

December 26, 2002

Mr. Ben Baker  
Project Manager  
The Dow Chemical Company  
9008 Bldg., Office 154  
4520 East Ashman  
Midland, MI 48674

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION ON THE LICENSE  
AMENDMENT REQUEST FOR THE REVISED SUPPLEMENT TO THE  
DECOMMISSIONING PLAN, BAY CITY SITE, MI (TAC# L60463)

Dear Mr. Baker:

I am responding to The Dow Chemical Company's (TDCC's) letter dated January 31, 2002, requesting U.S. Nuclear Regulatory Commission staff review and approval of a revised supplement (dated January 28, 2002) to the previously approved decommissioning plan (DP) for License STB-527. During the initial processing, which included a limited technical review, some omissions/deficiencies were identified. These deficiencies were discussed by the NRC staff and TDCC staff, and TDCC provided additional technical information to the NRC to address the deficiencies in a letter dated July 19, 2002 (Attachment 1 to the Supplement).

On August 5, 2002, you were informed that these documents were accepted and forwarded to the staff for detailed technical review and evaluation. At that time you were notified that the detailed technical review may identify additional omissions in the submitted information or technical issues not identified during the initial processing that require additional information. During the detailed technical review, questions have arisen for which we require additional information and clarification. Please provide responses to the enclosed request for additional information (RAI) within 45 days from the date of this letter. If you prefer to meet with the NRC staff to discuss the RAI, a meeting can be arranged. Following receipt of the responses to the RAI, we will continue our evaluation of your amendment request.

TDCC has proposed in the supplement that the unrestricted use criteria for groundwater in the saturated zone will be based on compliance with the U.S. Environmental Protection Agency's (EPA's) Safe Drinking Water Regulations at license termination. In applying the maximum concentration levels (MCLs) to groundwater, TDCC proposes to subtract background radionuclide concentrations in groundwater in demonstrating compliance with MCLs. In applying MCLs, EPA does not exclude background. EPA's interpretation is that MCLs are defacto compliance limits that have to be met regardless of the contribution from background. The following example illustrates NRC's implementation of the MCLs. The uranium recovery (UR) program is using criteria in 10 CFR Part 40, Appendix A, Criteria 5B(5)(b), which refers to the table in paragraph 5C (Maximum Values for Ground-Water Protection). This table gives a combined MCL value for both radium-226 and radium-228 as 5 pCi/L. In demonstrating compliance with these criteria, NRC requires that MCLs be met without accounting for any contribution from background. Therefore, our position is that background groundwater concentrations should not be subtracted from MCLs.

Mr. Baker

2

In addition, a decommissioning funding plan with an updated detailed cost estimate for the revised supplement to the DP is required [Reference: 10CFRPart40.42(g)(4)(v)] and, if necessary, additional financial assurance to cover the cost. Also, we request a groundwater monitoring plan and groundwater assessment for the Bay City site (Reference: License Condition 14A). The review of the decommissioning funding plan and the groundwater monitoring plan may result in additional RAIs.

On July 19, 1996, License Amendment No. 6 was issued to Mr. Larry Giebelhaus, TDCC Project Manager, approving the decommissioning (remediation) plan for the Midland and Bay City (Michigan) Site Decommissioning Management Plan (SDMP) sites. An Environmental Assessment (EA) was enclosed to License Amendment No. 6. On July 21, 1997, License Amendment No. 7 was issued to Mr. Larry Giebelhaus, TDCC Project Manager, approving the decommissioning criteria for the Midland and Bay City (Michigan) SDMP sites. An EA was also enclosed to License Amendment No. 7. We request any changes in the information, including permits, licenses and approvals to update the previous Environmental Assessments for purposes of preparing a new EA for the proposed License Amendment.

On August 16, 2002, we sent a letter to you enclosing deficiencies in the Final Status Survey Reports for Verification Areas VA-I through VA-VI for the Bay City site. We requested a response within 30 days from the date of the letter. To date, we have not yet received your response. Please respond to this request within 20 days from the date of this letter.

If you have any questions concerning this letter, please contact me at (301) 415-6694.

