

May 19, 2011

Mr. John Buckley  
U.S. Nuclear Regulatory Commission, Senior Project Manager  
11545 Rockville Pike  
Rockville, MD 20852

**SUBJECT: FINAL - CONFIRMATORY SURVEY PLAN FOR SOILS ASSOCIATED  
WITH THE PLANT 5 FOOTPRINT AT THE MALLINCKRODT INC.  
SITE, ST. LOUIS, MISSOURI  
(DOCKET NO. 040-6563) DCN 2046-PL-02-0**

Dear Mr. Buckley:

The Oak Ridge Institute for Science and Education (ORISE) is pleased to provide the enclosed final survey plan for conducting confirmatory surveys of the final status survey activities associated with survey units 01 and 03 within the Plant 5 footprint. Any comments you may have will be incorporated into the final plan.

My contact information is listed below or you may contact Tim Vitkus at 865.576.5073 should you have any questions or require additional information.

Sincerely,

*Erika N. Bailey*

Erika N. Bailey  
Deputy Survey Projects Manager  
Independent Environmental  
Assessment and Verification

ENB:bf

Enclosure

c: N. Altic, ORISE/IEAV  
File/2046

electronic distribution: S. Roberts, ORISE/IEAV T. Vitkus, ORISE/IEAV

Distribution approval and concurrence:	Initials
Technical Review	DAK

**FINAL  
CONFIRMATORY SURVEY PLAN  
FOR SOILS ASSOCIATED WITH THE PLANT 5 FOOTPRINT  
MALLINCKRODT INC. SITE  
ST. LOUIS, MISSOURI**

**INTRODUCTION**

Mallinckrodt Inc. is a Delaware based company with its principal place of business located in St. Louis, Missouri. Mallinckrodt has held a Nuclear Regulatory Commission (NRC) License (STB-401) for the extraction of columbium and tantalum (C-T) from natural and synthetic ores and slags since 1961. Prior to this, Mallinckrodt refined uranium ore and concentrate to produce uranium compounds to develop atomic weapons under an Atomic Energy Commission source material license R-226 (Covidien 2008). Uranium, thorium, and rare earth elements were also extracted during this period. Mallinckrodt is currently seeking to terminate license STB-401 by remediation of radiological contamination associated with C-T production. C-T production occurred in an area designated as Plant 5 at the St. Louis Plant.

Historical information regarding radiological releases during the C-T extraction process was attained through interviews with past and present employees. The interviews revealed three different release events:

- 1) Raffinate tanks located north of Buildings 246 and 247 overflowed on more than one occasion. Backup tanks were in place, but in some instances did not contain all spilled materials.
- 2) The entrained liquid from a high-pressure vacuum steam jet on the southwest roof of Building 238 occasionally sprayed into the air, which could have potentially contaminated roofs of surrounding buildings.
- 3) Minor spills occurred during various C-T raw material and residue handling activities outside of Plants 5, 6, and 7.

Specific information about the spills was not available. This historical information does not account for any accidental spills or releases of radioactive material from the time period in which the C-T extraction process was operational (Covidien 2008).

Decommissioning of the C-T extraction process is being performed in two phases (Covidien 2008). Phase I will include decommissioning of the buildings and equipment to meet the NRC's guidelines for unrestricted release. Phase II includes the remediation of the building slabs and foundations, paved surfaces, and all subsurface materials. Phase I was completed in December 2004 and Phase II began in July 2010.

## **SITE DESCRIPTION**

The Mallinckrodt Inc. site is a 43-acre property occupying approximately 12 city blocks near the west bank of the Mississippi River in the northeastern section of St. Louis, Missouri. The Mallinckrodt property address is 3600 North Second Street St. Louis, Missouri. Specifically, Plant 5 is located south of Destrehan Street and east of Second Street.

## **OBJECTIVES**

The objectives of the confirmatory activities are to provide independent contractor field data reviews and to generate independent radiological data for use by the NRC in evaluating the adequacy and accuracy of the decommissioning contractor's procedures and final status survey (FSS) results.

## **RESPONSIBILITY**

Work described in this survey plan will be performed under the direction of Tim Vitkus, Survey Operations Director, and Erika Bailey, Deputy Survey Projects Manager, of the Oak Ridge Institute of Science and Education (ORISE). The cognizant ORISE site supervisor has the authority to make appropriate changes to the survey procedures as deemed necessary, and after consultation with NRC personnel. Changes to the scope of this survey plan or procedures will be documented in the site logbook.

## **DOCUMENT REVIEW**

ORISE has reviewed the licensee's C-T Phase II Decommissioning Plan (DP). The DP was specifically reviewed for historical information, to identify the radionuclides of concern (ROCs) and the applicable derived concentration guideline levels (DCGL<sub>w</sub>). The purpose of this review was to ensure that the regulatory requirements are being met by the licensee and to develop the

confirmatory plan. ORISE will ensure the current FSS activities within the Plant 5 area are adequate and appropriate taking into account any supporting documentation and *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM) guidance (NRC 2000).

## **PROJECT HEALTH AND SAFETY**

ORISE will adhere to all applicable regulatory requirements and participate in any required site-specific training. ORISE will perform verification activities in accordance with requirements of the site's overall health and safety plan (HASP) and radiological protection plan (RPP) during site activities. Personnel working on the project will be informed of known and potential hazards to effectively apply required safety precautions. A walk-down of the project area prior to the survey will assist ORISE to evaluate any additional potential health and safety issues that are not currently addressed in the ORISE Survey Procedures Manual job hazard analyses (JHAs) (ORISE 2008). Should ORISE identify a hazard not covered in the ORISE Survey Procedures Manual or the site HASP, work will not be initiated or continued until it is addressed by an appropriate JHA. Survey activities may be conducted in areas that require radiation work permits but no special dosimetry requirements are expected.

