December 29, 2004

MEMORANDUM TO: Claudia M. Craig, Section Chief
Reactor Decommissioning Section
Decommissioning Directorate, DWMEP

FROM: John T. Buckley **/RA/**
Reactor Decommissioning Section
Decommissioning Directorate, DWMEP

SUBJECT: MEETING REPORT FOR THE DECEMBER 16, 2004, MEETING WITH MALLINCKRODT INC.

On December 16, 2004, U.S. Nuclear Regulatory Commission (NRC) staff members met with representatives of Mallinckrodt Inc. to discuss NRC's draft health physics, and dose modeling comments its Phase 2 Decommissioning Plan. Attached is the meeting report documenting this meeting.

Attachment: Meeting Report

Docket: 040-06563
License: STB-401

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MEETING REPORT

Date: December 16, 2004

Time: 9:00 am - 3:00 pm

Place: U.S. Nuclear Regulatory Commission
11545 Rockville Pike
Rockville, MD 20852

Purpose: To Discuss NRC's Draft Health Physics, and Dose Modeling Comments on Mallinckrodt Inc.'s Phase 2 Decommissioning Plan

Attendees:

NRC	Mallinckrodt Inc.	Others
John Buckley	Jim Grant	Berton Pinkham (Envirocare)
Jay Thompson	Karen Burke	Ben Moore (MDNR - by phone)
Xiaosong Yin	Henry Morton	Joanne Wade (MDNR - by phone)
Tom Youngblood		Kay Drey (by phone)
Boby Eid		

Background:

Mallinckrodt Inc. (Mallinckrodt) has elected to decommission the columbium - tantalum (C-T) project areas of its property located at Mallinckrodt & Second Street in St. Louis, Missouri, in two phases. 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. 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 ultimate goal of the project decommissioning is to remediate those areas of the site associated with C-T production, to the extent necessary, to terminate License STB-401.

On November 20, 1997, Mallinckrodt submitted the "C-T Project Decommissioning Plan, Part 1" (DP), for NRC review and approval. Mallinckrodt submitted a revised DP on January 18, 2001, which the NRC approved on May 3, 2002. On May 14, 2003, Mallinckrodt submitted the C-T Phase 2 DP for review and approval.

Discussion:

The NRC staff is conducting its review of the Mallinckrodt Phase 2 DP. As a result of this review, the staff developed a number of draft comments associated with the health physics and dose modeling sections of the DP. The attached draft comments were distributed to participants prior to the meeting to aid in the discussion. During the meeting, the staff discussed each of the comments to ensure that Mallinckrodt understood the comments and the technical bases.

Attachment

Following the discussion of NRC's draft comments, staff from the Missouri Department of Natural Resources (MDNR) and Ms. Kay Drey were given an opportunity to ask questions and/or make comments. The meeting was adjourned at 3:00 pm.

Actions:

(1) NRC committed to send copies of the Mallinckrodt Phase 2 DP to the MDNR and Ms. Kay Drey.

(2) NRC committed to send an NRC Meeting Feedback Form to the MDNR and Ms. Kay Drey.

Mallinckrodt Phase II DP
Request for Additional Information
Jay Thompson

1. Section 9.5 contains a list of changes that may not be made without NRC approval:

"Mallinckrodt may make justified changes related to the decommissioning process without filing an application for an amendment to the license to change the decommissioning plan when the following conditions are satisfied:

a. The change does not conflict with requirements specifically stated in license STB- 401 nor impair Mallinckrodt's ability to meet all applicable NRC regulations;

b. There is no degradation in safety or environmental commitments addressed in the NRC-approved decommissioning plan for the activity being performed;

c. The quality of the work, the remediation objectives, or health and safety will not be adversely affected significantly;
d. The change is consistent with the conclusions of actions analyzed in the Environmental Assessment;

e. Reasonable assurance that adequate funds will be available for decommissioning remains;

f. The coverage requirements for scan measurements and/or sample density will not be reduced;

g. The derived concentration guideline levels and related minimum detectable concentrations (for both scan and fixed measurements methods) will not be increased;

h. The radioactivity level, relative to the applicable derived concentration guideline level, at which an investigation occurs will not be increased;

I. The statistical test applied to a final status survey will not be other than approved section 14 herein, or a Sign test, a Wilcoxon Rank Sum test, or those described in NUREG-1505;

j. The Type I decision error will not be increased beyond what is authorized in section 14 herein and;

k. A final status survey area classification will not be decreased, e.g., from impacted to non-impacted; Class 1 to Class 2; Class 2 to Class 3; or Class 1 to Class 3."

