J. Dehmel

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

February 4, 2002

MEMORANDUM TO: Claudia M. Craig, Section Chief
Facilities Decommissioning Section
Decommissioning Branch, DWM

FROM: John T. Buckley JTB
Facilities Decommissioning Section
Decommissioning Branch, DWM

SUBJECT: MEETING REPORT FOR THE JANUARY 23, 2002, MEETING WITH MALLINCKRODT INC.

On January 23, 2002, U.S. Nuclear Regulatory Commission staff members met with representatives of Mallinckrodt Inc. to discuss technical issues associated with its Phase 2 Decommissioning Plan. Attached is the meeting report documenting this meeting.

Attachment: Meeting Report

Docket: 040-06563
License: STB-401

MEETING REPORT

Date:	January 23, 2002
Time:	8:00 - 11:00 am
Place:	U.S. Nuclear Regulatory Commission 11545 Rockville Pike Rockville, MD 20852
Purpose:	To Discuss Technical Issues Associated With Mallinckrodt Inc.'s Phase 2 Decommissioning Plan

Attendees:	NRC	Mallinckrodt
	John Buckley	Mark Puett
	Jean-Claude Dehmel	Henry Morton

Background:

On November 11, 1997, Mallinckrodt Inc. (Mallinckrodt) submitted its Phase 1 Decommissioning Plan (DP) to the U.S. Nuclear Regulatory Commission (NRC) for review and approval. Phase 1 of the decommissioning process includes demolition or decontamination of above ground buildings and equipment. Phase 2 includes the cleanup of surface and subsurface soils and building foundations. Mallinckrodt is scheduled to submit its Phase 2 DP in January 2003. Most (approximately 80%) of the contamination at the Mallinckrodt facility is being remediated under the U.S. Department of Energy's Formerly Utilized Sites Remedial Action Program (FUSRAP) program managed by the Army Corps of Engineers. The NRC portion of the facility is being cleaned up by Mallinckrodt to terminate its NRC license.

Discussion:

Mallinckrodt is now in the process of preparing it's Phase 2 DP. Mallinckrodt requested a meeting with the NRC to discuss the following issues: (1) improving the decommissioning planning process; and (2) determining background radioactivity concentrations in soil. Mallinckrodt provided the attached agenda to guide discussion during the meeting.

Mallinckrodt presented several statistical methods for determining background radionuclide concentration in soil. The staff agreed that, in theory, each method is acceptable for determining background. However, in the Phase 2 DP, Mallinckrodt must successfully integrate the chosen alternative into the MARSSIM process.

The meeting was adjourned at 10:45 am.

Actions:

None.

Attachment

Agenda
NRC – Mallinckrodt Meeting

Goals

- Solicit acceptance of some improvements to decommissioning planning.
- Promote understanding of relation of background radionuclide concentration in soil and DCGL.
- Gain NRC staff acceptance of method of interpreting background concentration key radionuclides in soil.

Methods of Interpreting Background Radioactivity Concentration in Soil

The facts

Regulated radioactive materials of interest to CT decommissioning are uranium series and thorium series.
Mallinckrodt SLDS land is unconsolidated fill, comprised of coal slag and cinders, brick and concrete rubble, sand, and silt, containing elevated and variable U series and Th series.

Variability in background radionuclide concentration in cinder fill is prominent relative to prospective $DCGL_W$.

Where background radioactivity is prominent, the MARSSIM anticipates assessment of compliance with cleanup criteria, $DCGL_W$, by statistical comparison of background and survey unit radioactivity surveys.

The issues

There are obstacles to sampling cinder fill offsite to measure background:

- upland geology to the west
- Mississippi River to the east
- dense population of buildings and streets to the north and south
- uncertain variability in composition of fill by geographic location.

Those obstacles hinder collection of an adequate number of cinder fill samples to represent background in Plant Area 5.

- Mallinckrodt analyzed 13 samples from 11 locations not in Plant 5.
- The USACE sampled background at 12 locations.[1]

Attachment

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[1] USACE. *Background Soils Characterization Report for the St. Louis Downtown Site.* §3.1 & Fig. 3-1. Mar. 1999.

At issue is whether background radioactivity in fill on the SLDS, and particularly in Plant Area 5, is more likely to represent background against which assessment of compliance with cleanup criteria should be tested than would samples taken off-site.

Another issue is whether representative background can be interpreted from soil samples collected on-site.

Our Position

The NRC staff recognized that a background reference area might not be readily available. It said, "A derived reference area may be used when it is necessary to extract background information from the survey unit because a suitable reference area is not readily available. For example, it may be possible to derive a background distribution based on areas of the survey unit where residual radioactivity is not present."[2]

Under some conditions, background radioactivity can be differentiated from contamination within a geographical area. Methods of interpreting background radioactivity in measurements made in a geographical area can be defined. Some methods of interpreting background radioactivity are:

- a differential graphical method by histogram with curve fit
- an integral graphical method by cumulative frequency on probability scale as a function of radionuclide concentration,
- Kolmogorov-Smirnov 2-sample statistics, and
- Kruskall-Wallis statistical test for multiple background distributions.

Where background radioactivity can be interpreted from within a potentially affected area with more confidence than from a reference area or reference medium, or where a background reference area is not practically available, then an alternate method of interpreting background radioactivity should be acceptable.