Sincerely,

**/RA/**

M. (Sam) Nalluswami, Project Manager  
Facilities Decommissioning Section  
Decommissioning Branch  
Division of Waste Management  
Office of Nuclear Material Safety  
and Safeguards

cc: Liane S. Smith, MDEQ

Docket No.: 040-00017

License No.: STB-527

Enclosure: Request for Additional Information

Mr. Baker

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**/RA/**  
M. (Sam) Nalluswami, Project Manager  
Facilities Decommissioning Section  
Decommissioning Branch  
Division of Waste Management  
Office of Nuclear Material Safety  
and Safeguards

cc: Liane S. Smith, MDEQ  
Docket No.: 040-00017  
License No.: STB-527  
Enclosure: Request for Additional Information

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**ADDITIONAL INFORMATION NEEDED TO SUPPORT THE REVISED SUPPLEMENT  
TO THE DECOMMISSION PLAN FOR THE DOW CHEMICAL COMPANY'S  
BAY CITY, MICHIGAN, SITE**

December 2002

**BACKGROUND**

The NRC staff has reviewed the supplemental decommissioning plan (SDP) submitted by The Dow Chemical Company (TDCC) on January 31, 2002 (TDCC 2002a), and the additional information submitted as Attachment 1 to the SDP on July 19, 2002 (TDCC 2002b). TDCC proposed to remediate subsurface contamination in the saturated zone consistent with the intent of the Site Decommissioning Management Program (SDMP) Action Plan (NRC 1992a). Specifically, TDCC proposed that the unrestricted use criteria for the thorium contamination in the saturated zone be based on compliance with the 10  $\mu$ R/hr exposure rate criteria (i.e., 1981 Branch Technical Position, "Disposal of Thorium or Uranium Wastes from Past Operation," (46 FR 52061) and the EPA National Primary Drinking Water Standards (i.e., 40 CFR Part 141).

At the time of final status survey (FSS), TDCC will need to justify and commit to the thorium isotopic guideline values (i.e., Th-228, Th-230, and Th-232) to be used to demonstrate regulatory compliance. Please confirm that this will be done. Under License Amendment No. 7, the guideline for thorium concentration at the Bay City site ranges from 10.0 to 21.0 picocuries of total thorium per gram (pCi/g) of soil (Th-228 + Th-230 + Th-232) depending on the isotopic ratio in the survey area.

The staff reviewed the following aspects of the SDP and Attachment 1: dose modeling scenario, saturated zone concentration criteria development, characterization data, calculations, and the final status survey design.

**REVISED SUPPLEMENT TO AMEND THE DECOMMISSIONING PLAN (TDCC 2002a)**

1. Section 1.1.3, Current Site Condition, page 5 - Geology, soil and groundwater conditions are described starting from the first full paragraph up to fifth full paragraph. Please provide data to support depth to groundwater (between 3 and 5 feet), groundwater gradient (0.004 ft/ft) and related information. Geologic cross-sections, water table elevations, flow directions, well locations and related data need to be provided to support this information.

The sixth paragraph notes two permits currently held by TDCC to allow excavating and regrading of areas during decommissioning activities. Please provide a list of all Federal, State, and local permits and licenses held by TDCC pertaining to the site. Identify additional permits that will be needed to complete remediation and decommissioning.

Basis: Information on permits, licenses and approvals should be included in the licensee's environmental report (10 CFR 51.45(d)). Also, TDCC intends to perform the final status survey of the wetlands after the areas remediated by excavation are backfilled and graded to original contour. Information on backfill permits is needed to determine if the final status survey to demonstrate unrestricted release compliance can be performed as proposed by TDCC.

2. Section 1.1.5, Future Land Use, pages 7 to 8 - TDCC has proposed a future unrestricted land use scenario where the critical group will most likely consist of either recreational users or individuals that consume drinking water from a well that draws water from the site. Under this scenario, TDCC notes that the saturated zone contamination is not expected to contribute a significant dose to the critical group. Also, in the supplemental decommissioning plan (SDP), Section 3.1, page 9, TDCC states "As described previously in Section 1.1.5, there is very low probability that the material in the saturated zone would be excavated and is not considered a plausible scenario." In contrast, NRC staff conversations with the Michigan Department of Environmental Quality, Land and Water Management Division in the Bay City District, indicated that there are other plausible land use scenarios that could involve the excavation or dredging of the saturated zone, such as development for a marina or condominium complex. TDCC needs to justify why recreational use should be considered as the bounding land use scenario.

