

## **SAFETY EVALUATION REPORT**

SUBJECT: U.S. NUCLEAR REGULATORY COMMISSION EVALUATION OF SITE REMEDIATION, RADIOLOGICAL FINAL STATUS SURVEYS AND ACCEPTABILITY FOR UNRESTRICTED USE OF THE FORMER MICHIGAN CHEMICAL COMPANY BRECKENRIDGE DISPOSAL SITE, BRECKENRIDGE, MICHIGAN LICENSE NO.: SMB-00833 (TERMINATED), DOCKET NO.: 040-06264 (TERMINATED)

### **EXECUTIVE SUMMARY**

The purpose of this safety evaluation report (SER) is to document the U. S. Nuclear Regulatory Commission's (NRC) review of the decommissioning contractor's remediation activities, final status surveys (FSS), and final status survey report (FSSR) CS-313111-004, "Final Status Survey Report, Breckenridge Disposal Site, Madison Road, St. Louis, Bethany Township, Michigan," Revision 1. This document is available for review in the NRC's Agencywide Document Access and Management system (ADAMS) using Accession Number ML12004A051. The scope of the review was to determine the adequacy of the radiological FSS of the Breckenridge Disposal Site (BDS) and to determine if the site can be released for unrestricted use.

The decommissioning contractor, *EnergySolutions* (NRC License No. 06-20775-01), was awarded the contract by the Site Custodial Trustee (see Section 3.0 "Site History" below), to complete remediation at the BDS; the contractor began work in May 2010 and completed FSSs in September 2011. Site remediation and FSSs were performed and documented in accordance with the NRC-approved work plan CS-OP-PN-042, "Remedial Work Plan, Waste Excavation and Site Restoration for the Breckenridge Disposal Site," Revision 0 (ML100280041); and CS-313111-001, "Re-Evaluation of Breckenridge DCGLs, Gamma Scan Sensitivity, Gamma Scan Action Levels, and Development of Area Factors," Revision 1 (ML110260149).

The NRC used NUREG-1757, "Consolidated Decommissioning Guidance – Characterization, Survey, and Determination of Radiological Criteria," Volume 2, Revision 1; and NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)," Revision 1, dated August 2000, to complete its review. In addition, the NRC completed 25 on-site, in-process inspections and confirmatory surveys to determine the adequacy of the contractor's remediation activities and FSSs.

### **Conclusion**

Based on the 25 on-site NRC inspections, confirmatory surveys, and the NRC's review of the FSSR for the BDS, the NRC concluded that the BDS radiological status is consistent with the provisions of 10 CFR Part 20, "Standards for Protection against Radiation," Section 20.1402, "Radiological Criteria for Unrestricted Use;" therefore, the site is suitable for unrestricted use.

Enclosure

## Report Details<sup>1</sup>

### **1.0 SITE LOCATION AND DESCRIPTION**

The BDS is located at 4490 East Madison Road, Breckenridge, Michigan about 6.44 kilometers (km) east of downtown St. Louis, Bethany Township. The Breckenridge property is a narrow triangular-shaped parcel of land that is mostly flat and grassy with scattered large trees with no structures on site. The site, bounded by Madison Road on the north, by Bush Creek on the east, and by farmland on the west, is about 5,285 square meters (m<sup>2</sup>) in size with a former waste disposal area of approximately 3,880 m<sup>2</sup>. The area surrounding the site is rural farmland, and the nearest residence is located approximately 0.20 km to the east across Bush Creek.

### **2.0 SITE HISTORY** (*License Number/Licensed Activities/Authorized Activities*)

The Michigan Chemical Company (MCC) operated a rare-earth metals processing plant from 1967 through 1970 in St. Louis, Michigan. Feed-stock materials used by MCC contained licensable quantities of source material authorized until April 1971 when license number SMB-0833 was terminated. The MCC facility manufactured an array of chemical products; the products manufactured were fire retardant materials, insecticides, animal food supplements, and rare earth oxides. The MCC began operations in 1936 and continued as a subsidiary of Velsicol Chemical Corporation from 1963 until 1978. In 1986, the Fruit of the Loom Corporation and related company NWI Land Management Corporation (NWI) purchased MCC.

