TECHNICAL EVALUATION REPORT
RADIOLOGICAL STATUS: ACCEPTABILITY OF CSX TRANSPORTATION PROPERTY (INKSTER ROAD, LIVONIA, MICHIGAN) FOR UNRESTRICTED USE
DOCKET 040-00235
June 2011

1.0 INTRODUCTION

The CSX Transportation, Inc. (CSXT) property, which consists of operating rail lines and associated rights-of-way, is located to the immediate west of Inkster Road in Livonia, Michigan. The parcel of potential concern is adjacent to and runs parallel to the southern boundary of the AAR Manufacturing Inc. (AAR) site. The AAR site was formerly owned by Brooks & Perkins, Inc., a licensee of the U.S. Atomic Energy Commission (AEC). The AEC terminated Brooks and Perkins' license (STB-0362) on May 17, 1971. In 1981, AAR purchased Brooks and Perkins and obtained the property. In March 1994, the U.S. Nuclear Regulatory Commission (NRC) staff informed AAR that radioactive thorium had been detected at several surface and subsurface locations on the AAR site and requested that AAR perform radiological surveys and remediation activities (NRC 1994).

In May 1997, NRC inspectors performed a limited independent radiation survey of the CSXT right-of-way (ROW) adjacent to the AAR site (NRC 1997a). NRC staff provided the inspection report to CSXT in a June 12, 1997, letter; the report identified three locations with elevated thorium in soil that were found (NRC 1997a). NRC staff indicated that some residual radioactive material may have spread from the AAR site onto the CSXT property (NRC 1997a). In a September 8, 1997, letter, NRC requested that CSXT provide an accurate characterization of the property (NRC 1997b). CSXT, with its contractor, ARCADIS Geraghty and Miller, performed characterization and dose modeling of the property. CSXT submitted the report to NRC September 13, 2000 (CSXT 2000). The ARCADIS conclusion in that report was that the dose modeling results demonstrate that no remedial actions or restrictions on site usage are required and that the total site dose does not exceed the 25 mrem/year NRC criteria for unrestricted release.

In October 2000, based on review of the September 2000 report, NRC staff requested that CSXT provide additional information and clarification on several technical issues (NRC 2000). The issues included:

Survey Techniques – To NRC staff, it was unclear whether a 100% scan survey was performed. Also, it appeared to NRC staff that the instrument used may not have had sufficient capabilities for the intended use.

Survey Results – To the NRC staff, there appeared to be inconsistency between the elevated direct readings and corresponding soil analyses.

Dose Assessment – The NRC staff considers that the dose assessment should have addressed the residual radioactivity in elevated areas, which was not done.

These issues had not been addressed by CSXT.

2.0 EVALUATION

To address the open technical issues, the NRC staff had its independent contractor, the Oak Ridge Institute for Science and Education (ORISE), perform radiological surveys at the CSXT property in September 2010. This Technical Evaluation Report describes the NRC staff evaluation of the survey results.

2.1 Facility Description

The CSXT property, which consists of operating rail lines and associated rights-of-way, is a narrow strip of land, approximately 12 m wide (including railbed and right-of-way along the tracks) by 370 m long. The property is located to the immediate west of Inkster Road in Livonia, Michigan. The parcel of potential concern is adjacent to and runs parallel to the southern boundary of the AAR Manufacturing Inc. (AAR) site. A fence is in place along most of the border with the AAR site. The land terrain includes a drainage along the railbed, and the land surface slopes down from the railbed and down from the AAR site. The portion of the property other than the railbed is generally vegetated, with brush and some small trees. A small railroad building exists on the western end of the property. Currently, use of the property is for operating rail lines and use of immediate neighboring land is industrial. However, residential properties exist in the general area of the property.

