the stabilization mound and that the outside area that no longer contained radioactive material be released for unrestricted use. In March 1987, the NRC released an *Environmental Assessment* (NRC 1987) concerning the license amendment request and approved the amendment subject to two conditions. In May 1987, AMAX applied for a renewal of its license to store radioactive contaminated soil and rubble in the stabilization area. In this license application was a legal description of the 15.16-ac (6.14-ha) area containing the stabilization mound.

After its license was renewed, AMAX in November 1987 requested in a letter to the DOE that the DOE assume title and custody of the stabilization area. This license termination request was submitted pursuant to Subtitle D, Section 151(c) of the Nuclear Waste Policy Act of 1982, which gives the terms for the transfer. AMAX fulfilled the terms for the transfer and the DOE was obligated to assume long-term ownership and responsibility for the site. However, it is the DOE's responsibility, under the DOE Orders 5440.1E, "National Environmental Policy Act (NEPA) Compliance Program," and 5400.1, "General Environmental Protection Program," to assess the potential liabilities the agency may be incurring as a result of its acceptance of title to the site and to determine if the site, as remediated, conforms to applicable State and Federal environmental regulations. To answer these concerns, particularly in respect to ground-water flow direction and contamination, radon flux, and erosion potential, the LTSM Program at the GJPO, which will provide for the long-term care and custody of DOE disposal sites, collected additional characterization data on the stabilization area in 1994 and 1995.

Rust Geotech, the prime contractor for the DOE at the GJPO, conducted the additional site characterization tasks according to the *Work Plan for Confirmation of Waste Containment at the AMAX Radioactive Material Storage Area* (DOE 1993b), completed in December 1993. The associated documents, *Sampling and Analysis Plan/Quality Assurance Project Plan* (DOE 1994b) and *Health and Safety Plan* (DOE 1994a) were also prepared in early 1994. To adequately characterize ground-water conditions and movement, two additional monitor wells (MW–5 and MW–6) were installed by Rust Geotech along the north edge of the stabilization mound in May 1994. Rust Geotech made radon-flux measurements on the surface of the stabilization mound in August 1994 and prepared a report of the results in September 1994 (Rust Geotech 1994b).

The report on *Site Characterization Results* (DOE 1995b), completed in September 1995, contains results of ground water and radon sampling and concluded that the buried wastes were properly contained within the AMAX stabilization mound. Ground water beneath the site complies with State of West Virginia ground-water standards and with Federal Safe Drinking Water Act standards. Radon emissions were found to comply with the National Emission Standards for Hazardous Air Pollutants (NESHAP) codified at 40 CFR 61, Subpart Q. On the basis of computer modeling results of hydrologic conditions downgradient from the stabilization mound, it was recommended that additional ground-water sampling at MW–5 and MW–6 sometime during the period from 1997 to 2002 (15 to 20 years after site closure) might detect slow-moving contamination that has migrated downgradient (north to northeast) from the stabilization mound.

As part of preparation for transfer of site ownership from AMAX to the DOE, the U.S. Army Corps of Engineers (COE), Huntington District, conducted surveys of the site and of an access road to the site. In February 1993, the COE surveyed the site security fence and its nine corners and determined that the fence enclosed an area of 12.098 ac (4.896 ha). The COE also surveyed a 20-ft (6-m) wide right-of-way easement for a site access road from Foster Drive to the entrance gate near the northeast corner of the security fence around the stabilization mound. The area of this right-of-way was determined to be approximately 0.34 ac (0.13 ha). On July 8, 1993, a General Warranty Deed (Appendix B) transferred title of Tracts 101 and 101E (stabilization mound area and permanent access road easement, respectively) from AMAX to the DOE. However, ownership of the site was not formally assumed by the DOE until March 4, 1994. As a result of the ownership transfer, on June 7, 1994, the NRC cancelled AMAX's license for the site. Additional characterization work in 1994 at the site created the need for another survey, which Rust Geotech subcontracted to a private surveyor. This survey (Plate 1) was conducted in May 1995 and consisted of the following determinations: elevations of all six monitor wells, horizontal coordinates of the two new monitor wells (MW–5 and MW–6), and horizontal and vertical coordinates for the six new boundary monuments.

An initial or baseline inspection of the Parkersburg site was conducted by Rust Geotech in March 1994 (Rust Geotech 1994a). This inspection found the site to be in good condition; main recommendations were to control the headward erosion of the gully near the southwest corner of the site and to set boundary monuments delineating the site property. Six boundary monuments were set on the property corners in late 1994. The second annual inspection of the site was conducted by Rust Geotech in March 1995 (Rust Geotech 1995a). This inspection found the site to be in good condition; main recommendations were to control the headward erosion of the gully near the southwest corner of the site and to install 15 warning signs on the security fence. The signs were installed on the site security fence in the summer of 1995, and a design for the control of erosion in the gully near the southwest corner of the site has been approved and will be implemented in 1996.

3.0 Final Site Conditions

3.1 Disposal Cell Design

The stabilization mound inside the security fence at the site covers an area of about 12 ac (4.9 ha). The mound was constructed from July to November 1982 by Chem-Nuclear Systems, Inc., under contract to AMAX. Radioactive soil and other debris were removed form other parts of the AMAX property and placed on grade. Part of the existing grade included concrete pad foundations of two buildings (fabrication shop to the west and weld shop to the east) that L.B. Foster Company had started to build in 1978 (Plate 2). Construction activities on the buildings had been halted because of explosions resulting from encounters with pyrophoric material, believed to be zirconium and magnesium metal. During construction of the mound, effort was made to place the most contaminated soil on the concrete pads for the buildings (AMAX 1984). The resulting grass-covered, gently-sloping stabilization mound rises to a maximum height of only about 9 ft (3 m).

Because the mound is gently sloping, surface drainage off the mound is not well defined. To improve surface drainage, about a year after the mound was constructed, in late 1983, a shallow drainage furrow (perimeter ditch in Plate 2) was constructed in the west side of the mound to channel water to the south off the mound. To protect the stabilization mound from horizontal movement of off-site shallow subsurface ground water, a 2-ft (0.6-m) wide barrier trench from 4 to 7 ft (1.2 to 2.2 m) deep was dug around the perimeter of the mound and backfilled with compacted clay
(AMAX 1984).

Radioactive soil and pyrophoric material in the stabilization mound are capped by clay and protective topsoil. Information on the construction of the stabilization mound is in the *Stabilization Plan, Construction and Final Survey* (AMAX 1984). A conceptual schematic section of the component layers of the stabilization mound is shown in Figure 3–1.