Disposal activities at the BDS were performed pursuant to 10 CFR 20.304, "Disposal by Burial in Soil," which was rescinded in 1981. The buried waste material was a solid waste byproduct, known as filter cake, which originated from the former licensee's rare-earth metal (yttrium) extraction process. Disposal records reported that the filter cake was typically a dense, clay-like material that contained elevated levels of naturally occurring uranium and thorium.

In 1981, Oak Ridge Associated Universities (ORAU) performed a radiological assessment of the Breckenridge property under contract with the NRC. The assessment examined the surface and outer boundaries of the disposal area. The report from the survey indicated that the average level of radionuclides was below the NRC's guideline for areas accessible to the public and that no migration of materials from the BDS was identified. (Sciencetech NES, Inc. 1999; ML993610209)

In September 1996, an environmental consultant performed shallow trenching at the BDS to investigate reports of improperly buried chemical materials. In October 1996, the NRC was contacted by the Michigan Department of Environmental Quality (MDEQ) to investigate the site because the environmental contractor believed that radioactive materials may have been discovered and disturbed during the environmental investigation. The NRC, assisted by MDEQ, performed a radiological scoping survey of the BDS. The NRC's report from the survey indicated that no significant risk was identified. However, since the survey identified levels in excess of the NRC's guidelines for unrestricted use, the NRC requested in a letter dated December 10, 1996, that additional characterization activities be performed. (Sciencetech NES, Inc. 1999)

On April 14, 1999, the NRC issued a letter to NWI directing NWI to bring the BDS to an acceptable closure under the regulatory framework of 10 CFR 20, Subpart E, "Radiological Criteria for License Termination." (Scientech NES, Inc. 1999) Action on the NRC's request was delayed as the result of the Fruit of the Loom Corporation and NWI declaring bankruptcy in 1999; a bankruptcy settlement was reached between the United States government and Fruit of the Loom/NWI in 2002.

As part of the bankruptcy settlement, Fruit of the Loom and NWI gave title to the BDS to a Custodial Trust, which was established to remediate the BDS using the framework set forth in 10 CFR Part 20, Subpart E. Under the terms of the settlement, the Custodial Trust was not subject to NRC licensing or enforcement authority, but would consult with NRC in its development and application of a remediation plan for the BDS. The NRC's role in the remediation has been to provide technical assistance to the Custodial Trust and independent verification of site remediation.

Characterization studies were performed at the BDS by several contractors between 1982 and 2007. Remediation of the site was attempted in 2004; and during that remediation effort, unexpected and additional surface cover soils were found to be contaminated along with the discovery of additional unidentified trenches of waste. As a result of the discovery of an unexpected increase in the waste volume, it was determined that the Custodial Trust had insufficient funds to complete the remediation and the operation was shut down until additional funding could be obtained. In 2007, the NRC was informed that the Custodial Trust had obtained additional funding. In early 2010, the Trustee with the NRC's review signed a contract with EnergySolutions to complete the decommissioning of the BDS.

### **3.0 DECOMMISSIONING ACTIVITIES/RADIOLOGICAL STATUS**

Between May 2010 and September 2011, the NRC conducted 25 inspections (ML110590136, ML11279A019) of the contractor's decommissioning activities which included: site mobilization and preparation, managing an on-site counting laboratory, training, safety, excavation/remediation, and FSS activities. Specifically, the NRC's inspections were performed to ensure work was performed consistent with the contractor's NRC-approved remedial work plan (RWP) and the NRC's regulations. The inspectors also performed independent and confirmatory radiological surveys of site survey units as defined in the contractor's RWP and FSS plans .