Basis: In NRC's feedback to TDCC on the proposed conceptual plan (NRC 2001), NRC indicated that use of the recreational scenario was to be based on the assumption that zoning laws would only allow the site to be used in this manner. It was also noted that the NRC staff will require further justification for using the recreational scenario before approving the plan.

3. Section 3.1, Unrestricted Use Criteria for Soil in the Saturated Zone, Page 9 - TDCC states in the fourth paragraph, "In summary, consistent with the SDMP Action Plan, TDCC proposes that the unrestricted use criteria for the contaminated material in the saturated zone be based on compliance with the 10  $\mu$ R/hr SDMP exposure rate criteria and the EPA Safe Drinking Water Regulations." TDCC needs to indicate in the SDP that all of the EPA MCLs will be complied with at license termination.

Basis: The focus of the SDP is demonstrating compliance with the radium MCL at license termination. However, other provisions as defined by EPA also need to be addressed by TDCC (e.g., gross alpha and beta/photon radioactivity MCLs) in order to demonstrate groundwater compliance. In addition, the Site Decommissioning Management Program (SDMP) Action Plan (NRC 1992a) when discussing application of this cleanup criteria simply states "The Environmental Protection Agency's (EPA's) National Primary Drinking Water Standards, " 40 CFR Part 141. The SDMP Action Plan makes no indication that only specific provisions of the EPA standard need to be applied to demonstrate groundwater compliance.

4. Section 3.2, Demonstrating Compliance with Exposure Rate Criterion, page 10 - TDCC has proposed to use as backfill, the unsaturated soil which was removed from those areas where the saturated zone was remediated. Describe the method for assessing the level of thorium contamination in the unsaturated soil before it is used as backfill. If no assessment is to be done, explain this rationale.

Basis: This information is needed to assess the potential for recontamination of saturated zone regions previously determined to have met the release criteria, as well as compliance with the SDMP release criteria.

5. Section 3.3.1, Method for Determining Drinking Water Criterion, page 13 - TDCC has proposed to use the EPA's National Primary Drinking Water Standards (10 CFR Part 141) at time of license termination and 5 pCi/L Ra-226/228 after 1000 years ingrowth as unrestricted

use criteria for the contamination in the saturated zone. Thus, TDCC intends to cleanup the Th-230/232 in the saturated zone to a soil concentration which results in 5 pCi/L Ra-226/228 in groundwater after 1000 years ingrowth. Using this approach and site-specific information, TDCC performed a calculation to determine the permissible amounts of each radium isotope at 1000 years, for which the total radium groundwater concentration is approximately 5 pCi/L. Limiting values of 2.5 and 2.4 pCi/L of Ra-226/228 at 1000 years were derived and correspond to Th-230/232 soil concentrations at license termination of 72 and 24 pCi/g, respectively. Based on this approach, NRC staff concludes that TDCC will not succeed in meeting the Ra-228 in groundwater criterion at 1000 years if the groundwater is cleaned up to the 5 pCi/L MCL at license termination. Therefore, NRC staff finds the proposed approach to be unacceptable. In order to succeed with the proposed criterion based on a 1000 year time frame, TDCC could commit to meeting a Ra-228 groundwater concentration of 2.4 pCi/L at license termination or could propose an alternative method to show that the criterion at 1000 years will be met.

Basis: Since the Th-232 concentration in the saturated zone has reached secular equilibrium, the Ra-228 concentration in groundwater can only remain the same or increase (due to additional leaching) from the slag over the next 1000 years. Consequently, TDCC's determination that the Ra-228 concentration is 2.4 pCi/L at 1000 years then becomes the unrestricted release criterion for radium in groundwater, to allow for the ingrowth of 2.5 pCi/L of Ra-226 over the next 1000 years. Also, given that TDCC has specifically proposed in the SDP (4<sup>th</sup> full paragraph, Section 3.1, Page 9) to meet the radium MCL at license termination and then meet a concentration value at 1000 years thereafter, staff concludes that the MCL methodology should be consistently applied over the 1000 year period. Therefore, background levels cannot be subtracted from groundwater samples when demonstrating compliance with the groundwater criteria. In applying the MCLs, EPA does not exclude background. EPA's interpretation is that MCLs are defacto compliance numbers that have to be met regardless of the contribution from background.

