Revised Safety Evaluation for License Amendment No. 37 to Special Nuclear Materials License No. SNM-00007

April 30, 2008

DOCKET NO: 070-00008

LICENSE NO: SNM-00007

FACILITY: Battelle Memorial Institute (BMI), Battelle Laboratories Decommissioning Project (BCLDP), West Jefferson, Ohio

SUBJECT: REVISED SAFETY EVALUATION REPORT FOR THE TERMINATION OF SPECIAL NUCLEAR MATERIALS LICENSE NO. SNM-00007, AUTHORIZING FOR UNRESTRICTED USE THE BMI NORTH NUCLEAR SCIENCES SITE LOCATED NEAR WEST JEFFERSON, OHIO

1. EXECUTIVE SUMMARY

By letter dated August 3, 2006, Battelle Memorial Institute (BMI) submitted an amendment request to the U.S. Nuclear Regulatory Commission (NRC) to terminate License No. SNM-00007. If approved, the termination would relinquish NRC regulatory control over BMI's former West Jefferson North Site (WJN) located near West Jefferson, Ohio, and approve the Site for unrestricted use. The Battelle license termination request is accessible through the NRC's public electronic reading room "ADAMS" via Accession Number ML062200140.

The purpose of this Safety Evaluation Report (SER) is to evaluate Battelle's license termination request, and to make a determination that the licensee has provided sufficient documentation to demonstrate that residual contamination remaining at Battelle's former North Nuclear Science Site (WJN) is consistent with the licensee's unrestricted release criteria as specified in Battelle's NRC-approved decommissioning Plan (DP).

Battelle's DP (ML003711118) was originally approved by the NRC during 1993, before implementation of the current NRC "License Termination Rule." The unrestricted release criterion cited in the DP was based on current regulatory guidance in effect at that time, that is, concentration and surface release tables, and consistent with criteria outlined in an NRC letter to the licensee dated April 17, 1992 (ML070180226). The licensee's DP was incorporated into NRC Special Nuclear Materials License No. SNM-00007 by License Amendment No. 23, on August 25, 2000 (ML010410001). This action was consistent with Title 10 of the Code of Federal Regulations (CFR), Part 20, Section 20.1401(b)(2), "General provisions and scope," which states, in part, that "The criteria in this subpart do not apply to sites which have previously submitted and received Commission approval on a license termination plan (LTP) or decommissioning plan that is compatible with the SDMP Action Plan criteria." Thus, the incorporation of the DP into the BMI license, did not change the previously approved release criteria, but the licensee voluntarily implemented an administrative "as low as reasonably achievable" limit of 25 mrem per year dose limit throughout the WJN decommissioning project. Battelle's unrestricted release criteria are discussed in greater detail in Section 4.

2. FACILITY OPERATING HISTORY

Historically, Battelle performed atomic energy research and development for the U.S. Department of Energy (DOE) and its predecessor agencies between 1943 and 1986 at its Columbus Laboratories sites. The DOE, as the successor to the Atomic Energy Commission that was involved in the government's earlier work at the site, had predominant financial liability and responsibility for decontamination and decommissioning (D&D) of the Battelle facilities.

Between the late 1980s and 1993, DOE and the NRC met to discuss coordination of the BCLDP project. As a result, DOE decided to not impose DOE Orders where such orders would duplicate existing regulations which the project was already required to follow. It was agreed that the DOE would maintain day-to-day operational responsibility for the D&D project, and that the NRC would impose three statutory responsibilities, which were to: 1) conduct periodic inspections; 2) approve the release criteria used; and 3) certify the final release of the Battelle site. Region III met with DOE and the Ohio Department of Public Health on a number of occasions to ensure good communications and coordination between the respective agencies, for example: February 27, 2002, and July 24, 2003, meeting reports (ML020630335 and ML032050639). The NRC also addressed an Agreement State reciprocity issue in letters to the licensee and the State of Ohio Health Department, dated December 24, 2003, and January 23, 2004, respectively (ML040260042). Based on the NRC review of the licensee's special nuclear limits, it was decided that the NRC would retain regulatory oversight of the SNM-00007 license and the WJN Site until the license is terminated.

The NRC notified Battelle in a December 6, 1993 (ML070300232), letter that, "We have completed our review of the document titled "Decommissioning Plan for the Battelle Memorial Institute Columbus Operations," which you submitted under a separate cover letter dated May 25, 1993, and have determined your decommissioning program is adequate and acceptable." The licensee's DP committed to completing decommissioning of Battelle's former North Nuclear Sciences Site located near West Jefferson, Ohio, by September 30, 2000. Battelle's DP License Amendment No. 23 authorized, in part, the licensee to extend the decommissioning end date to December 31, 2005, and to possess licensed radiological materials incident to a radiological survey, storage of waste awaiting disposal, decontamination, and remediation of buildings, equipment, and materials, and outdoor areas as described in the original DP. Due to subsequent decommissioning schedule issues, the NRC extended the decommissioning completion date to June 30, 2008.

The environmental aspects for the Battelle DP were addressed by the DOE and provided to the NRC. Specifically in a letter dated December 16, 1990, the NRC acknowledged the receipt of DOE's "Environmental Assessment for the Battelle Columbus Decommissioning Project," June 1990 (ML062990356) and the DOE's "Finding of No Significant Impact and Environmental Assessment, Battelle Columbus Laboratories Decommissioning Project," June 1990 (ML062990353). The licensee also submitted to the DOE for review on August 31, 2001, an "Evaluation of 1990 Environmental Assessment" (ML063070070).

3. SITE AND FACILITIES DESCRIPTION

The Battelle West Jefferson site is located in Madison County, approximately 15 miles west of Columbus, Ohio. The site consists of a 1,000-acre tract of land, and the total area of the WJN Site is about 32 acres. Research involving licensed materials was performed at two areas: the WJN area in the northern portion and the Engineering area in the southeastern portion. The WJN site contained four major buildings, a guardhouse, and several smaller structures on a

bluff overlooking Darby Creek and Battelle Lake. Three of the major buildings and their support structures were the focus of the final phase of the decommissioning project. Several active and abandoned filter beds, and part of the site sanitary sewer system was also included in the project. A number of buildings in the Engineering area were used for fuel element fabrication and ballistics studies and are still standing and in use by Battelle. On August 31, 1999, the State of Ohio became an NRC Agreement State and assumed regulatory authority for byproduct and source materials in the State of Ohio, which included the West Jefferson South Site. The State of Ohio was informed in a December 24, 2003, letter (ML040260042), that the Battelle WJN Site was being retained for decommissioning, since the Battelle license possession limits triggered provisions of 10 CFR Part 150.11, which prevented the license being transferred to the State of Ohio.

The WJN area contained the former JN-1 building, which was the Hot Cell Building, and was the most highly contaminated. Work conducted there included examinations and evaluations of power and research reactor fuels; post-irradiation examination of fissile control rod, source, and structural materials and components; and examinations of irradiation surveillance capsules. In addition, this building has been the site of radiation source encapsulation and of physical and mechanical property studies of irradiated materials and structures. The other two buildings at the WJN area were the JN-2 building, which contained the Critical Assembly Laboratory, and the JN-3 building, which contained the Battelle Research Reactor. The Critical Assembly Laboratory was used for a reactor critical assembly experiments, direct energy conversion experiments, experiment assembly, special nuclear materials handling, and plutonium research activities. The JN-3 Research Reactor Building contained the Battelle research reactor, which was actively used from 1956 until 1974, when it was partially dismantled. At that time, the associated NRC License R-4 was changed to a possession-only license; in 1987, the entire JN-3 facility was added to the SNM-00007 license with the termination of NRC License R-4.

4. DECOMMISSIONING PLAN UNRESTRICTED USE CRITERIA

The licensee established unrestricted release criteria as attachments to the Battelle approved DP using two technical basis documents: Attachment 2, “Surface Release Criteria, Technical Basis Document, Battelle Columbus Laboratories Decommissioning Project (BCLDP), October 1992,” and Attachment 3, “Volumetric Release Criteria, Technical Basis Document, Battelle Columbus Laboratories Decommissioning Project (BCLDP), DD-93-03, Rev 0, April 1993.” The “Final Certification of Completion Columbus Closure Project, West Jefferson North Site,” (ML062890357) document summarizes the performance and results of the final status surveys of the affected and unaffected areas of the WJN site. The document DD-93-03 detailed the development, selection, and application of the volumetric release criteria. As part of the development process, BMI set the volumetric release criteria to reflect a comprehensive review of the guidance given in source documents. The source documents included DOE Order 5400.5, § IV.a.2, for the generic guidelines for residual concentrations of radium-226, radium-228, thorium-230, and thorium-232. Battelle also used radiological guidelines specified in NRC letter dated April 17, 1992 (ML070180226).