The contractor mobilized personnel and equipment to the BDS May 5, 2010, after the NRC approval of the RWP (ML100410102). Excavation of site soils began May 15, 2010, in accordance with the RWP; which specified that site soils would be removed in six-inch lifts. The plan required that, prior to removal of each six-inch soil lift, a 100 percent walk-over survey would be performed using a sodium iodide detector coupled with a Global Positioning System (GPS) device. According to the RWP, after each walk-over survey, the survey data was then plotted and used to determine soil sampling collection points. Sample collection was based on RWP-specified radiological investigational triggers and site Derived Concentration Guideline Levels (DCGLs) (see Section 5.0 "Site Specific Release Criteria" below for derivation of the DCGLs). The soil samples were collected in each RWP-specified survey unit throughout the area based upon the measured readings by navigating back to specific locations using GPS.

As the contractor removed each lift, the survey and sampling data was used to segregate releasable site “clean soils” from soils contaminated above the NRC-approved RWP DCGLs. This method was employed for six lifts, or to three feet below the site grade surface (bgs), at which time the excavation plan was modified to allow one-foot lifts until five-feet bgs was reached where the tops of the trenches or Confirmed Waste Areas (CWAs) were expected to be unearthed in Survey Units (SU) 2 and 3. To fully expose the tops of the CWAs, and aid in the trench excavation, surrounding clean soils were removed as necessary and stockpiled for use in backfilling excavated areas after being determined to meet site release limits. The “clean site soils” were re-surveyed and systematically sampled prior to being placed back into excavated site areas.

The CWAs were encountered approximately at five feet bgs. The tops of the trenches within SU-3 or the southern third of the site were exposed on or about July 28, 2010. The excavation of the CWAs began on or about August 1, 2010 starting with CWA-5 at the south fence working north. The radioactive waste (filter cake) and the surrounding contaminated soils were removed and stockpiled prior to loading. Contaminated soils were then removed and loaded directly into super-sacks and sealed, moved to the north end of the site, surveyed, and staged for shipment to the Clive disposal facility in Clive, Utah, as radioactive waste. (EnergySolutions 2011)

On August 5, 2010, drums of acid were unexpectedly encountered and broken in CWA-5, spilling the contents within the excavated trench. The area was immediately evacuated and the contractor’s management, the NRC, and the State of Michigan were notified. The project was placed in temporary shutdown until a proper path forward was identified. (EnergySolutions 2011)

To address the unexpected identification of the hazardous chemical waste, an addendum to the RWP was completed (ML11349A053). The addendum did not require NRC approval (ML102600284), because it did not affect the previously approved work plan regarding the radioactive waste at the site. Site remediation restarted on September 20, 2010; as the CWA excavation progressed, several more drums were encountered and notifications made. Attempts were made to recover the drums and drum liners; however, the conditions of the drums had deteriorated such that recovery was difficult. Samples were taken, as necessary, and shipped for off-site analysis to assess the materials to ensure proper disposal. Over the course of excavation, four drums and drum liners were recovered and over-packed for shipment and disposal as mixed waste. (EnergySolutions 2011)

Trench excavation proceeded until November 2, 2010, when three unknown trenches, Trenches A, B and C, were identified within SU-2 and found to contain laboratory chemicals and containers. Environmental Recycling Group (ERG) was contracted by the Trustee to help oversee the excavation of these three trenches and to sort, characterize, and temporarily package the chemicals and containers for future disposition and disposal by the United States Environmental Protection Agency (EPA). (EnergySolutions 2011) The EPA took responsibility for managing the removal of the chemical waste from the site, and hired an environmental contractor who collected and removed all remaining chemical waste for disposal in September 2011.

Site excavation activities were completed December 4, 2010, and the project was demobilized mid-December until January 4, 2011; at which time the remaining

radioactive and mixed wastes were shipped off site for disposal. All waste shipments were completed January 13, 2011. A total of 4,107 cubic yards of radioactive waste was shipped off site during the remediation phase of the project.

