NUCLEAR REGULATORY COMMISSION
DIVISION OF NUCLEAR MATERIALS SAFETY
REGION I

SAFETY EVALUATION REPORT RELATED TO APPROVAL OF THE DECOMMISSIONING PLAN

LICENSE NO. 19-00915-03, DOCKET NO. 03004530

UNITED STATES DEPARTMENT OF AGRICULTURE
LOW-LEVEL RADIOACTIVE BURIAL SITE
BELTSVILLE AGRICULTURAL RESEARCH CENTER
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1.0 Introduction

This Safety Evaluation Report (SER) addresses the U. S. Nuclear Regulatory Commission (NRC) staff's review of the Decommissioning Plan (DP), which incorporates a separate Final Status Survey Design Plan, for the United States Department of Agriculture's (USDA) Low-Level Radiation Burial Site (LLRBS) at the Beltsville Agricultural Research Center (BARC) in Beltsville, Maryland. Specifically, the USDA submitted a request to amend its NRC License No. 19-00915-03 (NRC Docket No. 03004530) to seek approval of the DP to conduct remediation activities at the BARC LLRBS so that the residual radioactivity at the site can be reduced to a level that meets the criteria for release for unrestricted use. In 1987, the USDA initiated use of a commercial service to have radioactive waste transported and disposed offsite at a licensed disposal facility and no longer disposes of radioactive waste at the LLRBS or any other onsite location.

The LLRBS is an area of less than one acre within the 6600-acre BARC site. The USDA utilizes licensed radioactive material at other (laboratory) areas on the BARC site, but these areas are not near the LLRBS. Although the criteria for release for unrestricted use are applicable to the entire BARC site, the cleanup criteria developed for the LLRBS in order to meet the NRC criteria for release for unrestricted use do not need to be adjusted because the other areas of licensed radioactive material use are not close enough to effectively contribute a radiation dose to an individual. Although license termination is typically associated with decommissioning, the USDA license will not be terminated at this time because the USDA will continue to conduct authorized activities under this license at other locations.

This SER summarizes the USDA's actions in development of the DP and the NRC staff's assessment. Major elements of this SER include: (a) the radiological characterization of the site to identify what areas require remediation and the extent of the required remediation; (b) the description of the dose model that demonstrates how the licensee will meet the dose criteria of 10 CFR 20.1402; and (c) the manner in which the licensee will conduct the Final Status Survey to demonstrate that the site meets the criteria for release for unrestricted use.

1.1 Background

In August 2009, the USDA submitted a DP with associated appendices (Agencywide Document Access and Management System (ADAMS) Accession Nos. ML092370149, ML092370159, and ML092370172) and a Final Status Survey Design Plan (ADAMS No. ML092370174) for the BARC LLRBS in accordance with the regulations in 10 CFR 30.36(g)(1). The staff performed an acceptance review of the documents and, in a November 2009 letter (ADAMS No. ML093240246), informed the USDA that the information in the documents was sufficient to initiate a full technical review. The staff reviewed the DP, associated appendices, and Final Status Survey Design Plan to determine whether the documents submitted met the requirements of 10 CFR 30.36(g)(4), 10 CFR 30.36(g)(5), and Subpart E of 10 CFR Part 20. The staff used the guidance in NUREG-1757, "Consolidated Decommissioning Guidance, Decommissioning Process for Materials Licensees" to assess whether the USDA had met these regulatory requirements. Adherence to this guidance is not required to meet the regulations, but adherence is one means of demonstrating that the regulatory requirements have been met.

As a result of the technical review of the DP, associated appendices, and Final Status Survey Design Plan, the staff identified additional information that was required from the USDA to assist the staff in assessing the adequacy of aspects of the DP. The staff prepared a Request for Additional Information that was provided in a September 2010 letter (ADAMS No. ML102600244) to the USDA. In lieu of specific responses to the questions posed in the Request for Additional Information, the USDA provided two subsequent revisions to the DP and Final Status Survey Plan in March 2011 (ADAMS No. ML110730506) and January 2012 (ADAMS No. ML120600551), and provided an additional clarifying addendum memorandum to the DP in February 2012 (ADAMS No. ML120600526). Any subsequent reference to the DP in this document will refer to the combination of the January 2012 Revised Final Decommissioning Plan, the incorporated Final Status Survey Design Plan, and the February 2012 addendum memorandum.

On July 11, 2012 (77 FR 40917), the NRC issued a *Federal Register* Notice announcing the USDA license amendment request and providing opportunity to provide comments, request a hearing and petition for leave to intervene. No hearing requests, comments, or petition for leave to intervene on the DP were submitted.

2.0 Facility Operating History

The staff has reviewed the information in Section 1.0, "Facility Operating History", and Section 2.0, "Facility Description" of the DP for the BARC LLRBS, and determined that the USDA has provided the information required under 10 CFR 30.36(g)(4)(i). The information is sufficient to aid NRC staff in evaluating the USDA's determination of the radiological condition of the facility and the USDA's planned decommissioning activities to ensure that the decommissioning can be conducted in accordance with NRC requirements.

2.1 Site History

The BARC LLRBS was established in 1949 and was used for disposal of low-level radioactive waste from research and development activities with radioactive materials until 1987. The BARC LLRBS is made up of a total of 50 designated waste burial pits, of which, only 46 were reportedly used. The pits are approximately 10 feet wide by 12 feet long by 10 feet deep and are separated approximately five feet horizontally from one another. Each pit was reportedly backfilled to surface grade with at least 5 feet of clean soil. Various BARC laboratories generated radioactive waste that included materials such as gloves, paper, and syringes; sealed sources and electron capture detectors; glass and plastic liquid scintillation vials; aqueous and organic liquids; plastic bags containing decomposed small animal carcasses, bedding, and excreta; and other radioactively contaminated laboratory wastes. The radioactive isotopes used at the BARC facilities and disposed as radioactive waste material at the BARC LLRBS consisted of hydrogen-3 (tritium), carbon-14 (C-14), chlorine-36 (Cl-36), nickel-63 (Ni-63), strontium-90 (Sr-90), cesium-137 (Cs-137), lead-210 (Pb-210), and radium-226 (Ra-226). In addition, short-lived radioactive materials were also disposed at the LLRBS, and included phosphorus-32 (P-32), mercury-203 (Hg-203), and polonium-210 (Po-210). According to available records, the types of containers used to dispose of waste included cardboard boxes, plastic and glass containers, fiberboard drums, and metal 55-gallon drums. Inventory records of burials from 1949 through 1960 could not be located and thus the estimated radionuclide activities in the BARC LLRBS may to be greater than the tabulated values listed in Section 4.4.1. The characterization study of the pits initiated in 2005 included one of the pits where the disposal records could not be located. The radioactive isotopes identified and the types of waste were not different than the contents of the pits for which records were available.

2.2 License History

In 1949, the USDA initiated disposal of low-level radioactive waste from research laboratory operations at the USDA's LLRBS at the BARC in Beltsville, Maryland under agreement with the USDA and the U.S. Atomic Energy Commission (AEC) (predecessor of the NRC). The authorization for onsite disposal by burial in soil was subsequently established in AEC and NRC regulations (10 CFR 20.304, "Disposal by Burial in Soil"). In January 1981, the NRC rescinded the regulations in 10 CFR 20.304 that authorized generic onsite disposals by burial in soil. However, the USDA continued authorized disposal of low-level radioactive wastes at the BARC LLRBS under the regulations in 10 CFR 20.302, "Method for Obtaining Approval of Proposed Disposal Procedures", with specific prior approval of the NRC. In 1987, the USDA initiated use of a commercial service to have radioactive waste transported and disposed at a licensed disposal facility and terminated radioactive waste disposal at the BARC LLRBS.

The USDA plans to decommission the site by exhuming the buried wastes and having the wastes transported offsite for disposal or treatment. Because the current USDA license does not specifically authorize decommissioning activities, a DP must be approved in order to conduct decommissioning activities. The decommissioning activities described in the DP and associated documents are intended to provide the basis for completing remediation activities at the BARC LLRBS so that the site meets the criteria for release for unrestricted use pursuant to 10 CFR Part 20, Subpart E, "Radiological Criteria for License Termination." Although decommissioning is typically associated with license termination, the USDA is not seeking termination of its NRC license at this time because of additional permitted activities ongoing under its license.

2.3 Previous Decommissioning Activities

During a historical characterization of the site initiated in 2005, a USDA contractor, in accordance with approved work plans, exhumed the contents of four of the burial pits to determine characteristics of the waste in order to develop the DP and identify cost effective disposal options for the waste. Radioactive wastes from these characterization activities were treated or disposed at authorized facilities.

2.4 Spills

As described in section 2.1 and 2.2 above, wastes in a variety of containers were disposed in unlined burial pits at the BARC LLRBS. There are no written records of spills or uncontrolled releases of radioactive materials in the vicinity of the burial pits.

2.5 Prior Onsite Burials

Onsite burial was used as a disposal method for contaminated materials and wastes at the BARC LLRBS as described in sections 2.1 and 2.2 above.

2.6 Prior Partial Site Releases

There have been no prior partial site releases.

3.0 Facility Description

Section 2.0 of the BARC LLRBS DP provides detailed descriptions of the site location; the population distribution surrounding the site; current and future land use of the site; and the physical characteristics of the site including meteorology, climatology, geology, seismology, hydrology, and natural resources. As discussed in Section 2.0 of this SER, the information provides a description of the conditions of the site sufficient to meet the requirements in 10 CFR 30.36(g)(4)(i). Summaries of these topics are provided below.

3.1 Site Location and Description

The BARC facility is situated in the Atlantic Coastal Plain Province in an area that can be described as gently rolling hills with broad valleys. There are extensive wooded tracts in the central and eastern portions of the BARC, while open agricultural fields are prevalent in the western section. The elevation varies from about 60 feet above mean sea level where Indian Creek flows beneath Interstate 95/495 to 268 feet above mean sea level in the extreme western portion of the BARC facility near the LLRBS. Topography slopes to the east and southeast at 10 to 15 percent toward the nearest perennial stream, the Little Paint Branch, located approximately 2000 ft east of the site boundary. Downstream, Little Paint Branch feeds into Paint Branch, 1.4 miles to the south, eventually draining into the Anacostia River (approximately 6 miles from the facility), which empties into the Potomac River at Washington, D.C. There are no known wetlands in the immediate vicinity of the BARC LLRBS.

3.2 Population Distribution

According to the U.S. Census Bureau, the 2010 population for Beltsville, Maryland was 16,772. The nearest resident is approximately 500 feet from the BARC LLRBS (due West across Cherry Hill Road and up gradient of the groundwater direction).

3.3 Current and Future Land Use

The BARC is best characterized as minimally developed and is surrounded by land that is largely urbanized and densely populated. Inside the facility's boundaries, land use is agricultural, forest, and urban, with more than 800 buildings, including laboratories, greenhouses, barns, office buildings, and some residences. A major portion of the facility is currently being used for crops, grazing livestock, and orchard research projects, located primarily in the central and western portions of the BARC. The central and eastern portions of the facility are primarily covered with mixed deciduous/evergreen forest. The urbanized portions of BARC are scattered throughout the property. The BARC land is shielded from development by both the state and federal governments. Maryland law designates the BARC property as "agricultural open space" and prohibits the Prince George's County Council from changing that designation. The USDA has provided information that the BARC LLRBS is located in an area of exclusive Federal jurisdiction. The USDA does not have any current or future plans to utilize the area that will be remediated under the DP. Because the BARC LLRBS facility is not specifically listed on the USDA's NRC license, the USDA's NRC license will not have to be amended to remove the remediated LLRBS area from the license as an authorized location of use. However, in accordance with the requirements in 10 CFR 30.35(g), the USDA will maintain records of the remediation activities conducted at the LLRBS.