Change item j to:

j. The Type I decision error (for Scenario A of NUREG-1505) or the Type II decision error (for Scenario B) will not be increased beyond 0.05;

Attachment

Add an item l:

l. Following failure of a final status survey, a survey unit will not be subdivided and reclassified without NRC approval.

Add an item m:

m. Scenario B of NUREG-1505 will not be used unless approved by the NRC.

2. Table 4-7 contains the radiological results (designated BH-001 through BH-056) from subsurface sampling conducted per the C-T Characterization Plan. Many of the boreholes (BH-009 to BH-056) have samples with the top sample depth listed as 0 feet. However, the sample results appear to be at incremental depths and not averages over the whole column. For example, BH-030 has U-238 samples results of 14.6 pCi/g for 0-12.5 ft and 6.3 pCi/g for 0-14.5 ft. This is inconsistent since it would take another 12.5 feet at zero concentration to reduce the concentration to 7.3 pCi/g if the average concentration is 14.6 pCi/g for 0-12.5 ft. However, the concentration in the table for 0-14.5 ft is less than this with the addition of only two feet. Please review the table and revise the upper limits.

3. Please review the data for BH-065 and BH-066 in Table 4-8 for appropriate top sample depths.

4. Chapter 5: Please clarify if the soil and pavement scenarios are independent, i.e., if exposures to pavement/slabs and soil are mutually exclusive.

5. The cost estimate in the first paragraph of section 7.4.2 is $347,000 while the calculation below it totals to $367,400.

6. The cost estimate in the first paragraph of section 7.4.3 is $397,000 while the calculation below it totals to $395,500.

7. Section 8.4.3 states “Downstream sewerage will reasonably be assumed to be uncontaminated if surveys of drains and other at-grade locations do not identify the presence of radioactivity above criteria.” However, if at-grade locations have been decontaminated, contaminated sediment may still be present. Provide the technical and/or historical basis for the proposed survey/sampling or modify the plan.

8. Sections 8.5.1 and 8.7: the NRC should be notified prior to backfilling an excavation as specified in Section 8.7. However, “timely NRC response” prior to backfilling is too ambiguous. Please include an allowance for a 14 calendar day notification.

9. Section 8.5.1: Please clarify if a survey will be performed after backfilling an excavation, in addition to the one of the excavation prior to backfill.

10. Footnote 2 on page 14-1 states: “A subsurface building foundation within a soil survey unit that passes a FSS will also be assumed to pass FSS and will not be sampled.” Please explain why this is adequate or provide more information concerning construction, given that radioactive material may have been present along seams at slab-foundation joints.

11. Footnote 3 page 14-2: page 18 of DG-4006 is referenced. The citation is on page 15 of my copy of DG-4006. Please verify the page number or cite "Section 2.9" of DG-4006.

12. On page 14-3, last paragraph of Section 14.2, it is stated that: "Where Characterization Survey data are insufficient in number to serve as the entire data set for a particular survey unit, those data may be supplemented, where appropriate, by additional FSS measurements using a statistically based sampling design, such as a two-stage sampling plan." Please add that any such plan will be reviewed to ensure it meets DQOs such as the allowable Type I and II errors.

13. On page 14-3, third paragraph of Section 14.3, it is stated that: "Where remedial action survey data are insufficient in number to serve as the entire data set for a particular survey unit, those data may be supplemented, where appropriate, by additional FSS measurements using a statistically based sampling design, such as a two-stage sampling plan." Please add that any such plan will be reviewed to ensure it meets DQOs such as the allowable Type I and II errors.

14. In section 14.4.1, it is stated that: "Typical instrumentation is listed in Tables 14-1 (field methods) and 14-2 (laboratory methods). Other instrumentation meeting requisite detection capabilities may be used provided it meets quality objectives for calibration, operability, and detection capability." The licensee should commit to providing a technical basis document to the NRC prior to use that demonstrates the new instrumentation meets quality objectives.