The site remobilized on July 5, 2011 to complete the site FSS. The site surveys and sampling were completed and the site backfilled using "clean soils." These clean soils consisted of 27 bags of on-site clean soil, and additional off-site clean soil obtained from a local farm. The off-site soil was verified to be clean after extensive surveys and laboratory analyses for radiological and chemical constituents and results verified by the NRC. Site backfill was completed on September 1, 2011, at which time the BDS was re-graded and hydro-seeded. On August 18, 2011, the NRC completed an on-site inspection of backfilling activities and concluded that those activities were consistent with the NRC-approved work plan and commitments (ML11279A019). Full site demobilization was completed by September 21, 2011.

The final dose contribution from each of the survey units is well below the total effective dose equivalent (TEDE) of 25 millirem (mrem) per year dose criterion for unrestricted release (see table below). It should be noted that this is based upon gross activities and does take contribution from background into account. As a result, the reported residual dose is conservative. (EnergySolutions 2011)

***SUM OF FRACTIONS (SOF) AND FINAL TEDE DETERMINATION***

| <b>Survey Unit</b>        | <b>MARSSIM Class Designation</b> | <b>TEDE (mrem)</b> | <b>SOF</b> |
|---------------------------|----------------------------------|--------------------|------------|
| <b>On-Site Clean Soil</b> | 1                                | 7.25               | 0.29       |
| <b>SU-1</b>               | 1                                | 6.5                | 0.26       |
| <b>SU-2</b>               | 1                                | 17.2               | 0.69       |
| <b>SU-3</b>               | 1                                | 17.5               | 0.70       |
| <b>SU-4</b>               | 3                                | 5.5                | 0.22       |

The NRC agreed with the contractor's development of DCGLs, based on available funds and remediation costs, as being conservative and reasonably achievable. The resultant "as-left" site dose is below the NRC's unrestricted use limits, with an overall site dose estimate of 10.8 mrem.

#### **4.0 SITE SPECIFIC RELEASE CRITERIA (DCGLs)**

The site release criterion or DCGLs for the BDS was documented in the contractor's RWP, Revision 0 (ML100280041). In a letter dated February 8, 2010 (ML100410102), the NRC informed EnergySolutions of the acceptance of the plan. However, it was necessary to modify the site DCGLs based on additional site survey information obtained during mobilization and the unexpected identification of elevated levels of thorium-230 (Th-230). The new site release criterion was documented in EnergySolutions document CS-313111-001, "Re-Evaluation of the Breckenridge DCGLs, Gamma Scan Sensitivity, Gamma Scan Action Levels and Development of Area

Factors,” Revision 1, dated January 19, 2011 (ML110260149). The NRC reviewed the addendum to the work plan and determined the document to be adequate and consistent with MARSSIM (ML110590136).

The site DCGLs were developed for the following decay chains to most closely model the conditions at the BDS: Thorium-232 (Th-232) + Chain (C), Uranium-238 (U-238) + Daughters (D), Uranium-234 (U-234), Th-230, and Radium-226 (Ra-226) + C.

The table below provides the DCGLs, in picocuries (pCi) per gram (g), as used with the unity rule for demonstrating site compliance with the dose based release criteria:

| Radionuclide      | DCGL <sub>w</sub> (pCi/g) |            |
|-------------------|---------------------------|------------|
|                   | Surface                   | Subsurface |
| <b>Th-232 + C</b> | 5.0                       | 65.9       |
| <b>U-238 + D</b>  | 442.4                     | 8,658      |
| <b>U-234</b>      | 2,729                     | 6,113      |
| <b>Th-230</b>     | 276.9                     | 97.9       |
| <b>Ra-226 + C</b> | 6.2                       | 51.2       |

(EnergySolutions 2011)