Land use outside of the facility boundaries is largely mixed urban and lightly developed, primarily forested parcels. There is widespread residential development along the western, southwestern, and northwestern boundaries of the BARC. Commercial development is prevalent along U.S. Route 1 and the Beltsville Industrial Center north of Sunnyside Avenue. Other major transportation routes that either border or pass through the BARC are Interstate 95, Interstate 95/495, the Baltimore-Washington Parkway, and the B&O Railroad.

3.4 Meteorology and Climatology

Meteorological data provided by the USDA for the Beltsville area is derived from references to Washington DC area data. The humid continental climate for the area allows for a large variance in weather conditions and temperatures. There is a difference of 43 °F in the average temperatures from the coldest month of the year (January) to the warmest month of the year (July). The area receives an average of 39.54 inches of rain per year, with an average of 12 inches of snow per year. Precipitation is well distributed throughout the year. The greatest rainfall recorded for a 24-hour period was 7.31 inches, on August 11-12, 1928. The greatest snowfall ever recorded in the area was 28 inches, which occurred in January of 1922. The average annual relative humidity for the area is 63% and the average annual wind speed is 9.4 miles per hour.

3.5 Geology and Seismology

The USDA Natural Resources Conservation Service soil maps for Prince George's County describe numerous soil associations and groups of soils within the facility. Many of these units are described as comprising silty loam, loamy sand, and sandy loam of variable slope, drainage characteristics, and susceptibility to erosion. Surface soils are underlain by highly variable deposits, ranging from gravels to clays. Soil textures beneath the site are well-sorted alluvial sand and gravel with minor clay lenses. This sand and gravel sequence overlies several feet of clay, below which are the igneous and metamorphic rocks. The sands have a heavy-mineral component that includes zircon. Zircon is naturally high in uranium and thorium compared to most other minerals. Uranium and thorium are radioactive precursors of Ra-226 and radium-228 (Ra-228).

The history of this immediate area shows a low probability of an earthquake of sufficient magnitude originating near the site to cause damage to structures. Vibrations felt in Maryland have been associated with sources from adjacent states and Canada. The most recent event was a magnitude 5.8 earthquake with an epicenter near Mineral, Virginia (84 miles southwest of Beltsville) on August 23, 2011 that damaged structures up into New York State. There are no structures within the BARC LLRBS.

3.6 Surface Water Hydrology

There are many perennial and intermittent streams, wetlands, and surface water bodies within the BARC boundaries, but not within the boundaries of the LLRBS. Drainage features include Paint Branch and Little Paint Branch, which flow from north to south and are located in the western portion of the BARC. All of these drainage features eventually flow southward into the Anacostia River (approximately 6 miles from the facility), which empties into the Potomac River at Washington, D.C. The distance from the BARC's location on Little Paint Branch to the Potomac River is 13 stream miles downstream. The nearest surface water body is a branch of the Little Paint Creek, which lies 2000 feet east of and down gradient from the site.

3.7 Groundwater Hydrology

The uppermost soil consists of the deposits that are approximately 30 feet thick and unsaturated. The water-table aquifer beneath the unsaturated soil coincides with the Patuxent Formation and is approximately 20 feet thick. A lower aquifer is separated by formations that create an aquitard between the two aquifers. The nearest potable water well is 2.5 miles east of the BARC LLRBS and is screened from 200 to 600 feet.

The shallow groundwater of the unconfined portion of the Patuxent Aquifer in adjacent Anne Arundel County is known to the U.S. Environmental Protection Agency (USEPA) to contain elevated levels of Ra-226 and Ra-228. The Patuxent wells that were closest to the site had total radium (Ra-226 + Ra-228) results that exceeded the USEPA's Maximum Contaminant Level for drinking water of 5 picocuries per liter (pCi/l). The nearest Patuxent well in the study is located seven miles away at Fort Meade and had a total radium concentration of 23 pCi/l. The source of the radium in groundwater is thought to be from the decay of uranium and thorium in the Patuxent aquifer materials. The aquifer materials have elevated thorium and uranium bearing minerals, and radium concentration in groundwater is correlated with local groundwater geochemistry.

3.8 Natural Resources

There are no known significant mineral deposits, water resources, coal deposits, or other natural resources in the vicinity of the BARC LLRBS.

4.0 Radiological Status of Facility

Using the guidance in NUREG 1757, Vol. 1, Rev. 2, Section 16.4, the staff reviewed the information in Section 3.0, "Radiological Status of the LLRBS" section of the BARC LLRBS DP. Based on this review, the staff has determined that the USDA has described the types and activity of radioactive contamination at the BARC LLRBS sufficiently to allow the staff to evaluate: (1) the potential safety issues associated with remediating the burial pits, (2) whether the remediation activities and radiation control measures proposed by the USDA are appropriate for the type and quantity of radioactive material present, (3) whether USDA 's waste management practices are appropriate, and (4) whether the USDA's cost estimates are reasonable, given the amount of contaminated material that will need to be removed.

4.1 Contaminated Structures

There are no structures within the LLRBS where licensed activities occurred; therefore, structural decommissioning activities are not considered.

4.2 Contaminated Systems and Equipment

There are no known systems or equipment within the LLRBS; therefore, system or equipment decommissioning activities are not considered.

4.3 Surface Soil Contamination

Based on historical records provided by the USDA and data from the 2005 waste characterization study, the top five feet of soil overburden associated with each burial pit and the soil between the pits is considered uncontaminated soil. There is no known surface contamination. Upward migration of radiological contamination or undocumented spills into the clean overburden will be evaluated through testing of these soils. The overburden is to be removed in one-foot lifts and segregated from the waste removed from the LLRBS. The over burden may be suitable for use as clean backfill pending analytical results. Sample results will be compared to the cleanup criteria developed for the sub-surface soil.

4.4 Sub-Surface Soil Contamination

4.4.1 Radiological Contaminants

The BARC LLRBS is comprised of a total of 50 designated waste burial pits, of which, only 46 were reportedly used. The pits are approximately 10 feet wide by 12 feet long by 10 feet deep and are separated approximately five feet horizontally from one another. After each pit was filled, it was reportedly backfilled to surface grade with at least 5 feet of clean fill. Two contiguous fenced fields, the North Field and the South Field, make up the BARC LLRBS, each of which is approximately 150 feet by 200 feet. The geophysical surveys performed during the 2005 waste characterization study confirmed findings from the historical data, indicating that the South Field was not used for burials. Subsurface soils associated with each burial pit have the potential for significant radiological and non-radiological contamination as a result of the materials disposed in the cells. Vertical downward and horizontal down gradient (i.e. in the direction of groundwater flow) migration of contaminants is likely to have occurred due to storm water infiltration, snow melt, and groundwater motion.

The total volume of waste buried at the BARC LLRBS was not well documented. The USDA estimated that as much as 33,000 cubic feet (1,200 cubic yards) of waste may have been buried. As previously indicated, buried materials included both short-lived and longer-lived radioactive isotopes. The contaminated material is in the form of liquid scintillation fluids; contaminated metal, glass, and plastic containers and laboratory equipment; contaminated animal carcasses; and animal wastes. Animal remains, contaminated with tritium and C-14, were routinely incinerated beginning in the early 1980s, in one of two incinerators located at BARC. Incinerator ash that tested positive for radioactivity may also have been sent to the LLRBS for disposal. Based on the available records from 1960 through 1987, the USDA estimates that approximately 1.9 curies (1900 millicuries) of radioactive isotopes remain in the BARC LLRBS. Table 4-1 lists the activity by radionuclide. The values listed in Table 4-1 and the total estimated activity disposed have been corrected for radiological decay from December of the year of disposal through January 2011. It is important to note that Ra-226 and Pb-210 (a decay product of Ra-226) are also naturally occurring radioactive nuclides and have been identified in soil samples from background reference locations. Soil samples from the site's background reference area had an average Ra-226 concentration of 0.61 pCi/g (maximum was 0.87 pCi/g of eight samples). As previously indicated, disposal records from 1948 through 1960 have not been located; therefore the estimated radionuclide in the BARC LLRBS may be greater than the tabulated values.

Table 4-1
BARC LLRBS Accumulated Radionuclide Inventory
1960-1987 (millicuries)

H-3	C-14	Cl-36	N-63	Sr-90	Cs-137	Pb-210	Ra-226
906	837	0.1	112	3.1	2.9	15.6	9.0

In addition, short-lived radioactive materials were also disposed in the LLRBS, and included P-32 (half-life – 14.3 days), Hg-203 (half-life – 46.6 days), and Po-210 (half-life – 138 days). Due to the elapsed time since disposal of these radionuclides, the decay-corrected current activities for these three radionuclides are zero and therefore will not be further considered in any radiation dose evaluations.

4.4.2 Non-Radiological Contaminants

As discussed above, some of the radionuclide burials were in the form of liquid scintillation solutions, which are typically used in the analysis of tritium and C-14 in samples. These disposals may have been as small vials (20 milliliter or less) or the solutions may have been aggregated into larger containers. The types of organic liquids contained in the liquid scintillation fluids were not identified in records, but typically, organic solvents associated with liquid scintillation fluids include toluene and xylene. There was no indication of the volume of liquid scintillation fluids that may have been disposed.

In addition to the organic solvents disposed as liquid scintillation solutions, the BARC LLRBS burials included other non-radiological components consisting of organic chemicals - chloroform, benzene, bromodichloromethane, and trichloroethylene - and the metals arsenic, chromium, and vanadium. Elevated concentrations of chloroform have also been identified in down gradient monitoring well samples near the LLRBS. The planned remediation actions for the BARC LLRBS should also be effective in addressing the non-radiological contaminants. However, regulatory authority regarding the acceptability of any residual quantities of the non-radiological contaminants in soil (and potentially groundwater) lies with the USEPA under its authority under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

4.5 Surface Water

There are no surface water features within the BARC LLRBS. Therefore, surface water features are not addressed in the DP. The nearest body of surface water is the Little Paint Branch, located 2000 feet southwest and down gradient from the BARC LLRBS. Three water samples were collected from this stream in November 2010 and analyzed for radionuclides. One of the three samples collected from an upstream location, one from the location nearest the BARC LLRBS, and one from a downstream location, and were analyzed for tritium, C-14, Ra-226, and Ra-228. Results were indicative of natural background concentrations for each of these radionuclides.

4.6 Groundwater

Previous investigations suggest radionuclide and chemical contaminants have migrated from the burial pits due to infiltration of surface water and subsequent vertical migration to the water table. This migration has resulted in the presence of these contaminants in the saturated (soil) zone and upper groundwater aquifer. Onsite monitoring wells have been sampled as part of an ongoing groundwater monitoring program since 1998.

Prior to 2002, elevated concentrations of tritium had been identified in down gradient groundwater monitoring well samples immediately adjacent to the LLRBS. Some of these values exceeded the USEPA Maximum Contaminant Level for that radionuclide (20,000 pCi/l). Tritium concentrations since 2002 have been less than the USEPA Maximum Contaminant Level, with the most recent available sampling data from 2010 indicating a maximum concentration of 3900 pCi/l. Elevated tritium concentrations have only been identified in the down gradient monitoring well samples that are located immediately adjacent to the LLRBS.

Carbon-14 was detected at only two down gradient monitoring wells within the last ten years. The wells are located adjacent to the LLRBS boundary, immediately down gradient to the burial pits. The concentrations of C-14 in monitoring well samples have remained a factor of approximately ten below the 2000 pCi/l USEPA Maximum Contaminant Level. Elevated C-14 concentrations have not been identified in far down gradient monitoring well samples.