2.2 Method for Comparing Survey Results to Criteria for Unrestricted Use

Although the CSXT property is not an NRC-licensed site, the NRC staff is evaluating the CSXT property against the criteria for license termination for unrestricted use, in 10 CFR 20.1402. For unrestricted use, the dose criterion is 25 mrem/yr to the average member of the critical group and as low as is reasonably achievable (ALARA). Staff is using the derived concentration guideline level (DCGL) method to evaluate the CSXT property. That is, a DCGL is developed, and results of the survey of the CSXT property are compared to the DCGL. The DCGL is based on the dose assessment NRC staff performed for the neighboring AAR site (NRC 2009a). It is noted that NRC staff is performing the survey and evaluation of results, rather than the more usual case of NRC staff reviewing a licensee's evaluation.

2.3 Dose Assessment for the AAR Site

In the dose assessment for the AAR site, the NRC staff considered a number of potential exposure scenarios. At the time of the assessment, AAR had proposed unrestricted use for the eastern parcel of the site and restricted use for the western parcel. Because the CSXT property is being evaluated against the unrestricted use criteria, staff considered the exposure scenarios used for the eastern parcel of the AAR site to be appropriate. For the eastern parcel of the AAR site, the NRC staff concluded that the reasonably foreseeable scenario recommended for direct comparison against radiological criteria for license termination was a resident gardener scenario. The source term was based on radionuclide concentrations averaged over large areas of the parcel of approximately 10,000 m^2 each. (This scenario is labeled 5d in the AAR assessment (NRC 2009a).)

The NRC staff also evaluated potential exposure scenarios involving smaller areas of contaminated soil (i.e., elevated areas), of approximately 100 m^2 and approximately 2000 m^2. However, staff determined that these scenarios were not appropriate for comparison against the license termination criteria, because (a) significant land disturbance is expected to be required to develop the AAR site for residential use, and this disturbance is expected to cause mixing of

soils such that there are no true "hot spots": and (b) receptors would be exposed to various areas of the site for the same amount of time. Staff determined that use of average concentrations over the exposure area (which was up to 10,000 m^2) would provide reasonable estimates of risk associated with residual radioactivity remaining at the site. Thus, elevated measurement criteria ($DCGL_{EMC}$) were not necessary and were not developed for the AAR assessment. Staff notes that the AAR dose assessment is a site-specific analysis that should not be applied to other sites.

Pertinent aspects of the dose assessment for the AAR site are summarized in Table 1.

Table 1. Summary of dose assessment for resident gardener scenario (5d) for eastern parcel of AAR site (ref: NRC 2009a)

Area over which radionuclide concentrations averaged:	Approximately 10,000 m^2
Average net[a] concentration Th-232 in surface (0–1 m) soil:	1.98 pCi/g
Average net Th-230 concentration in surface soil [b]:	5.19 pCi/g
Average net Th-232 concentration in subsurface (1–2 m) soil:	0.37
Average net Th-230 concentration in subsurface (1–2 m) soil [2]:	0.96
Calculated dose:	13.4 mrem/yr

[a] All soil concentrations are net, which are average measured concentrations minus average background concentrations (see NRC 2009 for details).

[b] In the dose assessment for the AAR site, it was determined that a reasonable average ratio of Th-230 to Th-232 concentrations is 2.62:1. That ratio was used to determine average Th-230 concentrations.

2.4 Applicability of AAR Dose Assessment to CSXT Property

The NRC staff considers that the exposure scenarios included in the AAR dose assessment are bounding for doses likely to occur for the CSXT property. The exposure scenario in the AAR assessment recommended for comparison to the radiological criteria for license termination is a residential gardener scenario. The current use of the CSXT property is a right-of-way for railroad tracks. This use is expected to continue. The CSXT property is a narrow strip of land, approximately 12 m wide (including railbed and right-of-way along the tracks) by 370 m long. If use of the property for railroad tracks ceased, it is unlikely that a residence could or would be built on the property, because of how narrow the property is. It is plausible that if the tracks are removed, the CSXT property could be combined with a neighboring property and houses could be developed on it. Non-residential uses of the property would generally result in exposures less than those of a residential scenario because (1) occupancy times are expected to be much lower than for residential use, (2) consumption of food grown on the site is unlikely for non-residential land use. The NRC staff considers residential use of the property in the future to be less likely but plausible. For any of the reasonably foreseeable or plausible cases, the NRC staff concludes that the residential gardener exposure scenario used in the AAR assessment to be a bounding scenario for the CSXT property. Thus, it is appropriate to develop a wide-area DCGL ($DCGL_W$) for the CSXT property from the AAR dose assessment results.