Radiologically contaminated soil and debris placed on grade was compacted by D-8 bulldozers and tandem truck wheels. An inorganic clayey soil obtained from the field west of the site was spread over the contaminated material and compacted to a dense 6-in (15-cm) thick layer using a flat drum vibrator roller. A low permeability clay cap layer 12 in (30 cm) thick was constructed over the clayey soil layer to protect the waste material from leaching. The clay material, classified as CL and with a high percentage of inorganic clay, was selectively borrowed from the floodplain (a low terrace) just east of the Ohio River to the west of the site. Water was added as necessary to maintain optimum moisture content (about 20 percent) of the clayey material as it was spread by scrapers and compacted using a flat drum vibrator compactor. The clay material in compaction tests exceeded 90 percent density, and permeability of the layer was less than 1×10^{-7} cm/second (sec).

A 30-in. (75-cm) thick layer of topsoil was placed over the clay cap to protect it from weathering and erosion and to provide a soil base for growth of grass cover. The topsoil was obtained from borrow areas just west of the site and was compacted by a smooth drum vibrating compactor after being placed on the mound. The final 6 in. (15 cm) of topsoil was not compacted to allow for seeding of grass. Construction of the topsoil layer allowed surface drainage from all directions off the stabilization mound by limiting the final grade to between 1 and 5 percent over areas where the contaminated material had been placed. The final surface grade exceeded 5 percent at the southwest edge of the mound, which is outside the area where contaminated material was deposited. In late fall 1982, fertilizer, grass seed, and mulch were spread by hydromulch system over the final grade of the

Figure 3–1. Conceptual Schematic Section of Stabilization Mound

mound surface. The mixture of grasses seeded on the mound included winter wheat, Kentucky 31 Fescue (bluegrass), rye, and red clover.

The surface condition of the stabilization mound will be monitored during annual inspections to determine if the mound and erosion protection measures are functioning as designed. Guidelines to be followed when inspecting the stabilization mound and criteria for corrective action or repairs are as presented in Section 4.0.

3.2 Site Drawings and Photographs

At the completion of remedial action, certain as-built conditions of the stabilization mound and adjacent area were documented by drawings, maps, and aerial photographs. This information is mainly in the *Stabilization Plan, Construction and Final Survey* (AMAX 1984) and the *Radiological Survey of the AMAX Site, Parkersburg, West Virginia* (Frame and Berger 1985). Conditions at the site just before the termination of AMAX's license are documented in the "1994 Annual Site Inspection" (Rust Geotech 1994a) report of the inspection conducted in March 1994. Site conditions soon after the site was transferred to the DOE are described in the "1995 Annual Site Inspection" (Rust Geotech 1995a) report of the inspection conducted in March 1995. The baseline conditions provided by these reports are the basis against which future conditions at the site can be compared.

A site atlas will be prepared that includes a site location map, a topographic map, and a disposal site map. The site atlas will be updated by the GJPO, as necessary, after each site inspection. All the drawings, maps, and photographs will be archived at the GJPO in accordance with the "LTSM Records Management Plan" in the permanent site file as identified in the permanent site file index (Appendix C).

3.2.1 Site Location Map

The main part of the site location map (Figure 1–1) at a scale of 1 in (2.6 cm) = 2,000 ft (610 m) covers an area of approximately 1.0 mi (1.6 km) around the site. The map also shows the relationship of the site to West Virginia and to Wood County and nearby towns. The map shows the site property boundary, surrounding geographic features, industrial facilities, latitude and longitude, drainages, railroads, and roads.

The site location map will be updated, as necessary, after each site inspection. If changes to the map are necessary, a new map will be prepared and will include a revision number and the year of revision.

3.2.2 Site Topographic Map

The site topographic map, as part of the disposal site map shown in Plate 2, was prepared from a Preliminary Plat that AMAX had published on November 25, 1987, as part of the AMAX letter to DOE requesting that DOE assume title and custody of the stabilization area. This topographic map displays a contour interval of 5 ft (1.5 m); however, it was modified from an original topographic map, which was prepared from an aerial photograph taken on November 25, 1982, at a scale of 1 in. (2.6 cm) = 100 ft (30 m) and a contour interval of 1 ft (0.3 m). The 1982 topographic map, shown in the *Stabilization Plan, Construction and Final Survey* (AMAX 1984), shows the site after most of the construction was completed. Post-construction adjustments to drainages on and around the stabilization mound are not shown on the topographic map, and more recent changes to the drainage at the southwest corner of the site

to route the drainage away from the Blennerhassett Warehouse building (Plate 2) are not shown. These features as well as the recent erosion in the outflow channel from the perimeter ditch in the southwest part of the site are reasons to produce a new topographic map of the site. As recommended in the "1995 Annual Site Inspection" report (Rust Geotech 1995b), a new topographic map of the site is needed; the contour interval should be 2 ft (0.6 m) and coverage should extend from the site northward to Foster Drive and elsewhere to at least 500 ft (150 m) outside the site boundary.

When the site topographic map is updated, the revised map will include a revision number and the date of the revision. The original topographic map and all revisions will become part of the permanent site file.

3.2.3 Disposal Site Map

The disposal site map is at a scale of 1 in (2.6 cm) = 100 ft (30 m) and shows the stabilization mound, site property boundary, and site access road. This map will serve as the base map for site inspections (Section 4.1.5). Site inspections conducted in 1994 and 1995 used a base map at a scale of 1 in (2.6 cm) = 50 ft (15 m) that showed the stabilization mound and only part of the site access road.

In addition to topography, the disposal site map includes the following features:

- Site property boundary and boundary monuments
- Site access road easement
- Perimeter ditch on stabilization mound
- Site security fence, gates, and warning signs
- Monitor wells
- Drainages adjacent to site
- Railroad tracks and buildings near site

After each inspection, a new inspection map will be prepared that shows the results of that inspection. Each inspection map will indicate the type of inspection and the date of the inspection. All of the periodic site inspection maps will become part of the permanent site file.

3.2.4 Site Baseline Photographs

Site photographs were not included in the reports (AMAX 1984; Frame and Berger 1985) prepared at the time of completion of stabilization mound construction. Ground photographs were included in the "1994 Annual Site Inspection" (Rust Geotech 1994a) and the "1995 Annual Site Inspection" (Rust Geotech 1995b) conducted in March 1994 and March 1995, respectively. These photographs taken during the initial site inspections will serve as the baseline photographic record of final conditions at the site. Each photograph was recorded on a field photograph log form (Appendix D), and an appropriate description of the feature photographed (including azimuth, if necessary) was recorded on the form. These photographs and negatives, as well as all corresponding field photograph log forms, are in the permanent site file.