15. In the last paragraph of Section 14.4.3.2, page 14-11, the classification of temporary paving is discussed. It is stated that "All of this material in Class 1 areas and some of this material in Class 2 areas will be removed to allow FSS surface contamination measurements as part of the Phase II Plan. The material removed has very low potential for contamination, and will be considered non-impacted subject to confirmatory survey to determine that average radionuclide concentration does not depart significantly from background." However, this paving is in close proximity to or in contact with radioactive material in Class 1 and 2 areas. Please provide further justification as to why this material should be considered non-impacted or Class 3.

16. In Section 14.4.3.3, it is stated that "Alternatively, the tested hypothesis may be that measurements in a survey unit do not exceed background + $DCGL_w$, i.e., Scenario B, and apply alternate, appropriate statistical test(s)." Please add a note that if Scenario B is used, NRC approval is required.

17. In Section 14.4.3.5, page 14-14, it is stated that "The required number of measurements determined in the first iteration may exceed reasonable bounds. The process can be repeated using more suitable values of Δ, α, and β as appropriate." Please add a note that NRC approval is required for using α or β values greater than 0.05, per Section 14.4.3.4, page 14-12.

18. In Section 14.4.3.5, page 14-16, it is stated that "Scanning is unnecessary for Class 3 building slab and pavement survey units." Please change to indicate that judgmental

scanning is performed for Class 3 areas. Note that the last paragraph of Section 14.4.3.7 does recognize that scans of Class 3 areas will be performed.

19. Footnote 19 on page 14-16 states "$n_{wilcoxon}$ = number of measurements needed to provide desired confidence in a Wilcoxon Rank Sum test, as calculated from either Equation 14-1 or 14-2". However, These equations give an N equal to the total number of measurements (survey area and background). Please clarify that $n_{wilcoxon}$ is N/2, not N, for comparison to n_{EA} in the last paragraph of Section 14.4.3.5.

20. In Section 14.4.3.8, page 14-20, under the paragraph Evaluation of Measurements Individually, it is stated that "…An investigation level depends on survey unit classification. A scan result which exceeds the corresponding investigation threshold listed in Table 14-5 shall be confirmed by stationary location measurement. Scan measurement results will remain as paper records. The direct measurement data only will be recorded and used for further analysis and classification." In the next paragraph, it is noted that "Scan results for those units subject to scanning will also be compared to investigation levels." Scan results may also be used to define the extent of elevated areas of contamination. Please clarify the use of scan data. It seems like scan results are used for further analysis and classification.

21. In Section 14.4.3.8, page 14-21, it is stated that "Depending on the outcome of the elevated measurement test and other tests, resurvey, reclassification, partial or complete remediation, or some combination of these measures may be required. (If only partial remediation is required, resurvey of some portion of the unit after supplementary remediation will also be required. To the extent practical and appropriate, original survey data from portions of the unit outside the supplementary remediation area will be used in conjunction with new survey data from the supplementary remediation area in new tests to determine whether the unit meets release criteria.)." Please note that NRC concurrence is required for subdividing and partial reclassification of a survey area. Also, a partial remediation (e.g., cleanup of a small area exceeding the $DCGL_{EMC}$) without an entire resurvey of the whole survey area may be performed if the survey area as a whole passed originally.

22. For the scanning investigation level for Class 1 slab and pavement in Table 14-5, p. 14-22, the alternate limit of MDA is redundant since the $DCGL_{EMC}$ may be a function of the MDA. Recommend deleting "or MDA".

23. Please clarify in Table 14-5 that the Class 1 slab and pavement investigation levels also apply to surface soils.

24. On page 14-23, in the paragraph on Low Level Screening, it is stated that "If the class 3 survey unit contains no flagged measurements, the unit will be rated acceptable, and no further evaluation will be needed." An implicit assumption is that the MDA is less than the $DCGL_W$. This is covered in the next paragraph on page 14-23. Please add that it is necessary to demonstrate that the average concentration is less than the $DCGL_W$, and delete the "no further evaluation" comment.

25. In Table 14-6, the second survey result is "Difference between any survey unit measurement and any reference area measurement greater than $DCGL_W$ (not to be used for survey units with less than 5 measurements)". Please add a condition to the first survey result (all survey measurements less than the $DCGL_W$) to indicate that the minimum number of measurements should also apply to the first survey result.