Regarding potential exposure to smaller elevated areas, staff considers that the exposure conditions expected for the AAR site would be bounding for the CSXT property, including that it is unnecessary to compare the dose from smaller areas (e.g., 100 m^2) to the dose criterion, as

discussed in Section 2.2 above. Thus, for the CSXT property, only a $DCGL_W$ is needed; no elevated area criteria (e.g., $DCGL_{EMC}$) are needed.

2.5 Determination of $DCGL_W$ for Application to CSXT Property

The NRC staff calculates a $DCGL_W$ from the source term concentration of Th-232 and the calculated dose of the AAR assessment. Based on the surface (0–1 m) Th-232 concentration of 1.98 pCi/g and the calculated dose of 13.4 mrem/yr, the Th-232 $DCGL_W$ is determined to be:

$$\mathrm{DCGL_W} = (25\ \mathrm{mrem/yr})\frac{(1.98\ \mathrm{pCi/g})}{(13.4\ \mathrm{mrem/yr})} = 3.7\ \mathrm{pCi/g}$$

This $DCGL_W$ is the concentration of Th-232, with its entire decay chain in equilibrium and with Th-230 present at the ratio described above (Table 1). This $DCGL_W$ is applicable to the average concentration for a large area (up to 10,000 m^2), but are applied to survey units on the CSXT property with area about 2000 m^2. As discussed above, for the CSXT property, criteria for elevated areas ($DCGL_{EMC}$s) are not necessary.

2.6 2010 Radiological Survey of the CSXT Property

Prior to performing the CSXT property survey, ORISE prepared a project specific survey plan (ORISE 2010), which was approved by NRC staff. ORISE performed the field survey September 20–21, 2010 (ORISE 2011). For the 2010 radiological surveys, the CSXT property was divided into two survey unit (SU) areas. The total surface area of the entire survey area is about 3080 m^2, with each survey unit covering approximately 1500 m^2. Gamma surface scans and soil sampling were performed in each SU. In the survey plan, ORISE had initially divided the CSXT property into three SUs. However, due to several of the original randomly selected soil locations being located within the railroad tracks or railbed and the logistics for surveying the uneven terrain, the originally planned radiological survey activities were reduced in width to surveying the area from the area from the edge of the railbed to the AAR fence-line. The NRC staff concurred in this field decision, in part because preliminary survey results (and historical results) showed no indications of residual radioactivity near the tracks. With this change, the area of the property surveyed was reduced in width to about 8 m; the survey was reduced to two SUs instead of three; and the random samples were reduced to 24 instead of 36.

Global positioning system (GPS) coordinates were used for referencing measurement and sampling locations. High density (approximately 90% scan coverage due to overgrowth and terrain) gamma radiation surface scans were conducted over the soil surface within each of the SUs. Surface scans were performed using sodium iodide (thallium-activated) [NaI(Tl)] scintillation detectors coupled to ratemeters or ratemeter-scalers with audible indicators. Field personnel relied on the audio output to identify and mark for further investigations any locations of elevated direct gamma radiation that might suggest the presence of residual radioactivity.

In the survey plan (ORISE 2010), ORISE determined that twelve systematic soil samples from each SU would be adequate to estimate the mean concentrations. During the survey, judgmental surface soil samples were collected from locations where gamma scan results were elevated. Subsurface soil samples were collected based on an increase in gamma radiation levels at the bottom of the (surface) sampled location. ORISE had collected background soil samples during a previous site visit to the adjacent AAR facility in August 2003.