5.0 Dose Analysis

The regulations in Subpart E to 10 CFR Part 20, “Radiological Criteria for License Termination”, in part, establish criteria for the release of sites for unrestricted use. Specifically, the residual radioactivity that is distinguishable from background levels must result in a total effective dose equivalent to the average member of the critical group that does not exceed 0.25 millisieverts per year (mSv/yr) (25 millirem/year (mrem/yr)), and the residual radioactivity must also be reduced to levels that are As Low As is Reasonably Achievable (ALARA). The critical group is defined in 10 CFR 20.1003 as, “the group of individuals reasonably expected to receive the greatest exposure to residual radioactivity for any applicable set of circumstances.”

Using the Residual Radioactivity (RESRAD) Computer Code, version 6.5, to model the potential dose to the average member of the critical group, the USDA developed Derived Concentration Guideline Levels (DCGLs) using site specific information to demonstrate compliance with the NRC dose-based criteria. A DCGL is the level (concentration) of each Radionuclide of Concern that would result in a calculated dose of 25 mrem/yr to the average member of the critical group. When more than one radionuclide is present, the “sum of fractions” rule is applied to ensure that the total dose remains within the limit. The “sum of the fractions” calculation is performed following completion of remediation activities using the data generated from the final status survey. The calculation considers the residual radionuclide concentration for each radionuclide present and divides it by the DCGL of the same radionuclide. This calculation is repeated for each of the radionuclides of concern. The sum of the ratios of all the radionuclides of concern must be less than or equal to one in order to demonstrate compliance with the regulations in Subpart E to 10 CFR Part 20.

The computer model calculation assumes that the residual radionuclide concentrations for the entire site are at the concentrations that would result in a dose of 25 mrem/yr to the average member of the critical group. This is typically a conservative assumption because areas are typically remediated to levels that will be below the concentrations equivalent to 25 mrem/yr so that post-remediation testing can readily demonstrate that remediation has been successful. This compliance approach provides the NRC staff with reasonable assurance that the exposure will not exceed the regulatory-specified limit of 25 mrem/yr. As indicated previously, the USDA has proposed remediation activities for the BARC LLRBS that would allow the site to meet the criteria for release for unrestricted use; however, the USDA is not seeking license termination at this time.

5.1 Sub-Surface Soil

5.1.1 Sub-Surface Soil Source Term

The USDA identified and quantified the Radionuclides of Concern based on radionuclide inventory records, the results from a 2005 waste characterization study that exhumed the contents of four of the burial pits, and the results from the analysis of down gradient groundwater monitoring well samples. The extent and depth of contamination was determined from a review of the historical information related to the burial pits and information from the 2005 waste characterization study, which included making geophysical measurements to identify locations of buried materials. The geophysical measurements confirmed that the south field had not been used for burials of contaminated laboratory waste. The area of contamination is assumed to be only half of the approximately 1.4 acre BARC LLRBS since the south field was not used for disposals. The presence of tritium and C-14 in down gradient groundwater monitoring well samples, at concentrations less than the USEPA Maximum Contaminant Levels, indicates some horizontal and vertical migration of contaminants. In process surveys and sample analysis during the remediation process will be used to supplement characterization data from the 2005 waste characterization study.

5.1.2 Scenarios

5.1.2.1 Resident Farmer Scenario

The USDA applied the Resident Farmer scenario based on the current and likely future use of the property as the base case for exposure for the critical group. In this scenario, a hypothetical adult farmer is assumed to live on the site and grow a portion of his/her food on the site, using the water for drinking and irrigation of crops, and watering livestock.

The following pathways were considered:

- External exposure to soil contaminated by irrigation water.
- Inhalation of resuspended soil contaminated by irrigation water.
- Ingestion of contaminated drinking water.
- Ingestion of plant products grown in soil contaminated by irrigation water.
- Ingestion of contaminated animal products (animals consume contaminated groundwater and plant products grown in contaminated soil).
- Ingestion of fish and aquatic foods from a contaminated surface water source.
- Direct ingestion of soil contaminated from irrigation.

The included pathways reflect a subsistence farming practice and are feasible considering the physical, geological, and hydrogeologic characteristics of the BARC LLRBS. The staff concluded that the choice of the resident farmer scenario is reasonable because it considers the potential routes of exposures of the critical group. Additionally, the use of the resident farmer scenario is consistent with the NRC guidance in NUREG-1757, and NUREG/CR-5512, “Residual Radioactive Contamination from Decommissioning, Technical Basis for Translating Contamination Levels to Annual Total Effective Dose Equivalent.” Since the exposure pathways associated with the resident farmer scenario cover all the potential routes of exposures, this scenario typically results in more restrictive DCGLs than many other scenarios. Therefore, the resident farmer scenario is considered acceptable for initial consideration in developing soil DCGLs.

5.1.2.2 Alternative Scenarios

Based on discussions with NRC staff, in addition to the basecase scenario that considered leaching of residual subsurface soil contamination into groundwater and exposure of a resident to contaminated groundwater, the USDA considered alternative exposure scenarios that involved intrusion into residual radioactive material at depth. The additional exposure scenarios included the following: (i) acute exposure to a well driller, (ii) chronic exposure to a resident from contaminated drill cuttings, and (iii) chronic exposure to a resident from contaminated soils following basement excavation. The results of the alternative analyses indicate that the basement excavation scenario can be more limiting than the base case scenario for certain radionuclides.

The exposure pathways considered in the acute well driller scenario included external exposure to the gamma-emitting radionuclides and soil ingestion. The chronic well driller and basement excavation scenarios assume that the displaced soil, which includes part of the residual radioactivity, is spread across the surface and food is grown on the contaminated soil. Given the greater volume of residual radioactivity brought to the surface in the basement excavation scenario, basement excavation was found to be more limiting than the well driller scenario. For the more limiting basement excavation scenario, sensitivity analysis was performed to select an area (and associated thickness) of soil contamination that was most limiting for the distribution of contamination following the excavation (i.e., 500 m^2 and 0.244 m thick). The basement excavation scenario also includes the leaching of the radionuclides from their buried position into the groundwater, which is then used by the residential farmer consistent with the basecase scenario. The USDA selected the most limiting DCGL from all of the scenarios evaluated as the final DCGL. These DCGLs are listed in Table 5-1 below.

5.1.3 Computer Code and Parameter Selection Method for Soil Models

The USDA utilized the RESRAD Computer Code, Version 6.5 to calculate the soil DCGLs. The computer code uses a mathematical model along with a series of physical, behavioral, and metabolic input parameters to compute a dose to an individual. The parameter values used in the model can be selected from default values in the computer code, site-specific values, or values provided in references from regulatory agencies. The USDA's methodology for selecting input parameter values is described in Section 4.2.2 and Appendices B and C of the DP. Appendix D of the DP provides RESRAD output summary reports based on the selected input parameters.

The USDA implemented a hierarchy to select RESRAD model input parameter values. In general, the preference was to use site-specific information first, followed by NRC recommended values, EPA recommended values, and finally RESRAD default values. Site-specific parameters that are used are based on the physical characteristics of the site, such as area, depth of contaminated soil, and soil type. Where site-specific information was not readily obtainable, the USDA developed input values from the following NRC reports; "Comparison of the Models and Assumptions used in DandD 1.0, RESRAD 5.61,and RESRAD-Build 1.50 Computer Codes with Respect to the Resident Farmer and Industrial Occupant Scenarios;" NUREG/CR-5512 Volume 4, "Residual Radioactive Contamination From Decommissioning – Parameter Analysis, Draft Report for Comments; NUREG/CR-5512 Volume 3," and "Residual Radioactive Contamination From Decommissioning: Technical Basis for Translating Contamination Levels to Annual Total Effective Dose Equivalent" NUREG/CR-5512 Volume 1, and "Development of Probabilistic RESRAD 6.0 and RESRAD-Build 3.0 Computer Codes" NUREG/CR-6697. The following EPA documents were mainly used for comparison purposes and for selection of conservative values for intake parameters: "Soil Screening Guidance for Radionuclides: User's Guide, EPA/540-R-00-007" and the "Exposure Factors Handbook, Volumes I, II, and III, EPA/600/P-95/002Fa-c." RESRAD default values were selected with guidance from the "Data Collection Handbook to Support Modeling Impacts of Radioactive Material in Soil, Environmental Assessment and Information Sciences Division, Argonne National Laboratory."

5.2 Calculated DCGL Values

As discussed in Section 5.0 and 5.1 above, the USDA calculated soil DCGL values to meet the dose criteria in 10 CFR 20.1402. These values were provided by the USDA in the DP and are listed below for each radionuclide of concern.

Table 5-1 Soil DCGL Values (pCi/gram)

Radionuclide of Concern	Base Case Scenario	Well Driller Scenario	Basement Excavation Scenario	Final Site-specific DCGL Values
tritium	121.2	54969	121	121
C-14	22.4	2250	21.0	21
Cl-36	18	989	13.2	13.2
Ni-63	120,424	24,108,000	77,954	77,954
Sr-90	4.9	26	4.7	4.7
Cs-137	273.3	344	16.9	16.9
Pb-210	2.0	2.3	1.9	1.9
Ra-226	2.2	121	4.6	2.2

As previously discussed, radionuclides that were listed on inventory records, but with relatively short half-lives compared to the time since the last burial (P-32 (half-life -14.3 days), Hg-203 (half-life - 46.9 days) and Po-210 (half-life - 138.4 days)) were excluded from the DCGL calculations because their current activities are negligible. As discussed in Section 5.0 above, when more than one radionuclide is present, the "sum of fractions" rule is applied to ensure that the total dose remains within the limit.

5.3 NRC Independent Analysis

In the initial technical review of the DP, the staff performed independent analyses of the USDA's calculations used in developing the DCGL values. Based on the technical review and independent analysis, the staff determined that modifications to model assumptions were needed and justification and changes were required for some of the input parameter values used in the calculations by the USDA. The NRC also requested that the USDA consider alternate exposure scenarios to ensure the DCGLs were sufficiently bounding for buried contamination.

The USDA provided subsequent revisions to the DP and provided an additional clarifying addendum memorandum to the DP. In these DP revisions and clarifying addendum, the USDA incorporated the comments provided by the NRC and revised the input values for some of the parameters used in the DCGL calculations. The NRC staff concluded that the revised values for input parameters were appropriate, and the resulting DCGLs derived from these revised input parameters and scenario calculations meet the dose criteria in 10 CFR 20.1402.

5.4 Dose Assessment Review Conclusion

The USDA developed site-specific DCGLs for each radionuclide of concern identified from historical inventories of the waste and from a waste characterization survey initiated in 2005. Radionuclides that were listed on inventory records, but with relatively short half-lives compared to the time since the last burial (P-32 (half-life -14.3 days), Hg-203 (half-life - 46.9 days) and Po-210 (half-life – 138.4 days)) were excluded from the DCGL calculations because the current activities are negligible. The USDA used the RESRAD computer code to develop a base case scenario that considered leaching of residual subsurface contamination and exposure of a resident farmer to various groundwater dependent pathways. USDA also considered alternate scenarios: acute exposure to a well driller and chronic exposure to a resident dwelling on contaminated soils brought to the surface following basement excavation. The DCGLs were calculated based on compliance with NRC's criteria in 10 CFR Part 20, Subpart E, "Radiological Criteria for License Termination." The regulations in 10 CFR Part 20, Subpart E provide an all-pathways dose criteria of no more than 0.25 mSv/yr (25 mrem/yr). The most conservative DCGL from all of the scenarios evaluated was then selected for each radionuclide of concern. If residual contamination from more than one radionuclide of concern exists in any of the remediated areas, the sum of fractions approach will be used to demonstrate compliance with the dose limits.

Based upon the analyses above, the staff concludes that the dose modeling completed for unrestricted use for the BARC LLRBS site is reasonable and is appropriate for the exposure scenarios under consideration. The dose estimate provides reasonable assurance that the dose to the average member of the critical group is not likely to exceed the 0.25 mSv (25 mrem) annual dose criterion in 10 CFR 20.1402. This conclusion is based on the modeling effort performed by the licensee and the independent confirmatory analyses performed by the staff.