The unity rule, or sum of fractions (SOF), was used to demonstrate compliance to the DCGLs for mixtures of radionuclides using the following equation:

$$\text{SOF} = \frac{C_{\text{Th}_{232}}}{\text{DCGL}_{\text{Th}_{232}+\text{C}}} + \frac{C_{\text{U}_{238}}}{\text{DCGL}_{\text{U}_{238}+\text{D}}} + \frac{C_{\text{U}_{234}}}{\text{DCGL}_{\text{U}_{234}}} + \frac{C_{\text{Th}_{230}}}{\text{DCGL}_{\text{Th}_{230}}} + \frac{C_{\text{Ra}_{226}}}{\text{DCGL}_{\text{Ra}_{226}+\text{C}}}$$

Note: U-238 is used as a surrogate for U-234 with a demonstrated 1:1 ratio based upon off-site alpha spectroscopy analyses (i.e., secular equilibrium).

When measured by alpha spectroscopy analysis (from off-site laboratory), the actual Th-230 activity was used in the unity equation; otherwise, the concentration of Th-232 was used as a surrogate for Th-230 using the ratio of 9.8:1 for Th-230 to Th-232 activity. This activity ratio was based on statistical evaluation of the off-site alpha spectroscopy analytical data. The Th-230 to Th-232 ratio and Th-232 concentration was inserted into the Th-230 term of the unity equation above; this revised Th-230 term is illustrated below:

$$\frac{C_{\text{Th}_{230}}}{\text{DCGL}_{\text{Th}_{230}}} = \frac{9.8 * C_{\text{Th}_{232}}}{\text{DCGL}_{\text{Th}_{230}}}$$

(EnergySolutions 2011)

Note: “C<sub>isotope</sub>” in each of the equation’s numerator above is the concentration in activity per unit mass (pCi/g) for each of the specified isotopes.

## 5.0 AS LOW AS IS REASONABLY ACHIEVABLE (ALARA) CONSIDERATIONS

The NRC’s unrestricted use dose criterion also requires that doses be reduced to ALARA levels. The NRC noted that the mean activity concentrations for all the “Isotopes

of Concern (IOC)” in soil are at a small fraction of their respective DCGLs (see Section 6.0 “As-Left...” table). For a site like the BDS property that is meeting the unrestricted use dose criteria, the main ALARA consideration is the use of typical good practice efforts, including the removal of readily removable radioactivity in soils. Based on the contractor’s and the NRC’s confirmatory survey results, there were no indications of radioactive material on the BDS property that might be readily removable. The NRC concluded that for ALARA considerations, there are no additional decontamination or remediation activities necessary to ensure the suitability of the BDS property for unrestricted use.

## 6.0 EPA/NRC MEMORANDUM OF UNDERSTANDING (MOU) CONSULTATIVE TRIGGERS

The following discussion is in regards to the activity concentrations in soil; ground and surface waters were not a concern (see Section 7.0).

Because subsurface DCGLs exceeded the EPA limits for Th-232 (5 pCi/g) and Ra-226 (5 pCi/g) in soil, and before approving the DCGLs for the BDS, the NRC completed, in 2009, a Level 1 consultation with the EPA; as agreed to and described in Appendix H, “EPA/NRC Memorandum of Understanding (MOU),” of NUREG-1757, Volume 1, Revision 2.

The DCGLs and the pertinent EPA MOU trigger levels, as provided in NUREG-1757, Volume 1, Appendix H, are listed below:

### **BRECKENRIDGE RE-EVALUATED DCGLS**

| Radionuclide    | DCGL <sub>w</sub> (pCi/g) |            | EPA MOU LEVELS (pCi/g) |
|-----------------|---------------------------|------------|------------------------|
|                 | Surface                   | Subsurface |                        |
| <b>Th-232+C</b> | 5.0                       | 65.9       | 5                      |
| <b>U-238+D</b>  | 442.4                     | 8,658      | 74                     |
| <b>U-234</b>    | 2,729                     | 6,113      | 401                    |
| <b>Th-230</b>   | 276.9                     | 97.9       | n/a                    |
| <b>Ra-226+C</b> | 6.2                       | 51.2       | 5                      |

The NRC evaluated the “as-left” residual activity concentration levels, as reported in the contractor’s FSSR (shown in the table below), and compared them against the EPA’s consultation levels.