26. In Section 14.4.3.8, page 14-26, possible actions are listed if DQO are inappropriate or if a survey unit is misclassified. The first bullet states Mallinckrodt may "Review the DQO. If warranted, adjust values of parameters such as Type I and Type 2 error criteria or the lower bound of the gray region (LBGR)." Changing Type 1 or Type 2 error criteria may require NRC concurrence. Please add a note that these actions listed may require NRC concurrence.

27. In Section 14.4.3.8, page 14-26, possible actions are listed if DQO are inappropriate or if a survey unit is misclassified. The second major bullet deals with reclassification of a part of the survey unit. While this may be acceptable in some cases, approval depends on the specific circumstances. Add a condition that NRC approval is required.

28. In Section 14.4.3.8, page 14-26, possible actions are listed if DQO are inappropriate or if a survey unit is misclassified. The second major bullet states "If the reclassified part were Class 1, the measurement density appropriate for Class 1, and the number of measurements in it were fewer than would be estimated for an entire Class I survey unit, compliance would be accepted if every measurement in the reclassified part were less than the $DCGL_W$." Surveys must consist of enough samples to be statistically significant. Acceptance of a unit with the number of samples "fewer than would be estimated for an entire Class I survey unit" is too case-specific to grant on a general basis. However, in certain circumstances, fewer samples may be acceptable. Please add a condition that NRC approval is necessary to use alternate criteria. Also, please add a note that the reclassified area, now Class 1, would need a 100% scan.

29. In Section 14.4.3.8, page 14-26, it is stated "In the event a Class I survey unit area is less than 500 m^2 and the number of measurements are specified and tested statistically for compliance with $DCGL_W$, the area factor shall not exceed that specified in Section 5 for the elevated measurement test." It is not clear how the area factor is capped since equations with no maximum values are presented in Section 5. Please clarify how the area factor is limited.

30. In Section 14.4.3.8, page 14-26, it is stated "Alternatively, in the event a Class 1 survey unit area is less than about 500 m^2 **,** the number [of] measurements estimated to satisfy a WRS, Quantile, or Sign test might be unreasonably large in that survey unit. When both conditions exist, measurement density will be at least one measurement per 100 square meters at locations based on judgment. In that circumstance, the criterion for release shall be that every measurement in the survey unit does not exceed the $DCGL_W$." The thresholds for special consideration of small survey areas listed in the MARSSIM reference (page 4-15) are 10 m^2 for buildings and 100 m^2 for land areas. These are significantly smaller than the 500 m^2 proposed by the DP. Please justify the 500 m^2 area or change the text. Also add that NRC concurrence for the reduced coverage is necessary.

31. In Section 14.4.3.8, page 14-26, it is stated "In the event a Class 2 survey unit area is less than 2500 m^2 **,** the number measurements estimated to satisfy a WRS test might be unreasonably large in that survey unit. When so, measurement density will be at least one measurement per 500 m^2 at locations based on judgment. The criterion for release in that circumstance, shall be that every measurement in the survey unit does not exceed the $DCGL_W$." MARSSIM does not propose a threshold for reduced coverage of a Class 2 area. Please justify the threshold of 2500 m^2, and add a statement that NRC concurrence is needed.

32. In Section 14.4.3.8, last bullet on page 14-26, it is stated "If the scanning method was not sensitive enough in a Class 2 unit, a portion containing measurements greater than $DCGL_W$ may be reclassified as Class 1, measured at the measurement density required for a Class 1 area, with the rest of the survey unit remaining Class 2." Please add that NRC concurrence is necessary.

33. In Section 14.4.3.8, second bullet on page 14-27, it is stated "If a survey unit passes. Compute the radiological dose associated with each measurement as if it represented the entire survey unit and calculate the arithmetic mean dose represented by all the measurements in the area of elevated radioactivity. If the mean dose does not exceed the product, area factor x radiological dose criterion, *i.e.,* AF x $DCGL_W$, compliance would be demonstrated for the elevated measurements criterion for that local area." Note that "area factor x radiological dose criterion" and "AF x $DCGL_W$" do not have equivalent units. Please clarify which expression is correct.