The final status survey processes adhered to the requirements of the "Radiological Characterization and Final Status Plan for Battelle Columbus Laboratories Decommissioning Project, West Jefferson Site" DD-97-02, Rev 0, which reflected the requirements of NRC “NUREG/CR-5849, “Manual for Conducting Radiological Surveys in Support of License Termination.” In addition to quality reviews by the licensee, the DOE and the DOE decommissioning contractor, the Environmental Survey and Site Assessment Program (ESSAP) of the Oak Ridge Institute for Science and Education (ORISE), functioned as an Independent

Verification Contractor, performing independent verification surveys and reviews of the licensee's final status survey reports.

It was the licensee's objective to decontaminate or remove residual radioactive contamination so the site would be available for use without radiological restrictions. In order to clearly define the objective, the licensee applied the above technical basis documents throughout the decommissioning process. Table 2 of the Final Certification of Completion document presents the surface release criteria, which was consistent with the NRC Regulatory Guide 1.86, "Termination of Operating Licenses for Nuclear Reactors."

Release surveys of Buildings JN-2, JN-3, JN-6, and the Transuranic Waste Staging Pad Area, and the North Site Well House areas, material, and equipment were performed to ensure that surface contamination levels were at or below those listed in Table 2. The surveys included scanning and static measurements, and smear surveys for removable contamination. Decontamination was performed if surveys indicated residual surface contamination above that listed in Table 2. The JN-1 facility was not free released, that is, the building was demolished with the building rubble and wastes being disposed of to an authorized disposal site.

Table 3 of the "Final Certification of Completion, Columbus Closure Project, West Jefferson North Site" contains the referenced guidelines for residual radioactivity concentrations for soil and solid volumes as applied to the licensee's decommissioning activities. Volumetric release criteria for residual radioactivity concentrations in soils, debris, and other solid media resulting from the decommissioning were from DD-93-03.

The licensee performed assessments of environmental pathway and dose analysis for residual soil radioactivity using the DOE Residual Radioactivity Material (RESRAD) computer program. The technical basis document contains the results of the RESRAD analysis. The criteria presented in the table are the maximum allowable concentrations of residual radioactive material above background levels, which could be left in soil and solid volumes released for unrestricted use. The table limits were maximum concentrations for individual or mixtures of radionuclides that could be allowed to be present in solid media. The radiological screening levels for mixtures of radionuclides were developed by summing the individual fraction of the radionuclide to its specific release criteria. Summed fractions less than unity or 1 were said to meet the release criteria.

The external gamma radiation exposure limit for ground surfaces specified in DD-93-03 was 5 microRoentgen per hour above mean background, at 1 meter above the ground surface, which was applied as an additional requirement in determining compliance with the unrestricted release criteria.

The NRC April 17, 1992, letter also informed the licensee that it would be necessary for the licensee to comply with the following guidance:

1. "The U.S. Environmental Protection Agency's (USEPA's) "National Primary Drinking Water Standards," 40 CFR Part 141. In accordance with FC 83-23, the maximum contaminant levels for radionuclides in public drinking water as established by the USEPA should be used as reference standards for protection of groundwater and surface water resources.

2. The USEPA's Radiation Dose Guidelines for Protection Against Transuranium Elements Present in the Environment as a Result of Unplanned Contamination (42 FR 60956; November 30, 1977). This document provides guidelines for acceptable levels of transuranium elements in soil.

5. GROUNDWATER ASSESSMENT AND FINDINGS

In a letter dated May 23, 2006, and a technical report dated December 10, 2007, Hydrogeologic Assessment of the Battelle West Jefferson Former North Nuclear Site from Battelle to the NRC (ML061450071 and ML080100362, respectively), the licensee provided groundwater and radiological monitoring information as follows:

The hydrogeological units under the WJN Site from land surface down are:

- the surface till unit (containing the water table)
- the 885 sand layer
- dense till
- the 855 sand layer
- dense till
- the basal (805) sand layer
- limestone bedrock

The WJN Site has five groundwater-bearing units that may have been impacted by site activities. Four of these units are within the unconsolidated material above the bedrock. These groundwater-bearing units are as follows:

- The shallow surface unit, which includes the shallow water-bearing till layer, which includes the Bog Area near the dam of the Silver Creek Reservoir (Battelle Lake) and the alluvial layer adjacent to the Big Darby Creek.

- The 885-foot sand layer (885 layer) is about 30 feet below land surface.

- The 855-foot sand layer (855 layer) is about 60 feet below land surface.

- The 805-foot basal sand layer (805 layer) is about 100 feet below land surface.

- The limestone bedrock below the basal sand layer.

The licensee indicated in the May 23, 2006, letter that the groundwater in the 885 and 855 layers and a shallow surface unit near the Silver Creek Reservoir are not suitable as drinking water sources because the water yields are too low. However, the licensee assumed that the groundwater from the 885 layer could migrate to Silver Creek Reservoir, resulting in a potential aquatic food pathway. The monitoring information for this layer was used in the licensee's Site-wide RESRAD dose projection model (Revision 0), which is discussed below in Section 6. The 855 layer was not used for the aquatic pathway in the RESRAD dose projections, because the licensee's evaluation indicated that the radionuclide travel times from the residual radioactivity in surface soil to the 855-foot layer would be longer than for the 885-foot layer, resulting in lower radiation doses due to slow transport through the soil and resultant radionuclide decay.

The licensee's May 23, 2006, report further indicated that the 855 and 805 sand layers are confined hydrostratigraphic units. The limestone bedrock which lies below the 805 basal sand layer is the regional drinking water aquifer. The basal sand layers vary in thickness from 6 inches to about 2 feet. The groundwater from the limestone bedrock is suitable as a drinking water supply and for irrigating crops and watering stock. The licensee draws water from this unit using three active pumping wells. The licensee's radiological monitoring of these wells for gross alpha and beta radiations, strontium-90, gamma spectroscopy, and alpha spectroscopy has never exceeded the USEPA's Maximum Contaminants Levels (MCLs).

The licensee determined that the shallow surface unit which includes the Bog Area is unsuitable as a source of water due to the low yield and shallow depth to this water table. Additionally, the State of Ohio requires wells that are used for drinking water to be screened at a minimum depth of 25 feet below the land surface. Thus the water from these areas is considered a non-potable water supply.

During the fall 2005 site remedial action work, the unsaturated, historically contaminated soils above the shallow surface unit in the restricted area were successfully remediated. Other than the Bog Area, which is discussed below, Battelle concluded in its report that the 805 basal layer and the 855 layer meet the USEPA MCLs for gross alpha, beta particle/photon emitters, and uranium. The 885 layer, for the most part, met the USEPA MCLs as well with the exception of one case each of slightly exceeding the gross alpha standard and exceeding the uranium standard. In both cases, Battelle's evaluation of the sample determined that the exceedances are most likely due to natural radioactivity present in excessive soil fines present in the samples as well as the site procedure to apply acidification/preservation procedures prior to filtration. An October 6, 2006, ORISE letter to the NRC (ML062860125) reported results consistent with the Battelle findings.

The licensee believed that the detection of slightly elevated strontium-90 levels in the Bog Area was due to the past discharges of its facilities' slightly radiologically contaminated storm water drainage to the Bog Area associated soils and subsequent movement to the water table from normal percolation and associated rain. The maximum measured concentration of strontium-90 in the bog area was 29 pCi/L. The last sampling campaign conducted during April 2006 identified one well with a strontium-90 concentration of 22 pCi/L. Thus, the licensee indicated that elevated levels of strontium-90 may continue to be detected until sufficient time allowing for radionuclide decay and dilution by precipitation infiltrating through the overlying soils occurs. The licensee has noted that the detection of strontium-90 in these wells have not been consistently above the USEPA limits. The water from the Bog Area was not used in the licensee's RESRAD dose model, because the flow in the Bog Area is essentially non-existent and it is not suitable for use by either water recovery capabilities or state standards.

During the NRC's consultation process (Section 9) the USEPA and the State of Ohio's Environmental Protection Agency (OEPA) expressed concern regarding the strontium-90 contamination in the Bog Area and its use as a potential drinking water source. During a September 25, 2007, (ML0729808490) NRC and OEPA meeting, the NRC's hydrogeologist discussed the technical evaluation performed by the NRC using USEPA guidelines (ML072620095) to determine sustainable yield analysis of the water-bearing unit referred to as the Bog Area at Battelle's West Jefferson Facility. The analysis indicated that the water-bearing unit associated with Well 168 and nearby Wells 150, 155, and 172 would not have the capacity to sustain a household well, nor the ability to communicate with other water supplies, and as

such would not impact the drinking water supply. Dose modeling regarding potential impacts of the groundwater in the Bog Area is discussed in Section 6, below.