### **“AS-LEFT” AVERAGE ACTIVITY PER UNIT MASS (pCi/g) RESIDUAL CONCENTRATIONS**

|                   | Th-232 | Ra-226 | U-238 | Th-230* | SOF* |
|-------------------|--------|--------|-------|---------|------|
| <b>Background</b> | 0.57   | 0.57   | 0.50  | 0.57    | 0.21 |

|                                          | <b>Th-232</b> | <b>Ra-226</b> | <b>U-238</b> | <b>Th-230*</b> | <b>SOF*</b> |
|------------------------------------------|---------------|---------------|--------------|----------------|-------------|
| <b>BDS Final Grade – Biased</b>          | 1.88          | 0.84          | 1.47         | 18.4           | 0.58        |
| <b>Off-Site Backfill (Clean Soil)</b>    | 0.37          | 0.53          | 0.43         | 0.38           | 0.16        |
| <b>On-Site Backfill (Clean Soil)</b>     | 0.72          | 0.75          | 0.60         | 6.75           | 0.29        |
| <b>Trench Backfill (Bagged Material)</b> | 3.18          | 1.34          | 2.57         | 29.8           | 0.38        |
| <b>SU-1 Systematic and Biased</b>        | 0.63          | 0.72          | 0.56         | 5.4            | 0.26        |
| <b>SU-1 Subsurface</b>                   | 0.64          | 0.81          | 0.76         | 5.99           | 0.19        |
| <b>SU-2 Systematic and Biased</b>        | 0.80          | 1.03          | 0.76         | 7.77           | 0.36        |
| <b>SU-2 Trench (CWA)</b>                 | 1.57          | 1.68          | 2.19         | 9.07           | 0.18        |
| <b>SU-2 Subsurface</b>                   | 0.58          | 0.67          | 0.77         | 5.64           | 0.11        |
| <b>SU-3 Systematic and Biased</b>        | 1.92          | 1.37          | 1.89         | 21.4           | 0.35        |

|                          | Th-232 | Ra-226 | U-238 | Th-230* | SOF* |
|--------------------------|--------|--------|-------|---------|------|
| <b>SU-3 Trench (CWA)</b> | 1.39   | 1.25   | 1.52  | 8.38    | 0.15 |
| <b>SU-3 Subsurface</b>   | 0.72   | 0.75   | 0.88  | 6.39    | 0.14 |
| <b>SU-4 Soil Surface</b> | 0.54   | 0.67   | 0.48  | 0.60    | 0.22 |

*\*Note: The SOF and Th-230 numbers are for information only to show that the BDS is acceptable for unrestricted release, they are not applicable for determining if EPA consultation is warranted.*

Thus, the activity per unit mass concentration levels for all applicable IOC listed in the above table, except Th-230 since it is not listed as an IOC in the MOU Table 1; do not exceed the EPA's trigger levels. The NRC concluded that additional consultation with the EPA under the EPA/NRC MOU was not required.

## 7.0 GROUND AND SURFACE WATERS

Due to the relatively insoluble nature of thorium and uranium, groundwater and surface water impacts were not considered to be a concern. No monitoring wells were required for the site.

The activity for Ra-226 in water samples collected July 2011 by the NRC during an in-process inspection, and analyzed by the NRC's contract laboratory, Oak Ridge Institute for Science and Education (ORISE), was less than the EPA's drinking water standards (ML112200913). Two sediment samples were also collected by the NRC during an August 2011 inspection: one at a discharge point into Bush Creek and one downstream from the discharge point. The sample results were less than the release criterion for the site (ML112200250).