6. Section 4, Final Status Survey, page 14 -

- a. The first sentence at the top of this page states "The FSS (final status survey) methods are consistent with NUREG/CR-5849 guidance and apply to surface soil, subsurface unsaturated soil, and subsurface saturated soil." However, TDCC then proposed FSS methods which contradict the guidance recommended in NUREG/CR-5849 (NRC 1992b). TDCC should revise the final status survey methods to strictly adhere to the NUREG/CR-5849 guidance or delete this reference and justify TDCC proposing its own guidance.

Basis: Although TDCC proposed to follow the survey methodologies in NUREG/CR-5849, there are also instances where TDCC referenced guidance from the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) (NRC 1997b) and other federal agency documents. The use of multiple guidance documents can lead to incorrect interpretations and misunderstanding. Most of the guidance documents were not written to support the use of another document.

- b. The second paragraph notes "Future final surveys of surface soil will not include consideration of integrated count rate since no soil compositing is proposed." TDCC

- c. needs to clarify this statement. Specifically, revise the SDP to explain what is meant by “will not include consideration of integrated count rate” and “no soil compositing is proposed.”

Basis: This information is needed to assess the adequacy of the FSS plan to demonstrate compliance with the release criteria.

- 7. Section 4.1, Final Survey of Saturated Zone Soil, pages 14 to 15 - Provide the following technical information in order to facilitate the review and adequacy of the FSS design which is used to demonstrate regulatory compliance:

- a. The introductory paragraph indicates that the Th-232 concentration in the soil will be sampled and measured directly using the on-site gamma spectroscopy laboratory. Confirm how the concentrations of Th-228/232 will each be determined. Previously, the final status survey data analysis for Verification Areas I to VI appeared to involve the separate determination of each thorium isotope when demonstrating regulatory compliance. In contrast, it appears that for the characterization data submitted for the area covered by the SDP, the Th-232 concentration was directly measured and the Th-228/230 concentrations inferred. If TDCC intends to use the latter method to demonstrate compliance, this needs to be specified and rationale given why this is acceptable to demonstrate compliance.
- b. The first bullet states “Compliance will be based on the mean concentration of Th-232 in saturated zone.” Verify that the mean concentration to be complied with is the saturated zone unrestricted use criterion of 24 pCi/g for Th-232 stated in Section 3.3.1, Equation 11 on Page 13, of the SDP.
- c. The second bullet notes that the mean Th-232 concentration will be demonstrated at the 95% confidence level using Equation 8-13 in NUREG/CR-5849. Equation 8-13 is based on calculating the average level of all measurements in a survey unit and comparing that level with the guideline. This evaluation is inappropriate because staff has determined that in order to demonstrate groundwater compliance, the MCL needs to be met at every borehole location; therefore the Th-232 concentration for each bore hole sample cannot exceed the mean concentration.
- d. Regarding the third bullet, TDCC states “A hot-spot criterion of three times the mean concentration limit will be applied, i.e, an individual sample may be between 1 and 3 times the criteria if the mean meets the criteria at the 95% confidence interval.” This evaluation is inappropriate because staff has determined that in order to demonstrate groundwater compliance, the MCL needs to be met at every borehole location; therefore the Th-232 concentration for each bore hole sample cannot exceed the mean concentration.
- e. In the fourth bullet, TDCC provides justification for the acceptability of the number of borehole samples to be taken in the saturated zone. The method of calculation in this section appears to be correct. However, TDCC needs to explain the basis for assuming a standard deviation of 5.8, and what level of assurance there is, that it is not greater than 5.8, since this affects the shape of the curve. If, for example, the standard deviation is greater than 5.8, the curve would be flatter and, therefore, the

chance of not detecting an average concentration greater than 24 pCi/g is going to be higher than 5 percent.

