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Infrastructure, environment, buildings

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ENVIRONMENTAL

Subject:
Risk Assessment Feasibility Evaluation, Inkster Road, Livonia, Michigan.
CSXT 9717003
ENV981800PJKR
ARCADIS Geraghty & Miller Project No. MI000703.0001

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Contact:
Katie Panczak

Extension:
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Dear Paul:

Per your request on December 3, 1998, ARCADIS Geraghty & Miller evaluated available information for the Inkster Road, Livonia, Michigan site to determine the feasibility of completing a risk assessment to obtain regulatory closure. The evaluation included researching the United States Nuclear Regulatory Commission (NRC) guidance documents to identify the regulatory and procedural requirements associated with a risk assessment and reviewing site information to identify potential data collection needs.

As a result of this evaluation, ARCADIS Geraghty & Miller determined a specific risk assessment model is approved by the NRC to determine if the site meets regulatory closure requirements. In addition, supplemental soil sampling for isotope-specific analysis would be necessary to correlate site conditions with the regulatory model output. Along with a summary of site conditions and the regulatory requirements, ARCADIS Geraghty & Miller has included in this letter a description of the risk assessment model and a preliminary cost estimate to complete risk assessment modeling. An estimate of the costs are provided in the attached Table 1.

Site Background

On March 29, 1994, the NRC informed the AAR Manufacturing Group (AAR) that radioactive impacts had been discovered at the AAR facility located at 12633 Inkster Road in Livonia, Michigan, adjacent to the CSX Transportation right-of-way (ROW). The AAR facility had been licensed by the Atomic Energy Commission to use thorium (contained in a 40-percent thorium master alloy and in a thorium-magnesium alloy) during product manufacturing. During a subsequent field survey conducted by the NRC, elevated levels of radioactivity were detected in the CSX Transportation ROW.

During spring 1998, ARCADIS Geraghty & Miller completed a radiometric field survey to characterize the CSX Transportation site area and more clearly determine the extent of the radioactive impacts. Consistent with the previously completed NRC survey, a Victoreen Survey and Count meter (scintillometer) fitted with a Victoreen GM Probe Model RP-1 was used during the field survey to detect alpha, beta, and gamma radiation in the surface and near surface (1 foot below grade) site soils.

The radiation measurements were obtained at regularly spaced intervals across the site, and the field survey results indicated surficial soil radiation measurements ranged from the site background measurement (24 microroentgen per hour [uR/hr]) to 71 uR/hr. Subsurface radiation measurements were obtained where surface radiation values were the greatest, and the subsurface soil radiation measurements ranged from background to 50 uR/hr. Sampling and analysis for specific isotope concentrations were not completed during this study, and a more detailed summary of the field survey is presented in the June 5, 1998 ARCADIS Geraghty & Miller report.

Based on the results of the field survey, ARCADIS Geraghty & Miller calculated the volume of affected soil and developed several off-site disposal options that were summarized in a June 19, 1998 letter to you. To explore alternate remedial options, CSX Transportation requested ARCADIS Geraghty & Miller review the feasibility of completing a risk assessment at the site.

Regulatory Risk Assessment Requirements

According to the NRC Region III Branch Chief, Mr. Bruce Jorgensen, the NRC is the governing regulatory agency for sites in Michigan having greater than 0.05 percent by weight thorium. Mr. Jorgensen stated that the NRC regulations are no longer concentration based, and the NRC currently regulates to dose levels. If an exposure is less than 25 millirem per year (mrem/year) from all relevant dose pathways, then regulatory closure could be obtained at the site.

Mr. Jorgensen identified the RESRAD (RESidual RADioactivity) computer model as the approved code to develop dose exposures for thorium-impacted sites. In addition, Mr. Jorgensen indicated all relevant radioactive isotopes at the site should be used to develop the dose concentrations. He referred to the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) document as a comprehensive guidance tool for completing site investigations and risk assessments at radioactive sites.

RESRAD Risk Assessment Model

The objective of the risk assessment is to determine whether thorium-impacted soil can be left in place at the site without violating regulatory radiation dose compliance criteria. Because of radioactivity, certain thorium isotopes and their daughter

products present a possible danger to future users of the site, as well as provide a potential source for off-site exposure. To remain in compliance with the NRC residual radioactivity standards, it must be shown that the dose rate to a member of the average population will not exceed 25 mrem/year during the next 1,000 years.

Given a known thorium concentration distribution in the soil, the dose rate can be simulated by taking into account the various site-specific pathways of environmental transport and human exposure. If this simulation is iterated with different soil concentrations, a concentration distribution can be found that results in the limiting exposure level of 25 mrem/year. This soil concentration distribution can then be used in the remedial alternative decision-making process. Alternately, the computer program RESRAD can solve the inverse approach and conduct simulations to determine a maximum thorium concentration in site soils that will ensure a maximum dose rate of 25 mrem/year or less. This maximum-allowed concentration derived from the RESRAD model can be compared with known thorium concentrations in the site soils to determine compliance with closure criteria.

RESRAD takes into account multiple exposure pathways (groundwater, surface water, plant uptake, direct radiation, etc.) and includes the production, decay, and transport of all daughter products, as well as the parent radionuclide. Changes in constituent concentration and radioactivity are simulated over time in the source soil and in the environmental compartments along exposure pathways between the source and the receptor. Then, the initial limiting concentration of the parent radionuclide is automatically computed by the model for a given total dose rate limit.