The OEPA also expressed concern that the dose modeling, which evaluated risk from exposure to groundwater in the lower part of the glacial overburden was too limited and should be expanded to evaluate potential risks associated with shallower groundwater at the site, namely in the 885 and 855 layers which occur in the upper and middle part of the glacial till, respectively. The licensee did not evaluate the upper units in the original dose modeling because they were determined by evaluation not to be laterally extensive or hydraulically capable of providing sufficient yield to support on-site or off-site drinking water or irrigation wells. In response to the OEPA concerns, Battelle voluntarily performed a further assessment of the West Jefferson Site hydrogeology. Battelle's assessment indicated that there may be a water-bearing unit (855 layer) which may be laterally continuous, extending from beneath the area that was formerly occupied by site buildings to Big Darby Creek. This would provide a potential conduit for groundwater to flow from beneath the site to the creek. However, the amount of ground water that infiltrates through the upper glacial till and reaches the 855 layer, where it may move laterally, was not quantified. Based upon this assessment, Battelle conservatively elected to perform additional dose modeling to evaluate the potential impact of site-generated radionuclides in the 855 layer on the site dose. Battelle provided to the NRC a revised dose model, "West Jefferson North Site Dose Assessment, Revision 1, January 2008," (ML080100370) which is discussed in Section 6, below.

The NRC's Environmental Protection and Performance Assessment Directorate performed a detailed technical review of Battelle's Groundwater information. The Directorate's memorandum, "Technical Evaluation Report on Battelle's Groundwater Monitoring Plan and the Radiological Impact of Site Activities on the Groundwater at the West Jefferson North Site West Jefferson, Ohio" (ML063600048), documents the NRC staff findings regarding the Battelle site.

6. WEST JEFFERSON SITE RADIATION DOSE ASSESSMENTS

The licensee provided to the NRC two separate West Jefferson North Site Dose Assessments Revision 0 and Revision 1, dated July 17, 2006, and January 2008, (ML061990464 and ML080100370) respectively. The purpose of the dose assessments was to quantify potential radiation doses from residual radioactivity at the WJN Site. The licensee divided the site into three areas for the assessments as follows: 1) the Upper Area, 2) the Filter Bed Area, and 3) the JN-4 Drainpipe Area. The Upper Area and the Filter Bed Area were separated because they are each surrounded by unaffected areas and separated by an access road. The JN-4 Drainpipe Area was kept separate because it contained a different typical ratio of licensed radionuclides than the Upper Area and the Filter Bed Area. Radionuclide concentrations in each of these areas were determined using data from Final Status Survey reports that document the radiological conditions at the WJN Site after remediation (references #26-53).

The pre-decommissioning radiological characterization surveys of the WJN Site identified cesium-137 as the primary radionuclide present in soil samples. Other radionuclides typically present in soil samples included cobalt-60, strontium-90, europium-152, europium-154, plutonium-238, plutonium-239/240, and americium-241. The licensee used cesium-137 as a surrogate for the other radionuclides present in surface soil because it typically results in 64 percent of the total activity in surface soil samples. The surrogate relationship between cesium-137 and other radionuclides present in surface soil samples is presented in Table 2 of Revision 0 of the Site-Wide Dose Assessment and is based on data collected from March through September 2000. The average cesium-137 concentration over the WJN Site in the

licensee's reference surface soil grids was 0.20 pCi/g and the maximum concentration in surface soil grids was 2.55 pCi/g. In the Upper Area the average cesium-137 concentration in surface soil grids was 0.14 pCi/g and the maximum concentration in surface soil grids was 1.2 pCi/g. In the Filter Bed Area, the average cesium-137 concentration in surface soil grids was 0.29 pCi/g and the maximum concentration in surface soil grids was 2.55 pCi/g. The maximum concentrations represent the maximum averages for grids in these areas and do not represent the maximum cesium-137 concentration reported in a single soil sample. The cesium-137 surrogate values used were 7.3 pCi/g for the JN-1 footprint and associated grounds remediation and 11 pCi/g for the remainder of the site. The use of the surrogate values are discussed in each final status survey report.

The radiation doses through the exposure pathways were estimated using the Argonne National Laboratories RESRAD computer code. Radiation doses were estimated from the time of site closure (0 years) to 1,000 years after site closure. Default parameters for the residential farmer scenario were used in Revision 0, except for cases were changes were necessary to model conditions at the WJN Site. These changes are listed in Table 9 of the licensee's report.

The major differences between the July 2006 WJN Dose Assessment Report (Revision 0) and the January 2008 WJN Dose Assessment Report (Revision 1) are as follows:

1. **Distribution Coefficients**: In the July 2006 WJN Dose Assessment Report (Revision 0), the RESRAD default distribution coefficients (K_ds) were used to estimate leaching of radionuclides from the contaminated zone and subsequent transport in groundwater. In the January 2008 WJN Dose Assessment Report (Revision 1), K_ds specific to the soil types at the WJN site were used.

2. **Unsaturated Zone**: In the July 2006 WJN Dose Assessment Report (Revision 0), transport to the 885 layer was used to estimate aquatic food consumption radiation doses and transport to the 805 layer was used to estimate drinking water and irrigation related radiation doses. The unsaturated zone was modeled as being 3.05 meters thick for transport to the 885 layer or 24.4 meters thick for transport to the 805 layer. Hydrologic parameters for the unsaturated zone were chosen to be representative of sand clay or silt clay. In the January 2008 WJN Dose Assessment Report (Revision 1), the unsaturated zone was modeled as being 3.05 meters thick and no transport to the 805 layer was modeled. An unsaturated zone thickness of 3.05 meters corresponds to the top of the 885 layer. To model water use from the 855 layer, a well intake of 9.14 meters below the water table was used. Hydrologic parameters for the unsaturated zone were chosen to be representative of silt loam.

3. **Saturated Zone**: In the July 2006 WJN Dose Assessment Report (Revision 0), two saturated zones were modeled, the 885 layer and the 805 layer. Water from the 885 layer was used to estimate radiation doses from aquatic food and water from the 805 layer was used to estimate drinking water and irrigation related radiation doses. The 885 layer had properties representative of sand and the 805 layer had properties representative of limestone. In the January 2008 WJN Dose Assessment Report (Revision 1), a single saturated zone was used to estimate radiation doses from aquatic food and from drinking water and irrigation related pathways. This layer started at the 885-foot level and extended below the 855-foot level. This layer had properties representative of sand. In addition, a site-specific hydraulic conductivity was used. For the drinking water and irrigation related pathways, a well intake of 9.14 meters below the water table was used. This corresponds to a well intake at the 855-foot level. No

radiation doses were estimated from ground water from the 805 layer in the January 2008 WJN Dose Assessment Report (Revision 1).

4. **Contaminated Areas**: In the July 2006 WJN Dose Assessment Report (Revision 0), radiation doses were presented for four areas: 1) the Upper Area, 2) the Filter Bed Area, 3) the Combined Upper Area and Filter Bed Area, and 4) the JN-4 Drainpipe Area. The radiation doses from the Combined Upper Area and Filter Bed Area and the JN-4 Drainpipe Area were compared to the 25 mrem/yr standard. In the January 2008 WJN Dose Assessment Report (Revision 1), radiation doses were presented for two areas: 1) the Combined Upper Area and Filter Bed Area and 2) the JN-4 Drainpipe Area. Separate radiation doses were not presented for the Upper Area and the Filter Bed Area. The radiation doses from the Combined Upper Area and Filter Bed Area and the JN-4 Drainpipe Area were compared to the 25 mrem/yr standard.

5. **Strontium-90 Concentration in Ground Water**: In the July 2006 WJN Dose Assessment Report (Revision 0), the radiation dose from strontium-90 in the 805 layer was based on gross beta measurements in the 805 layer and the ratio of the strontium-90 to gross beta concentration in the caisson wells. This procedure yielded a strontium-90 concentration of 22 pCi/L and a radiation dose of 2.4 mrem through the drinking water, plant, meat, and milk pathways. In the January 2008 WJN Dose Assessment Report (Revision 1), the radiation dose from strontium-90 in the 855 layer was based on strontium-90 measurements from the 855 layer. This procedure yielded a strontium-90 concentration of 1 pCi/L and a radiation dose of 0.11 mrem through the drinking water, plant, meat, and milk pathways.

   In neither case discussed above did the radiation dose include the contribution from radioactive material leaching from the contaminated zone, which was estimated separately by RESRAD. For both the 2006 and 2008 WJN Dose Assessment Reports, the strontium-90 concentration in the contaminated zone was estimated to be 0.0554 pCi/g. This was the concentration of Sr-90 from the Filter Bed Area, which was higher than the concentration in the Upper Area (0.0263 pCi/g). This concentration was assumed to be present throughout the Combined Upper Area and Filter Bed Area (131,000 m^2).