- f. Since your analysis under the fourth bullet showed that 25 samples would be justified using the Data Quality Objectives process, explain the rationale for the proposed sample size of 330. Also, provide an explanation of the method to be used for locating the boreholes in the 100 m<sup>2</sup> areas.
- g. Describe how the surface and subsurface unsaturated zone soil portion of the borehole samples will be used in the FSS design.
- h. The seventh bullet states “Any saturated zone areas found to contain Th-232 exceeding the unrestricted use criteria during the final survey will be remediated.” As regulatory compliance in the saturated zone is based on groundwater MCLs and exposure rate at the surface, clarify that the intent is to remediate using the mean concentration of Th-232 in the saturated zone. As explained in RAI 7c above, in order to demonstrate groundwater compliance, the MCL needs to be met at every borehole location; therefore, the Th-232 concentration for each bore hole sample cannot exceed the mean concentration.
- i. TDCC has previously provided borehole characterization data for the saturated zone. A number of these samples exceeded the mean concentration of Th-232. TDCC should confirm that these areas will be cleaned up to comply with the mean thorium concentration criterion.

8. Section 4.2, Final Survey of Surface Soil and Subsurface Unsaturated Zone Soil, page 15-16

*General Comment* - TDCC has not requested to change the exposure rate nor thorium concentration criteria for this region, both of which were previously approved under License Amendment No. 7 (NRC 1997a). However, TDCC has proposed a final survey plan to demonstrate regulatory compliance which is different from that approved under License Amendment No. 7. Since there are no changes to the release criteria, it is unclear why TDCC would propose to modify the final status survey plan. TDCC should provide the rationale for deviating from the previously approved final status survey plan and justify the adequacy of the proposed plan.

Basis: TDCC recently completed the final status surveys for 31 acres which are contiguous with the area now proposed for separate consideration under the SDP. These surveys were performed in accordance with License Amendment No. 7, and made no distinction between surface soil and unsaturated zone soil to demonstrate regulatory compliance. Furthermore, since TDCC has proposed to use a different compliance criteria and FSS for the saturated zone, the saturated zone should have no bearing on the FSS design for the surface soil and subsurface unsaturated zone soil.

9. Section 4.2, Final Survey of Surface Soil and Subsurface Unsaturated Zone Soil, pages 15 to 16



*Specific Comments* - Provide the following technical information in order to facilitate the review and adequacy of the FSS design which is used to demonstrate regulatory compliance:

- a. The first bullet states "Scan ground surface using NaI detector." TDCC needs to indicate the scan coverage for each survey unit. Additionally, TDCC needs to provide appropriate MDCs (minimum detectable concentrations) and corresponding sensitivities.
- b. Regarding the second bullet, given that more than one elevated scan location could be present in the 25 m<sup>2</sup> subgrid quadrant, justify the method to further assess only the location with the highest NaI surface scan result.
- c. The third bullet states "If exposure rate measurement and surface soil sample meet unrestricted use criteria no further sampling required." Given the heterogeneity of the thorium contamination and that no additional samples are obtained in the 25 m<sup>2</sup> subgrid quadrant, TDCC needs to explain how it will demonstrate that the subsurface unsaturated zone soil in this area complies with the concentration criterion. Please describe what concentration will be detected by your instrumentation in the subsurface unsaturated zone soil. Also, please show all calculations.
- d. In the section, Additional Clarifications to Supplement (Page 9), under Attachment 1 to the SDP (TDCC 2002b), TDCC revised the FSS protocol for the fourth and fifth bullets of Section 4.2. Regarding this revision, please justify the number of additional exposure rate measurements taken and explain how these locations are predetermined, since you are applying a multiple sampling technique. Also, explain what actions will be taken when any one location meets or exceeds two times the criterion.
- e. Regarding the revision to the fourth and fifth bullets, the SDP needs to discuss the procedure to be followed if the average of the resulting five exposure rate measurements is greater than two times the criterion or the average over the entire 100 m<sup>2</sup> is greater than the criterion.
- f. In the section, Additional Clarifications to Supplement (Page 9), under Attachment 1 to the SDP (TDCC 2002b), TDCC revised the FSS protocol for the sixth and seventh bullets of Section 4.2. Regarding this revision, please justify the number of additional soil samples taken and explain how these locations are predetermined, since you are applying a multiple sampling technique. Also, explain what actions will be taken when any one location meets or exceeds three times the criterion.
- g. Regarding the revision to the sixth and seventh bullets, the SDP needs to discuss the procedure to be followed if the average of the resulting four samples is greater than two times the criterion or the average over the entire 100 m<sup>2</sup> is greater than the criterion.
- h. The revision to the sixth and seventh bullets also states "The same averaging criteria will be applied to the unsaturated zone borehole sample results." Averaging of multiple borehole samples for the same 100 m<sup>2</sup> is acceptable provided that the entire sample from each borehole is profiled to assess for hot spots exceeding three times the concentration criterion and that an action guideline has been met per borehole