3.2.5 Site Aerial Photographs

Aerial photographs were taken of the site in 1978 before remedial action and in 1983 or 1984 after remediation and construction of the stabilization mound. The earlier color photograph was taken in June 1978 and shows two buildings of L.B. Foster Company that appear to be completed (roofs on buildings) in the area that later became the stabilization mound. This photograph was taken as part of the aerial radiological survey of the site conducted for the DOE by EG&G, Inc. (EG&G, Inc. 1979). The later photograph is in black and white and is included in the post-construction radiological survey report conducted by Oak Ridge Associated Universities for the NRC (Frame and Berger 1985). This photograph was taken in 1983 or 1984 just after construction of the stabilization mound was completed. Both photographs are in the permanent site file.

The aerial photographs provide useful information on pre-remediation and post-remediation site conditions. The photographs serve as useful orientation before site inspections. Site conditions have changed in the past 10 to 12 years and a new set of aerial photographs should be made in conjunction with the preparation of a new site topographic map (Section 3.2.2). Because of the constant changes in nearby land use, vegetation, and erosion patterns, the need for updated aerial photographs will be evaluated at 5-year intervals beginning in the year 2001. Updated aerial photographs will be dated and included in the permanent site file. Specifications for aerial photographs at the Parkersburg site are summarized in Table 3–1. More detailed guidance is given in Attachment 3 of the *Guidance for Implementing the UMTRA Project Long-Term Surveillance Program* (DOE 1992).

3.3 Permanent Site Surveillance Features

Permanent surveillance features at the Parkersburg site consist of boundary monuments, warning or perimeter signs, and monitor wells. Six boundary monuments define the six corners of the legal boundary of the site property. Fifteen warning signs are placed on the security fence at spaced intervals around the perimeter of the site so that one or more of the signs is visible in daylight to a person approaching the site from any direction. The construction and emplacement of the boundary monuments and warning signs are described below according to specifications in DOE's *Guidance for Implementing the UMTRA Project Long-Term Surveillance Program* (DOE 1992). Six ground-water monitor wells are around the perimeter of the stabilization mound and inside the security fence; wells are located in the north (three wells) west-central, south-central, and northeast parts of the site
(Plate 2).

3.3.1 Boundary Monuments

Bernsten Federal aluminum survey monuments, Model A–1, were used for the six boundary monuments (Figure 3–2). Ceramic magnets are epoxied into the cap and base of each monument and are vertically oriented so that the monument can easily be found if it becomes buried. Each 4-ft (1.2-m) long monument is set with the cap within several inches above the ground surface. All the monuments are set exactly on the property line. Because of thick grass covering the stabilization mound and adjacent area, the boundary monuments may become difficult to locate with time. For this reason, a steel "T" bar fence post that stands 5 ft (1.5 m) above the ground surface was set beside each

Table 3–1. Aerial Photography Specifications for Parkersburg Site

Area to be photographed	Site property boundary plus a minimum of 0.25 mi (0.4 km) beyond

	the site boundary, unless site conditions require otherwise.
Products to be delivered	One set of vertical color, infrared stereo contact prints, 9 in. by 9 in. (23 cm by 23 cm), scale 1:2400; double weight, glossy, not trimmed.
	One index map, scale 1:2400; flight lines and frame numbers will be provided.
	One set of 2 each of low and high oblique photographs (and negatives) in natural color, 8 in. by 10 in. (20 cm by 25 cm) or 9 in. by 9 in. (23 cm by 23 cm) contact prints.
Flight date	To be determined upon acceptance of this LTSP and re-evaluated at 5-year intervals thereafter.
Camera	Precision, 9 in. by 9 in. (23 cm by 23 cm) format for vertical photos. A 35-millimeter (single lens reflex) or larger format camera for oblique photographs is acceptable.
Film	Eastman-Kodak Aerochrome Infrared 2443, or its equivalent, for vertical photographs.
	Eastman-Kodak Ektacolor, or its equivalent, for oblique photographs.
Filter	Wratten Nos. 12 or 15 for infrared photographs. Skylight filter for color photos.
Flight line coverage	60 percent end overlap; 30 percent average side overlap.
Ground control	Control stations will be second order, Class 1, for horizontal control and third order for vertical control (standard U.S. Geological Survey map accuracy specifications.)

boundary monument as a reference post to aid in location of the boundary monument. Survey coordinates and elevation for each of the six boundary monuments are given in Table 3–2.

3.3.2 Warning Signs

Fifteen aluminum warning or perimeter signs are bolted on the site security fence by aluminum straps and contain the following information: the name of the disposal site, the international symbol indicating presence of radioactive material, a notice that trespassing is forbidden on this Federally owned site, and the 24-hour telephone number for the DOE–GJPO. The signs are of the dimensions and specifications shown in Figure 3–3. The signs are situated no more than 200 ft (61 m) apart around the site security fence. The signs are numbered in counterclockwise order starting with the sign on the site entrance gate. Perimeter sign locations are shown on Plate 2. Whenever the DOE 24-hour telephone number changes, the new number will be shown on corrected signs.

Figure 3–2. Boundary Monument at Parkersburg Site

Figure 3–3. Warning Sign at Parkersburg Site

3.3.3 Monitor Wells

Six monitor wells (MW) are around the edge of the stabilization mound, just inside the site security fence. The wells are numbered in the chronological order in which they were drilled and installed and are shown on Plate 2. MW–1 through MW–4 were drilled and installed by AMAX; MW–1 and MW–2 in June 1980 and MW–3 and MW–4 in the fall of 1982. MW–5 and MW–6 were drilled and installed by Rust Geotech in May 1994.

The well heads of the first four wells are protected by rusting steel casings about 2 ft (0.6 m) in diameter that rise 2 to 3 ft (0.6 to 0.9 m) above the ground surface. The casing for MW–3 leans about 15 degrees to the east, is loose, and apparently is not cemented to the subsurface well casing. The top of each steel well casing is closed by a steel cap, which is locked by a padlock. Well construction and completion records are incomplete for these four wells. Completion information for MW–1 and MW–2 is in the report on *Hydrogeology of the AMAX Property* (Williams and Associates 1980). Scant information on MW–3 and MW–4 is in the *Stabilization Plan, Construction and Final Survey* (AMAX 1984).