2.7 Overview of Results of 2010 Survey

Gamma radiation surface scans identified several areas of elevated gamma radiation, primarily along the northern fence line. Eleven (eight surface and three subsurface) judgmental soil samples were collected from locations identified as having elevated gamma radiation levels during the gamma surface scans. The radiological survey results demonstrate that residual soil radioactivity is present along the fence line in several small areas. Detailed results are provided in the ORISE report (ORISE 2011).

2.8 Verification of Th-230 to Th-232 Ratio

Soil samples collected in the 2010 survey of the CSXT property were analyzed for Th-232 and Th-230 (as well as Th-228). The NRC staff evaluated the ratios of Th-230 to Th-232, to verify the assumed ratio of 2.62:1 used in the DCGL development (described in Table 1). As staff had done in determining an average ratio for the AAR site, staff considered only those sample results for which the net Th-232 concentration was greater than 1.0 pCi/g. Results are shown in Table 2, with calculated ratios of Th-230 to Th-232. For the ten samples, the average ratio is 2.98, with standard error of the mean of 0.20. The NRC staff considers these results to be generally consistent with the Th-230 to Th-232 ratios for the AAR site (which had an average ratio of 2.62). Thus, staff considers the radionuclide source term mix at the CSXT property to be consistent with assumptions of the DCGL development.

Table 2. Determination of Th-230 to Th-232 Ratio for CSXT Property*

	gross concentration (pCi/g)		net concentration (pCi/g)		Ratio Th-230 to
Sample	Th-230	Th-232	Net Th-230	Net Th-232	Th-232
S009	10.5	3.4	9.95	3.08	3.23
S021	18.5	6.63	17.95	6.31	2.84
S025	11	4.05	10.45	3.73	2.80
S027	141	54.8	140.45	54.48	2.58
S035/27	206	80.3	205.45	79.98	2.57
S034/21	7.9	1.89	7.35	1.57	4.68
S028	23.4	8.35	22.85	8.03	2.85
S029	15	5.91	14.45	5.59	2.58
S030	12.7	4.58	12.15	4.26	2.85
S031	3.4	1.33	2.85	1.01	2.82
mean					2.98
standard deviation					0.63
number of samples					10
standard error of mean					0.20

* Compilation here is all samples for which the net Th-232 concentration is greater than 1.0 pCi/g.

2.9 Evaluation of Mean Concentrations and Comparison to $DCGL_W$

A total of twelve systematic soil samples were collected from each survey unit. The summary data for the two surveys units are presented in Table 3.

Table 3. Radionuclide Concentrations (pCi/g) in Systematic Soil Samples

Survey Unit	Th-230	Th-228	Th-232	Natural Th*
SU 1	-11.6 to 10.5	0.20 to 3.61	0.21 to 3.40	0.41 to 7.01
SU 1 Mean	-1.0	0.8	0.8	1.5
SU 2	-12.8 to 18.5	0.31 to 6.46	0.29 to 6.63	0.61 to 13.09
SU 2 Mean	-1.4	0.9	0.9	1.8
Site Mean	-1.2	0.8	0.8	1.7
Site Median	-0.3	0.4	0.4	0.8

* Natural Thorium = Th-228 + Th-232.

Eleven (eight surface and three subsurface) judgmental soil samples were collected from locations identified as having elevated gamma radiation levels during the gamma surface scans. There were three elevated areas in SU 1 and two elevated areas found in SU 2. The summary data for the judgmental soil samples are presented in Table 4.

Table 4. Radionuclide Concentrations (pCi/g) in Judgmental Soil Samples

Survey Unit	Th-230	Th-228	Th-232	Natural Th*
SU 1	1.2 to 206	0.02 to 78.7	0.11 to 80.3	0.13 to 160
SU 2	2.8 to 23.4	0.51 to 8.08	0.49 to 8.35	1.0 to 16.4

* Natural Thorium = Th-228 + Th-232.

The NRC staff calculated an area-weighted mean Th-232 concentration, to evaluate the impact of elevated areas on the overall average concentration (and thus on dose). Table 5 shows the calculation of the area-weighted mean concentrations for the two survey units. The calculated weighted mean net (after subtracting background) Th-232 concentrations are 0.6 pCi/g. This is substantially lower than the Th-232 $DCGL_W$ of 3.7 pCi/g. The NRC staff concludes that the weighted mean concentration provides reasonable assurance that the unrestricted use criteria is satisfied.

