

**State of Missouri, Department of Natural Resources (MDNR), Comments on Mallinckrodt
Phase 2 Decommissioning Plan (Dated March 6, 2009),
Draft NRC Responses, and Comment Resolution**

1. MDNR Comment 1

Section 2, Executive Summary. This section describes work remaining for Plant 7, which indicates that it will be addressed under a document entitled C-T Phase IIa. The text in this section and other sections of the plan imply that the U.S. Army Corps of Engineers [USACE] is responsible for contamination in Plant 7. The department knows of no agreement having been reached between Mallinckrodt and the USACE regarding responsibility division. Also, the Executive Summary notes that there will be inaccessible areas (i.e., Plant 6 under building 101). Will the NRC [U.S. Nuclear Regulatory Commission] license STB-401 remain in effect until all areas are remediated or will another license be issued?

NRC Response

NRC does not agree that the Decommissioning Plan (DP) implies that the USACE is responsible for the contamination in Plant 7. The DP states that delineation of responsibility for contamination in Plant 7 must still be determined. Please note the following:

Page 1-2, paragraph 4, states, "Delineation of responsibility for remediation, particularly in areas known as Plants 6 and 7 within the St. Louis Plant site, remains to be decided between Mallinckrodt and the U.S. Army Corps of Engineers."

The staff is unable to locate the discussion regarding inaccessible areas in the Executive Summary as referenced by the state. However, the NRC will not terminate Mallinckrodt's license until all C-T processing areas meet the unrestricted release criteria of 10 CFR Part 20.1402. Currently inaccessible C-T process areas in Plant 6 (burial trench 10 under Building 101) will have to be remediated by Mallinckrodt prior to license termination. In addition, a delineation agreement for Plant 7W must be reached and remediation completed in the C-T process areas before license termination.

Resolution

MDNR believes that the NRC response adequately addresses its concern and no additional information is required in the DP.

2. MDNR Comment 2

The Phase II preferred plan states the implementation will "complete" the decommissioning process. Very little, if any, hazardous chemical sampling results have been provided by Mallinckrodt. Knowing the processes used here and sample findings at other similar industrial sites, it is reasonable to conclude that hazardous chemicals will be encountered with the radioactive waste, which will require characterization/treatment of mixed waste. The Executive

Summary provides evidence that spills occurred at the raffinate area (which would have mixed waste material). The State's Hazardous Waste Program's Permits Section will need to be

involved when this occurs, as it has regulatory authority in this area. Please provide more detail on this aspect.

NRC Response

The NRC is not responsible for ensuring that Mallinckrodt is in compliance with the requirements of 40 CFR 260 – 270, nor the U.S. Department of Transportation regulations regarding the transportation of hazardous material. The DP describes the decommissioning activities necessary to remove residual radioactive material, including mixed waste, from C-T process areas such that these areas meet NRC's unrestricted release criteria. However, the NRC does regulate mixed waste. NUREG-1757 describes the information to be included in the DP regarding mixed waste. Section 12.3 of the DP states that Mallinckrodt site characterization activities have not identified any mixed waste in the soil or other materials to be remediated during decommissioning. Further, it states that if mixed waste is encountered during remediation, Mallinckrodt will characterize the waste, identify a disposal method...and notify NRC. Mallinckrodt has a RCRA part B permit authorizing on-site storage of hazardous and mixed waste. The staff is satisfied that Mallinckrodt has adequately addressed mixed waste in the DP given the results of characterization studies performed to date.

Resolution

NRC understands the Mallinckrodt and MDNR had a meeting on February 6, 2009, to discuss Mallinckrodt's responsibilities under the Resource Conservation Recovery Act (RCRA). On April 20, 2009, Mallinckrodt submitted a letter to the MDNR describing how it would comply with RCRA requirements during decommissioning. MDNR will notify NRC if the Mallinckrodt submittal is unacceptable.

NRC agreed to make Mallinckrodt's site characterization data for hazardous materials publicly available in ADAMS.