Major assumptions contributing to this conclusion include the following:

- The use of a base case and alternative exposure scenarios to develop DCGLs and selecting the most limiting DCGL for each radionuclide of concern;
- The exclusion of radionuclides with short half-lives (P-32, Hg-203, and Po-210) relative to the time since disposal is justified since the current activities are negligible and thus there is no significant contribution to dose; and
- USDA revised parameter input values based on analysis by NRC staff and using available data from down gradient groundwater modeling wells.

NRC's conclusions are contingent on the following considerations:

- Following remediation, USDA plans to backfill excavated disposal pits with a minimum of 2.4 m (8 ft) of clean soil cover, consistent with the final configuration of residual contamination assumed to be present in the RESRAD modeling used to derive soil DCGLs.

- The USDA plans to sample groundwater directly below the disposal pits following pit excavation to ensure that groundwater is not impacted above a level that poses a potential risk to a future receptor at the unrestricted use level.

Using the guidance in NUREG-1757, Vol. 1, Appendix E, "Checklist for Use of Generic Environmental Impact Statement for License Termination and Sample Environmental Assessment for Sites that Use Screening Criteria," the NRC staff evaluated whether the "Generic Environmental Impact Statement (GEIS) in Support of Rulemaking on Radiological Criteria for License Termination of NRC-Licensed Nuclear Facilities," NUREG-1496, Vols. 1, 2 and 3 (ADAMS Nos. ML042310492, ML042320379, and ML042330385) is bounding for the decommissioning of the BARC LLRBS. As indicated in NUREG-1757, Vol. 1, Appendix E, the GEIS reference facilities were developed to broadly represent categories of licensee facilities and thus specific facilities will not exactly match the descriptions and conditions that exist within the reference facilities. As stated in Appendix E, "The primary purpose of comparing a specific facility to the reference facility with regard to dose assessment is to determine whether the specific facility has important contaminants, potential scenarios, or pathways that were not analyzed for the reference facilities or which may be sufficiently different from those in the GEIS to change conclusions regarding environmental impacts. In general, if a specific facility has contaminants, concentrations, and spatial distributions less than or generally equivalent to those used for the reference facilities, the GEIS should be applicable." To aid in this assessment, Appendix E provides a discussion on potential limitations of the GEIS dose assessments and a summary of the characteristics of the reference facilities.

In regard to building occupancy and structures, the potential limitations discussed in Appendix E are not applicable because there are no structures on the site. For residual soil contamination, Appendix E lists four potential limitations of the GEIS dose assessments: 1) assumption that people will live and work on the site over a 1000-year period; 2) site weather or other events that could result in extensive redistribution or movement of contaminants; 3) evaluation of pre-existing groundwater contamination on a site-specific basis; and 4) need for site specific evaluation of prior 10 CFR 20.302 burials.

The USDA addressed the potential limitation assumption that people will live and work on the site over a 1000-year period in the DCGL calculation. The USDA used the RESRAD version 6.5 computer code to develop DCGL values for each radionuclide of concern. These calculations used selected time periods from the present (time = 0 years) out to 1000 years. The DCGLs were then calculated from the time of peak dose, and therefore addresses occupancy of the site over a 1000-year period. Most of the radionuclides of concern, including the primary dose contributors tritium and C-14, have the peak dose occurring at or near time =0.

In sub-sections to this SER's Section 3.0, Facility Description, the NRC summarizes the meteorology, climatology, geology, seismology, and hydrology conditions at the BARC LLRBS. Based on these summaries, the staff concludes that there does not appear to be any unusual weather or other events that could result in extensive redistribution or movement of contaminants. Additionally, the USDA evaluated an alternate scenario where a resident would be chronically exposed to contaminated soils brought to the surface following excavation of a basement for a dwelling. Any DCGL calculated from this scenario was incorporated into the DP if it was more limiting. Because there are no surface water features near the site, and the site is located up gradient from the nearest creek, flooding of the burial site is not expected to be a concern. The site is located far from the coast and is not expected to experience any significant coastal storm effects. During soil excavation, soil removed from the pits will be placed in large, sturdy inter-modal containers with secure covers that should prevent dispersal of the contents during significant wind events.

In Section 4.6, the NRC staff has discussed pre-existing groundwater contamination in monitoring wells adjacent to the BARC LLRBS by comparing the concentrations for tritium and C-14 (the two primary contributors to dose) to the USEPA Maximum Contaminant Levels for each radionuclide. The USEPA Maximum Contaminant Levels are derived values that yield a dose of 4 mrem/year to the Total Body or any Critical Organ from the drinking water pathway. It should be noted that the USEPA Maximum Contaminant Level calculations are not performed in the same manner as the NRC calculations for dose from the groundwater pathway. Based on ratios of radionuclide concentrations compared to the Maximum Contaminant Levels, these two radionuclides, if consumed at these concentrations as drinking water, would yield maximum doses of approximately 0.8 and 0.4 mrem/year for tritium and C-14, respectively, for a total dose of approximately 1.2 mrem/year. Because these doses represent a small fraction of the annual NRC dose limit, the USDA does not anticipate the need to perform any specific groundwater remediation in addition to the soil and waste removal described in the DP. The removal action is intended, in part, to remove the source of potential radionuclide migration to groundwater. In the DP, USDA has indicated that they will be sampling groundwater located below each disposal pit following remediation. Furthermore, license condition 29 of the USDA's NRC license requires monitoring of the BARC LLRBS.

The radioactive waste present in the burial pits is the result of specifically authorized disposals by the AEC and NRC. Based on historical information, these wastes are the only radionuclide contamination present at this specific location. Because the DP was specifically prepared to address these burials, there is no need for any further site specific evaluation of prior 10 CFR 20.302 burials.

The NRC staff also compared the physical characteristics of the BARC LLRBS to the characteristics of the reference facilities. The staff determined that the physical size of the impacted area of the site (30,000 ft^2 for the BARC LLRBS versus 100,000 ft^2 for the reference uranium fuel processing plant and the reference rare metal extraction facility), and the volumes of waste expected to be generated (33,000 ft^3 for the BARC LLRBS versus 250,000 ft^3 for the reference rare metal extraction facility), in addition to the contaminants and the potential dose scenarios or pathways, at the BARC LLRBS, are bounded by those in the GEIS reference facilities. Based on this comparison, the staff concludes that there are no potential limitations to the use of the GEIS dose assessment scenarios. The staff has determined that the affected environment and the environmental impacts associated with this decommissioning action are bounded by information contained in the GEIS (NUREG-1496, Vols. 1, 2 and 3).

5.5 USEPA Consultation

On October 9, 2002, the NRC and the USEPA entered into a Memorandum of Understanding (MOU) on "Consultation and Finality on Decommissioning and Decontamination of Contaminated Sites". In accordance with the MOU, for decommissioning sites that trigger the criteria in the MOU, the NRC is required to consult with USEPA in the decommissioning process. The NRC staff compared the current groundwater radionuclide concentrations and the proposed soil DCGLs to the EPA criteria in the MOU. On March 22, 2012, the NRC sent the USEPA a Level 1 consultation letter (ADAMS No. ML120760350) indicating that some of the proposed soil DCGLs (Cl-36, Ni-63, and Cs-137) for the BARC LLRBS exceeded the trigger criteria contained in the MOU Table 1 (residential soil concentration). Current concentrations of radionuclides in groundwater did not exceed the EPA trigger levels. In the consultation letter, the NRC indicated that based on the estimated radionuclide inventory of the waste, the NRC staff believes that because the inventory of these radionuclides is very limited, they would not be present in sufficient quantities following remediation to result in a significant dose impact.

The USEPA responded to the NRC's consultation letter on May 21, 2012 (ADAMS No. ML121710096). In that letter, USEPA stated that if the BARC LLRBS is unable to meet the EPA Table 1 soil values for residential land use, then the NRC should consider a more restricted land use, such as industrial, with appropriate institutional controls. In addition, USEPA suggested that the NRC should consider determining if the use of site-specific parameters was justified in modeling at the BARC LLRBS.

The NRC responded to the USEPA letter on June 22, 2012 (ADAMS No. ML12166A078), indicating that in most cases, the NRC prefers to use site-specific parameters to ensure that the most accurate dose estimates are made, and due to the complexity of the BARC LLRBS, and the number of radionuclides expected to be present, it is not clear that default screening parameter values would produce the most accurate dose estimates. The NRC concluded that the use of the proposed DCGLs should result in a post-remediation dose that should meet the NRC's dose criterion in 10 CFR 20.1402.

Following site remediation activities, the USDA will submit a Final Status Survey Report. The NRC staff will review information in the Final Status Survey Report and will compare the remaining residual radioactivity to the MOU trigger levels for both soil and groundwater. If the Final Status Survey measurements exceed the MOU values, in accordance with the MOU, the NRC will initiate a Level 2 consultation between the agencies to identify and resolve any remaining issues.

6.0 Environmental Information

In accordance with the NRC's regulations in 10 CFR Part 51, which implement the requirements of the National Environmental Policy Act (NEPA) of 1969, as amended, and utilizing the NRC staff guidance contained in NUREG-1748, "Environmental Review Guidance for Licensing Actions Associated with NMSS Programs," dated August 2003, the staff determined that the appropriate level of environmental review required for the DP is an Environmental Assessment (EA).

As required by Section 106 of the National Historic Preservation Act, NRC staff contacted the Maryland Historical Trust, the agency responsible for determining if the decommissioning project would have an adverse effect on designated historic properties. On August 14, 2012, the Maryland Historical Trust provided a response indicating “No Adverse Effect” (ADAMS No. ML12237A250) would result from conducting the decommissioning project.

As required by Section 7 of the Endangered Species Act, the NRC staff contacted relevant wildlife agencies to determine if endangered or threatened species would be affected by the decommissioning activities at the site. Staff accessed the United States Department of the Interior, U.S. Fish & Wildlife Service online service to confirm that there were no proposed or listed endangered or threatened species known to occur in the area of the decommissioning project. Based on the online information, NRC staff confirmed that except for transient individuals, there were no proposed or listed endangered or threatened species known to exist in the project area (ADAMS No. ML12237A229). NRC staff also contacted the Maryland Department of Natural Resources, Wildlife and Heritage Service to confirm that there were no Maryland-identified threatened or endangered species in the project area. A response was received from the Maryland Department of Natural Resources on September 14, 2012 (ADAMS No. ML12275A103) confirming that there were no State or Federal records for rare, threatened or endangered species within the delineated boundaries of the project site.

Using the information provided in the DP and information obtained in the consultations with the Maryland Historical Trust and the wildlife agencies, the staff prepared an EA (ADAMS No. ML12347A281). The staff provided a draft of the EA to the Maryland Department of the Environment (MDE) on October 23, 2012. MDE requested information confirming that the area to be remediated was under “Exclusive Federal Jurisdiction.” The NRC forwarded information provided by the USDA to the MDE confirming that the area to be remediated was under “Exclusive Federal Jurisdiction” (ADAMS No. ML12325A201 and ADAMS No. ML12325A228). On November 8, 2012, an MDE representative responded that the MDE had no additional comments or concerns on the EA (ADAMS No. ML12325A256).

7.0 ALARA Analysis

The NRC’s regulations at 10 CFR 20.1402 include a provision that before a site may be considered acceptable for unrestricted use, the residual radioactivity must be reduced to levels that are ALARA. The staff utilized the guidance in NUREG-1757, Volume 2, to assess whether the USDA had met this regulatory requirement. This guidance indicates that the ALARA evaluation for compliance with decommissioning criteria should include quantitative analyses when appropriate and typical good practice efforts.