## **PROCEDURES**

The ORISE survey team will conduct field activities to evaluate soil areas within Plant 5 by performing visual inspections, measurements, and soil sampling activities. Specifically, ORISE is tasked with performing confirmatory survey activities within survey units 01 and 03 associated with the Plant 5 footprint as well as backfill soil (if available). Survey activities performed by the ORISE team will be conducted in accordance with the ORISE Survey Procedures and the Oak Ridge Associated Universities (ORAU) Quality Program Manuals (ORISE 2008; ORAU 2011).

### **Reference System**

ORISE will reference survey results using the reference system established by the licensee and/or global positioning system (GPS) coordinates and prominent site features. Measurement and sampling locations will be documented on detailed survey maps.

### Surface Scans

Surface scans for gamma radiation will be performed in the two survey units and as requested by the NRC. Scans will be performed using NaI scintillation detectors coupled to ratemeter-scalers with audible indicators. Detectors will be coupled to GPS equipment that enable real-time gamma count rate and spatial data capture. Locations of elevated direct gamma radiation will be marked for further investigation. High-density surface scans will be performed.

### Soil Sampling

Surface soil and/or miscellaneous material samples will be collected from judgmental locations where elevated direct gamma radiation could exceed the DCGLs. The number of samples will be based upon the findings as the surveys progress. Additionally, up to five samples of the backfill material will be collected from either random or judgmental locations (if available) and up to five of the decommissioning contractor's FSS soil samples may be requested for confirmatory analysis.

## GUIDELINES

The primary ROCs for the Plant 5 soil area are uranium and thorium and their respective decay radionuclides. Soil cleanup criteria were developed for the significant radionuclide contributors listed in Table 1 (Covidien 2008). Natural uranium is considered to be processed uranium that includes all the uranium isotopes from U-238 to U-234 and the associated short-lived progeny. A separate DCGL<sub>w</sub> is defined for unprocessed uranium containing Th-230, Ra-226, Pb-210 and all their short lived progeny. This grouping is considered separately because the RESRAD dose factor is much greater for these specific radionuclides within the uranium decay series.

**TABLE 1: APPLICABLE RADIOLOGICAL  
SOIL CLEANUP CRITERIA**

CONTAMINANTS OF CONCERN	DCGL <sub>w</sub> (PCI/G)
Th Series	23.9
Natural Uranium	721
Th-230 + Ra-226 + Pb-210	29.4

## SAMPLE ANALYSIS AND DATA INTERPRETATION

All data collected onsite will be brought back to the ORISE facility for interpretation. Samples collected for radiological analysis will be delivered to the ORISE radiochemistry laboratory in Oak Ridge, Tennessee for analysis. Sample analyses will be performed in accordance with the ORISE Laboratory Procedures Manual (ORISE 2011). Soil samples will be analyzed by gamma spectroscopy for the radionuclides of both the uranium and thorium series. The spectra will also be reviewed for other identifiable photopeaks. Alpha spectroscopy may also be performed as necessary based on the gamma spectroscopy results. Soil sample results will be reported in units of picocuries per gram (pCi/g). The data generated will be compared with the approved criteria. Results will be presented in a draft report to the NRC for review and comment.

## TENTATIVE SCHEDULE

- ORISE personnel plan to conduct measurements and sampling activities May 24 through 25, 2011.
- A draft report documenting the confirmatory survey results will be submitted to the NRC within 15 days of receipt of all sample analysis data. Any sample results that exceed the cleanup criteria and would impact project completion will be reported immediately to NRC.
- A final report will be submitted within 10 days of the receipt of comments from the NRC.

## REFERENCES

- Covidien. *C-T Phase II Decommissioning Plan, Revision 2*. St. Louis, MO; August 12, 2008.
- Oak Ridge Associated Universities (ORAU). *Quality Program Manual for the Independent Environmental Assessment and Verification Program*. Oak Ridge, Tennessee; May 10, 2011.
- Oak Ridge Institute for Science and Education (ORISE). *Survey Procedures Manual for the Independent Environmental Assessment and Verification Program*. Oak Ridge, Tennessee; May 1, 2008.
- Oak Ridge Institute for Science and Education. *Laboratory Procedures Manual for the Independent Environmental Assessment and Verification Program*. Oak Ridge, Tennessee; February 28, 2011.
- U.S. Nuclear Regulatory Commission (NRC). *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*, NUREG-1575; Revision 1. Washington, DC; August, 2000.

---

**From:** Bonano, Eugenio  
**Sent:** Friday, May 20, 2011 7:49 AM  
**To:** RIIIDNMS\_ADMIN Resource  
**Cc:** Buckley, John  
**Subject:** FW: ORISE Final survey plan  
**Attachments:** 2046-PL-02-0.pdf; 665S v2 - Mallinckrodt-ORISE Survey PlanII.doc

Please put into ADAMS.....thanks!

---

**From:** Bailey, Erika [<mailto:Erika.Bailey@orau.org>]  
**Sent:** Thursday, May 19, 2011 3:28 PM  
**To:** Buckley, John; Bonano, Eugenio  
**Subject:** ORISE Final survey plan

I did include the survey unit information from Karen. The northern unit is SU 01 and the southern one will be SU 03.

We are flying out at 11:15 on Monday arriving in St. Louis at 2:40. If anything changes before then please let me know.  
See you Tuesday.

Thanks,  
Erika

Erika N. Bailey  
Health Physicist/Project Manager  
Deputy Survey Projects Manager  
865-576-6659  
[Erika.Bailey@orau.org](mailto:Erika.Bailey@orau.org)