3. MDNR Comment 3

The Phase II preferred plan's goal is decommissioning in order for the area to be "released to unrestricted use in an industrial setting." For the foreseeable future this setting appears to be reasonable; however, it is unrealistic to conclude that the site will be industrial for the next 1000 years, without an enforceable, durable instrument or layers of instruments that give future generations a historic accounting of what the site's environmental restrictions are. While there are no guarantees of what type of instrument can provide this long-term assurance, deed restrictions, environmental covenants and other similar land use controls can and are currently being used at other sites with success. Although the rationale in the preferred plan may meet with approval by NRC, how will Mallinckrodt ensure that this aspect is addressed?

NRC Response

Mallinckrodt's goal is to decommission the site to the extent necessary for unrestricted release and to continue industrial productivity at the site. In accordance with Section 5 of NUREG-1757, Mallinckrodt must evaluate the potential doses resulting from residual radioactivity remaining on the site after decommissioning activities are completed. The unrestricted release criterion in 10 CFR Part 20.1402 does not require an investigation of all possible scenarios; its focus is on the dose to members of the critical group for the compliance scenario. The critical group is the group of individuals reasonably expected to receive the greatest exposure to residual radioactivity for any applicable set of circumstances.

The dose assessment time period (for demonstrating compliance) is 1000 years for all scenarios (i.e., dose assessments must evaluate the peak dose over the 1000-year time period after license termination). However, a 100-year timeframe is used for estimating reasonably foreseeable future land use scenarios (i.e., land uses reasonably likely to occur within 100 years, based on regional information and planning for similar land areas), which may be used as the compliance scenario for the dose assessments.

Based on the historical land use of the site, Mallinckrodt's plans to continue industrial use of the site, and current City of St. Louis zoning restrictions the staff believes that the most likely land use scenario for Plant 5 is industrial. If Mallinckrodt completes decommissioning in accordance with the DP, NRC will terminate its license without land use restrictions. NRC would not have a regulatory basis for requiring institutional controls as a condition of license termination.

Resolution

MDNR would prefer that Mallinckrodt decommission the C-T process areas to the same clean-up criteria used by the USACE for the Formerly Utilized Sites Remedial Action program (FUSRAP) areas of the site. NRC understands the MDNR's position. NRC acknowledges that the State may pursue restricted release of the entire site with Mallinckrodt. However, any restricted release agreement between the State and Mallinckrodt is outside of NRC's regulatory authority.

4. MDNR Comment 4

With reference to comment 3 above, this plan states that "material" from the area can be used at other areas of the plant. Based on the cleanup goals of the preferred plan (Alternative 2) versus the lower concentration goals of the FUSRAP areas (Alternative 3), soils used as backfill from the C-T Phase II area will re-contaminate the cleanup being conducted by the U.S. Army Corps of Engineers. It appears that the C-T Decommissioning plan needs to develop a management plan for this issue. How will the Phase II plan address this concern?

NRC Response

Section 12.1.6 of the DP provides Mallinckrodt's plan for waste disposition. In summary, it says:

- Material which is indistinguishable from background may be released without restriction.

- Material which is distinguishable from background but contains radioactivity concentrations less than the unimportant quantity of source material, as defined in 10 CFR 40.13, will be disposed of in accordance with an NRC-authorized transfer to a disposal facility, subject to the cognizant state regulatory agencies in which the disposal facility is located.
- Material which contains greater than unimportant quantities of source material, as defined in 10 CFR 40.13, will be disposed of at an NRC-regulated disposal facility authorized by license to receive it.
- Material whose radioactivity concentration is less than the Derived Concentration Guideline Level (DCGL) (29.3 pCi/g soil) may be used for backfill in on-site excavations deeper than 4 feet below grade.

The USACE cleanup criteria, as specified in the Record of Decision (ROD) is 5 pCi/g composite for soil to a depth of 6 inches, 15 pCi/g composite for soil from 6 inches to 4 feet deep, and 50 pCi/g for U-238 in soil to a depth of 4 feet. Below 4 feet, the composite criterion defined in the ROD is 50 pCi/g Ra-226, 100 pCi/g Th-230, and 150 pCi/g U-238.