For soil removal, NRC guidance (NUREG-1757, Vol. 2, Section N.1.6) indicates that a quantitative ALARA analysis may not be necessary for residual radioactivity in soil at sites cleaning to the unrestricted use criteria. Regarding typical good practice efforts, Section 5 .0 of the DP did not specifically discuss good ALARA practices, but did contain a limited discussion indicating removal and disposal of the soil between pits if it was impractical to perform surveys and also discussed the selection of an experienced contractor to conduct operations. Also, because there are multiple radionuclides of concern and the sum of the fractions rule must be applied to assess that the cleanup criteria has been met, there is a built in ALARA consideration since the peak dose for some of the radionuclides of concern occur at different times. Additional, the USDA used a base case and alternate exposure scenarios, and selected the most limiting DCGLs for each radionuclide of concern from different exposure scenarios. From this assessment, the staff concluded that the USDA's actions are ALARA with respect to soil removal.

8.0 Planned Decommissioning Activities

8.1 Soil

Decommissioning activities will be performed by a contractor who possesses an NRC decommissioning radioactive materials license. The contractor's license safety procedures will serve as the primary radiation protection protocols. All onsite decommissioning activities will be governed under the contractor's license. A written agreement will be executed between the USDA and the contractor prior to initiation of decommissioning. This agreement will unambiguously describe the license responsibilities of USDA and the contractor. The USDA will retain responsibility for decommissioning the BARC LLRBS.

The USDA provided a general overview of the planned decommissioning activities in the DP. The decommissioning activities are listed below in the general order of performance; however, some tasks may be performed concurrently. Those steps are as follows:

- Excavate, segregate and sample non-impacted soil cover.
- Excavate the waste from the cells. A power screen or other mechanical separation technique will be used as appropriate to size and segregate debris, liquid scintillation vials, and soil. Precautions will be taken to collect free-standing liquids and prevent liquids from being shipped for disposal without suitable treatment.
- Excavate, segregate and sample excavation sidewall soils to determine their ultimate disposition. Soils from the cells previously excavated during the waste characterization study are a part of this category.
- Place the excavated material in a temporary storage for subsequent reuse or to be packaged for shipment. Separated waste streams will include:
  - intact liquid scintillation vials,
  - waste soil/debris, and
  - bulk liquids.
- Package wastes in appropriate shipping containers, prepare shipping papers, and transport the waste to licensed disposal/treatment facilities.
- Return excavated cover soil that is below DCGLs to the excavation area. Soils will be sampled at a frequency of one sample per 100 cubic yards of soil to determine suitability for re-use as backfill.
- Survey the soil as the area is excavated. The South Field does not contain waste cells; however, since packaged wastes will be temporarily stored there, a release survey will be conducted following removal of waste packages. The temporary storage area in the South Field will be sampled and surveyed prior to use in order to insure there is no pre-existing soil contamination. The boundary of the South Field may need to be expanded as necessary to manage material.
- Perform a Final Status Survey of the BARC LLRBS site to support release for unrestricted use.

Decommissioning activities are planned to be executed in a single phase, but based on availability of funding, more than one phase may be required. If more than one field event is required, Final Status Survey samples will be collected in each excavated pit, and low-permeability fill and clean cover soil may be used to backfill the excavation. Following excavation, a Final Status Survey will be performed on the excavated surface in order to ensure that further excavation is not required from the pits. After backfilling of all pits, a Final Status Survey will be performed on the surface.

Physical barriers will be installed and buffer zones maintained to protect portions of excavations available for Final Status Survey. Buffer zones will be transitioned to areas available for Final Status Survey, as the excavation proceeds. Open excavations will be maintained throughout the Final Status Survey, and until restoration is authorized. Restoration of excavations will include placement of clean fill from an approved source, or site material that meets the criteria for re-use as backfill, followed by grading and re-vegetation.

Using the guidance in NUREG 1757, Vol. 1, Rev. 2, Section 17.1, the staff reviewed the information in Section 5.0, "Planned Decommissioning Activities" of the BARC LLRBS DP. Based on this review, the staff has determined that the USDA has effectively described the planned decommissioning activities associated with the remediation of contaminated soil and subsurface soil during decommissioning in sufficient detail to meet the requirements of 10 CFR 30.36(g)(4)(ii).

8.2 Surface and Ground Water

There are no surface water features within the LLRBS. Therefore, surface water features have not been addressed in the DP. It is expected that groundwater will not be encountered during excavation activities because the burials are within the unsaturated zone. However, during the waste characterization study, perched water (or leachate) was encountered in two of the excavations. Steps will be taken during the excavation of the site to collect any free-standing water. Accordingly, any water accumulated during decommissioning activities will be handled, stored, and dispositioned in accordance with appropriate procedures and regulatory requirements. A Surface Erosion Control Plan will be implemented in order to mitigate any inflow or runoff due to precipitation.

Based on the last ten years of groundwater samples from the existing monitoring wells, radionuclide concentrations of tritium and C-14 have not shown a large variation. Prior to 2002, concentrations of tritium in samples from monitoring wells adjacent and immediately down gradient from the BARC LLRBS exceeded the USEPA Maximum Contaminant Level, but within the last ten years have remained below this 20,000 pCi/l level. Concentrations of C-14 have remained at approximately one tenth of the 2000 pCi/l USEPA Maximum Contaminant Level. It is expected that the proposed removal of the source term (excavation of waste and contaminated soil) will reduce the potential for further migration of radionuclides into groundwater from the LLRBS. The current radionuclide concentrations are less than their respective USEPA Maximum Contaminant Levels and thus the potential dose resulting from the current levels of radionuclides in this area is not significant. Groundwater in the vicinity of the BARC LLRBS is not used for drinking water and further down gradient monitoring well samples are at background concentrations for the radionuclides that are the most significant contributors to dose. Therefore, remediation of impacted groundwater is not being considered in the DP.

As part of the Final Status Survey, soil and groundwater will be sampled beneath each disposal pit to further characterize the potential extent of contamination. As part of the subsequent investigation being undertaken by the USEPA under its CERCLA authority, the USEPA will continue semiannual groundwater monitoring for non-radiological contaminants for the next five years. Groundwater samples collected during that time will be utilized in order to evaluate changes in radionuclide concentrations and to determine if any further response action is required. Any response actions, if required, would be selected following consultation with the NRC and other regulatory authorities.

Using the guidance in NUREG 1757, Vol. 1, Rev. 2, Section 17.1, the staff reviewed the information in Section 5.3 (Surface and Groundwater) of the BARC LLRBS Decommissioning Plan and relevant sections of the Final Status Survey Design Plan. Based on this review, NRC staff has determined that the USDA has described the planned sampling and decommissioning activities specifically associated with surface and groundwater at the BARC LLRBS sufficiently to comply with 10 CFR 30.36(g)(4)(ii).

8.3 Schedules

The USDA estimates that it will cost approximately $7M to complete the decommissioning project at the LLRBS. This estimate is largely dependent on the amount of mixed waste in the burials pits and the associated costs of disposal or treatment. Based on this cost estimate, the decommissioning will be executed within approximately 12 months following approval of the DP by the NRC. The USDA will provide a schedule to the NRC after approval of the DP and selection of a decommissioning contractor.

9.0 Project Management and Organization

Using the guidance in NUREG 1757, Vol. 1, Rev. 2, Section 17.2, the NRC staff has reviewed the description of the decommissioning project management organization, position descriptions, management and safety position qualification requirements and the manner in which the USDA will use contractors during the decommissioning of its facility. Based on this review, the NRC staff has determined that the USDA's descriptions of the proposed decommissioning management and organization are adequate to serve as the basis for concluding that the licensee's management program will exercise the appropriate control during decommissioning operations.

9.1 Decommissioning Management Organization

In Section 6.0, Decommissioning Management Organization, of the DP, the USDA indicates that implementation of the DP will be managed by a team comprised of management, radiation safety, and occupational safety personnel from the USDA and decommissioning contractor organizations. The USDA will retain overall responsibility for management and execution of the DP. The USDA will contract an NRC-licensed decommissioning contractor to execute the DP.

The contractor will provide the equipment, materials, and a trained and experienced labor force to perform the decommissioning activities. Responsibilities of key individuals are described in the DP. Additional staff, along with applicable subcontractors, may be utilized as appropriate.

9.2 Decommissioning Task Management

Section 6.2 of the BARC LLRBS Decommissioning Plan discusses work control practices and the use of Radiation Work Permits. Radiation Work Permits provide administrative control of activities within areas that may have radiological hazards. Radiation Work Permits will address radiation safety precautions, including external dosimetry, contamination control, protective clothing, access controls, air sampling, and respiratory protection requirements. The contractor's Radiation Safety Officer will review and approve Radiation Work Permits prior to implementation. The Contractor Radiation Safety Officer will ensure that ambient radiation, surface radioactivity, and airborne radioactivity surveys are performed as required to define and document the radiological conditions for each job. The contractor will use Radiation Work Permits to describe tasks to be performed, outline tasks with elevated dose potentials and significant radiological hazards, define protective clothing and equipment to be used, and identify personnel monitoring requirements. Information in Radiation Work Permits will specify any special instructions or precautions pertinent to radiation hazards in the area, including listing the radiological hazards present; the area dose rates and hot spots; removable surface radioactivity; and identify other hazards as appropriate.

9.3 Decommissioning Management Positions and Qualifications

Responsibilities of key individuals are summarized in Section 6.3 of DP. The contractor will provide qualified trained field technicians to conduct the decommissioning activities at the BARC LLRBS. In the DP, the USDA indicates that the contractor technical staff will be experienced professionals possessing the expertise and technical competence to perform decommissioning activities. Additional staff, along with applicable subcontractors, may be utilized as appropriate.

9.3.1 USDA Radiation Safety Officer

The USDA Radiation Safety Officer has overall responsibility for the decommissioning project at the BARC LLRBS. His duties include: ensuring activities conducted under the USDA license are in compliance with applicable standards and requirements; coordinating communication with contractor(s); coordinating with the NRC; and overseeing contractor activities.

9.3.2 Contractor Project Manager

The Contractor Project Manager is responsible for ensuring that all necessary resources are provided to the project for its successful completion. This individual is the main point of contact for questions, requests, and other information requested of the contractor. The Contractor Project Manager is responsible for:

- Reviewing and approving project documents;
- Reviewing and approving schedules and work activities;
- Coordinating communication between the contractor and USDA;

- Reviewing proposed project methodologies to ensure they serve the data quality needs of the project;
- Serving as official contact for quality assurance and quality control matters pertaining to the project;
- Obtaining approval for proposed major changes to the Work Plan and other critical project documents; and
- Establishing a project record system.

9.3.3 Site Supervisor

The Site Supervisor is responsible for the day-to-day operations for decommissioning activities. The Site Supervisor reports to the Contractor Project Manager and is responsible for:

- Ensuring that all work is conducted in accordance with the Health and Safety Plan;
- Reviewing daily quality control documents;
- Transmitting data generated to the Project Technical staff;
- Preparing and reviewing project documents;
- Conducting daily tailgate safety meetings and maintaining attendance logs and records;
- Assigning duties to project staff;
- Supervising project team performance and day-to-day field operations;
- Reviewing major project deliverables for technical accuracy and completeness prior to their release;
- Ensuring field personnel receive necessary training;
- Routinely communicating project status, progress, and/or problems; and
- Proactively identifying and responding to quality assurance/quality control needs.

9.3.4 Certified Waste Broker

The Certified Waste Broker reports directly to the Contractor Project Manager and is responsible for:

- Developing the waste profiles for the disposal/treatment facilities based on sample data;
- Ensuring all generated waste materials are inspected and properly prepared for shipment;
- Preparing waste manifests;
- Obtaining generator certification;
- Procuring necessary permits;
- Ensuring that the waste hauler is properly certified;
- Witnessing waste shipments from the site; and
- Acting as support oversight for waste disposal activities.