RESRAD Input Requirements

The site-specific information listed below can be used to supply input parameters for RESRAD. However, by making conservative assumptions, a useful worst-case scenario can be simulated without knowledge of most of the following parameters:

- Thorium release date.
- Surface area
  - — of contaminated soil,
  - — of the watershed of the nearest stream or pond receiving runoff from the site.
- Length of contaminated zone parallel to groundwater flow.
- Porous media composition (soil type)
  - — of contaminated soil,
  - — of each stratum between contaminated soil and the water table,
  - — of the water-table aquifer.
- Vertical distance between the bottom of the contaminated soil and the water table.
- Hydraulic gradient in the water-table aquifer beneath the site.
- Hydraulic conductivity
  - — in the water-table aquifer beneath the site,
  - — in the contaminated soil,

  - in the cover material,
  - in unsaturated layers between the contaminated soil and the water table.
- Thickness
  - of material covering the contaminated soil (none at this site),
  - of the contaminated soil,
  - of each lithologic layer between the contaminated soil and the water table.
- Rate of erosion
  - of contaminated soil,
  - of the cover material.
- Nearest groundwater well downgradient of the site
  - well pumping rate,
  - distance from contaminated zone to the well,
  - screen depth.
- Distribution coefficient for thorium
  - in the contaminated soil,
  - in each layer of the unsaturated zone between the contaminated soil and the water table,
  - in the water-table aquifer.

Site Application

Although knowledge of the present concentrations of thorium or other radionuclides in the site soil is not needed for RESRAD input, site-specific thorium concentration data are necessary to compare site conditions with the maximum concentration limits determined by the RESRAD analysis.

The MARSSIM document identifies the sampling frequency considered adequate to characterize the site, and the ARCADIS Geraghty & Miller field survey completed in 1998 was conducted in accordance with the MARSSIM approach. However, the field data generated during the survey consist of total alpha, beta, and gamma radiation counts. Therefore, discrete soil sampling and analysis are necessary to quantify the specific radioactive isotope concentrations present. Importantly, however, the results of the field survey can be used to limit the number of isotope-specific samples required for analysis because it can be used to identify zones of varying levels of impacts at the site (i.e., moderately impacted, hot spot). One soil sample can then be collected from the highest-impacted area within each zone and conservatively used to represent the concentration within the entire zone. To ensure the highest-impacted soils within each zone are sampled, the soils should be scanned with a field survey instrument prior to collection. If site conditions indicate soil concentrations within each zone are below the RESRAD-derived maximum, compliance with the 25 mRem/yr dose criteria for closure can be demonstrated.

No site groundwater data currently exists, but the Livonia, Michigan area is characterized by limited saturated horizons, and a conservative assumption of the groundwater-related input parameters is believed to be the appropriate initial step.

Cost Estimate

The level of effort required for this task will depend on the number of samples analyzed, the exposure pathways that need to be included in the simulations, and the availability of input parameters for these pathways. Based on the preliminary evaluation of the field survey data, ARCADIS Geraghty & Miller believes the collection of five soil samples for isotopic thorium analysis would be adequate to characterize the site. Core Laboratories of Casper, Wyoming provided a quote of $140 per sample to complete the isotopic thorium analysis.

The attached table provides a breakdown of the estimated cost to complete the sampling and RESRAD analysis. The table includes a cost estimate to obtain one limiting thorium soil concentration (assumes thorium 232 isotope) based on one set of input parameters and compliance criteria, including all exposure pathways. As summarized in Table 1, the cost to complete sampling and one RESRAD model simulation is estimated at $12,550. The risk assessment sampling and model could be completed in approximately 10 weeks. This schedule is dictated primarily by the four-week turnaround time for isotopic thorium analysis that is considered standard.

Multiple RESRAD analyses could also be conducted to determine the limiting thorium 232 concentration given different sets of input parameters (e.g., with and without a cover of clean soil). This extension of the task scope may be desirable if the site soil concentration is not in compliance with the initial limiting concentration and CSX Transportation wishes to compare different site management scenarios. As indicated in Table 1, the cost to complete each additional scenario simulation is estimated at $4,300. This cost, however, does not include additional site data collection activities, as may be required under a refined input scenario.

ARCADIS Geraghty & Miller appreciates the opportunity to work with CSX Transportation at this site and hopes this summary letter aids in your evaluation of remedial options. Please contact Curt Cramer or me if you have any questions and/or comments regarding the information included in this letter.

Sincerely,

ARCADIS Geraghty & Miller, Inc.

Katherine A. Panczak
Staff Engineer

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Table 1. Per-task Cost Estimate to Complete Risk Assessment, CSX Transportation, Inkster Road, Livonia, Michigan.

		ARCADIS Geraghty & Miller		Laboratory	Task
		Labor	Expenses	Expenses	Subtotal
Task 1:	Sampling and Analysis	$950	$300	$700	$1,950
Task 2:	Construction of RESRAD Model	$4,900	$50		$4,950
Task 3:	Predictive Model Simulation	$2,000	$50		$2,050
Task 4:	Data Analysis/Report Preparation	$3,600	$0		$3,600
				Estimated Project Total:	**$12,550**
Optional Task:					
Task 5	Additional Scenario Modeling (Includes input preparation, simulation, and reporting).	$4,200	$100		$4,300
				Cost Per Additional Model Simulation:	**$4,300**

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