sample that is some fraction of the concentration criterion. TDCC needs to commit to using such a protocol and revise the SDP accordingly. Also, please clarify the situations that would justify taking samples from multiple boreholes in the unsaturated zone for a 25 m<sup>2</sup> subgrid quadrant. For example, explain whether collecting three additional surface soil samples for the purpose of averaging would also involve boreholes of the unsaturated zone soil.

- i. The eighth bullet states “If the soil meets the criteria but the exposure rate exceeds criteria, collect a composite sample of the unsaturated zone soil (1-3 feet).” Regarding this statement, clarify whether the term “soil” means “surface soil.” Please confirm that composite samples of the subsurface unsaturated zone soil will be collected at one meter depth intervals, starting at the surface soil boundary (i.e., 6" from the ground surface) and continuing to the saturated zone boundary. TDCC needs to discuss how boreholes and resulting samples will be assessed to identify the presence and distribution of subsurface activity to guide remediation and how the hot-spot criterion of three times the soil concentration limit will be applied.
- j. The eighth bullet also states that the proposed method for subsurface soil compositing is consistent with NRC guidance related to the AAR Corporation (NRC 1997a). TDCC needs to clarify whether portions of this guidance, other than the soil compositing interval, are also intended to be part of the FSS design.
- k. The ninth bullet indicates that the elevated exposure rate is assumed to result from saturated zone soil if the composite sample of the unsaturated zone soil column meets the soil criteria. Explain what borehole and sample profiling will be done to verify that the elevated exposure rate was not due to the unsaturated soil zone. Also, assuming that the unsaturated zone meets the criteria, please specify what concentration will be detected by your instrumentation at the unsaturated/saturated zone boundary. Please show all calculations.
- l. TDCC has previously provided borehole characterization data for the surface soil and subsurface unsaturated zone soil. Many of these samples were between one and three times the soil concentration criterion, as well as three times the criterion. Please explain how cleanup of the surface soil and subsurface unsaturated zone soil will be done prior to the conduct of the FSS. Also, the SDP needs to explain whether these results will be used to supplement the FSS data.

#### **ATTACHMENT 1(dated July 19, 2002) TO THE SDP (TDCC 2002b)**

- 10. NRC Request #3: Statistical Analysis of Saturated Zone Sampling Results, pages 5 to 6 - The second paragraph states that the F-Test and the Wilcoxon Rank Sum (WRS) tests were used to determine differences between the means at the 95% confidence level. It should be noted that the F-Test is typically used to determine the equality of two variances as opposed to means; therefore, the F-Test may not be the appropriate statistical test. A more appropriate test to compare means would be a Z-test or a T-test. However, when reviewing the two data sets for the 24 pCi/g truncate, the two means are noticeably different (1.83 versus 1.37) based on the large sample size (295 and 406), contrary to TDCC's conclusion. Consequently, NRC staff has determined that the conclusion is incorrect and that TDCC should explain the following: 1) the decision to truncate at 24 pCi/g and delete at 10 pCi/g

since data should not be manipulated prior to any statistical assessment, 2) the difference between "truncate" and "delete," 3) what value was assigned to non-detects, 4) whether the whole set (untruncated) was analyzed and what was found, 5) what was tested with the F test, 6) why the WRS test was run, 7) what was tested with the WRS test, 8) whether a test for "normality" was done, 9) explain why the results of the WRS test were not used.

Basis: During the April 30, 2002 meeting, TDCC agreed to review the sampling results from the first and second round of saturated zone sampling to determine if the means from the data sets were significantly different in order to assess variations in the distribution of saturated zone contamination.

11. NRC Request #5: Remediation Action Level for Exposure Rate in Excavated Saturated Zone Areas, page 8 - Although not stated, it is assumed that the ratio developed in Table 4 is based on Th-232 being at naturally occurring concentrations in the backfill material. Please confirm that this is correct and, if not, revise the ratio. In addition, staff cannot reconcile the factors provided in the second and third sentences of the second paragraph.