6. **Recreational Scenario**: In the July 2006 WJN Dose Assessment Report (Revision 0), a recreational scenario was not analyzed. In the January 2008 WJN Dose Assessment Report (Revision 1), a recreational scenario was included as Appendix A.

7. **Contaminated Wound Scenario**: In the July 2006 WJN Dose Assessment Report (Revision 0), a contaminated wound scenario was not analyzed. In the January 2008 WJN Dose Assessment Report (Revision 1), a contaminated wound scenario was included as Appendix B.

Site-Wide Dose Assessment Revision 0, Conclusions: The licensee's initial dose assessment performed to determine the total radiation dose from the WJN Site used maximum radionuclide concentrations in conjunction with a resident farmer scenario and summed the radiation doses from the combined Upper Area and the Filter Bed Area, the JN-4 Drainpipe Area, and the groundwater, which resulted in a worst-case peak radiation dose of 20.6 mrem/yr. This resultant worse case dose projection is below the licensee's DP commitment, as well as being below a Total Effective Dose Equivalent (TEDE) to an average member of a critical group that does not exceed 25 mrem per year, including that from groundwater sources of drinking

water, as specified in Title 10 of the CFR, Part 20, Section 20.1402, “Radiological criteria for unrestricted use.” The licensee concluded its initial assessment with the rationale that the radiation dose projection of 20.6 mrem/yr represents a conservative estimate for several reasons as follows:

- Maximum surface soil concentrations were used to estimate radionuclide concentrations. Using average concentrations would reduce the radiation doses by a factor of about 70 percent, to about 6 mrem/yr.

- The entire WJN Site was assumed to contain residual radioactivity at the maximum radionuclide concentrations. In reality, a substantial portion of the WJN Site would not contain residual radioactivity at these levels.

- A resident farmer scenario was used to estimate radiation doses. Although agricultural activities are common near the WJN Site, agricultural activities are not likely to occur in the Filter Bed Area because of topography. In addition, the resident farmer was assumed to get a substantial portion of their food from the WJN Site. This is also not likely to occur.

- Leaching of radionuclides from surface soil and subsequent transport to surface water and groundwater was not partitioned. All the radioactivity leached from the surface soil was assumed to be transported to the 885 layer and then transported to surface water, exposing the resident farmer through the aquatic foods pathway. In addition, all the radioactivity leached from the surface soil was assumed to be transported to the 805 layer and then transported to a well, exposing the resident farmer through drinking water and other water dependent pathways. The radiation doses from these two routes of exposure were added, which overestimates the radiation dose to the resident farmer.

- The Upper Area and Filter Bed Area were assumed to contain residual radioactivity to a depth of 20 feet. In reality, residual radioactivity is not present to this depth over the entire Upper Area and Filter Bed Area.

- All residual radioactivity was assumed to be present at the surface with no cover. In reality, much of this residual radioactivity is present below the surface and is covered by clean soil or by soil with lower radionuclide concentrations.

- The radiation doses from strontium-90 in the 805 layer were assumed to be constant over the assessment period, which was 1000 years. Given the half-life of strontium-90, 28.6 years, this is not likely to occur. Additionally, the licensee's subsequent water sampling of this groundwater bearing unit with the new monitoring wells supported the licensee’s conservative assessment.

Site-Wide Dose Assessment Revision 1, Conclusions: The licensee’s second RESRAD dose assessment was conducted for the residual radioactivity at the WJN Site, using soil and groundwater site specific parameters, as well as maximum radionuclide concentrations in conjunction with a resident farmer scenario. The assessment yielded a radiation dose of 9.6 mrem/yr through all exposure pathways. The derived radiation dose includes the radiation dose from the combined Filter Bed and Upper Areas and the JN-4 drainpipe area. The radiation dose includes the radiation dose from residing on a contaminated site and from consuming contaminated ground water from a onsite well. The radiation dose also includes consuming well water with a measured concentration of 1 pCi/L of Sr-90. This resultant dose projection is below

the licensee's DP commitment, as well as being below a TEDE to an average member of a critical group that does not exceed 25 mrem per year, including that from groundwater sources of drinking water, as specified in Title 10 of the CFR, Part 20, Section 20.1402, "Radiological criteria for unrestricted use." The licensee concluded the second assessment with the rationale that the radiation dose projection of 9.6 mrem/yr represents a conservative estimate for several reasons as follows:

- Maximum surface soil concentrations were used to estimate radionuclide concentrations. Using average concentrations would reduce the radiation doses by a factor of about 10, to about 1 mrem/yr.

- The entire WJN Site was assumed to contain residual radioactivity at the maximum radionuclide concentrations. In reality, a substantial portion of the WJN Site would not contain residual radioactivity at these levels.

- A resident farmer scenario was used to estimate radiation doses. Although agricultural activities are common near the WJN Site, agricultural activities are not likely to occur in the Filter Bed Area because of topography. In addition, the resident farmer was assumed to get a substantial portion of their food from the WJN Site. This is also not likely to occur.

- The Upper Area and Filter Bed Area were assumed to contain residual radioactivity to a depth of 20 feet. In reality, residual radioactivity is not present to this depth over the entire Upper Area and Filter Bed Area.

- All residual radioactivity was assumed to be present at the surface with no cover. In reality, much of this residual radioactivity is present below the surface and is covered by clean soil or by soil with lower radionuclide concentrations.

- The radiation doses from strontium-90 in the 855 layer were assumed to be constant over the assessment period, which was 1,000 years. Given the half-life of Sr-90, 28.6 years, this is not likely to occur.

Potential Radiation Dose Resulting from Exposure to the Bog Area Groundwater: During a February 13, 2008, meeting between the NRC, OEPA and Battelle, Battelle's dose assessor discussed a dose assessment, which evaluated a radiation dose to a hypothetical individual living on the 0.2 acre Bog Area. The Battelle assessment used a scaling factor (0.1102 mrem/yr per pCi/L) as was used in the West Jefferson North Site Dose Assessment (Revision 1, January 2008) to estimate strontium-90 radiation doses through the water dependent pathways. The assessment estimated that a constant concentration of 29 pCi/L of strontium-90, if present, would yield a radiation dose of about 3.2 mrem/yr. This hypothetical scenario included dose contributions from the drinking water, plants, meat, and milk pathways. When the 3.2 mrem/yr radiation dose from the Bog Area water was combined with the radiation doses from the other pathways assessed in the West Jefferson North Site Dose Assessment (Revision 1, January 2008), the total radiation dose to the resident farmer was estimated to be 13 mrem/yr.

The Appendix A "Recreational Scenario" and the Appendix B "Contaminated Wound Scenario" attached to Battelle's Site-Wide Dose Assessment, Revision 1: Battelle selected the Ken Jockety Girl Scout Camp as the most sensitive off-site receptor. This was

done to provide a conservative estimate of the radiation dose from radioactive material that might be blown from the West Jefferson North Site and could potentially expose people at the Ken Jockety Girl Scout Camp, or from radioactive material that might migrate to the Big Darby Creek and could potentially expose a swimmer. Specifically, the exposure assessment used model input values for the external exposure, soil ingestion exposure, and inhalation exposure, based on an individual standing on the West Jefferson North Site for one week, and also assumed that a person would swim for one hour per day for one week.

Both assessments presented in Appendix A and B resulted in findings that the individual doses would be fractions of 1 mrem/yr, which is significantly below the NRC's license termination criteria of 25 mrem/yr. The NRC conducted dose modeling for similar types of scenarios and obtained similar results. With the offsite potential doses being so small, the NRC staff concluded that the original dose calculations using onsite dose pathways represented the most sensitive and most conservative dose receptor.

To support the NRC staff review of the licensee's site-wide dose assessment, a Quality Assurance Evaluation of the Region III review was performed by the NRC's Environmental Protection and Performance Assessment Directorate (EPPAD). In a December 1, 2006, memorandum (ML063330301), EPPAD summarized the findings of the quality assurance evaluation of Region III's analysis of Battelle's West Jefferson Facility site wide dose assessment. The EPPAD concluded that the Region III analysis of Battelle's dose assessment was adequate and consistent with the standard procedures discussed in NUREG-1757, Vol. 2, Rev. 2, Consolidated NMSS Decommissioning Guidance - Characterization, Survey, and Determination of Radiological Criteria; and in ANL/EAD/TM/04-03, Rev. 2 - Evaluation of Dose Modeling for Compliance with Radiological Criteria for License Termination (Training Course). The EPPAD also concluded that the dose assessment is conservative because of the use of extremely conservative site parameters, and that the conclusion is supported by recently available Battelle and ORISE radiological results from newly installed groundwater monitoring wells that are screened in the 805 layer, which is hydraulically connected to the drinking water aquifer for the site and nearby homesteads.