The last two wells (MW–5 and MW–6) in the north part of the site have their well heads protected by a steel casing of about 8 in. (20 cm) diameter that rises about 18 in. (46 cm) above a concrete pad resting on the ground surface. Three steel posts set in each concrete well pad provide further protection for the well head. The top of each steel well casing is covered by a steel cap, which is secured by a padlock. Well completion and lithologic information are in the report on *Site Characterization Results* (DOE 1995b).

Table 3–2. Survey Coordinates and Elevations for Boundary Monuments and Monitor Wells at Parkersburg Site

Feature	Coordinates[a]		Elevation (ft)	
	North (N)	East (E)	Ground[b]	Measuring Point
Boundary Monument 1	280,769.373	1,381,610.297	631.99	---
Boundary Monument 2	281,125.097	1,380,878.172	629.11	---
Boundary Monument 3	281,163.526	1,380,730.015	626.75	---
Boundary Monument 4	281,002.681	1,380,591.266	618.45	---
Boundary Monument 5	280,367.203	1,380,584.925	611.66	---
Boundary Monument 6	280,188.014	1,381,250.134	634.50	---
Monitor Well 1	---	---	636.8	638.65
Monitor Well 2	---	---	631.7	633.44
Monitor Well 3	---	---	636.2	638.19
Monitor Well 4	---	---	637.3	639.58
Monitor Well 5	281,062.002	1,380,928.770	636.0	638.65
Monitor Well 6	280,917.444	1,381,225,080	635.4	638.05

[a]Coordinates for the older monitor wells, MW–1 though MW–4 were not determined in this survey conducted in the spring of 1995.

[b]Elevation shown for the boundary monuments is that of the survey cap.

4.0 Long-Term Surveillance and Maintenance Program

In 1988, the DOE designated the GJPO to be the program office for long-term surveillance and maintenance of all DOE remedial action project disposal sites, as well as other sites [including Section 151(c) sites] as assigned, and to establish a common office for the security, surveillance, monitoring, and maintenance of these sites. The DOE established the LTSM Program at the GJPO to carry out this responsibility.

The LTSM Program is responsible for the preparation and revision of this LTSP, as well as for site inspection, monitoring, and maintenance of the site. Other responsibilities of the LTSM Program include annual and other reporting requirements and maintenance of site records. General guidance for the LTSM Program is provided in *Draft General Guidance for Long-Term Surveillance and Maintenance of Off-Site DOE Radioactive Waste Disposal Sites* (DOE 1990).

4.1 Site Inspections

Inspections of the Parkersburg disposal site are conducted to ensure that the stabilization mound continues to function as designed. The principal objective of a site inspection is to identify potential problems before extensive maintenance, corrective action, or repairs are needed. Identification and documentation of progressive change caused by slow-acting natural processes are a fundamental part of the inspections. Finds from these inspections will be compared to initial baseline conditions to provide a basis for future inspections. Two types of site inspections are annual or scheduled inspections and follow-up inspections.

Each site inspection must be documented in a report that identifies the findings of the inspection. Copies of each report will be submitted to the DOE–GJPO and will be placed in the Parkersburg permanent site file. Annual or scheduled site inspection reports will be completed and submitted to the DOE–GJPO within 90 days of the inspection. Follow-up inspection reports will be submitted to the DOE–GJPO within 60 days of the inspection.

4.1.1 Frequency of Inspections

Annual inspections of the Parkersburg site will occur for the first 5 years after approval of this LTSP (1996 through 2000). At the end of the 5-year period, the GJPO will evaluate the need to continue annual inspections. The resulting recommendation will be based on an evaluation of the annual reports and any other reports filed for maintenance or unscheduled events. If it is determined that less frequent inspections are required, the GJPO will modify the LTSP and submit it to the DOE–GJPO for approval. Subsequent inspections will be considered as scheduled site inspections.

Late summer and fall are preferred times for inspections at the Parkersburg site. This is a relatively dry time of year and is near the end of the growing season so that the effect of vegetative growth on and around the stabilization mound can be assessed.

4.1.2 Inspection Preparation

Before each scheduled inspection, an inspection team consisting of a chief inspector and one assistant will be selected. Both professionals should be technical experts knowledgeable in processes that

could adversely affect the site. In the case of follow-up inspections, the inspection team will include at least two technical experts having expertise appropriate to the problems under investigation.

Before each inspection, team members will do the following:

- Review the final LTSP, the permanent site file, the previous site inspection report(s) and site inspection map(s), and all maintenance or corrective action reports.
- Prepare the site inspection checklist based on previous inspections or repairs; incorporate any necessary modifications.
- Verify and update the names and telephone numbers of all parties with whom access or notification agreements have been made.
- Verify the DOE–GJPO 24-hour telephone number and arrange to modify the warning signs if necessary.
- Schedule the site inspection and pre-inspection briefing meeting.
- Notify the DOE–GJPO and other appropriate parties for their attendance at the inspection if they so choose.
- Assemble all equipment needed for the inspection
- Adjust the magnetic declination of the Brunton compass to be used in the inspection for that of the Parkersburg area (currently 7 degrees west of true north).

4.1.3 Inspection Checklist

The inspection is guided by the inspection checklist. An initial site inspection checklist for the Parkersburg site is included as Appendix E. This initial checklist is a guideline for the inspectors. After completion of each inspection, the checklist will be revised to include new information or to delete items that are no longer pertinent. The revised checklist will be prepared prior to the next scheduled inspection.

4.1.4 Inspection Photographs

Ground photographs (color prints) will be taken during site inspections to document conditions at the stabilization mound, site perimeter, and outlying areas. These photographs will provide a continuous record for monitoring changing conditions through time. Comparison of these photographs with baseline photographs can be made to determine if changes are affecting site integrity. Each photograph will be recorded on a field photograph log (Appendix D) along with an appropriate description of the feature photographed, including azimuth (if necessary). Copies of the photographs and the photograph log form will be included in the site inspection reports.

When possible, a photograph should include a reference point such as a boundary monument, monitor well, or perimeter sign. A north arrow and scale should also be included for reference in photographs of erosional features or other small-scale subjects. In specific areas where a photograph is used to monitor change over time, the azimuth and distance from the feature should be recorded, and all

subsequent photographs should be taken from the same orientation to provide an accurate record of change. The magnetic declination of the compass should be adjusted so that the compass points to true north. This declination angle adjustment will be recorded on the inspection checklist and on the field photograph log. All site inspection photographs taken, as well as corresponding field photograph log forms, will be maintained in the Parkersburg permanent site file.