9.3.5 Contractor Radiation Safety Officer

The Contractor Radiation Safety Officer reports directly to the Contractor Project Manager and is responsible for ensuring that radiation health and safety procedures are followed throughout the duration of the project. The Contractor Radiation Safety Officer establishes radiological areas, monitors radiation exposure levels, and inspects all material/equipment entering or leaving the project for compliance with project document requirements. The Contractor Radiation Safety Officer is responsible for the execution of the routine on-site duties for health and safety that include:

- Conducting periodic safety reviews of the project site and project documentation;
- Performing regular and frequent site inspections to identify hazards and observe work activities;
- Ensuring radiological instruments and test equipment are properly calibrated and checked for operability;
- Determining emergency evacuation routes, establishing and posting local emergency telephone numbers, and arranging emergency transportation;
- Ensuring that all site personnel and visitors have received the proper training; and
- Establishing any necessary controlled work areas.

9.4 Training

Training for decommissioning project staff is described in Section 6.5 of the DP. The categories of training established in the DP include: General Employee Training, Radiation Worker Training, and Hazardous Waste Operations Training. Project personnel who work in controlled areas with the potential for exposure to hazardous materials are required to undergo Hazardous Waste Operations training in accordance with 29 CFR 1910.120 and contractor requirements. The USDA will post the information required by the regulations in 10 CFR 19.11, Posting of Notices to Workers, at the job site. Visitors to the site will be escorted.

General Employee Training will be provided at the start of fieldwork and will consist of an oral presentation by the Contractor Radiation Safety Officer, handout materials, and completion of a form acknowledging receipt of training. General Employee Training will include information on the type and form of radioactive material present, the location of the contractor's radiation protection policies and procedures, employee and management responsibilities for radiation safety, identification of radiation postings and barriers, protective equipment and procedures, work zone setup, decontamination procedures, emergency procedures, and directions on contacting contractor representatives and project radiation safety staff.

Project personnel who will work in radiologically controlled areas are required to undergo Radiation Worker Training prior to arrival at the site. The contractor will include the following topics in this training: radioactivity and radioactive decay; characteristics of ionizing radiation; radiation exposure effects and risks; special considerations with respect to exposure of women of reproductive age; dose limits; modes of potential exposure (internal and external); basic protective measures; procedures for maintaining exposures ALARA; radiation survey instrumentation; radiation monitoring programs and procedures; contamination control, protective clothing and equipment; personnel decontamination; emergency procedures; warning signs, labels, and alarms; and responsibilities of employees and management. The training will consist of classroom lecture, procedure review, and practical demonstrations, a question/answer period, and a handout. Prior contractor training or knowledge demonstration may be able to be substituted.

A tailgate safety meeting will be conducted at the beginning of each work shift, whenever significant changes in job scope are made, whenever significant changes in site conditions (physical or radiological) occur, or whenever new personnel arrive at the job site. Health and safety procedures and issues for the day, any unique hazards associated with an activity, and a review of any significant topics from previous activities will be presented at these meetings.

9.5 Contractor Support

As indicated in the DP, the USDA's contractor will focus on nuclear, occupational health and safety, regulatory compliance, and project management matters. Specialty services (e.g., disposal, treatment, transportation, and laboratory analyses) may be subcontracted to firms with the appropriate skills and experience. Each subcontractor will designate a Task Manager and, as necessary, a health and safety and/or quality control contact, who will report to the Task Manager. The contractor will remain responsible for the scope, quality, and timeliness of services provided by all subcontractors. The Contractor Radiation Safety Officer will verify that the subcontractor personnel are adequately informed of the hazards, protective measures, and the procedures associated with performing each decommissioning task. The Contractor Radiation Safety Officer will verify that subcontractor personnel perform decommissioning activities in accordance with all license commitments and regulatory requirements.

10.0 Health and Safety Program During Decommissioning

In Section 7.0 of the DP, Health and Safety Program During Decommissioning, the USDA and its contractors indicate that decommissioning activities will be completed in a manner that is protective to workers, the public, and the environment. Plans and procedures encompassing both administrative procedures and operating procedures will be used to direct decommissioning activities. Copies of procedures pertinent to decommissioning activities will be maintained onsite for reference and regulatory review.

Although exposures associated with the planned decommissioning operations are expected to be low, all exposures are assumed to entail some risk to employees, visitors, and contractors. Instructions to all project staff and visitors will include a discussion on maintaining potential exposures ALARA. Methods to be used to reduce exposure will be reviewed during initial site-specific training and tailgate meetings. Plans and procedures may be modified, as conditions warrant, in order to address employee exposure to radioactive materials and hazardous chemicals, as well as construction safety concerns.

Using the guidance in NUREG 1757, Vol. 1, Rev. 2, Section 17.3, the staff has reviewed the information in Section 7.0 (Health and Safety Program During Decommissioning) of the BARC LLRBS DP. Based on this review, and as summarized in the sections below, the staff has determined that the plans, procedures, and controls to be put in place during decommissioning operations should be sufficient to demonstrate compliance with radiation worker safety in accordance with the requirements in 10 CFR Part 20 and 10 CFR 30.36(g)(4)(iii).

10.1 Radiation Safety Controls and Monitoring for Workers

Standard operating procedures will be used to provide instructions to workers. Radiological surveys will be conducted using survey instrumentation and equipment suitable for the nature and range of hazards anticipated. Equipment and instrumentation will be calibrated, and, where applicable, operationally tested prior to use in accordance with procedural requirements. Routine surveys will be conducted at a specified frequency to ensure that contamination and radiation levels in unrestricted areas do not exceed license limits. The radiation safety staff will perform non-routine surveys during decommissioning activities as may be necessary to identify or confirm radiological conditions. Potential exposures to personnel working at the site during decommissioning include direct contact (e.g., external gamma, ingestion exposure pathway) and airborne dusts. Personnel will perform routine monitoring for radioactive contamination to minimize the spread of contamination and maintain potential exposures ALARA.

10.2 Air Sampling Program

Radiological air sampling surveys and monitoring will be performed in accordance with written procedures, and to ensure compliance with 10 CFR Part 20 requirements. Air sampler flow meters will be calibrated prior to site mobilization and following repair and/or modification. Both breathing zone and general area air samples will be collected from areas where there is the potential for generation of airborne radioactive material. Breathing zone air samples will be the primary method of monitoring the worker’s intake of radioactive material and will be collected from the workers’ breathing zones at work locations where there are most expected to be known or suspected release points. Air samples will also be collected from general and localized areas, including areas downwind from excavation and other areas with the greatest likelihood of the presence of airborne dust.

Air sampling will be performed prior to initiating construction activities in order to document background radioactive airborne particulate activities. Air sampling will be performed to monitor airborne particulate activity when excavation activities commence, during decommissioning activities, and after any significant changes in operating conditions. Sampling durations will be determined prior to the commencement of sample collection based on required action levels, counting instrument sensitivities, and other conditions as warranted.

Following air sample collection, the filter media will be stored for at least 24 hours in order for short-lived radon progeny to decay. Air samples will then be counted with sufficient time to achieve required minimum detectable concentration goals. Air sample analysis results will be compared to the appropriate Derived Air Concentration values. Breathing zone air samples are collected using personal lapel (or equivalent) air samplers or grab samplers. If the breathing zone concentration exceeds 10% of Derived Air Concentration values, the Contractor Radiation Safety Officer will perform an evaluation.

10.3 Respiratory Protection Program

Concentrations of airborne radioactive materials will be typically controlled through the application of process and engineering controls such as containments and ventilation equipment.

10.4 Internal Exposure Determination

Internal exposure determinations will be performed through analysis of breathing zone air samples in compliance with written procedures and, as necessary, bioassay results. The Contractor Radiation Safety Officer will review and validate bioassay and air monitoring results prior to their inclusion in the internal dose assessment process.

10.5 External Exposure Determination

External exposure potential will be routinely monitored through the use of suitable radiation survey meters in order to assess the level of external exposures to ionizing radiation. If it is determined that personnel may likely receive within one year, a dose in excess of 10% of the applicable limits from radiation sources external to the body, individuals will be monitored by personnel dosimetry such as themoluminescent dosimeters. The personnel dosimetry devices will indicate the amount of ionizing radiation to which the wearer was exposed. The personnel dosimetry device will be processed by a facility accredited by the National Voluntary Laboratory Accreditation Program.

10.6 Summation of Internal and External Exposures

The Contractor Radiation Safety Officer will make a determination that external dosimetry is required if personnel are likely to receive within one year, a dose in excess of 10 % of the applicable limits from radiation sources external to the body. The Contractor Radiation Safety Officer will also evaluate air sampling and bioassay measurements to assign an individual internal dose. If an individual receives both a documented internal and external dose, the doses will be summed and entered into the individuals' dose file.

10.7 Contamination Control Program

In Section 7.7 of the BARC LLRSB DP, the USDA describes the contamination control program that will be implemented so that radioactive contamination on surfaces outside controlled areas does not exceed the levels specified in NRC guidelines for the decontamination of facilities and equipment prior to release for unrestricted use as presented in the NRC's Policy and Guidance Directive FC 83-23. Radiological surveys will be performed throughout the decommissioning process to identify and quantify radioactive material levels to evaluate known or potential radiological hazards.

Engineering, administrative, and personnel protection provisions will be utilized to limit or prevent personnel exposure to radioactive material. Engineering controls will predominantly be comprised of containment, isolation, ventilation, and decontamination. Administrative controls will be used to control work conditions and work practices to reduce the potential for exposure of individuals. Administrative controls will include: access control to limit entry to work areas to only the personnel necessary to accomplish required tasks or activities; postings and barriers to inform personnel of hazards or conditions associated with radioactive material; written plans and procedures to describe specific radiation protection requirements necessary for tasks that involve radioactive material; and use of Radiation Work Permits that will describe worker personal protection equipment requirements for activities involving radioactive material. Personal protective equipment may include head covering, eye protection, respiratory protection, coveralls, gloves, and/or protective shoes or shoe covers. The level of personal protective equipment may be upgraded or downgraded based on ambient conditions as work proceeds.

To ensure that radioactive materials remain under control, individuals working in a contaminated area will be monitored for contamination using suitable, calibrated, instruments prior to leaving the contaminated work area. Equipment and materials will also be monitored and decontaminated, as necessary, prior to removal from the controlled area. Personal and equipment action levels will be established.

10.8 Instrumentation Program

Instruments used for radiation detection and measurement will be operated in compliance with standard operating procedures. These procedures will contain instructions on the proper use of the instrument, as well as calibration instructions for those instruments. Instrumentation will be calibrated by a certified calibration facility. Radiation detection instruments will be calibrated in a manner and frequency as per license and manufacturer requirements and after each repair that would affect the accuracy of the instrument. Only personnel trained in accordance with the procedures will use radiation detection instruments. A calibration sticker will be attached to the instrument to indicate that the instrument is within current calibration prior to use. Instruments are to be visually inspected, battery checked, and checked for operability prior to use.

10.9 Health Physics Audits, Inspections, and Recordkeeping Program

The Radiation Safety Program for the BARC LLRSB DP will be subject to an audit as well as periodic inspections to determine if radiological operations are being conducted in accordance with regulations, license conditions, and written procedures. An audit of the program will be conducted at least once during the execution of the project. The audit will consider the basic functional areas of the program; e.g., Radiation Work Permits, Radiation Protection Procedures, radiological surveys and air monitoring, ALARA program, individual and area monitoring results, access controls, respiratory protection program, and training. The audit will be conducted in accordance with a specific audit plan and a written report describing the results will be generated upon completion. If necessary, a written corrective action plan will be prepared to address non-compliance issues and corrective actions tracked to completion.

The Health and Safety staff will conduct periodic inspections. These inspections will be routine reviews performed of operations and activities. The inspections will normally be completed using a pre-established checklist. Any findings discovered during a routine inspection will be recorded on a tracking log. The log will include a description of planned corrective action and date of completion of corrective action.