7. LICENSEE COMPLIANCE HISTORY

Between the calendar years 2000 and 2007, the NRC performed 24 inspections at the WJN site (references 1-24). These inspections evaluated the licensee's compliance with its NRC DP, including such program areas as: management oversight and controls, radiation protection, transportation, waste storage and disposal, environmental monitoring, Occupational, Safety and Health Administration compliance, fire protection, emergency plan, and final status surveys. Additionally, NRC inspectors observed licensee personnel during the conduct of radiological survey monitoring and collection of soil and water samples for radiological analysis. The inspectors also performed side by side radiological measurements with the licensee personnel, as well as, performing independent measurements and collection of samples during the inspections and confirmatory surveys. The NRC inspectors concluded that the licensee's survey methods and procedures were adequate and in compliance with the NRC-approved DP. Also, the NRC review of analytical results for samples collected by the inspectors was comparable to the licensee's final status survey results.

8. REVIEW OF LICENSE TERMINATION

The NRC staff reviewed the licensee's August 3, 2006, termination request, which included an executed NRC Form 314, "Certification of Disposition of Radioactive Materials," with an attached Table 1 (Disposal of radioactive materials), a discussion of Final Status Survey Documentation which was contained in the document "Final Certification of Completion-Columbus Closure Project West Jefferson North Site West Jefferson, Ohio" and a table titled "NRC Reviewed Final Status Survey Report Change Summary" documenting changes to Final Status Survey Reports previously transmitted via letter by J. Jacobsen to G. McCann, NRC, dated June 2, 2006, with subject "Transmittal of Final Status Survey Reports and Associated Documentation from the Battelle West Jefferson, Ohio Site for NRC Review." The table documented non-editorial changes to final status survey documents reviewed by NRC, which are referenced in that original letter.

The NRC staff also performed independent evaluations of the licensee's West Jefferson North Site Dose Assessments, the licensee's Environmental Report for Termination of the NRC License for Battelle Columbus Laboratories Facilities at Columbus and West Jefferson, Ohio, and the submitted final status surveys for the WJN Site (references 26-53), and determined that the assessments, and reports were consistent with the commitments made in Battelle's DP, and complies with the provisions of 10 CFR Part 70, Section 70.38(k), regarding actions necessary for termination of licenses.

9. FEDERAL, AND STATE CONSULTATIONS

The Ohio Department of Public Health was notified on October 28, 2006, of the proposed license termination. On November 2, 2006, Mr. Charles McCracken, Supervisor, Ohio Department of Health, Bureau of Radiation Protection, Nuclear Materials Safety section, Materials Decommissioning and Safeguards, indicated in an e-mail message (ML070360083), that the State found the SER to be comprehensive and did not have any comments to add or change. The NRC staff met with the Ohio Department of Health on August 7, 2007, and February 19, 2008, briefing the State on the status of the Battelle license termination.

Concurrent with the NRC's review of the licensee's termination request, the NRC consulted with the U.S. Environmental Protection Agency (U.S. EPA) on March 23, 2007, (ML070080126) pursuant to the provisions of an October 9, 2002, Memorandum of Understanding between the USEPA and USNRC. The USEPA responded to the NRC in a June 21, 2007, letter (ML071860213). The USEPA's June 2007 letter advised the NRC to consult with the Ohio Environmental Protection Agency (OEPA) regarding the ground water use determinations for the WJN Site. In response to the USEPA letter, the OEPA sent an August 29, 2007, letter to the NRC regarding the WJN Site (ML072410145).

The OEPA's August 29th letter outlined four recommendations regarding various aspects of Battelle's decommissioning activities, and requested that the NRC consider the OEPA's recommendations prior to holding a public meeting to inform the public about the NRC's intent to terminate Battelle's license. To that end, NRC and Ohio EPA (OEPA) staff and management met on several occasions from June to November 2007 discussing questions, concerns, and the recommendations that the OEPA staff had regarding the Battelle site and the planned termination of the site's NRC license.

The NRC responded to the OEPA's recommendations in a January 22, 2008, letter (ML080230126) concluding that, "Based on the many meetings and questions and our answers, this completes our consultation activities pursuant to the initial USEPA consultation letter. We are currently planning to hold an informational public meeting on February 20, 2008, to discuss the Battelle license termination." The Informational Meeting was held on February 20, 2008, and a February 22, 2008, memorandum summarizes the meeting presentations and questions from the public meeting (ML080560047).

In a February 19, 2008, letter (ML080530162) OEPA requested that additional actions be taken regarding the decommissioning of the Battelle West Jefferson site. Specifically, OEPA requested that due to the existence of strontium-90 in a 0.2 acre storm water run-off area (referred to as the Bog Area), which periodically exceeded the USEPA drinking water MCLs, that additional hydrogeologic evaluations be completed to quantify the levels of strontium-90 and potential for migration. The OEPA further requested that if strontium-90 remediation actions do not occur that institutional controls should be put in place to prevent residential wells from being drilled on the Battelle property to prevent the Bog Area from being disturbed.

Since the Ohio Department of Health is the NRC's principal point of contact for matters regarding the use and control of radioactive materials in the State of Ohio, the NRC explained its final decision regarding NRC and OEPA interactions, in an April 28, 2008, letter (ML081190534) to the Ohio Department of Health's Director. The Director was informed, that the NRC reviewed its evaluations and technical bases for the decisions to support license termination to ensure that the site meets all USNRC requirements for unrestricted use as described in 10 CFR Part 20.1402. The letter went on to indicate that, "We maintain that the evaluations the NRC performed at the Battelle West Jefferson site were technically sound and were confirmed through independent means. None of the issues raised or identified by the Ohio EPA would change our position relative to the Battelle site meeting all NRC regulatory requirements for unrestricted use and termination of the site license. Therefore, we plan to proceed with the termination of the Battelle West Jefferson site license."

10. CONCLUSIONS

Based on the considerations discussed above, NRC staff concludes that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by the proposed license termination, and (2) satisfies the provisions of 10 CFR Part 70.38, "Expiration and termination of licenses and decommissioning of sites and separate buildings or outdoor areas." Additionally, the staff determined that remaining residual contamination meets the unrestricted release criteria specified in Battelle's NRC-approved DP, as well as being below a TEDE to an average member of a critical group that does not exceed 25 mrem per year, including that from groundwater sources of drinking water, as specified in Title 10 of the CFR, Part 20, Section 20.1402, "Radiological Criteria for Unrestricted Use."

REFERENCES:

NRC Inspection Reports for Battelle Memorial Institute, Battelle Columbus Laboratories Decommissioning Project (BCLDP)

1. NRC Inspection Report No. 070-00008/2000/001 ML003719696
2. NRC Inspection Report No. 070-00008/2000/002 ML003757248
3. NRC Inspection Report No. 070-00008/2000/003 ML003781131
4. NRC Inspection Report No. 070-00008/2001/001 ML013130665
5. NRC Inspection Report No. 070-00008/2001/002 ML011730195
6. NRC Inspection Report No. 070-00008/2001/003 ML012840523
7. NRC Inspection Report No. 070-00008/2001/004 ML013480339
8. NRC Inspection Report No. 070-00008/2002/001 ML021280022
9. NRC Inspection Report No. 070-00008/2002/002 ML022310131
10. NRC Inspection Report No. 070-00008/2002/003 ML022880564
11. NRC Inspection Report No. 070-00008/2002/004 ML023400377
12. NRC Inspection Report No. 070-00008/2003/001 ML030650496
13. NRC Inspection Report No. 070-00008/2003/002 ML031000083
14. NRC Inspection Report No. 070-00008/2003/003 ML032060318
15. NRC Inspection Report No. 070-00008/2003/004 ML040070113
16. NRC Inspection Report No. 070-00008/2004/001 ML041750188
17. NRC Inspection Report No. 070-00008/2004/002 ML043060115
18. NRC Inspection Report No. 070-00008/2004/003 ML050190185
19. NRC Inspection Report No. 070-00008/2004/004 ML050320222
20. NRC Inspection Report No. 070-00008/2005/001 ML051820238
21. NRC Inspection Report No. 070-00008/2005/002 ML052730179
22. NRC Inspection Report No. 070-00008/2005/003 ML053220615
23. NRC Inspection Report No. 070-00008/2005/004 ML060880421
24. NRC Inspection Report No. 070-00008/2007/001 ML072050299

Background Material:

25. August 3, 2006, letter from Battelle Memorial Institute requesting license termination of NRC Special Nuclear Materials License No. SNM-00007 (ML062490203)

26. Table 8, CCP Final Status Survey Report, ORISE Independent Verification Letter Reports, & NRC Inspection Reports

27. FSSR #1 Columbus Closure Project Characterization and Final Status Survey Report for the JN-4 North Grounds Area, Revision 2, Dated June 16, 2006.