The following site features should be documented by photographs during each scheduled inspection at the Parkersburg site:

- Permanent site surveillance features (6 boundary monuments, 15 warning signs, and 6 monitor wells shown on Plate 2). Only one photograph of a representative warning sign is necessary; additional signs should be photographed if they have been damaged.

- Site entrance gate. Show damage to the fence, entrance gate, or walk gates by additional photographs.

- Site access road.

- Surface of the stabilization mound and any evidence of settling, burrowing, ponding of water, erosion (ruts, rills, gullies), seepage, and invasion of noxious vegetation. A 360-degree photographic panorama will be taken from the top of the stabilization mound to document the general condition of the mound surface and its grass cover.

- Perimeter ditch in the west part of the stabilization mound.

- Drainage ditches along the north and west edges (west drainage) of the site.

- Evidence of erosion peripheral to the stabilization mound both inside and just outside of the site property boundary. These are features that the inspector considers to be significant enough to affect the site in the future and which are included in the text of the inspection report. These features may include headward advance of gully erosion in the outflow channel of the perimeter ditch southwest of the stabilization mound, erosion of the stream east of the site, rills that start on the stabilization mound and continue offsite, and concentrations of animal burrows that can initiate and contribute to erosion.

- Areas of ponded water in flat, poorly drained areas just south and east of the stabilization mound.

- Extent and condition of wooded area adjacent to the south security fence.

- Seep areas near the stabilization mound and indications of seeps such as discolored grass or soils.

- Nearby industrial activity or other land uses (including drainage modifications) that might affect the site.

All new or potential problem areas identified during a site inspection will be well documented with photographs. Photographs will also be taken to record developing trends in the condition of the site. These

photographic records will be used to make decisions concerning follow-up inspections, custodial maintenance or repairs, or corrective actions. The number of photographs, view directions, and lenses used will be determined by the inspectors according to site conditions and lighting conditions.

4.1.5 Inspection Transects

To ensure that the Parkersburg site is thoroughly covered during an inspection, the site is divided into two transects that are walked by inspectors. Observations and photograph locations will be recorded and described during the walk through each transect. Observations will be recorded in a field notebook, photograph locations and other notes will be recorded on a disposal site map (Plate 2), and photograph information will be recorded on field photograph log forms. After the inspection, information on the disposal site map will be drafted and retained in the Parkersburg permanent site file. The two transects (stabilization mound, and site perimeter and outlying area) and the permanent site surveillance features and other features that they contain, along with conditions that should be noted, are as follows:

- Stabilization mound – Inspectors will walk over the entire area of the stabilization mound inside the security fence. The objective is to achieve thorough visual coverage of the surface condition of the mound. During each inspection, a 360-degree photographic panorama will be taken from the top of the stabilization mound. The eight photographs that compose the panorama will be taken at 45-degree azimuth increments.

  Inspectors will search for evidence of differential settling or depressions in the mound surface that would affect drainage and cause ponding of water. The presence of vehicle ruts, from water-sampling or grass-mowing activities conducted during times of wet/soft ground conditions, also can affect drainage and create areas of ponded water. Evidence of erosion, slumping, and seepage will be sought along the steeper-sloping southwest edge of the stabilization mound. Wet areas on the mound surface and areas where running water has cut drainage pathways (rills) will be noted. The condition and composition of the grass cover (density and health of grass, discolored or dying grass, and mowed height of grass) will be noted. The mound surface will be examined for disturbances by animals (woodchuck burrows and mice/gopher holes). Trash deposited by wind from nearby industries will be noted and removed from the mound. Inspectors will walk along the length of the perimeter ditch to determine whether drainage is occurring and the ditch is functioning as designed. Included in this transect are the six monitor wells, and their conditions will be noted.

- Site perimeter and outlying area – This transect includes the security fence, gates, and warning signs; the six boundary monuments; the area around the perimeter of the stabilization mound, generally from the security fence outward about 200 ft (61 m); and the site access road. Inspectors will note any damage to the security fence and gates and warning signs (and if any are missing). Emphasis in the area outside the fence will be on the progress of gully erosion in the southwest corner of the site property that is advancing headward toward the edge of the stabilization mound. Erosion rills should be noted and whether or not they are extensions of rills formed on the stabilization mound. Progress of erosion in the drainage in respect to boundary monuments 3 through 5 will be noted. Seep areas will be noted and other indications of seeps such as discolored grass or soils. Animal burrow location and frequency will be noted so that their activities and movements in relation to the stabilization mound can be determined. The condition of the grass cover and extent of woodland along the south edge of the site property will be noted. The presence and evidence of grazing animals will be noted. Wind-transported trash will be removed from the

site property (from the security fence to the property boundary). The condition of the site access road will be noted along with any adjacent land uses that may restrict use of the road.

4.1.6 Inspection Report

After each scheduled inspection, a site inspection report will be completed that includes the following information:

- Narrative that describes the inspection, including results and recommendations.
- Disposal site map (Plate 2), which will show photograph locations, locations of new or anomalous features, locations of features identified during previous inspections for observation or monitoring, and the inspection date. This map will become Plate 1 of the inspection report.
- Inspection photograph log (that describes each photograph) and photographs.
- Description of any new conditions discovered during the inspection that require monitoring or immediate action; recommendation of a follow-up inspection (if required) or custodial maintenance or repair.

A copy of the inspection report will be submitted to the DOE–GJPO within 90 days after the date of the inspection. A copy of all site inspection reports will be kept in the Parkersburg permanent site file.

4.1.7 Follow-Up Inspections

Follow-up inspections are unscheduled inspections conducted to investigate and quantify specific problems found during a scheduled inspection, ground-water sampling event, or special study. They determine whether processes currently active at or near the site threaten site security or stability, and they evaluate the need for custodial maintenance, repair, or corrective action.

The follow-up inspection begins with an on-site visit to assess the need for definitive tests or studies. Additional visits may be scheduled if more data are needed to form conclusions and recommend corrective action.

After completion of the follow-up inspection, information will be analyzed and a follow-up inspection report will be prepared and submitted to the DOE–GJPO within 60 days of the follow-up inspection date. The report will include at least the following:

- A description of the problem.
- A preliminary assessment of the maintenance, repair, or corrective action required.
- Conclusions and recommendations.

- Assessment data, including field and inspection data, and photographs.

- Names and qualifications of the field inspectors.

4.1.8 Custodial Maintenance or Repair

Custodial maintenance will be performed as needed at the Parkersburg disposal site. The need to conduct unscheduled maintenance or repair will be based on the results of annual site inspections and follow-up inspections.