A personnel file is maintained for each employee assigned work duties involving radioactive materials. The content of these files will include at a minimum: a record of radiation exposure received by the individual during previous employment where the individual worked with radioactive materials; a record of current personnel dosimeter measurements; exposure investigation and exposure estimate for a lost or damaged dosimeter, evaluations of internal exposures if work was conducted in a location where the air concentration in the work area exceeded 10% of the Derived Air Concentration values; and the results from evaluations of a personal contamination incident above action levels. Individuals will have access to the information in their personnel files. Personnel records will be maintained in a secured location, typically a locked fire-proof file cabinet, when not continuously attended by authorized personnel.

Radiation and contamination survey records collected during site surveys, remediation/decontamination activities, and other decommissioning activities shall be stored in project-specific files at the contractor's office.

Records of waste disposal including radiation survey records, contamination survey records, shipping manifests, and certifications generated for a shipment of radioactive materials to a licensed disposal site will be stored in specific shipment files in the contractor's office.

11.0 Environmental Monitoring and Control Program

11.1 Environmental ALARA Evaluation Program

In Section 8.0, Environmental Monitoring and Control Program, the USDA provides an ALARA commitment for exposures to the public and the environment. Environmental monitoring and control activities performed during decommissioning activities will comply with 10 CFR Part 20 regulatory requirements. Measurements and observations from the previous waste characterization study involving the exhumation of four disposal pits found no issues with generation of significant quantities of airborne dust from the excavation and handling activities of the waste. Although specific implementation details of the ALARA evaluation program are not provided in the DP, the NRC staff used the guidance in NUREG 1757, Vol. 2, Rev. 1, Appendix N and determined that the general program description provided is sufficient for the staff to conclude that the USDA's program will comply with 10 CFR Part 20 and 10 CFR 30.36(g)(4)(iii).

11.2 Effluent Monitoring Program

Although not expected to be significant, the primary routes of contaminant transport during the on-site decommissioning activities are anticipated to be airborne dust from the excavation of the site, handling of the waste, covering operations, and movement of vehicles and equipment. Area air samples will be collected in the vicinity of the areas where decommissioning operations are conducted. In addition, samplers will be positioned downwind of work locations to ensure that the samples collected are representative of actual releases. The positions of the air samplers will be evaluated frequently by the Contractor Radiation Safety Officer to consider shifts in prevailing wind direction and the locations of potential dust-generating operations. Air samples will be analyzed onsite for gross alpha and gross beta activities and sent to an accredited laboratory to be analyzed for low-energy beta emitters. Background air samples will also be collected prior to the commencement of site activities in order to establish baseline background radionuclide concentrations.

Significant quantities of liquid effluents are not expected to be encountered or generated during decommissioning activities. Any water accumulated during decommissioning activities will be handled, stored, and dispositioned in accordance with appropriate procedures and regulatory requirements. A Surface Erosion Control Plan will be implemented in order to mitigate any inflow or runoff due to precipitation.

11.3 Effluent Control Program

Based on the results of the waste characterization study, the USDA does not expect decommissioning activities to generate significant levels of airborne particulate contamination. If significant dust is generated during decommissioning activities, controls such as water sprays will be used as necessary to reduce the potential for generating airborne contamination. Soil or similar material that is staged in piles, containers, or vehicles, will be covered as practical to prevent dispersion by wind or precipitation. If radiological air sampling results indicate the presence of airborne contaminants exceeding project action levels, work will be halted. The Contractor Radiation Safety Officer will evaluate conditions, implement corrective measures, and if necessary, perform dose evaluations.

During the waste characterization study activities, leachate was encountered in the excavated burial pits. This water was collected and subsequently containerized for disposal. If potentially contaminated liquid effluents are encountered, runoff will be controlled through the use of berms, silt fencing, absorbent materials, solidifying agents, or by other means as necessary. Liquids will be collected and stored, and based on analytical results, dispositioned in accordance with applicable regulations. A Sediment and Erosion Control Plan will be used to plan for the prevention of runoff.

12.0 Radioactive Waste Management Program

Section 9.0 of the DP provides a general description of decommissioning waste handling for the BARC LLRBS. The 2005 waste characterization study identified solid radioactive waste, liquid radioactive waste, and mixed wastes, and was also used to identify disposal options and locations. Excavated wastes will be analyzed for radiological and hazardous components and disposed of in accordance with the receiving facility waste acceptance criteria and facility licenses.

12.1 Solid Radioactive Waste

Waste materials exhumed from the burial pits will be transferred to a designated storage area in the South field of the BARC LLRBS to be managed and sampled prior to disposition. In this area, materials will be segregated by media type and sampled for waste profiling purposes. Once sampling results are available, materials will be packaged into U.S. Department of Transportation (USDOT) compliant containers for transport to the appropriate treatment and/or disposal facilities. Packaged waste will be staged in this area while awaiting transport.

12.2 Liquid Radioactive Waste

During the 2005 waste characterization study, liquid wastes were encountered both intact in their original disposal containers and as free-standing liquid. Liquids in containers will be segregated and packaged for offsite treatment/disposal in accordance with USDOT requirements. Free-standing liquid will be collected in tanks and dispositioned based on analytical results. Where necessary, appropriate containment devices will be used to ensure potential releases are contained.

12.3 Mixed Waste

Decommissioning activities may result in the generation of mixed waste and the subsequent need for treatment prior to disposal. Mixed waste meeting the proper acceptance criteria will be transferred to appropriate facilities for treatment and disposal. Packaged waste will be staged and protected while awaiting transport.

13.0 Quality Assurance

The overall Quality Assurance objective is to develop and implement procedures for obtaining and evaluating data that meet the Data Quality Objectives. Radiological survey data will be generated for demonstrating that the remedial effort has achieved the DCGLs. Quality Assurance procedures are established to ensure that field measurements, sampling methods, and analytical data provide information that is representative of actual field conditions, and that the data generated are technically defensible.

Using the guidance in NUREG 1757, Vol. 1, Rev. 2, Section 17.6, the staff has reviewed the Quality Assurance program associated with the DP for the LLRBS and determined that the program, if effectively implemented as described, provides reasonable assurance that accurate, high-quality information will be developed to support the decommissioning of the facility. Areas reviewed are discussed in the following subsections and include: organization, a general program description, document control, control of measurement and testing equipment, corrective actions, Quality Assurance records, and audits and surveillances.

13.1 Organization

The Project Engineer will serve as Quality Assurance Officer for the project and will have direct access to responsible management at a level at which appropriate corrective actions can be implemented, as necessary. Persons responsible for ensuring that the Quality Assurance Program has been established and for verifying that activities affecting quality are being correctly performed will have sufficient authority, access to work areas, and organizational freedom to accomplish the following:

- Identify quality concerns;
- Ensure that further decommissioning activities are controlled until proper resolution of a non-conformance or deficiency has occurred;
- Initiate, recommend, or provide solutions to quality problems through designated channels; and
- Verify implementation of solutions.

Daily tailgate safety meetings will provide supplemental training and ensure that personnel are given clear direction and the proper tools for performing their respective tasks. These meetings will also provide a forum for the field personnel to relate any potential safety or quality concerns that may require attention.

In addition, the USDA will designate an individual to provide independent oversight of project activities. The oversight will provide an additional level of independent quality oversight for the project.

13.2 Quality Assurance Program

Activities associated with the DP will be performed in accordance with written procedures and/or protocols in order to ensure consistent, repeatable results. Topics covered in project procedures and protocols may include proper use of instrumentation, quality control requirements, equipment limitation, etc. Implementation of quality assurance measures for the DP is described in the sections below.

13.3 Document Control

Data will be recorded and documented in accordance with the Contractor's data management system. Radiation survey maps will designate the location being surveyed, as well as the name of the surveyor. To the extent practical, state plane coordinates will be used to define soil sample locations. Data management personnel will ensure that chain-of-custody and data management procedures are followed for samples related to the Final Status Surveys. Procedures to properly handle, ship, and store samples after they are collected will follow established contractor protocols. Both direct radiation measurements and analytical results will be documented. The results for each survey measurement and/or each sample will be listed in tabular form along with the corresponding grid block location or coordinate. Radiation survey data will be recorded in a verifiable manner and reviewed for accuracy and consistency. Each of the major phases of the decommissioning process will be documented in a manner that is suitable for audits or assessments.

Electronic data collected during the day will be backed-up at the end of the same day on which it was collected before processing or editing. Field computers used to store project data will be backed up weekly, at a minimum. Raw archived data will be stored in a different location from weekly backups.

Substantive changes to the DP and the proposed Quality Assurance Project Plan will be submitted to the NRC for review and approval before they are implemented.

13.4 Control of Measuring and Test Equipment

The Project Engineer, or designee, is responsible for determining the instrumentation required for radiological surveys. Only approved instrumentation will be used to collect radiological data. The Contractor Radiation Safety Officer is responsible for ensuring individuals are appropriately trained to use instrumentation and other equipment, and that instrumentation meets the required detection sensitivities. Instrumentation shall be operated in accordance with either a written procedure or manufacturers' manual.

Instrumentation used for radiological surveys will be maintained and calibrated to manufacturer's specifications to ensure that required traceability, sensitivity, accuracy and precision of the equipment/instruments are maintained. Instruments will be calibrated at a facility possessing appropriate NRC and/or Agreement State licenses for performing calibrations using National Institute of Standards and Technology traceable sources. Field instruments will be response-checked at the beginning and end of each workday. Written records of daily checks will be maintained and filed in the project file. Instrumentation that does not meet the specified requirements of calibration, inspection, or response check will be removed from operation.

13.5 Corrective Action

The Quality Assurance Officer has overall responsibility for handling procedural deficiencies or nonconforming conditions. A deficiency or nonconforming condition will be documented on a Corrective Action Request Form. The form is to be completed by the individual who reported the nonconformance and is then submitted to the Quality Assurance Officer. The completed form will provide a detailed description of the nonconforming condition and reference the affected documents that apply. The Corrective Action Request Form will be reviewed and appropriate follow-up actions developed. The Quality Assurance Officer will review the response and verify that the actions address the original concern and provide effective preventive actions.

13.6 Quality Assurance Records

Quality Assurance records will be monitored by the contractor. Data reduction, Quality Control review, and reporting will be the responsibility of the analytical laboratory. Data reduction includes all automated and manual processes for reducing or organizing raw data generated by the laboratory. The laboratory will provide a data package for each set of analyses that will include a copy of the raw data in electronic format, and any other information needed to check and recalculate the analytical results. Once a data package is received from the laboratory, the analytical results and pertinent Quality Control data will be entered into a computer database. The data packages will serve as basic reference sheets for data validation, as well as for project data use.

The generation, handling, computations, evaluation, and reporting of final radiological survey data will be specified in written procedures. These procedures will include a system for data review and validation to ensure consistency, thoroughness, and acceptability of the data.

Sample collection will be managed to ensure that the integrity of the sample is maintained, that is, there will be an accurate record of sample collection, transport, and analysis. The goal is to ensure that the sample analyzed in the laboratory is actually and verifiably the sample taken from a specific location in the field. Individuals responsible for sample collection will initiate a

Chain of Custody record that will accompany the samples throughout transportation and analysis.

13.7 Audits and Surveillances

Periodic audits will be performed to verify that decommissioning activities comply with the DP, established decommissioning procedures, and other aspects of the Project Plan. The Project Manager and Quality Assurance Officer will verify that qualified personnel are employed to conduct audits to ensure that the applicable procedures are being properly implemented. The audits will be conducted on at least a quarterly basis for the duration of decommissioning activities. Health and safety personnel will also conduct audits in their technical area during the decommissioning activities. External program audits may also be used at the discretion of the contractor. Audit results will be reported to USDA in writing, and actions to resolve identified deficiencies will be tracked and appropriately documented. The audit information will become part of the decommissioning record for the site.