## 8.0 FINAL STATUS SURVEY REPORT REVIEW

The NRC's review confirmed that EnergySolutions FSSR CS-313111-004, "Final Status Survey Report, Breckenridge Disposal Site, Madison Road, St. Louis, Bethany Township, Michigan," Revision 1, December 13, 2011 (ML12004A051), was adequate to demonstrate compliance with the radiological criteria for unrestricted use per 10 CFR Part 20 Appendix E for the BDS. The FSS results, as documented in the report, demonstrated that each survey unit met the radiological criteria for unrestricted use. The staff used criteria as listed in Section 4.5.4, "Evaluation Criteria," of NUREG-1757,

Volume 2, Revision 1 to evaluate the FSSR. The staff concluded that the FSSs were consistent with guidance outlined in the following:

1. NUREG-1757, Volume 2, Revision 1, Appendix A, "Implementing the MARSSIM Approach for Conducting Final Radiological Surveys," Section A.9, "Determination of Compliance";
2. NUREG-1757, Volume 2, Revision 1, Appendix D, regarding survey data quality and reporting;
3. MARSSIM (NUREG-1575), Section 5.5.2, regarding acceptable number of samples; and,
4. MARSSIM (NUREG-1575), Sections 8.3, 8.4, and 8.5, describing interpretations of sample results.

The radiological surveys and soil sampling data were consistent with the data quality objectives as described in the FSSR, work plans, and NUREG-1757 and NUREG-1575.

EnergySolutions demonstrated that remaining residual radioactivity is below the TEDE to an average member of a critical group and does not exceed 25 mrem per year as specified in Title 10 of the CFR, Part 20, Section 20.1402, "Radiological Criteria for Unrestricted Use;" and there is reasonable assurance that the health and safety of the public will not be endangered by the unrestricted use of the BDS.

## **9.0 CONCLUSION**

Based on the NRC's 25 on-site inspections, the NRC's independent and confirmatory surveys, and the NRC's review of the contractor's FSSR for the BDS, the NRC concluded that the BDS radiological status is ALARA and consistent with the provisions of 10 CFR Part 20, "Standards for Protection against Radiation," Section 20.1402, "Radiological Criteria for Unrestricted Use;" therefore, the site is suitable for unrestricted use.

ATTACHMENT: SUPPLEMENTAL INFORMATION

## SUPPLEMENTAL INFORMATION

### REFERENCES

1. Title 10 Code of Federal Regulation Part 20, Standards for the Protection Against Radiation, 2011
2. NUREG-1757, "Consolidated Decommissioning Guidance – Characterization, Survey, and Determination of Radiological Criteria," Volume 1, Revision 2, September 2006
3. NUREG-1757, "Consolidated Decommissioning Guidance – Characterization, Survey, and Determination of Radiological Criteria," Volume 2, Revision 1, September 2006
4. NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)," Revision 1, August 2000
5. Inspection Report (IR) No. 040-06264/00-01, March 10, 2000 (ML003692929)
6. IR No. 040-06264/00-02, May 23, 2000 (ML003719757)
7. IR No. 030-22060/10-01, June 10, 2010 (ML101610766)
8. IR No. 030-22060/10-02 and 040-06264/10-01, February 23, 2011 (ML110590136)
9. IR No. 040-06264/11-01, October 4, 2011 (ML11279A019)
10. EnergySolutions Final Status Survey Report CS-313111-004, "Final Status Survey Report, Breckenridge Disposal Site, Madison Road, St. Louis, Bethany Township, Michigan," Revision 1, December 13, 2011 (ML12004A051)
11. EnergySolutions, CS-OP-PN-042, Remedial Work Plan – Waste Excavation and Site Restoration for the Breckenridge Disposal Site, Revision 0, January 27, 2010 (ML100280041), (Package: ML100280031 (Transmittal Letter and Work Plan))
12. EnergySolutions, CS-OP-PN-042 Addendum, Remedial Work Plan – Waste Excavation and Site Restoration for the Breckenridge Disposal Site, Revision 0, September 14, 2010 (ML11349A053)
13. EnergySolutions, CS-313111-001, Re-Evaluation of the Breckenridge DCGLs, Gamma Scan Sensitivity, Gamma Scan Action Levels and Development of Area Factors, Revision 1, January 19, 2011 (ML110260149)
14. EPA Letter to NRC, June 12, 2009 (ML091810846)
15. NRC Memorandum to File, "Discussion of Revised Breckenridge DCGLs in Regard to EPA MOU," February 22, 2011 (ML110690279)
16. NRC Letter to EnergySolutions, "Remedial Work Plan, Breckenridge Disposal Site, St. Louis, Michigan (Formally NWI Land Management)," February 8, 2010 (ML100410102)