ORISE Independent Verification – Final Report – Verification Survey Results for the Active North Filter Bed (ANFB) North Subsurface Sand Filter, JN-4 North Land Area, ANFB to Manhole 2 Trench, and the ANFB Former Dosing Chamber Excavation, Columbus Closure Project, West Jefferson Site, West Jefferson, Ohio, February 9, 2006. (ML062890357)

28. FSSR #2 Columbus Closure Project Characterization and Final Status Survey Report for Building JN-2, Revision 0, Dated November 2004.
    - ORISE Independent Verification- Final Report – Verification Survey of Building JN-2, Columbus Closure Project, West Jefferson Site, West Jefferson, Ohio, December 1, 2004. (ML062890357)
      NRC Inspection Report, 070-00008/2004-002(DNMS) - Battelle Columbus Laboratories Decommissioning Project NRC.
    - Letter from Kenneth G. O'Brien, Chief Decommissioning Branch (NRC) to J. Jacobsen (BMI), October 29, 2004. (ML062890357)

29. FSSR #3 Columbus Closure Project Characterization and Final Status Survey Report for Building JN-3, Revision 0, Dated November 2004.
    - ORISE Independent Verification – Final Report – Verification Survey of Building JN-3 and the Active North Filter Bed – South Subsurface Sand Filter. Columbus Closure Project, West Jefferson Site, West Jefferson, Ohio, March 2, 2005.
    - NRC INSPECTION REPORT, 070-00008/2004-002(DNMS)- Battelle Columbus Laboratories Decommissioning Project, NRC, Letter from Kenneth G. O'Brien, Chief Decommissioning Branch (NRC) to J. Jacobsen (BMI), October 29, 2004. (ML062890357)

30. FSSR #4 Columbus Closure Project Characterization and Final Status Survey Report for the JN-3 Foundation Area, Revision 2, Dated June 16, 2006.
    - ORISE Independent Verification - Final Report – Verification Survey Results for the JN-1 Fuel Pool, Transfer Canal, and Inside and Outside Sumps, the JN-2 Sanitary Line Sections B & C, the JN-3 Foundation Area, and the Active North Filter Bed Discharge Line, Columbus Closure Project, West Jefferson Site, West Jefferson, Ohio, February 9, 2006.
    - NRC Inspection Report, 070-00008/2005-001(DNMS) - Battelle Columbus Laboratories Decommissioning Project NRC, Letter from Jamnes L. Cameron, Chief, Decommissioning Branch (NRC) to J. Jacobsen (BMI), June 30, 2005. (ML062890357)

31. FSSR #5 Columbus Closure Project Characterization and Final Status Survey Report for Building JN-6, Revision 1, Dated July 2004.
    - ORISE Independent Verification - Revised Type A Verification Report – Columbus Project Characterization and Final Status Survey of Building JN-6, Columbus Closure Project, West Jefferson, Ohio; July 22, 2004. (ML062890357)

32. FSSR #6 Columbus Closure Project Characterization and Final Status Survey Report for The JN-1B Fuel Pool, Transfer Canal, and Both the Inside and Outside Sumps, Revision 1, Dated June 16, 2006.
    - ORISE Independent Verification – Final Report – Verification Survey Results for the JN-1 Fuel Pool, Transfer Canal, and Inside and Outside Sumps, the JN-2 Sanitary Line Sections B & C, the JN-3 Foundation Area, and the Active North Filter Bed Discharge Line, Columbus Closure Project, West Jefferson Site, West Jefferson, Ohio, February 9, 2006.

- NRC Inspection Report, 070-00008/2005-001(DNMS) - Battelle Columbus Laboratories Decommissioning Project NRC, Letter from Jamnes L. Cameron, Chief Decommissioning Branch (NRC) to J. Jacobsen (BMI), June 30, 2005. (ML062890357)

33. FSSR #7 Columbus Closure Project Characterization and Final Status Survey Report for The Remaining Affected Areas Within the Filter Beds Including the Well Injection Deep Extraction (WIDE) System, Revision 1, Dated June 16, 2006.
    - ORISE Independent Verification – Final Report – Independent Verification Survey Results for the Well Injection Deep Extraction (WIDE) System Area Excavation, Revision 1. Columbus Closure Project, West Jefferson Site, West Jefferson, Ohio, June 20, 2006.
    - ORISE Independent Verification – Final Report – Verification Survey Results for the Remaining Affected Areas of the Filter Beds, Columbus Closure Project, West Jefferson Site, West Jefferson, Ohio, June 20, 2006.
    - NRC Inspection Report, 070-00008/2005-001(DNMS) - Battelle Columbus Laboratories Decommissioning Project.
    - NRC, Letter from Jamnes L. Cameron, Chief Decommissioning Branch (NRC) to J. Jacobsen (BMI), June 30, 2005. (ML062890357)

34. FSSR #8 Columbus Closure Project Characterization and Final Status Survey Report for the JN-2 Sanitation Line Sections B and C, Revision 1, Dated June 16, 2006.
    - ORISE Independent Verification - Final Report – Verification Survey Results for the JN-1 Fuel Pool, Transfer Canal, and Inside and Outside Sumps, the JN-2 Sanitary Line Sections B & C, the JN-3 Foundation Area, and the Active North Filter Bed Discharge Line, Columbus Closure Project, West Jefferson Site, West Jefferson, Ohio, February 9, 2006. (ML062890357)

35. FSSR #9 Columbus Closure Project Characterization and Final Status Survey Report for JN-1/4 Sanitary Sewer Line, Revision 1, Dated June 16, 2006.
    - ORISE Independent Verification – Document Review and Final Report - Type A Verification of the JN-1/4 Sanitary Sewer Line, Columbus Closure Project, West Jefferson Site, West Jefferson, Ohio, June 20, 2006.
    - NRC Inspection Report, 070-00008/2004-003(DNMS)- Battelle Columbus Laboratories Decommissioning Project NRC, Letter from Jamnes L. Cameron, Chief Decommissioning Branch (NRC) to J. Jacobsen (BMI), January 18, 2005. (ML062890357)

36. FSSR #10 Columbus Closure Project Characterization and Final Status Survey Report for the Abandoned Middle Filter Bed, Revision 2, Dated June 16, 2006.
    - ORISE Independent Verification - Letter Report – Verification Survey of the Abandoned Middle and North Filter Beds and Manhole B to Manhole E1 Sewer Line, Columbus Closure Project, West Jefferson Site, West Jefferson, Ohio, February 7, 2005.
    - NRC Inspection Report, 070-00008/2004-004(DNMS) - Battelle Columbus Laboratories Decommissioning Project NRC, Letter from Jamnes L. Cameron, Chief Decommissioning Branch (NRC) to J. Jacobsen (BMI), February 1, 2005. (ML062890357)

37. FSSR #11 Columbus Project Characterization and Final Status Survey Report for Manhole 7 to Manhole "A" Sewer Line, Revision 2, Dated June 16, 2006.
    - ORISE Independent Verification - Letter Report – Verification Survey of Manhole 7 to Manhole A and 8 Sewer Lines, Columbus Closure Project, West Jefferson Site, West Jefferson, Ohio, December 13, 2004.
    - NRC Inspection Report, 070-00008/2004-003(DNMS) - Battelle Columbus Laboratories Decommissioning Project NRC, Letter from Jamnes L. Cameron, Chief Decommissioning Branch (NRC) to J. Jacobsen (BMI), January 18, 2005. (ML062890357)

38. FSSR #12 Columbus Closure Project Characterization and Final Status Survey Report for Active North Filter Bed – North Subsurface Sand Filter, Revision 2, Dated June 16, 2006.
    - ORISE Independent Verification – Final Report – Verification Survey Results for the Active North Filter Bed (ANFB) North Subsurface Sand Filter, JN-4 North Land Area, ANFB to Manhole 2 Trench, and the ANFB Former Dosing Chamber Excavation, Columbus Closure Project, West Jefferson Site, West Jefferson, Ohio, February 9, 2006.
    - NRC Inspection Report, 070-00008/2005-001(DNMS) - Battelle Columbus Laboratories Decommissioning Project NRC, Letter from Jamnes L. Cameron, Chief Decommissioning Branch (NRC) to J. Jacobsen (BMI), June 30, 2005. (ML062890357)

39. FSSR #13 Columbus Closure Project Characterization and Final Status Survey Report for Active North Filter Bed - South Subsurface Sand Filter, Revision 0, Dated August 2005.
    - ORISE Independent Verification – Final Report – Verification Survey of Building JN-3 and the Active North Filter Bed – South Subsurface Sand Filter. Columbus Closure Project, West Jefferson Site, West Jefferson, Ohio, March 2, 2005.
    - NRC Inspection Report, 070-00008/2004-003(DNMS)- Battelle Columbus Laboratories Decommissioning Project NRC, Letter from Jamnes L. Cameron, Chief Decommissioning Branch (NRC) to J. Jacobsen (BMI), January 18, 2005. (ML062890357)