14.0 Facility Radiation Surveys

14.1 Release Criteria

As discussed in Section 5.0 above, the staff has reviewed the information in Section 4.0 and Appendices B, C, D, and F of the BARC LLRBS Decommissioning Plan and determined that the USDA has adequately addressed the calculation of DCGLs to be used for survey design and for demonstrating compliance with the radiological criteria for license termination in Subpart E to 10 CFR Part 20. Specifically, the DCGLs have been calculated so that the residual radioactivity that is distinguishable from background level will result in a total effective dose equivalent to the average member of the critical group that does not exceed 25 millirem/year (mrem/yr). As discussed in Section 5.0 above, the USDA will apply the “Sum of Fractions” rule if more than one Radionuclide of Concern is detected in post-remediation samples.

14.2 Characterization Surveys

In Chapter 11 of the DP, the USDA references the waste characterization survey that was initiated by its contractor in 2005 (ADAMS No. ML110730519). The waste characterization survey consisted of geophysical surveys in the North Field to delineate the footprint of individual burial cells, and in the South Field to confirm that no burials have taken place in that area; gamma and beta walkover surveys to map potential near-surface radiological materials; groundwater sampling and analysis of selected wells around the site to assess migration of contaminants; excavation, radiological characterization, segregation, and packaging of soils and waste materials from four of the waste cells; and sampling surface and subsurface soil from the floor of each excavation.

The geophysical survey was conducted prior to the initiation of excavation activities to identify the footprint of each of the burial pits. Equipment used included ground penetrating radar, magnetometry, and electromagnetic terrain conductivity profiling. These investigation efforts were also used to confirm historical aerial photography findings that the South Field had not been used to conduct burials.

Analysis of the sample data identified the radionuclides of interest and their concentrations in the excavated areas, identified non-radiological contaminants, and served as preliminary information to identify cost-effective disposal options. The data from the characterization effort was used to develop preliminary safety practices for the decommissioning activities.

Using the guidance in NUREG 1757, Vol. 2, Rev. 1, Section 4.2, the staff reviewed the information relating to site characterization in the BARC LLRBS DP and the waste characterization survey report. Based on this review, the staff determined that the radiological characterization of the site is adequate to permit planning for remediation activities that will be effective and will not endanger workers; to demonstrate that it is unlikely that significant quantities of residual radioactivity have gone undetected; and to provide information that will be used to design the Final Status Survey.

14.3 Remedial Action Support (In-Process) Surveys

Radiological support surveys will be performed during decommissioning activities to assist and guide excavation activities and will be used to aid segregation of waste material removed from the burial pits. In addition, surveys and sample analysis will be conducted along pit walls and the floor of each pit to determine if contaminants have migrated and additional contaminated soil will need to be removed.

14.4 Final Status Survey Design

The Data Quality Objective process has been incorporated into the planning phase for scoping, characterization, remediation, and final status survey plan development. Data Quality Objectives are qualitative and quantitative statements that establish a systematic procedure for defining the criteria by which data collection design is satisfied in order to make determinations regarding the residual radioactivity in non-excavated soil following remedial activities. The six steps of the Data Quality Objective process, as outlined in Appendix D of NUREG-1575, Rev. 1, “Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM),” are detailed in Section 4.0 of Appendix F of the DP for the remediation project. These six steps are: State the Problem, Identify the Decision, Identify Inputs to the Decision, Define the Study Boundaries, Develop a Decision Rule, and Specify Limits on Decision Errors. The process is intended to be iterative and optimize data collection to meet the applicable decision criteria.

The Final Status Survey design is described in Appendix F of the LLRBS DP. The Final Status Survey was designed utilizing the guidance in NUREG-1575, Rev. 1, MARSSIM, and applicable Federal and Maryland regulations and guidance. The Final Status Survey design addresses post-remediation action surveys and subsequent sample analyses that are conducted prior to backfilling the remediated areas. The survey design is intended to support a conclusion that the site meets the conditions that the site is suitable for release for unrestricted use. A background reference area was established in a nearby non-impacted area for comparison of post-remediation samples. The objective of the Final Status Survey Plan is to provide a consistent approach for planning, performing, and assessing residual concentrations of Radionuclides of

Concern in site surface and subsurface soils to demonstrate compliance with the calculated DCGLs. The activities to be conducted such as survey coverage and sampling frequency will be consistent with MARSSIM guidance.

For the purpose of Final Status Survey design, site areas are classified according to their potential for residual radioactivity. Non-impacted areas are those areas identified through knowledge of site history or previous survey information where there is not any reasonable possibility (or extremely low probability) for residual radioactive contamination. Impacted areas are those that have a potential for radioactive contamination based on historical data or contain known radioactive contamination based on radiological surveys. Impacted areas may include areas where radioactive materials were used and stored; areas with records of spills, discharges, or other unusual occurrences resulting in the spread of contamination; and areas where radioactive materials were buried or disposed. Areas immediately surrounding or adjacent to these locations are included in this classification due to the potential for the inadvertent spread of contamination. For the purposes of the Final Status Survey design, the entire LLRBS is considered impacted because all areas within the North Field area have the potential for residual contamination.

Impacted areas are further divided into one of three groups (Class 1, Class 2, and Class 3), as defined in the MARSSIM guidance. Class 1 areas are areas that have, or had prior to remediation, known radioactive contamination that exceeds the DCGL or a potential for such contamination. The soil residing at the bottom of the disposal pits down to the groundwater interface, and interstitial soil between individual disposal pits residing below a height of five feet below original surface grade throughout the North Field area are considered to require a Class 1 Final Status Survey. Class 2 areas are areas that have known radioactive contamination or a potential for such contamination, but they are not expected to exceed the DCGL. The soil approximately one foot above the burials throughout the North Field area are considered to require a Class 2 Final Status Survey. This classification is warranted because this material may coincide with the top layers of waste material in the disposal pits. Class 3 areas are impacted areas that are not expected to contain any residual radioactivity, or are expected to contain levels of residual radioactivity at a small fraction of the DCGL based on site operating history and previous radiological surveys. The clean cover fill material utilized in disposal pits from original surface grade to five feet below original surface grade are considered to require a Class 3 Final Status Survey. Impacted areas are further subdivided into survey units. Guidance in MARSSIM provides recommended limits for the size of survey units based on their classification and the extent of required surveys.

Radiation detection methods to be used during the radiological surveys will include gross beta radioactivity count rate measurements, gross gamma scanning measurements, systematic soil sampling and laboratory analysis, and biased location soil sampling and laboratory analysis. Beta scan survey data is intended solely for the purpose of locating areas of elevated radioactivity to direct biased sample collection.

The systematic soil sample results will be evaluated by statistical testing to determine if the remediated areas meet the DCGLs computed for the BARC LLRBS. Because some of the radionuclides of concern are present in natural background, the non-parametric Wilcoxon Rank Sum test will be used to evaluate the sample results. This statistical test requires a comparison of the residual concentrations of concern in each survey unit to the concentrations of samples obtained in a suitable background reference area. A background reference area was established due west of the South Field. This area was not believed to be affected by disposal operations at the site. A background reference area is a geographical area from which representative samples of background conditions are selected for comparison with samples collected in the survey units at the remediated site. The background reference area should have similar physical, chemical, radiological, and biological characteristics to the site being remediated, but has not been contaminated by site activities. A gamma walkover survey was conducted to establish background radiological activities. Soil samples were collected from six locations for comparison with samples to be collected in excavations of disposal pits.

In using this statistical test, the hypothesis being tested is called the Null Hypothesis and assumes that the median concentration of the Radionuclides of Concern in the survey unit exceeds that in the reference area by more than the DCGL. The purpose of the statistical testing is to determine if the Null Hypothesis should be accepted or rejected. If remediation activities have been successfully performed, the sampling results from the remediated areas should be sufficiently low enough that the Null Hypothesis can be rejected. Rejection of the Null Hypothesis leads to the conclusion that the survey unit meets the release criteria. The USDA's survey design approach is consistent with MARSSIM guidance, and as such, at least a minimum number of measurements or samples will be taken within each survey unit, so that the nonparametric statistical tests used for data assessment can be applied with adequate confidence.

A discussion of survey decision errors was provided in Section 4.0 of Appendix F in the DP. The type I error (α) occurs when the null hypothesis is rejected when it is actually true. A Type I error is sometimes called a "false positive." The second type of decision error, called a Type II error (β), occurs when the null hypothesis is not rejected when it is actually false. A Type II error is sometimes called a "false negative." The power of a statistical test is defined as the probability of rejecting the Null Hypotheses when it is false and is numerically equal to $1-\beta$. For the purposes of this Final Status Survey, the acceptable error rate for Class 1, Class 2, and Class 3 survey units for both Type I and Type II errors is five percent ($\alpha = \beta = 0.05$).

The staff has reviewed the information in the USDA LLRBS DP and determined that the Final Status Survey design complies with 10 CFR Part 30.36(g)(4)(iv) because the activities to be conducted will be generally consistent with the guidance in NUREG-1757, Vol. 2, Rev. 1 and MARSSIM.

14.5 Final Status Survey Report

The Final Status Survey Report will provide a summary of the survey results and the overall conclusions that demonstrate that the site, meets the radiological criteria for release for unrestricted use. The staff will review the Final Status Survey Report prior to making a final determination that the site meets the radiological criteria for release for unrestricted use and will provide a written response to the USDA.

15.0 Financial Assurance

Section 12 of the DP provides a detailed cost estimate for implementation of this DP. The USDA estimated the total cost of the decommissioning project at approximately $7 million and based their estimate from the results of their earlier waste characterization study. The USDA has partnered with the Department of Defense Joint Munitions Command for contracting and technical oversight for this project. The USDA has transferred approximately $10.6 million to the Department of Defense Joint Munitions Command for the DP implementation. The available funds in excess of the cost estimate are available for unplanned costs required to complete the project. Guidance in NUREG1757, Vol. 3, "Consolidated NMSS Decommissioning Guidance, Financial Assurance, Recordkeeping, and Timeliness", Appendix A, indicates that cost estimates associated with decommissioning should apply a contingency factor of 25 percent to provide reasonable assurance for unforeseen circumstances that could increase decommissioning costs. The available decommissioning funds for this project exceed the cost estimate by over 50 percent and thus are in excess of the contingency factor indicated in NUREG-1757, Vol. 3, Appendix A. Based on the cost estimate as compared to the amount set aside for project completion, and the availability of funds in excess of the recommended 25 percent contingency, the staff has determined that the requirements of 10 CFR 30.36(g)(4)(v) have been met.

LIST OF ACRONYMS

ADAMS	Agencywide Document Access and Management System
AEC	Atomic Energy Commission
ALARA	As Low As is Reasonably Achievable
BARC	Beltsville Agricultural Research Center
C-14	Carbon-14
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
Cl-36	Chlorine-36
Cs-137	Cesium-137
DCGL	Derived Concentration Guideline Levels
DP	Decommissioning Plan
EA	Environmental Assessment
Hg-203	Mercury-203
LLRBS	Low-Level Radiation Burial Site
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MDE	Maryland Department of the Environment
MOU	Memorandum of Understanding
mrem/yr	millirem per year
mSv/yr	millisieverts per year
Ni-63	Nickel-63
NRC	Nuclear Regulatory Commission
P-32	Phosphorus-32
Pb-210	Lead-210
pCi/g	picocuries per gram
pCi/l	picocuries per liter
Po-210	Polonium-210
Ra-226	Radium-226
Ra-228	Radium-228
RESRAD	Residual Radioactivity (Computer Code)
SER	Safety Evaluation Report
Sr-90	Strontium-90
USDA	United States Department of Agriculture
USDOT	United States Department of Transportation
USEPA	United States Environmental Protection Agency