Planned maintenance at the site consists of cutting the grass on the stabilization mound and within the site boundary. Grass cutting will occur at least once per year; a second cutting may occur if conditions warrant during a year of high rainfall.

Unscheduled maintenance or repair that may be required at the Parkersburg disposal site include the following:

- Repairing the security fence and gates.

- Replacing the perimeter warning signs.

- Reestablishing boundary monuments or establishing reference boundary monuments.

- Repairing the site access road.

- Building erosion control structures in drainages on the west and southwest edges of the site.

- Removing trees and brush from the security fence along the south side of the site.

- Controlling burrowing animals on and near the stabilization mound.

The GJPO will prepare a statement of work (including subcontractor qualifications) and purchase order to authorize these types of repair. The annual inspection report should include a summary of the work that was necessary to remediate an unscheduled maintenance or repair item. After work completion, the subcontractor must submit verification of the completed work and/or a written report if the action is considered significant. The DOE will inspect the site, as necessary, and review the report before certifying that all work is completed in accordance with all required specifications. Copies of all records, documentation, and certifications will be included in the Parkersburg permanent site file.

4.1.9 Ground-Water Monitoring

The need for continued ground-water monitoring at the Parkersburg disposal site was evaluated in accordance with DOE Orders 5440.1E, "National Environmental Policy Act (NEPA) Compliance Program," and 5400.1, "General Environmental Protection Program." Ground-water sampling and analysis of the sample data, as part of additional characterization at the site during 1994 and 1995 (DOE 1995b), determined that ground water complies with State of West Virginia ground-water standards and with Federal Safe Drinking Water Act standards. Concentrations of major anions and cations measured in

water samples from wells at the Parkersburg site are of the same magnitude as those measured in samples from the public water supply wells (Lubeck Public Service District).

As part of the site characterization (DOE 1995b) a hydrologic assessment and computer modeling were performed to estimate the number of years a contaminant plume would take to reach downgradient wells MW–5 or MW–6 just north of the stabilization mound. This worst-case scenario assumed that the cover of the stabilization mound allowed water to infiltrate and saturate the buried radiologically contaminated material forming a contaminant plume that would migrate about 60 ft (19 m) downward through alluvial material to the alluvial aquifer. Results of computer modeling of hydrologic parameters indicated it would take 15 to 20 years (after site closure in 1982) for contaminants to reach MW–5 or MW–6 using the worst-case scenario.

From the site characterization results (DOE 1995b), recommended sampling of ground water at the Parkersburg site would occur between the years 1997 and 2002 in monitor wells MW–5 and MW–6. Because modeling results indicate that contamination of the aquifer would occur relatively slowly, ground-water quality should be monitored once every 5 to 10 years (after the initial sampling in the 1997 to 2002 time frame). Analysis of ground water should include metals (antimony, barium, beryllium, cadmium, chromium, lead, mercury, nickel, selenium, and thallium) hafnium, zirconium, thiocyanate, major cations and anions (calcium, magnesium, potassium, sodium, chloride, sulfate, and nitrate+nitrite), radionuclides (radium-226, radium-228, and uranium), gross alpha, and gross beta. Analytical results of future ground-water samples will be compared with results of samples collected in 1994 and 1995, published in *Site Characterization Results* (DOE 1995b), to determine if changes in ground-water quality have occurred. A separate sampling plan and report of results will be prepared for each future episode of ground-water sampling at the site.

4.1.10 Corrective Action

If natural or unpredictable events threaten the stability of the stabilization mound, corrective action appropriate to the problem could include temporary emergency measures. In addition, the LTSM Program would evaluate the factors that caused the problem to ensure that recurrence is minimized or avoided. A report of the evaluation would be submitted to DOE–GJPO.

4.1.11 Records

The LTSM Program maintains Parkersburg site records in a permanent site file at the DOE–GJPO in Grand Junction, Colorado. An index of documents in the Parkersburg permanent site file is included in Appendix C.

All LTSM Program records are maintained in full compliance with the following DOE requirements:

- DOE Order 1324.2A, Records Disposition
- DOE Order 1324.5, Records Management Program
- DOE Order 1324.8, Rights and Interests Records Protection Program
- DOE Order 5500.7B, Emergency Operating Records
- Criterion 4, Documents and Records, in both the *Quality Assurance Manual* (Rust Geotech 1995c) and the *LTSM Program Quality Assurance Program Plan* (DOE 1995a).

4.1.12 Emergency Notification and Reporting

Notification agreements with local (county), State, and Federal government agencies for notification of the DOE in the event of human intrusion or unusual or catastrophic natural events in the vicinity of the Parkersburg site have not been established. However, the site is equipped with 15 warning signs posted on the security fence that display a 24-hour DOE telephone number, which the public may use to report problems at the site.

4.1.13 Quality Assurance

The long-term custody of the Parkersburg site and all activities related to the surveillance and maintenance of the site will comply with the following:

- DOE Order 5700.6C., Quality Assurance
- *Quality Assurance Manual* (Rust Geotech 1995c)
- *LTSM Program Quality Assurance Program Plan* (DOE 1995a)

The Rust *Quality Assurance Manual* meets requirements of DOE Order 5700.6C, Quality Assurance, and the draft *Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs* (American Society for Quality Control 1994). The requirements of 10 CFR 830.120, Quality Assurance Requirements, have been recently incorporated. Quality Assurance requirements will be transmitted through procurement documents to subcontractors when appropriate.

Quality assurance/quality control (QA/QC) requirements and procedures followed during ground-water sampling for characterization activities on the site in 1994 and 1995 are described in the *Sampling and Analysis Plan/Quality Assurance Project Plan for Confirmation of Waste Containment at the AMAX Radioactive Materials Storage Area, Parkersburg, West Virginia* (DOE 1994b) and in Appendix C (Quality Assurance and Quality Control) of *Site Characterization Results* (DOE 1995b). Similar QA/QC procedures and requirements will be followed in a revised sampling plan, which will describe ground-water sampling from monitor wells MW–5 and MW–6 during the years 1997 to 2002 and in 5 to 10-year intervals thereafter.