Table 5: Evaluation of Elevated Areas and Weighted Mean Concentrations

Area	size (m^2)	Net Th-232 concentration (pCi/g)[a]
Survey Unit 1		
General area [b]	1500	0.5
Elevated area 1 [c] (includes sample S025)	0.25	3.7
Elevated area 2 [c] (includes sample S026)	0.25	0.0
Elevated area 3 [d] (includes samples S027, S032, and S035)	2.	80.
Survey Unit 1 weighted mean [e]	1500	0.6
Survey Unit 2		
General area [b]	1500	0.6
Elevated area 1 [c] (includes samples S014 and S035)	0.1	0.2
Elevated area 2 [d] (includes samples S021, S028, S029, S030, S031, and S034)	7.	8.0
Survey Unit 2 weighted mean [e]	1500	0.6

[a] Net concentration is gross minus average background concentration of 0.32 pCi/g.
[b] Concentration for general area is mean for the survey unit based on the systematic sampling (see Table 3).
[c] Concentration for this small elevated area is the single measured soil sample result.
[d] Concentrations used for this elevated area is the maximum of all soil sample results from the elevated area.
[e] The weighted mean is calculated as the mean of the general area and elevated area concentrations, weighted by the size (m^2) of each area.

2.10 Potential for Additional Elevated Areas

The NRC staff acknowledges the possibility of elevated areas that have not been detected or evaluated at the CSXT property. The gamma radiation surface scans were conducted over approximately 90% of the CSXT property; roughly 10% of the property could not be scanned (due to the presence of a small building, overgrown vegetation, and terrain). Areas not scanned may potentially include elevated concentrations. However, in addition to the multiple scan surveys performed by the ORISE and NRC staff of all accessible areas, systematic gamma measurements and soil samples and judgmental soil samples were taken in each survey unit. The combination of multiple surveyors and the measurements make it very unlikely that a large elevated area would not be detected. In addition, the calculated weighted mean concentration was substantially below the $DCGL_W$. Thus, the NRC staff concludes that there is reasonable assurance that elevated areas do not exist to an extent that would cause the weighted mean concentration to exceed the $DCGL_W$.

2.11 Comparison of 2010 Elevated Areas to 1996 NRC Inspection Results

The staff compared the soil sample results of the May 15, 1997, NRC inspection report with the results of the 2010 radiological survey of the CSXT property. During the 1997 NRC inspection, three areas were identified with elevated thorium soil concentrations. The three reported concentrations were 58, 56, and 18 pCi/g (note that these were reported as Th, and appear to

be natural thorium, i.e., Th-232 + Th-228) and were located from one to twenty feet of the fence line with the AAR property. The three highest Th-232 concentrations from the ORISE 2010 survey were 80.3, 54.8, and 8.35 pCi/g, which are reasonably consistent with the previous activity levels. It appears that the elevated areas reported in the 1997 inspection report are in the same general vicinity as the elevated areas identified in the 2010 radiological survey.

2.12 ALARA Consideration

The unrestricted use dose criterion also requires that doses be reduced to ALARA levels. The NRC staff notes that the weighted mean Th-232 concentrations for the two survey units are at a small fraction of the 3.7 pCi/g $DCGL_W$. Based on the 2010 survey, there do not appear to be any locations where radioactive material is readily removable with little cost. The NRC staff concludes that for ALARA considerations, there are no additional decontamination or remediation activities required for the unrestricted use of the CSXT property.