The C-T project DCGLs for Ra and Th are lower than the USACE cleanup criteria for soil below four feet. Characterization data presented in Tables 4-7 thru 4-16 indicates that the highest U-238 soil concentration value is 242.7 pCi/g and only a few samples have concentrations exceeding the USACE U-238 deep soil cleanup criteria. Characterization data indicates that the as-left soil concentrations for U-nat should be a small fraction of the Mallinckrodt DCGL of 721 pCi/g for U-nat (The USACE deep soil cleanup criteria of 150 pCi/g U-238 corresponds to approximately 307 pCi/g U-nat). Therefore, the staff does not agree that Mallinckrodt's option to use material, with radioactivity concentrations less than the DCGL, for backfill in on-site excavations deeper than four feet below grade will re-contaminate areas remediated by USACE.

Resolution

Mallinckrodt stated during the meeting that C-T process material will only be used as backfill in Plant 5.

5. MDNR Comment 5

Further, if this "material" is used for backfill at other sites, since there has been little to no characterization of the hazardous chemical constituents for Phase II, it is likely that additional solid waste management units will be created, which require coordination with the state's Hazardous Waste Program's Permits Section. Prior to backfilling the excavated material, it is recommended that Mallinckrodt characterize the excavated material for potentially hazardous constituents, to determine if the contamination level in the excavated soil is below the EPA's [Environmental Protection Agency's] Region VI medium specific screening levels. Prior to backfilling, the department's advice to Mallinckrodt is preparation of a comprehensive sampling protocol to adequately characterize the excavated material. The number of samples should be such that the excavated material is safe for backfilling at a 95% upper confidence interval. The

department recommends the use of clean characterized soil for backfilling. What provision does the plan or Mallinckrodt have for this aspect?

NRC Response

See response to Comments 2 and 5.

Resolution

Mallinckrodt stated that it understands that all backfill used in Plant 5 during decommissioning must meet the States requirements for hazardous materials.

6. MDNR Comment 6

This plan and previous drafts have rationalized that groundwater at this site is a non-issue. This is inaccurate from the state's perspective. Most, if not all of the groundwater hydrology information in this Phase II plan is derived from data collected and reports by other agencies (i.e., U.S. Army Corps of Engineers and the U.S. Department of Energy [DOE]). Conclusions reached in this Phase II plan mis-interprets the groundwater concerns and requirements of the state, which are noted in the Record of Decision of the Downtown Site (1998, page 8, second paragraph), "The B unit does qualify as a potential source of drinking water under the guidelines for Groundwater Classification under the EPA Groundwater Protection Strategy". Leakage and spills from the raffinate tanks and the site's sewer system points to the need for characterization of chemical and radioactive contamination. How will this issue be addressed?

NRC Response

The NRC believes that the site wide data collected and reports prepared by the USACE and DOE accurately depict the groundwater hydrology for the entire Mallinckrodt site and any additional hydrologic investigations would be redundant.

The NRC does not agree that the groundwater concerns and requirements have been misinterpreted in the DP. The 1998 ROD does not justify how the B Unit qualifies as a potential source of drinking water. The ROD describes the B Unit as a highly unlikely source of drinking water with high levels of naturally occurring dissolved solids and metal concentrations (iron and manganese above their Secondary Maximum Contaminant Levels, (SMCLS)) within the B Unit.

The groundwater supply throughout the Eastern Missouri Region is typically non-potable due to high salinity. Groundwater from the alluvial deposits in the St. Louis area "generally contain very hard calcium-magnesium-bicarbonate type with iron and manganese content commonly high." (Water Resources Report Number 62, Missouri Department of Natural Resources, 2002).

Total uranium was the only radionuclide detected in filtered samples at elevated concentrations across the Mallinckrodt site within the upper zone (A Unit) and no radionuclides were detected above EPA Maximum Containment Level (MCL) in filtered samples from the lower zone (B Unit) (USACE, Groundwater Characterization Report of 1997/1998).