Mallinckrodt proposes alternate methods of interpreting background and wants acceptance of:

- the concept of interpreting background radionuclide concentration in cinder fill in SLDS Plant Area 5
- in accordance with methodology described herein.

Explanation

In this meeting, Mallinckrodt will describe alternate methods to interpret background in overview, then with application to the St. Louis Downtown Plant Area 5.

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[2] USNRC. "Demonstrating Compliance with the Radiological Criteria for License Termination." draft Regulatory Guide DG-4006. §2.3.1. Aug. 1998.

Overview of Methods

Mallinckrodt will make the same presentation that HM made to the MARSSIM committee to demonstrate alternative methods of interpreting background radioactivity. The presentation will:

- name the methods
- describe data characteristics enabling interpretation
- describe graph of cumulative probability as a function of radioactivity (integral method), and
- describe histogram with curve fit (differential method)

Comparison of Methods

Compare the methods of interpreting background radioactivity from measurements within a potentially affected area.

Table

Method	Advantages	Disadvantages
Kolmogorov -Smirnov	Numerical test, no graph. Relies on some background measurements from an unaffected, reference area. Pre-decided rule and test to differentiate background from contaminated measurements	Requires some background measurements from an unaffected, reference area.
Kruskall-Wallis test	Accommodates multiple background distributions in multiple reference areas Is similar to the Wilcoxon Rank Sum test.	Requires multiple background distributions
Differential curve fit	Histogram, especially with curve fit, enables visual interpretation. Curve fit derives mean & standard deviation	Must construct histogram and perhaps fit a curve to the histogram data. Must decide whether normal or lognormal fit is better. Must judge approximate bound between background and contaminated measurements.

Integral curve fit	Enables visual interpretation. Integral method uses accumulated data. Does not require an histogram. Simpler graphic construction than differential curve fit. Provides mean & standard deviation.	Must decide whether normal or lognormal fit is better. Must judge approximate bound between background and contaminated measurements.

Estimates of Background Radioactivity Concentration in Cinder Fill Soil

Integral Graphical Method

Mallinckrodt described interpretation of background radionuclide concentrations in cinder fill in Plant 5 by the integral graphical method.

Differential Graphical Method

Mallinckrodt described interpretation of background radionuclide concentrations in cinder fill by fitting a curve to an histogram of measurements of core samples taken in Plant 5.

Kolmogorov-Smirnov Method

Jean Sebaugh interpreted background radionuclide concentrations in cinder fill by Kolmogorov-Smirnov 2-sample statistical analysis.

USACE Background Sampling

The USACE sampled 12 locations north and south of the SLDS. It included samples collected at multiple depths.

Regional and National Background

Coal Ash. Obstacles to finding coal ash off-site that is not contaminated by regulated source material makes it worthwhile, for perspective, to estimate the key radionuclide concentration in coal ash from other sources. Concentrations of elemental thorium and uranium in coal have been measured extensively (see refs. 1, 2, 3, 4, 5, and 6). U^{238} and its progeny, including Ra^{226}, are assumed present in equal concentration in coal and in its ash; although Ra^{226} has been reported to concentrate in fly ash by a factor of 1.5 to 2 times that in bottom ash.[3] All uranium, thorium, and radium in coal is assumed to remain in the coal ash. Thus, the radionuclide concentration in coal ash is estimated to be inversely proportional to the weight fraction of ash-to-coal times the concentration in coal. The uranium and thorium concentrations measured in coal and estimated in ash are in Table 3. Assuming coal burned in St. Louis was mined in either the Appalachian or Midwestern (Illinois) province, surveys of thorium and uranium in coal

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[3] Beck, *et. al.*

from these provinces were used to estimate Th^{232} and U^{238} in ash. The average Th^{232} and U^{238} concentration in all regional coal ash are estimated to be 3.1 and 4.4 pCi/g respectively.

Soil. Gamma-spectral measurements of Th^{232} and U^{238} in soil at more than 200 locations in the USA, averaged 1 pCi Th^{232}/g and 1.8 pCi U^{238}/g.[4] Assuming U^{238} and Ra^{226} are present in equal concentration in soil, these values are assumed to represent natural background average in topsoil nationally, although not at the SLDS because it is practically devoid of similar topsoil.

Decommissioning Planning

Current Situation

Currently, the contents of a DP become license conditions when a license is amended to authorize decommissioning in accordance with representations in the decommissioning plan. In effect, all of a decommissioning plan becomes a *specific* license, with every representation becoming a license condition.

Desirable improvements in decommissioning plan structure:

1 Steps in evolution toward a broad licensing concept would be desirable.

2 A licensee should be allowed to provide internal review and approval competence and administration in exchange for authorization to perform certain internally authorized changes.
  - A license amendment would specify requisite competence and administrative controls.
  - The licensee would be required to keep an inspectable record of authorized changes and their administration.
  - A license amendment would specify what can be changed and or boundary conditions on what cannot be changed by a licensee without NRC license amendment.

3 We need to find an agreeable way to differentiate more between specifications and other descriptive information and safety analyses.

4 We need to recognize that decommissioning plan content spans a range of relative importance. We need to find an agreeable way to grade relative importance among decommissioning plan content.

5 We need a timely means to resolve decisions about critical issues and obstacles to preparation of a decommissioning plan or to implementation of an approved plan.

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[4] Nat'l Council Rad. Prot. *Exposure of the Population in the United States and Canada from Natural Background Radiation.* NCRP report 94. Table 4.3, p. 61. Dec. 30, 1987.