40. FSSR #14 Columbus Closure Project Characterization and Final Status Survey Report for Grids 33, 42, 50, 51, 52, and 61 of the Abandoned North Filter Bed, Revision 1, Dated June 16, 2006.
    - ORISE Independent Verification – Document Review and Final Report – Type A – Verification of Grids 42, 50, and 51 of the Abandoned North Filter Bed, Columbus Closure Project, West Jefferson Site, West Jefferson, Ohio, June 20, 2006.
    - ORISE Independent Verification – Final Letter Report – Verification Survey Results of Grids 33, 52, and 61, Columbus Closure Project, West Jefferson Site, West Jefferson, Ohio, June 20, 2006. (ML062890357)

41. FSSR #15 Columbus Closure Project Characterization and Final Status Survey report for Manhole 7 to Manhole 8 Sewer Line, Revision 2, Dated June 16, 2006.
    - ORISE Independent Verification - Letter Report – Verification Survey of Manhole 7 to Manhole A and 8 Sewer Lines, Columbus Closure Project, West Jefferson Site, West Jefferson, Ohio, December 13, 2004.
    - NRC Inspection Report, 070-00008/2004-003(DNMS) - Battelle Columbus Laboratories Decommissioning Project. NRC, Letter from Jamnes L. Cameron, Chief Decommissioning Branch (NRC) to J. Jacobsen (BMI), January 18, 2005. (ML062890357)

42. FSSR #16 Columbus Closure Project Characterization and Final Status Survey Report for the Active North Filter Bed Discharge Line, Revision 1, Dated June 16, 2006.
    - ORISE Independent Verification – Final Report – Verification Survey Results for the JN-1 Fuel Pool, Transfer Canal, and Inside and Outside Sumps, the JN-2 Sanitary Line Sections B & C, the JN-3 Foundation Area, and the Active North Filter Bed Discharge Line, Columbus Closure Project, West Jefferson Site, West Jefferson, Ohio, February 9, 2006.
    - NRC Inspection Report, 070-00008/2005-001(DNMS) - Battelle Columbus Laboratories Decommissioning Project NRC, Letter from Jamnes L. Cameron, Chief Decommissioning Branch (NRC) to J. Jacobsen (BMI), June 30, 2005.
    - Technical Basis Document DD-05-01DD-05-01, Technical Basis Document for Unrestricted Release of Sanitary Sewer Line Beneath Lake Battelle and the Lake Battelle Dam, Revision 0, Dated October 2004. NRC Review of Final Status Survey and Technical Basis Document for the Sanitary Sewer Line Beneath Lake Battelle and the Battelle Lake Dam, Letter from Kenneth G. O'Brien, Chief Decommissioning Branch (NRC) to J. Jacobsen (BMI), November 10, 2004. (ML062890357)

43. FSSR #19 Columbus Closure Project Characterization and Final Status Survey Report for the JN-2 Foundation Area and Sanitary Line, Revision 2, Dated June 16, 2006. ORISE Independent Verification - Final Letter Report – Verification Survey Results for the JN-2 Foundation Area and Sanitary Line, Columbus Closure Project, West Jefferson Site, West Jefferson, Ohio, March 20, 2006. (ML062890357)

44. FSSR #20 Columbus Closure Project Characterization and Final Status Survey Report for the WJN Well House Building, Revision 1, Dated June 16, 2006. ORISE Independent Verification - Final Letter Report – Verification Survey Results for the Well House Building, Columbus Closure Project, West Jefferson Site, West Jefferson, Ohio, June 20, 2006. (ML062890357)

45. FSSR #22 Columbus Closure Project Final Status Survey Report for Remaining Land Areas Inside the WJN Site Restricted Area, Revision 1, Dated June 16, 2006.
    - ORISE Independent Verification - Final Letter Report - Verification Survey Results for the Remaining Affected Land areas Inside the WJN Site Restricted Area, Columbus Closure Project, West Jefferson Site, West Jefferson, Ohio, June 20, 2006.
    - NRC Inspection Report, 070-00008/05-004(DNMS)- Battelle Columbus Laboratories Decommissioning Project NRC, Letter from Jamnes L. Cameron, Chief Decommissioning Branch (NRC) to J. Jacobsen (BMI), March 23, 2006. (ML062890357)

46. FSSR #23 Columbus Closure Project Final Status Survey Report for Unaffected Land Areas Outside the WJN Site Fence Line, Revision 1, Dated June 16, 2006.
    - ORISE Independent Verification – Final Letter Report – Verification Survey Results for the Unaffected Land Areas, Columbus Closure Project, West Jefferson Site, West Jefferson, Ohio, June 20, 2006. (ML062890357)

47. FSSR #24 Columbus Closure Project Characterization and Final Status Survey Report for The Areas Surrounding and Including the Active Middle Filter Bed, Revision 2, Dated June 16, 2006.
    - ORISE Independent Verification – Final Letter Report – In-process Survey Results for the North and South Vitrified Clay Pipes, Active Middle Filter Bed Area, Columbus Closure Project, West Jefferson Site, West Jefferson, Ohio, June 20, 2006.
    - ORISE Independent Verification – Final Letter Report – Verification Survey Results for the JN1-4 Bog Area, SS-JN1-2 Outfall, JN-2 Sanitation Line (Section A), and Active Middle Filter Bed, Columbus Closure Project, West Jefferson Site, West Jefferson, Ohio, June 20, 2006.
    - NRC Inspection Report, 070-00008/05-002(DNMS) - Battelle Columbus Laboratories Decommissioning Project NRC, Letter from Jamnes L. Cameron, Chief Decommissioning Branch (NRC) to J. Jacobsen (BMI), September 29, 2005.
    - NRC Inspection Report, 070-00008/05-004(DNMS) - Battelle Columbus Laboratories Decommissioning Project NRC, Letter from Jamnes L. Cameron, Chief Decommissioning Branch (NRC) to J. Jacobsen (BMI), March 23, 2006. (ML062890357)

48. FSSR #25 Columbus Closure Project Characterization and Final Status Survey Report for the JN1-4 Bog Area and SS-JN1-2 Outfall, Revision 1, Dated June 16, 2006.
    - ORISE Independent Verification – Final Letter Report – Verification Survey Results for the JN1-4 Bog Area, SS-JN1-2 Outfall, JN-2 Sanitation Line (Section A), and Active Middle Filter Bed, Columbus Closure Project, West Jefferson Site, West Jefferson, Ohio, June 20, 2006.
    - ORISE Independent Verification – Final Letter Report – RE: Investigation of the SS-JN1-2 Outfall, Columbus Closure Project, West Jefferson Site, West Jefferson, Ohio, June 20, 2006.
    - NRC Inspection Report, 070-00008/05-004(DNMS)- Battelle Columbus Laboratories Decommissioning Project NRC, Letter from Jamnes L. Cameron, Chief Decommissioning Branch (NRC) to J. Jacobsen (BMI), March 23, 2006. (ML062890357)

49. FSSR #26 Columbus Closure Project Characterization and Final Status Survey Report for the JN-2 Sanitation Line Section A, Revision 1, Dated June 16, 2006.
    - ORISE Independent Verification – Final Letter Report – Verification Survey Results for the JN1-4 Bog Area, SS-JN1-2 Outfall, JN-2 Sanitation Line (Section A), and Active Middle Filter Bed, Columbus Closure Project, West Jefferson Site, West Jefferson, Ohio, June 20, 2006. (ML062890357)

50. FSSR #27 Columbus Closure Project Characterization and Final Status Survey Report for the JN-1 South and East Grounds, Revision 1, Dated June 16, 2006.
    - ORISE Independent Verification – Final Letter Report - Verification Survey Results for the JN-1 South and East Grounds, Columbus Closure Project, West Jefferson, Ohio, June 20, 2006. (ML062890357)

51. FSSR #28 Columbus Closure Project Characterization and Final Status Survey Report for the JN-1 A and C Foundation Excavation, Revision 1, Dated June 16, 2006.
    - ORISE Independent Verification – Final Letter Report - Verification Survey Results for the JN-1 A and C Foundation Excavation, Columbus Closure Project West Jefferson, Ohio, June 20, 2006.
    - NRC Inspection Report, 070-00008/05-004(DNMS) - Battelle Columbus Laboratories Decommissioning Project NRC, Letter from Jamnes L. Cameron, Chief, Decommissioning Branch (NRC) to J. Jacobsen (BMI), March 23, 2006. (ML062890357)