Basis: When TDCC demonstrated regulatory compliance for Verification Areas I to VI, a value of 3.2 pCi/g for Th-232 was generally used as the unrestricted release criterion for surface soil and unsaturated zone soil. It appears that such a value was not considered when doing the analysis.

#### **ADDITIONAL CLARIFICATIONS TO ATTACHMENT 1 THE SDP (TDCC 2002b)**

12. 2. Sampling Method for Excavating Sidewalls, pages 9 to 10 - This section regarding the sampling method for subsurface sidewalls states that sidewall samples will be collected by compositing over 1-meter depth intervals. Given that historically, compliance is achieved by composite sampling over 15 cm rather than 1-meter intervals, explain why TDCC has chosen to depart from historical precedence and guidance. Please clarify whether this sampling method applies to both the subsurface unsaturated zone soil and the saturated zone soil. Also, describe the depth beyond which the region of sidewall activity will be assessed in order to confirm regulatory compliance.
13. 3. Post-Excavation Sampling of Saturated Zone if Excavation Required Based on Elevated Exposure Rate, page 10 - Given that TDCC has committed to sample after excavation to ensure that remediation has been successful, clarify the sampling procedure and explain how the proposed concentration criterion of 24 pCi/g for Th-232 will be applied.
14. Section 1.1.1, Site History - TDCC states that a metallic magnesium alloy was produced at the Bay City and Midland sites, resulting in a magnesium-thorium slag as a by-product. TDCC needs to provide a more detailed description of the smelting process and primary feed material used in the alloy production process. In addition, information should be provided on the chemical composition of the types of slag contained at the site. This should include a percent weight breakdown of the key chemicals within the slag (e.g., metal oxides - MnO, TiO<sub>2</sub>, MgO, CaO, P<sub>2</sub>O<sub>5</sub>, Al<sub>2</sub>O<sub>3</sub>).

Basis: NUREG-1757 Vol. 1, Section 16.4.4 Subsurface Soil Contamination

According to Section 16.4.4 of NUREG-1757, the information provided by the licensee for residual radioactivity in the subsurface should be sufficient to allow NRC staff to evaluate the

potential safety issues associated with remediating the subsurface soil. Thus, in order to evaluate the potential long-term impacts from future releases of radioactivity from slag remaining in the saturated zone, a description of the chemical characteristic of slag is required. Information on the physical and chemical characteristics of the slag will enable a comparison of estimated leach-rate derived from site-specific information to leach rates reported in literature for similar forms of slag.

15. Section 3.3.1, Method for Determining Drinking Water Criterion - In determining an acceptable concentration of thorium in slag that can remain in the saturated zone, in compliance with the long-term ground-water radium concentration, TDCC assumes a ground water to soil ratio of 10% (i.e., a distribution coefficient  $\{K_d\}$  of 10,000 L/Kg). TDCC needs to justify the use of this value for making long-term (i.e., a 1000-year time frame) predictions on the behavior of the slag.

Basis: NUREG-1757 Vol. 1, Section 16.4.4 Subsurface Soil Contamination

According to Section 16.4.4 of NUREG-1757, the information provided by the licensee for residual radioactivity in the subsurface should be sufficient to allow NRC staff to evaluate the potential safety issues associated with remediating the subsurface soil. In assuming a constant distribution coefficient in estimating potential long-term releases from the slag, TDCC is assuming that releases of radioactivity can be modeled as a simple linear process representing the partitioning between the solid and liquid phases. Based on information on the leaching characteristics of slags from other sites, releases from the slag will likely result from much more complex processes. However, it may be possible to show based on studies on the degradation of slag at other sites, that estimated releases assuming a simple  $K_d$ -approach will be bounding, provided it can be demonstrated that concentrations within the ground water have reached their expected maximum. However, TDCC has not provided any information to support this conclusion. In fact, radium concentration data for several wells (C5-2D and I6-8C), in recent sampling (September 2002), are higher than those reported for February 2001. This would suggest that ground-water concentrations have not reached their maximum.