17. NRC Letter to Trustee, "Breckenridge Disposal Site, St. Louis, Michigan (Formally NWI Land Management)," September 16, 2010 (ML102600284)
18. NRC Memorandum, "The Proposed DCGLs for the Breckenridge Disposal Site," February 24, 2009 (ML090510550)
19. NRC Letter to EPA, "MOU Consultation on the Decommissioning of the NWI Breckenridge Site in Breckenridge, Michigan," March 23, 2009 (ML090640953)
20. NRC Letter to EPA, "Response to Recommendations Regarding the Decommissioning of the NWI Breckenridge Site in Breckenridge, Michigan," July 14, 2009 (ML091730216)
21. ORISE Laboratory Letter Report to NRC, August 2, 2011 (ML112200913)
22. ORISE Laboratory Letter Report to NRC, August 5, 2011 (ML112200250)
23. Sciencetech NES, Inc. Report, "Radiological Evaluation of the Breckenridge Disposal Site," August 31, 1999 (ML993610209)

#### **LIST OF ACRONYMS USED**

|                   |                                                                                          |
|-------------------|------------------------------------------------------------------------------------------|
| AEC               | Atomic Energy Commission                                                                 |
| ADAMS             | Agencywide Document Access and Management System                                         |
| ALARA             | As Low As Reasonably Achievable                                                          |
| BDS               | Breckenridge Disposal Site                                                               |
| bgs               | below grade surface                                                                      |
| CFR               | Code of Federal Regulations                                                              |
| CWA               | Confirmed Waste Area                                                                     |
| DCGL              | Derived Concentration Guideline Level                                                    |
| DCGL <sub>w</sub> | Uniform residual radioactivity concentration level that corresponds to release criterion |
| DNMS              | Division of Nuclear Materials Safety                                                     |
| ERG               | Environmental Recycling Group                                                            |
| EPA               | United States Environmental Protection Agency                                            |
| FSS               | Final Status Survey                                                                      |

|         |                                                             |
|---------|-------------------------------------------------------------|
| FSSR    | Final Status Survey Report                                  |
| GPS     | Global Positioning System                                   |
| IOC     | Isotopes of Concern                                         |
| IR      | Inspection Report                                           |
| MARSSIM | Multi-Agency Radiation Survey and Site Investigation Manual |
| MCC     | Michigan Chemical Company                                   |
| MDEQ    | Michigan Department of Environmental Quality                |
| NRC     | United States Nuclear Regulatory Commission                 |
| NWI     | NWI Land Management Corporation                             |
| ORAU    | Oak Ridge Associated Universities                           |
| ORISE   | Oak Ridge Institute for Science and Education               |
| RWP     | Remedial Work Plan                                          |
| SOF     | Sum of Fractions                                            |
| SU      | Survey Unit                                                 |
| TEDE    | Total Effective Dose Equivalent                             |