34. In Section 14.4.3.8, second bullet on page 14-27, it is stated "If a survey unit passes. Compute the radiological dose associated with each measurement as if it represented the entire survey unit and calculate the arithmetic mean dose represented by all the measurements in the area of elevated radioactivity. If the mean dose does not exceed the product, area factor x radiological dose criterion, *i.e.,* AF x $DCGL_W$, compliance would be demonstrated for the elevated measurements criterion for that local area." This is different than Equation 8-2 on p. 8-23 of the MARSSIM. Please add a condition to comply with Equation 8-2.

35. In Section 14.4.3.8, page 14-27, it is stated "Construct a retrospective power curve of the measurements. Evaluate whether the survey unit would have passed the release criterion using the non-parametric statistical test, *e.g.,* WRS test. If not, it would be acceptable to make more measurements at random locations in the survey unit and perform statistical test(s) on the expanded data set." This is essentially double sampling and requires NRC concurrence prior to performing to make sure the probability of releasing a contaminated area is acceptable. Please add NRC concurrence is required.

36. In Section 14.4.3.8, page 14-27, it is stated "Reverse the tested hypothesis and apply an alternate, appropriate statistical test, *e.g.,* from Scenario A to Scenario B. Specific DQO would be developed for this approach and be submitted to the NRC for approval, or would be addressed in the FSS report for survey units that fail." NRC concurrence should be obtained prior to using Scenario B. Please delete ", or would be addressed in the FSS report for survey units that fail".

37. In Section 14.4.3.8, page 14-27, last bullet, it is stated “In lieu of statistical testing, compute the radiological dose associated with the mean of measurements in the survey unit. Alternatively, compute the radiological dose attributable to each measurement as if it represented the entire survey unit and calculate the arithmetic mean dose represented by all the measurements in the survey unit. If the mean dose does not exceed the radiological dose criterion, compliance would be demonstrated for the survey unit.” The mean dose being less than the radiological dose criterion is a necessary condition for compliance but not a sufficient condition. Delete the last bullet.

38. The statement is made on page F-3 that “instrumentation used in the field is practically the same as used in a counting room”. However, the counting room instrumentation appears to be high-purity germanium (Table 14-2 p. 14-6), while the field instruments are sodium iodide. In general, these will not have comparable lower limits of detection. Clarify the types of instruments to be used in the counting room and the field. In addition, a commitment should be added to supply the NRC with a technical basis document, prior to use, for in-ground gamma spectroscopy.

39. Page “Attach 1-4” describes the results of RESRAD modeling of occupational dose for workers. Will construction workers be trained as radiation workers so that the occupational dose limits apply? If not, the statement “The estimated annual dose to the construction worker is less than 10% of the basic radiation dose limit.” is not true. Please clarify if construction workers will be trained as radiation workers.

40. Appendix E, Section E.1.1.6, references Tables 4-1 and 4-2. The correct tables to reference are Tables 14-1 and 14-2.

DRAFT RAIs
EPAD Staff Review of Dose Assessment for
Mallinckrodt C-T Phase II Decommissioning Plan
Request for Additional Information

By: Boby Eid
November 29, 2004

1. Introduction:

The Mallinckrodt the U.S. Nuclear Regulatory Commission (NRC) licensed facility (e.g., STB-401, docket number 04006563) includes the columbium and tantalum C-T plant located within the main Mallinckrodt St. Louis plant, at 3600 North Second Street, St. Louis, Missouri, 63147. The plant land parcel is approximately 43-acre (174,016 m^2) located near the west bank of the Mississippi River in the NE section of the City of St. Louis. The STB-401 license was amended on May 3, 2002, to authorize the decommissioning of certain C-T process buildings and structures in accordance with a C-T Phase I Decommissioning Plan (C-T Phase I DP). On May 15, 2003, Mallinckrodt submitted a C-T Phase II Decommissioning Plan (C-T Phase II DP) for remediation of the processing building slabs, sewerage, wastewater neutralization basins, and soils affected by the C-T processing. The C-T Phase II DP included analysis and computation of the derived concentration guideline levels (DCGLs) for the unrestricted release of these affected facilities. The licensee provided information describing the radiological status of the affected facilities and dose modeling approaches, computations, and results. The Division of Waste management and Environmental Protection (DWMEP) staff conducted a visit to Mallinckrodt site on June 22, 2004, to observe actual site settings and the surrounding environmental conditions. This report presents the Environmental and Performance Assessment Directorate (EPAD) staff review of the licensee's dose modeling approaches focusing on request for additional information to complete staff review.