Soil and groundwater samples will be taken for chemical and radioactive contaminants throughout the decommissioning of the site to ensure effluent release criteria and soil DCGLs are met. The NRC will follow procedures defined in the Memorandum of Understanding between the EPA and the NRC regarding soil and groundwater contamination exceeding the defined limits. In summary:

- The NRC will consult with the EPA if there is radioactive groundwater contamination in excess of EPA's MCLs.
- The NRC will defer to EPA regarding matters involving hazardous materials not under NRC's jurisdiction.

Resolution

NRC will obtain the reference for USACE's conclusion in the ROD that the lower unit is a potential source of drinking water. NRC and MDNR will have a follow-up conference call to discuss the groundwater issue.

7. MDNR Comment 7

It appears that a new RESRAD modeling has been completed for this revision of the Phase II plan. Based on a cursory review of the modeling information, the groundwater exposure input was not used. Based in part on comment 6, above, please provide a model that includes an evaluation of the following exposures:

- i. Future construction worker scenario and exposure to soils after remediation of elevated sources
- ii. Future on site residential scenario and exposure to soil and groundwater for an estimate of baseline
- iii. Current/future on and offsite industrial worker scenario and vapor intrusion for radon and other volatile chemicals for both soil and groundwater
- iv. Future offsite residential scenario (representing no land use restriction on adjoining properties) of vapor intrusion of radon and other volatile chemicals in groundwater, and
- v. The leaching of contaminants to groundwater pathway.

NRC Response

A construction worker scenario was analyzed in the first draft of the decommissioning plan. This scenario was not included in their final analysis because the expected doses from the Industrial scenario were much higher than the doses from the construction scenario. The Industrial scenario was therefore the limiting scenario when calculating DCGL values.

The pathways of exposure for an industrial worker and a resident are nearly identical. For example, both scenarios include external gamma exposure, inhalation of dust, and ingestion of soil. A suburban resident may also have exposure by ingestion of vegetables from a garden, but a resident at this site would likely be an urban resident who lives in a high rise building and does not have a vegetable garden.

The parameter values used in both an industrial worker scenario and residential scenario are similar, with the exception of the indoor and outdoor time fractions and the inhalation rate. The amount of time spent at a residence may be longer than the amount of time spent at work. In addition, an industrial worker would likely have an inhalation rate that is higher than a resident.

So, overall it is expected that the dose to a resident would be similar to a dose to an industrial worker, though the dose to the resident may be slightly higher due to the increased occupancy time. However, it should be noted that RESRAD calculates the dose for an occupant of the ground floor. A resident in a high rise building would be further from the source and would not receive as high a dose.

The groundwater pathway is not considered a viable pathway for this site because the natural quality of the groundwater is poor.

Resolution

NRC will provide the ADAMS Accession Numbers for the Phase 2 DP to Andrew McKinney. Karen Pinkston will provide the RESRAD input parameters for the residential scenario to Andrew McKinney. Participants agreed that no changes are required to the DP.

8. MDNR Comment 8

In addition to cleanup values/DCGL's concerns noted in the cover letter, review of pavement cleanup values shown in Table 5.4, appear to be excessively high. For example, the targeted cleanup value for Ra 226 is 19,000 pCi/100 sq cm, U 238 is 1,050,000 pCi/100 sq cm. Although the table suggests these values are protective for 20 mrem/yr, how will this material be managed (i.e., used as fill or disposed of off-site) should pavement replacement occur? We would like to discuss these values with you and our RESRAD analyst at your convenience.

NRC Response

NRC staff reviewed the derivation of the DCGLs for pavement and determined that the dose from these values is less than 20 mrem/yr.

Resolution

Mallinckrodt and MDNR will meet separately to address MDNRs questions about the derivation of DCGLs for pavement. Participants agreed that revisions to the DP are not required regarding disposal of waste material.