4.1.14 Health and Safety

Health and safety procedures of LTSM Program activities are addressed in the *Health and Safety Manual*, Volumes 1 and 2 (Rust Geotech 1995a). Immediate health and safety concerns are listed in the Inspection Checklist (Section 4.1.3 and Appendix E). Also in the Health and Safety section of the Inspection Checklist are 24-hour emergency phone numbers for fire, hospital and ambulance, police, and sheriff. Also in the checklist is the location of the telephone nearest to the site. The checklist is revised before each inspection to advise on-site personnel of new and continuing health and safety considerations. A Job Safety Analysis is completed before each inspection. At a pre-inspection briefing, on-site personnel review the Job Safety Analysis and are instructed on hazards that may be present at the site and health and safety procedures that must be followed.

Subcontractors (for maintenance) are advised of health and safety requirements through appropriate procurement documents. Subcontractors must submit health and safety plans for all actions subject to OSHA requirements. Subcontractor health and safety plans will be reviewed and approved before the contract is awarded. Proposals from subcontractors without an adequate health and safety plan are rejected.

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Appendix A
Subtitle D of Nuclear Waste Policy Act

Appendix B
Legal Description of Site

Legal Description

The Parkersburg site consists of two tracts (101 and 101E), which together comprise a 15.50-ac (6.27-ha) parcel of land at approximately 39° 15' N and 81° 41' W in the Washington Bottom area of Wood County, West Virginia. Only Tract 101 is held by the DOE as fee simple property; Tract 101E is a permanent access road easement through AMAX-owned property. The boundary of each tract is described in the following two paragraphs and is shown in Plate 1.

TRACT NO. 101

Beginning at an iron pin on the westerly right-of-way line of the Baltimore and Ohio Railroad Company at its intersection with the northerly line of Lot 2 of the Francis Keene Lewis Partition, a plat of which is of record in the Office of the Clerk of the County Commission of Wood County, West Virginia, in Deed Book 124, Page 313, which beginning point is further described as being located N 66° 38' 40" W 2564.68 ft from an iron pipe at the northeasterly corner of said Lot 2; thence, S 26° 23' 39" W along said westerly railroad right-of-way line a distance of 709.73 ft to a point on the southerly line of said Lot 2; thence running with said southerly lot line, N 74° 55' 26" W, passing a concrete monument at 10.20 ft, in all, a distance of 300 ft to the True Point of Beginning; thence, running with the said southerly line of Lot 2,

N 74° 55' 26" W 688.92 ft; thence, leaving said southerly lot line and severing said Lot 2,

N 00° 34' 18" E 635.51 ft
N 40° 46' 55" E 212.42 ft
S 75° 27' 33" E 153.06 ft
S 64° 05' 09" E 813.97 ft
S 31° 46' 54" W 683.89 ft to the True Point of Beginning, and contains 15.16 ac, more or less.

TRACT NO. 101E

Beginning at an iron pin on the westerly right-of-way line of the Baltimore and Ohio Railroad Company at its intersection with the northerly line of Lot 2 of the Francis Keene Lewis Partition, a plat of which is of record in the Office of the Clerk of the County Commission of Wood County, West Virginia, in Deed Book 124, Page 313, which beginning point is further described as being located N 66° 38' 40" W 2564.68 ft from an iron pipe at the northeasterly corner of said Lot 2; thence,

S 84° 26' 31" W 277.63 ft to the True Point of Beginning on the eastline of U.S.A. Tract 101 and has the approximate coordinate value of N280,718.85 E1,381,579.02; thence, running with the centerline of a proposed access road which has a right-of-way width of 20 ft, 10 ft on each side of the herein described centerline,

N 75° 21' 19" E 89.96 ft [88.27 ft][a]
N 30° 36' 39" E 156.11 ft

N 29° 55' 48" E 485.36 ft [493.14 ft][b] to a point on the south edge of West Virginia Secondary State Route No. 34/2, there terminates, and contains 0.34 ac, more or less.

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[a]Distance in brackets is measured distance shown in Plate 1.
[b]Distance in brackets is measured distance to the center of Route No. 34/2 (Foster Drive) shown in Plate 1.

Appendix C
Permanent Site File Index

Permanent Site File Index

Ownership Documentation
A. Final LTSP
B. Transfer of ownership from NRC to DOE

Documentation of DOE Title/Custody
A. Documentation
    -State
    -Federal
B. Legal description of site property and permanent access road easement
C. Custodial care agreements

National Environmental Policy Act (NEPA) Documentation
A. Environmental Impact Appraisal/Environmental Assessment
B. Additional NEPA documentation

Remedial Action Documentation
A. Characterization reports on the site by AMAX from 1978 to 1980
B. AMAX reports in 1980 on site stabilization scenarios and plans
C. Reports on stabilization mound completion and final radiological survey
D. Work plan for confirmation of waste containment at the site and the final reports of *Site Characterization Results* and *Results of Radon Flux Measurements*

Photographs
A. Photographs/video of stabilization mound construction
B. Aerial photographs
C. Inspection photographs
D. Photographs associated with activities related to the *Site Characterization Results* report

Monitoring Documentation
A. Construction permits and diagrams for monitor wells (active and abandoned)
B. Analytical results from monitor well water sampling
C. Inspection reports
D. Follow-up or contingency inspection preliminary assessments, reports, and records
E. Corrective action plans, reports, and records

Other
A. Quality assurance program plan
B. Custodial maintenance or repair reports and records
C. Site atlas

Appendix D
Field Photograph Log

Field Photograph Log

Site: _____ Roll No. __ (of __) Page 1

Date of Inspection: _____ **Time of Day:** From: _____ To: _____

Weather Conditions: _____

Frame	Azimuth	PL No.	Subject/Description

Inspector: _____ _____

Signature Printed Name

_____

[a]Adjusted to match frame number on negative.

[b]Declination angle: _____

[c]Photograph location number. Assigned when inspection report is written. See Plate 1 in inspection report for map of photograph locations.

Field Photograph Log

Site: _____ Roll No. __ (of __) Page 2

Date of Inspection: _____ **Time of Day:** From: _____ To: _____

Weather Conditions: _____

Frame	Azimuth	PL No.	Subject/Description

Inspector: _____ _____

Signature Printed Name

[a]Adjusted to match frame number on negative.
[b]Declination angle: _____
[c]Photograph location number. Assigned when inspection report is written. See Plate 1 in inspection report for map of photograph locations.

Appendix E
Initial Site Inspection Checklist

Initial Site Inspection Checklist for Annual Inspection

Site: Parkersburg Section 151(c) Disposal Site

Date Prepared:

Date of Last Inspection: March 23, 1995

Type of Inspection: Annual Inspection

Type of Planned Inspection:

I. General Instructions

A. This inspection checklist is site specific. It incorporates general and site-specific requirements for annual inspections of the subject site. This checklist may be revised in response to new requirements as result from previous inspections or maintenance develop, or as new information about the site is received.