2. Staff Reviews:

In conducting the review, EPAD staff reviewed the site description, location, and historical data regarding its operational history. Staff also reviewed the site land use for the past 100 years and current land zoning by State authorities. The staff also reviewed the radiological source-term characteristics and the conceptual model assumptions using the surface/subsurface survey and characterization data. Staff also reviewed the licensee's proposed exposure scenarios and associated exposure pathways. More importantly, the staff reviewed the licensee's dose analysis approaches, assumptions, input parameters, and dose results used in derivation of the DCGLs.

In summary, the plant site currently contains more than 50 manufacturing and support buildings in an area of twelve city blocks. The remainder of the site is paved with asphalt or concrete. The Mallinckrodt C-T Process facility, the support buildings, and all other affected areas above-ground level at the site have been, or will be, decontaminated in accordance with the C-T Phase I Decommissioning Plan (Phase I Plan). Activities in the Phase I Plan are authorized under license STB-401, as amended on May 3, 2002. This review involves only the Phase II DP including the C-T process facilities and support building floor slabs, subsurface sewer

system, contaminated soils, and the wastewater neutralization basins. Most of the activities required to decommission under C-T Phase II will take place within Plant 5. Plant 5 boundaries include Destrehan Street to the North, Angelrodt Street to the South, Hall Street to the East, and Second Street to the West. Within Plant 5 boundaries, there are of footprints, floors, or paved areas of small buildings that existed before and have been demolished in accordance with the C-T Phase I DP. These building locations include Buidings Nos: 260, 201, 200W, 200 E, 200A, 240, 213, 213 A, 213 B, 214, 215, 219, 222, 238, 236, 235W, 235E, 250, 238, 236, 235W, 235E, 248, 247A, 247B, 246, 246B, 245, 265, and 223. Within Plant 5, the C-T Project remediation area boundaries have been defined as follows:

- everything south of the south edge of Destrehan Street,
- everything north of a line drawn along the south sides of Buildings 200 and 260,
- everything west of a line drawn on the east side of Bldgs. 222 and 223, and
- everything east of a line drawn along the west sides of Buildings 240 and 250.

The following C-T support areas outside of Plant 5 will also be remediated during Phase II: (a) Building 91 sewers (if contamination of drains is identified in Phase I); and (b) Wastewater basins in Plant 7. The wastewater neutralization basins located outside Plant 5. This facility supported the C-T operations; therefore, it will also be decommissioned under the C-T DP II.

Certain Plant 5 areas outside of these boundaries contain residues of uranium processing under the Manhattan Engineering District (MED) and under the Atomic Energy Act (ACT). The MED/AEC residues are the responsibility of United States Army Corp of Engineers (USACE) under the FUSRAP. Therefore, FUSRAP is assumed to be responsible for evaluation and remediation of all areas containing MED/AEC residues, including any areas where such residues are commingled with other radioactive materials such as C-T materials.

3. Description of the Proposed Action

The licensee proposed to release the contaminated areas, under the C-T DP Phase II, for unrestricted use in accordance with the NRC's license termination rule (LTR) dose limit (i.e., 0.25 millisieverts per year (mSv/yr) [25 millirem per year (mrem/yr)], under the Code of Federal Regulations Title 10, Section 20.1402 (Subpart E). The licensee requested that the NRC release these areas for unrestricted use, following its remediation to the proposed $DCGL_w$ derived in Section 5.8.1.1 of the C-T DP Phase II (e.g., the DCGL derived for the industrial worker exposure scenario to soil as listed in table 5-1, page 5-13). The licensee also requested use of the derived $DCGL_{EMC}$ area factors in Section 5.8.1.2 (e.g., Figure 5-1) for elevated measurements of soils. In addition, the licensee requested use of the $DCGL_w$ derived in Section 5.8.3.1 for the industrial worker exposure to contaminated pavements (e.g., $DCGL_w$ listed in Table 5-3, page 5-16) and the $DCGL_{EMC}$ area factors in Section 5.8.3.2 (Figure 5-3, page 5-21) for elevated measurements of pavements.