52. FSSR #29 Columbus Closure Project Characterization and Final Status Survey Report for the JN-1 B Foundation Excavation, Revision 1, Dated June 16, 2006.
    - ORISE Independent Verification - Final Letter Report - Verification Survey Results for the East and West Well Caissons, JN-1 B Area, Columbus Closure Project, West Jefferson Site, West Jefferson, Ohio, June 20, 2006.
    - ORISE Independent Verification - Final Letter Report - Verification Survey Results for the JN-1B Foundation Excavation Including the HEC Excavation, Columbus Closure Project, West Jefferson Site, West Jefferson, June 20, 2006. (ML062890357)

53. FSSR #30 Columbus Closure Project Characterization and Final Status Survey Report for the JN-3 Cooling Waste Sewer Line – West Section, Revision 1, Dated June 16, 2006.
    - ORISE Independent Verification – Final Letter Report - In-process Inspection Results for the Western Section of the JN-3 Cooling Waste Line Excavation, Columbus Closure Project, West Jefferson Site, West Jefferson, Ohio, June 20, 2006. (ML062890357)

54. FSSR #31, FSSR #32, FSSR #33, FSSR #34, FSSR #35 Columbus Closure Project Characterization and Final Status Survey Report for the JN-3 Cooling Waste Sewer Line – East Section, Revision 1, Dated June 16, 2006.
    - ORISE Independent Verification - Final Letter Report - Verification Survey Results for the Eastern Section of the JN-3 Cooling Waste Line Excavation, Columbus Closure Project, West Jefferson Site, West Jefferson, Ohio, June 20, 2006.
    - Battelle Columbus Laboratory Decommissioning Project Characterization and Final Status Survey Report - JN-4 Yard and Drainage Pipe Removal, Dated May 2006.
    - NRC Inspection Report, 070-00008/05-004
    - Battelle Columbus Laboratory Decommissioning Project Characterization and Final Status Survey Report - West Jefferson North Abandoned Discharge Pipe, Dated April 2001.
    - NRC Inspection Report, 070-00008-2000003
    - Battelle Columbus Laboratory Decommissioning Project Characterization and Final Status Survey Report - TRU Waste Staging Pad Area
    - Battelle Columbus Laboratory Decommissioning Project Characterization and Final Status Survey Report - Investigatory Survey Report JN-3 Cooling Waste Sewer Line East
    - NRC Inspection Report, 070-00008/05-004 (ML062890357)

55. July 17, 2006, Letter from Battelle to the NRC, “Subject: Submission of West Jefferson North Site Dose Assessment Documents for NRC Review. (ML061990464)

56. Environmental Report for Termination of the NRC License for Battelle Columbus Laboratories Facilities at Columbus and West Jefferson, Ohio. (ML061860441)

57. Final Certification of Completion, Columbus Closure Project, West Jefferson North Site, West Jefferson, Ohio, Prepared for: U.S. Department of Energy, Columbus Closure Project Office, June 29, 2006, Contract Number: DE AC24-040H20171, Prepared by: ECC&E2 Closure Services. (ML062890357)

58. October 15, 2004, letter from Battelle to Mr. Mike McCann, “Subject: Submittal of final package for the Final Status Survey Technical Basis Document of the Sanitary Sewer Line Beneath Lake Battelle and the Battelle Lake Dam under the USNRC Material License SNM-7.” (ML042930808)

59. October 29, 2004, letter from Battelle to Mr. Mike McCann, “Subject: Submittal of Microshield Analysis supplement to the final package for the Final Status Survey Technical Basis Document of the Sanitary Sewer Line Beneath Lake Battelle and the Battelle Lake Dam.” (ML043070405)

60. November 17, 2004, letter to Mr. Mike McCann, “Subject: Submittal of final package for the Final Status Survey Report of JN-2 Facility under the USNRC Material License SNM-7.” (ML043280388)

61. July 19, 2004, letter from Battelle to Mr. Mike McCann, “Subject: Submittal of Final Package for the Final Status Survey Report of the JN-6 Facility under the USNRC Material License SNM-7.” (ML042300146)

62. April 21, 2006, NRC Telephone Conversation Record, documenting telephone conversation with Battelle Memorial Institute, “Subject: Discussion regarding Battelle’s March 9, 2006, letter which stated Battelle’s position regarding groundwater impacts due to past licensed operations. (ML061010652)

63. Decommissioning Plan Battelle Memorial Institute Columbus Operations, DD-93-19, Revision 3, August 8, 2000. (ML010410001)

64. August 25, 2000, NRC License Amendment, and cover letter, “Subject: Amendment No. 23, Approving Renewal of Battelle Memorial Institutes’ Decommissioning License No. SNM-00007, Condition 12.B.3, incorporated “Decommissioning Plan, Battelle Memorial Institute, Columbus Operations, DD-93-19, Revision 3, August 8, 2000.” (ML010370442)

65. Columbus Closure Project, Columbus, OH, Technical Basis Document for Unrestricted Release of Sanitary Sewer Line Beneath Lake Battelle and the Lake Battelle Dam, DD-05-01, Revision 0, October 2004. (ML042930808)

66. April 24, 2000, letter from Battelle to NRC, “Transmittal of Copy of Battelle's NRC-Approved Decommissioning Plan.” (ML 003711118)

67. Decommissioning Plan for the Battelle Memorial Institute Columbus Operations to U.S. Nuclear Regulatory Commission, Revision 0, May 1993, Prepared by Battelle, 505 King Avenue Columbus, Ohio 43201. (ML 003711118)

68. NRC License Amendment No. 21, License No. 070-00008. (ML003708894)

69. NRC License Amendment No. 23, License No. 070-00008. (ML010410001)

70. NRC License Amendment No. 23, License No. 070-00008. (ML010370442)

71. Correction to Decommissioning Plan Appendix E. (ML010540458)

72. Battelle Labs. Docket 070-00008, "West Jefferson North Facility: Monitoring Well Cluster Location Plan." (ML062970518)

73. May 23, 2006, letter from Battelle Memorial Institute to George M. McCann, NRC Region III, Decommissioning Branch, “Subject: Response to Request for More Information on the Battelle West Jefferson North Site Groundwater as Directed by NRC Telephone Conference Record, Dated March 21, 2006. (ML061450071)

74. October 15, 2004, letter from Battelle to the NRC, “Subject: Submittal of final package for the Final Status Survey Technical Basis Document of the Sanitary Sewer Line Beneath Lake Battelle and the Battelle Lake Dam under the USNRC Material License SNM.” (ML042930808)

75. DOE (U.S. Department of Energy), 1990, Environmental Assessment for Battelle Columbus Laboratories Decommissioning Project, DOE/EA-0433, June 1990. (ML062990356)

76. U.S. Department of Energy, 1990, “Finding of No Significant Impact, Decontamination and Decommissioning of the Battelle Columbus Laboratories in Columbus and West Jefferson, Ohio.” (ML062990353)

77. November 15, 2006, letter from Battelle to Mr. Mike McCann, “Subject: Summary Results of Installation and Sampling of Additional Groundwater Monitoring Wells at the Battelle West Jefferson North Site.” (ML063210470)

78. December 1, 2006, NRC memorandum, “Subject: Environmental Protection and Performance Assessment Directorate’s Quality Assurance Evaluation of Region III’s Division of Nuclear Material Safety Analysis of Battelle’s West Jefferson Facility Site Wide Dose Assessment. (ML063600043)

79. Environmental Protection and Performance Assessment Directorate’s Technical Evaluation Report on Battelle’s Groundwater Monitoring Plan and the Radiological Impact of Site Activities on the Groundwater at the West Jefferson North Site West Jefferson, Ohio. (ML063600043)

80. February 19, 2008, letter from the Ohio Environmental Protection Agency, to Steven Reynolds, NRC Region III, requesting that additional actions be taken regarding the decommissioning of the Battelle West Jefferson Site. (ML080530162)

81. June 29, 2007, telephone conversation record between the NRC and Ohio Environmental Protection Agency, regarding the Battelle West Jefferson Site. (ML072320403)

82. September 14, 2007, Battelle memorandum, “Review of Former West Jefferson North Site Filter Beds and Sanitary Sewer Treatment Systems.” (ML072760437)

83. August 29, 2007, letter from the Ohio Environmental Protection Agency requesting NRC address four recommendations regarding the West Jefferson Site decommissioning. (ML072410145).

84. January 22, 2008, letter from NRC responded to the Ohio Environmental Protection Agency responding to the Agency’s August 29, 2007, letter. (ML0802301260)

86. February 22, 2008, NRC memorandum summarizing a February 20, 2008, Public Meeting regarding NRC's Intent to terminate Battelle's SNM-00008 license. (ML080560047)

87. April 28, 2008, NRC Region III letter to the Ohio Department of Health, Subject: Information Regarding the License Termination Activities at the Battelle West Jefferson Site. (ML081190534)