B. Purpose of the checklist is to support

- Planning for the inspection
- Inspection of the site
- Evaluation of the thoroughness of the inspection before the inspection party leaves the site at the conclusion of the inspection
- Preparation of the inspection report

C. This checklist is provided for the convenience of those planning and conducting the inspection. Other information, materials, or guidance may be used in place of or in addition to the checklist if warranted by site conditions.

II. Preparation for the Inspection Review

A. Review inspection guidance documents:

- *Guidance for Implementing the UMTRA Project Long-Term Surveillance Program* (DOE 1992)
- *Long-Term Surveillance Plan for the Parkersburg, West Virginia, Disposal Site* (DOE this report)

B. Review previous inspection reports, field notes from previous inspections, maps and drawings of the site, and other documents as necessary to become familiar with site history, current conditions at the site, and the results of recent inspections and maintenance. Obtain copies of maps, plans, and other documents required for the inspection:

- 1995 inspection report and field notes
- 1995 inspection drawing
- Set of color photographs from the 1995 inspection report
- Specifications for site maintenance (see Section III.E)
- Information on deer ticks and lyme disease

C. Review site access procedures and protocols. Notify affected agencies. Complete actions required to enter the site.

- Grand Junction Projects Office: Mr. J. Virgona 970-248-6006
- L.B. Foster Company 304-863-3316
- Obtain keys for locks on entrance gate and monitor wells

D. Review specific observations to be made and problems to be studied or resolved during the coming inspection. (See Section III of this checklist.)

E. Inspection equipment: Assemble and pack field equipment required for the inspection of the site:

- Camera
- Spare batteries
- Camera accessories
- Film, two rolls of 36-exposure, ISO 200 (or equivalent) color print film
- Photograph scale/north arrow
- Brunton compass
- 50-foot tape
- 10- to 20-foot tape
- Clipboard

- Canteens or other provision for water in hot weather
- Field photograph log forms
- Orange field notebook
- Black, indelible, felt-tip marker with broad point
- First aid kit
- Extra padlocks and keys for monitor wells, entrance gate, and walk gates
- Rust-preventive lubricant

III. Site Inspection

A. The checklist is not intended to be exhaustive or constraining. The inspection party is free to make other observations as judgment and site conditions dictate.

B. Before the inspection of the site is completed and before the inspection party leaves the site, the inspection party should satisfy itself that the site has been fully inspected and evaluated and that adequate photographs and measurements have been obtained.

C. Health and Safety: The Parkersburg stabilization mound site contains thick grass, which is often wet and some brushy areas are adjacent to the mound. Safety shoes are not required at this site; however, high-topped boots that can be waterproofed are recommended. Inspectors should be familiar with the hazards posed by deer ticks (lyme disease) by reading the provided information on the subject. Weather conditions are characterized by high humidity and occasional rain. Personnel should plan accordingly for the following seasons:

1. Spring, Summer, and Fall:
    - Drinking water (personal canteens recommended)
    - Insect repellent for work in thick grass and underbrush
    - Waterproof footwear
    - Raincoat
2. Winter:
    - Warm, water repellent, layered clothing
    - Waterproof, insulated footwear

The nearest public phone to the Parkersburg site is along the south side of Foster Drive about 800 ft (240 m) northeast of the site. A telephone is also available in the L.B. Foster Company office north of the site. Emergency contacts and telephone numbers are as follows:

- Emergency Medical Service/Ambulance
  Camden-Clark Memorial Hospital in Parkersburg, 800 Garfield Avenue (State Highway 14, which is one-way southbound)

  Telephone 911 or 304-424-2111. 304-424-2212 for poison center

- Parkersburg Police Telephone 911
- West Virginia Police Telephone 304-420-4600
- Wood County Sheriff Telephone 303-424-1834
- Wood County Fire Department Telephone 911 or 304-485-7711

D. General Surveillance

1. Specific Site Surveillance Features

   - Warning or perimeter signs, 15
   - Boundary monuments, 6
   - Monitor wells, 6

2. Transects

   - Stabilization mound
   - Site perimeter and outlying area

3. For all transects:

   - Settlement, slumping, heaving, cracking
   - Erosion
   - Accumulation of water
   - Accumulation of trash
   - Encroachment of vegetation
   - Intrusion by humans or domestic animals

- Vandalism
- Other: animal burrows

4. Area Within 0.25 Mile of the Site
   - Change in land use
   - New construction or development
   - Earth movement, erosion, or changes in nearby stream channels
   - Accumulation of trash
5. Specific Tasks and Observations
   - Note condition of entrance gate and security fence
   - Assess the progress of erosion in the outflow channel near the southwest corner of the site
   - Note location and extent of rills around the outer perimeter of the stabilization mound
   - Replace padlocks on entrance gate, walk gates, and monitor wells with marine-type (rust-proof) padlocks
   - Note condition of the access road
   - Note condition of perimeter signs
   - Note the location and extent of animal burrows on and adjacent to the stabilization mound
   - Note condition of the grass on top of the stabilization mound and the presence of noxious species of vegetation
   - Note progress of erosion along the west drainage in respect to boundary monuments 3, 4, and 5

E. Recommendations from previous inspection:

- Add gravel to define or repair part of the site access road
- Remove trees growing through the security fence and remove trees and brush from a strip outside the security fence
- Install 15 new warning signs on the security fence

- Replace padlocks on entrance gate, walk gates, and monitor wells with marine-type (rust-proof) padlocks

- Set witness corners to denote positions of three boundary monuments, which may potentially be removed by erosion

- Remove windblown trash from the west drainage area

- Construct an appropriate erosion control structure to stop headcut erosion in the outflow channel

- Identify standing grass that is invading the site and control it if it is classified as a noxious species

IV. Inspection Closeout Summary

A. At the end of the inspection and before leaving the site, the inspection team should

1. Satisfy itself that it has sufficient information (photographs, measurements, sketches, etc.) to describe and evaluate findings and observations for the site inspection report.

2. Summarize, in the field notes or elsewhere, the following information:

   - Serious problems or threatening factors requiring immediate follow-up action;

   - Actual or potential problems not requiring immediate attention but that require further observation, possibly including a follow-up inspection; and

   - Changes recommended for this checklist before the next inspection.

B. If serious problems are identified during the inspection, the inspection team should

1. Notify the DOE–GJPO Project Manager immediately, and

2. Follow GJPO procedures for compliance with DOE Order 5000.3B (DOE 1993a).