4. Request for Additional Information:

Based on the staff review and analysis of the submitted information, the staff is unable to approve the proposed action particularly regarding the proposed DCGLs. In this regard, additional information is needed to clarify certain modeling assumptions and approaches, and to justify values of sensitive input parameters. The information needed is summarized in the following items:

(a) The thickness of the contaminated zone: The licensee selected a thickness of 2 m (RESRAD default value) to represent the contaminated area across the site. However, borehole data showed that the thickness varies from 0.01 to 4.5 m. Albeit that the average

thickness may correspond to 2 m; this parameter could be better represented as variable with a distribution between these two limits. Alternatively, the licensee may conduct a sensitivity analysis to demonstrate that a source thickness of more than 2m will not have any significant influence on the dose result.

(b) The mass loading for inhalation factor: the licensee used a factor of 3.500E-05 g/m^3 for the industrial worker scenario and a factor of 8.0E-05 g/m^3 for the construction/excavation worker scenario. The RESRAD default value is 1.00E-04 g/m^3. The licensee used references with ranges of mass loading factor. Since the value for this sensitive parameter is uncertain, this parameter could be better represented as variable with a distribution between the two limits 5.0E-04 and 2.3 E-05 g/m^3. Alternatively, the licensee may select a more conservative value to bound the variable site conditions within the 1000 years performance period.

(c) The licensee selected an indoor gamma shielding factor of 0.17. In other words the licensee assumed that only 17% of outdoor gamma radiation can be penetrated indoors. The RESRAD default value is 0.7. The licensee indicated that Plant 5 has concrete slab floors or concrete walls with few windows. Therefore, the licensee assumed that the factor 0.17 should represent the gamma shielding for the building flooring and walls. It should be noted that the performance period for decommissioning is1000 years. Therefore, the assumption that concrete floors and walls will be always available and well maintained to shield from gamma radiation is unrealistic. For example, prefabricated buildings may be constructed on the contaminated soil with minimum shielding from walls and floors. Further, a security guard may be located at the entrance of the building with much less shielding from outdoor gamma radiation. It should be noted that the shielding factor for the construction worker was conservatively selected as 1.0; however, the shielding factor for the industrial worker scenario is not well justified. This important sensitive parameter could be better represented as variable with a distribution between the two limits 0.17and 0.7. Alternatively, the licensee may select a more conservative value for the shielding factor to bound potential site-specific conditions within the 1000 year performance period.

(d) The Occupancy Time: The licensee selected for the industrial worker scenario an occupancy time of 0.1825 for indoors and 0.04566 for outdoors. These factors should be acceptable because they are based on an estimated 2000 working hours per year. The occupancy time for the construction worker scenario, however, was selected based on 80 working hours per year corresponding to a time fraction of 0.0081 expended outdoors. The 80 hours occupancy time may be limited to a certain construction worker doing excavation at the site. However, construction workers may conduct other activities besides excavation and may perform renovation activities. NUREG/CR-5512 Vol. 1 considered an occupancy time for building renovation of 8 h/d , for a total exposure period of 90 days. This time period corresponds to 28.3 days on the job which is equivalent to 0.057 time fraction for the year. However, for this scenario a fraction of this time should be expended indoors. Therefore, the occupancy time fraction for the construction worker scenario may be considered in two parts, an outdoor time fraction of 0.0081 and an indoor time fraction of 0.041. Because this parameter is uncertain, a distribution of occupancy parameter for outdoor could be represented in the range 0.008 - 0.041 and for the indoor in the range of 0.0 - 0.041. If the licensee prefers to exclude this scenario from the analysis and preferably use conservative assumptions and parameters for the industrial worker scenario this issue may be disregarded.

(e) Derivation of radionuclide specific $DCGL_w$ based on the radionuclideGuideline (G(i,t) at the time of the total peak dose. The licensee presented the $DCGL_w$ for each specific radionuclide (Table 5-1, page 5-3) based on the guidelines (e.g., radionuclide concentration equivalent to 25 mrem/y) at the time of the peak dose($G(i,t_{peak})$ of the overall

radionuclides in the three decay series. This approach is no-conservative and contrary to the recommendation of NRC Guidance in NUREG-1757Vol. 2, Section 2.7. When using the sum-of-fraction approach to establish the radionuclide specific DCGLs the licensee should select the conservative radiuonuclide specific guideline limit at the minimum single radionuclide soil guideline (G (i,t_{min}). Therefore, using NUREG-1757, Vol. 2 recommendations, the radionuclide specific DCGLs would change significantly. For example, The Th-232 DCGL using the G(i,t_{peak}) was derived at 394.9 pCi/g, whereas the Th-232 DCGL using the G (i,t_{min}) would be 20.77 pCi/g. The licensee should explain further and justify selection of these radionculde specific DCGLs assuming that the sum-of-fraction principle would be applied. Alternatively, the licensee may clarify that the radionuclide sum-of-fraction approach will not be used in the demonstration of compliance with the dose criteria.