2.13 Evaluation of EPA/NRC MOU Consultation Triggers

The NRC Staff evaluated the DCGL values in comparison to values that trigger consultation with the EPA. The EPA/NRC MOU trigger values are provided in NUREG-1757, Vol. 1, Appendix H (NRC 2006). The trigger values for Th-232 and Th-228 are 5 pCi/g and 15 pCi/g, respectively. There is not a trigger value for Th-230. The $DCGL_W$ used for the CSXT property is 3.7 pCi/g for Th-232, with the assumption that Th-228 is in equilibrium with Th-232. For the MOU, the sum of fractions approach does not apply to Th-232. Thus, the DCGLs for Th-232 and Th-228 are compared directly to the trigger values, and do not exceed the trigger values. The NRC staff concludes that consultation with the EPA under the EPA/NRC MOU is not required.

3.0 CONCLUSIONS

The NRC staff makes the following conclusions:

1. The 2010 ORISE survey was performed using appropriate methods consistent with NRC guidance. The survey results demonstrate that concentrations of Th are generally very low, but there are small areas of elevated residual radioactivity on the property.

2. Additional (undetected) elevated areas may exist, but the NRC staff considers the likelihood of large undetected elevated areas to be very small. Thus, impacts to the overall average Th concentration from undetected elevated areas are expected to be small and have insignificant dose consequences.

3. A $DCGL_W$ for Th-232 of 3.7 pCi/g was determined acceptable for use for the CSXT property.

4. The overall, weighted average Th concentrations, which account for general area residual radioactivity (based on systematic sampling) and elevated areas of radioactivity (based on judgmental sampling), are substantially below the $DCGL_W$.

Therefore, the NRC staff concludes that the CSXT property meets the criteria for release of sites for unrestricted use (no greater than 25 mrem/yr, per 10 CFR 20.1402) and no additional soil remediation or cleanup is required.

Principal Contributors:
Stephen Giebel, FSME/DWMEP/DURLD
Duane Schmidt, FSME/DWMEP/DURLD

4.0 REFERENCES:

ARCADIS 1998. *Results of Radiometric Survey, Inkster Road Site, Livonia, Michigan.* Letter P.J. Bartnic to P. Kurzanski, June 5, 1998. (ML110420461)

ARCADIS 1999. *Summary of RESRAD Model Construction and Initial Modeling Results, Inkster Road, Livonia, Michigan.* Letter K.A. Panczak to P. Kurzanski, October 27, 1999. (ML110420473)

CSXT 2000. *Request for Closure Determination.* Letter P. Kurzanski to B.L. Jorgensen, September 13, 2000. (ML090680748)

NRC 1994. *Inspection of Former Atomic Energy Commission (AEC) Licensed Site (NRC Report No. 999-90003/94012 (DRSS))*. Letter to H.A. Pulsifer, AAR Corporation, from G.L. Shear, US Nuclear Regulatory Commission, dated March 29, 1994. (ML110670259)

NRC 1997a. *NRC Inspection of Former Atomic Energy Commission (AEC) Licensed Site in Livonia, MI,* Letter R.J. Canaino to P. Kurzanski, June 12, 1997. (ML091000360)

NRC 1997b. *NRC Inspection of Former Atomic Energy Commission (AEC) Licensed Site in Livonia, MI,* Letter B.L. Jorgensen to P. Kurzanski, September 8, 1997. (ML101250613).

NRC 2000. Letter B.L. Jorgensen to P. Kurzanski, October 27, 2000. (ML003765576).

NRC 2006. *Consolidated Decommissioning Guidance, Decommissioning Process for Materials Licensees*, NUREG-1757, Vol. 1, Rev. 2, September 2006 (ML063000243).

NRC 2009. *Radiological Risk Assessment for the AAR Site in Livonia, Michigan*, C.S Barr and D.W. Schmidt, U.S. Nuclear Regulatory Commission, Division of Waste Management and Environmental Protection, December 2009 (ML093490979).

ORISE 2010. *Project-Specific Plan for the Radiological Survey of the CSX Transportation Property Adjacent to Inkster Road, Livonia, Michigan.* Letter W.C. Adams to K. Banovac, September 15, 2010. (ML102720146)

ORISE 2011. *Radiological Survey Results for Portions of the CSX Transportation Property Adjacent to Inkster Road, Livonia, Michigan.* Letter W.C. Adams to D.W. Schmidt, January 6, 2011. (ML110190181).