16. Section 3, Saturated Zone Soil Unrestricted Use Criteria - TDCC needs to provide the following information to support NRC's dose analyses of residual radioactivity remaining at the site:
- a. The average concentration of radionuclides expected at the site at termination. This should include concentrations for all key radionuclides (e.g., Th-232, Th-230, Th-228, Ra-226, and Ra-228) and a basis for the derived concentrations. Further, this information should address expected radioactivity within the unsaturated and saturated zones.
  - b. A schematic of the expected configuration of radioactive slag at termination. This schematic should show the thickness of the slag in relationship to the water table (i.e., the thickness of the slag in the unsaturated and saturated zones) considering average fluctuations in the water table.
  - c. A general schematic of the surface hydrogeology (uppermost groundwater system) at the site. This schematic should show the general thicknesses of the unsaturated and saturated zones at the site.

- d. The size of the watershed for the Bay City site.
- e. General information on ground-water use in the area. Specifically, information should be provided on the number of wells in the area, average annual withdrawal rates, general uses of ground-water, hydrogeologic zones from which water is withdrawn, and common well construction characteristics.

Basis: NUREG-1757 Vol. 1, Section 16.4.4 Subsurface Soil Contamination

According to Section 16.4.4 of NUREG-1757, the information provided by the licensee for residual radioactivity in the subsurface should be sufficient to allow NRC staff to evaluate the potential safety issues associated with remediating the subsurface soil. Even though TDCC proposes to release the site using soil and ground-water concentration limits per the SDMP Action Plan criteria (as opposed to the 25 mrem/y dose limit), staff will perform a dose analysis to evaluate potential doses to the public following release of the site. Thus, information is needed to support this analysis.

17. Section 3.3, Demonstrating Compliance with Drinking Water Criterion

- a. The supplement to the decommissioning plan states that TDCC intends to use water samples from at least 5 wells to evaluate compliance with the 5 pCi/L concentration limit for radium. TDCC needs to clearly identify the number of wells and number of rounds of samples that will be used to evaluate compliance, and provide a basis (e.g., Data Quality Objective - DQO) supporting the number of each that will be used. If TDCC intends to determine compliance using a single sampling round, they need to clearly demonstrate that concentrations in the ground water have stabilized over the short-term leading up to site release (and possibly the intermediate time period following site release). Further, TDCC needs to describe the protocol that will be followed for collecting and analyzing water samples as part of the compliance demonstration. The sampling plan should clearly describe the proposed design for monitor wells and their proposed location on the site (especially with respect to the known radioactivity sources and elevated ground-water concentrations). In addition, the sampling plan should clearly describe how samples will be collected, preserved, and analyzed. At a minimum, the sampling plan should include information on: the sampling objective, sample collection approach, any planned in-situ field analysis, planned sample preservation, and field and laboratory QA/QC plans.

Basis: NUREG-1757 Vol. 1, Section 16.4.4 Subsurface Soil Contamination

According to Section 16.4.4 of NUREG-1757, the information provided by the licensee for residual radioactivity in the subsurface should be sufficient to allow NRC staff to evaluate the potential safety issues associated with remediating the subsurface soil. The 5 pCi/L total radium concentration that TDCC will use to demonstrate compliance for the ground water must be met everywhere (i.e., at any well location at the site). Accordingly, TDCC needs to demonstrate that their proposed sampling plan will provide adequate coverage to make this demonstration.

- b. TDCC needs to provide a plan showing how ground water measured above the 5 pCi/L total radium limit will be remediated. This plan should identify the remediation

technology that will be used, its anticipated effectiveness, and the time period over which it will be used.

Basis: NUREG-1757 Vol. 1, Section 16.4.6 Ground Water

According to Section 16.4.6 of NUREG-1757, the information provided by the licensee for residual radioactivity in ground water should be sufficient to allow NRC staff to evaluate the potential safety issues associated with remediating the ground water. Radium concentrations in the ground-water reported by TDCC for monitor well I5-5C, for March 2001, and monitor wells G5-8, G6-9A, I5-5C, and I6-8C, for September 2002 indicate ground-water concentrations above the 5 pCi/L limit. Further, water quality data for several wells included in the 1993 Decommissioning Work Plan indicate radium concentrations for several wells significantly exceeding the 5 pCi/L limit in the early 1990's. Thus, there would appear to be a need for some ground water remediation at the site.

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