(f) The licensee did not explain the basis for release of the contaminated sewers (if contamination of drains is identified in Phase I) and the scenario to be used for derivation of the DCGLs and related computations. For example samples taken from manholes #2, #34, #42, and #4 show significant contamination levels. The licensee should explain if the DCGLs for soil would also be used for release of contaminated sewer systems. Staff may find that the soil DCGLs could be appropriate as well for the sewerage system. However, the licensee needs to address this issue through consideration of other potential exposure scenario appropriate for the sewerage source.

(g) The licensee indicated that the wastewater basins in Plant 7 (e.g., the wastewater neutralization basins located outside Plant 5) supported the C-T operations; therefore, it will also be decommissioned under the C-T DP II. The licensee provided in Table 4-5 showing that surface contamination (dpm/100 cm^2) of the wastewater neutralization basin did not exceeded the DCGLw. Table 4-5 did not show any data of volumetric contamination. In other words, the licensee appears to assume that only surface contamination is expected at the wastewater neutralization basin. The licensee should explain the basis for assuming only surface contamination may be present at the wastewater neutralization basin rather than volumetric contamination. The licensee needs to verify this assumption through sampling data on the depth of contamination at the basin. It should be noted that the assumption that the integrity of the lining material has been maintained over all the years of operation may not be sufficient to assume superficial surface contamination at the basin.

(h) Assumptions for the Industrial Worker Exposure to Pavement: For the exposure of industrial worker to residual radioactivity on pavements, the licensee made similar assumptions as those for the soil. However, the licensee assumed a thin layer of surface contamination on pavement with thickness of 0.1 cm. The licensee modified the approach to convert volumetric dose analysis results into surface activity results (e.g., dpm/100 cm^2). This was done through derivation of the radionuclide volumetric dose factor (mrem/y per pCi/g), converting this factor into areal density factor pCi/100 cm^2 (e.g., by assuming a thickness of pavement of 0.1 cm and a density of 1.5 g/cm^3) corresponding to 25 mrem/y and then converting the pCi into dpm (e.g., by multiplying by 2.22). Therefore, considering the volumetric dose analysis approach the following parameters and assumptions were made for industrial worker exposure to the pavement source: (I) Contaminated Zone: the licensee assumed that 0.1 cm thickness of soil adequately represents areal contamination on pavement. This is less conservative than the 2 m thickness assumed for the exposure to soil; (ii)The erosion rate for the pavement was assumed to be zero.

The licensee needs to verify that contamination only exist in a pavement medium of 0.1 cm thickness and no contamination below this thin crust of the pavement. In addition, by assuming an erosion rate of zero the licensee assumed that the pavement would be maintained through a performance period of 1000 years. The licensee needs to verify these assumptions and provide data and a rationale that the thin pavement layer would be maintained over a 1000 year time-frame.

(l) Area Factor for Elevated Measurements:

The licensee calculated the area factor for the industrial scenario elevated measurements exposure to soil and to pavement. The area factor is the ratio of the composite dose factor for the survey unit area to the composite dose factor for the local area (e.g., elevated measurements) of contamination. The licensee calculated the area factor for elevated measurements criterion in soil using contaminated areas of 10, 30, 100, 200, 1000, and 2000. A survey unit area of 10,000 m^2 was used for derivation of the area factor. In summary the area factor varied in the range of 1.1 (for an elevated area of 1000 m^2) to 2.3 for an elevated area of 10 m^2 for the composite radionuclide source of U-series , Ac-series, and Th-series. Similarly, the licensee calculated the area factors for elevated measurements on pavements for areas ranging from 10 m^2 to 2000m^2. These factors were found to vary in the range of 5.5 for the 10 m^2 area to 1.2 for the 2000m^2 area. The comments provided above regarding derivation of the $DCGL_w$ would also be applicable to derivation of the elevated measurements using the area factor(e.g., the $DCGL_{EMC}$).