

August 1, 2011

Thomas K. Spencer  
Radiation Safety Officer  
Sigma-Aldrich Company  
P.O. Box 14508  
St. Louis, MO 63178

SUBJECT: ACCEPTANCE REVIEW OF SIGMA-ALDRICH COMPANY LICENSE  
AMENDMENT REQUEST FOR RELEASE OF THE FORT MIMS SITE FOR  
UNRESTRICTED RELEASE (MAIL CONTROL NO. 574094)

Dear Mr. Spencer:

By letter February 2, 2011 (ML110390079), Sigma-Aldrich Company (Sigma) requested that the U.S. Nuclear Regulatory Commission (NRC) amend Byproduct Material License No. 24-16273-01 to release the Fort Mims site located in Maryland Heights, Missouri for unrestricted use, based on the conclusions provided in the dose assessment provided by letter dated December 10, 2010 (ML103490427), and subsequent letter dated January 25, 2011. In accordance with NUREG-1757, "Consolidated Decommissioning Guidance," NRC staff completed an initial acceptance review of your request on March 11, 2011. At the conclusion of the initial acceptance review, the NRC determined more information was necessary regarding the impact from previous operations of the site's septic tank (ML110730191). By letter dated April 12, 2011, Sigma provided additional information regarding the septic tank (ML111020380). NRC staff has reviewed these three documents with an emphasis on the hydrological parameters in the licensee's dose assessment and potential groundwater impacts from the proposed release of the site. In accordance with NUREG-1757, additional information needs to be incorporated into the submitted request before a detailed technical review can begin.

The specific areas NRC staff identified for which additional information and clarification is required are enclosed with this letter. Please respond to these items within 60 days from the date of this letter. During this review period, we may contact you to provide additional information or clarify additional items discussed in your request or your responses to the requested additional information.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter will be available electronically for public inspection in the NRC Public Document Room or from the NRC's Agencywide Documents Access and Management System (ADAMS), accessible from the NRC Web site at <http://www.nrc.gov/reading-rm/adams.html>.

T. Spencer

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If you have any questions regarding this letter or our technical review process, please contact Ted Carter at [ted.carter@nrc.gov](mailto:ted.carter@nrc.gov) or at 301-415-5543.

Sincerely,

**/RA/**

Paul Michalak, Chief  
Materials Decommissioning Branch  
Decommissioning and Uranium  
Licensing Directorate  
Division of Waste Management  
and Environmental Protection  
Office of Federal and State materials  
and Environmental management programs

Docket No.: 030-10716  
License No.: 24-16273-01

Enclosure:  
Request for Additional Information

cc:  
K. Henke, Missouri Department of Health  
and Senior Services  
J. Langston, Missouri Department of Health  
and Senior Services

T. Spencer

2

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Enclosure:  
Request for Additional Information

cc:  
K. Henke, Missouri Department of Health  
and Senior Services  
J. Langston, Missouri Department of Health  
and Senior Services

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## **Sigma-Aldrich Fort Mims Decommissioning Site Request for Additional Information**

The planned decommissioning activities described in the Decommissioning Plan (DP) (ML083010187) are associated with contaminated laboratory structure/systems and equipments, such as flame cabinets, drum compactor, fume hoods and ceiling tiles, floor tiles and drywall, and ventilation, vacuum and drain system. The subsurface soil, surface and groundwater were initially not a concern, and the DP does not contain sufficient information related to site geology, surface and ground water. The inputs for the RESRAD dose modeling require further justification with additional information related to the contaminant source, weather-related radionuclide transport parameters, and site ground water hydrology. The basis for the requested information is described in NUREG-1757, Vol. 1 Appendix D: Section III.d. Meteorology and Climatology; Section III.e. Geology and Seismology; Section III.g. Ground Water Hydrology (for facility description); Section IV.d. Subsurface Soil Contamination; and Section IV.f. Ground Water (for radiological status of facility). The needed level of detail for the requested information can also be found in Chapter 16 of NUREG-1757, Vol. 1 (Sec. 16.3.4; Sec. 16.3.5; Sec. 16.3.7; Sec. 16.4.4 ; and Sec. 16.4.6) and for the dose model evaluation in Chapter 5 (Sec. 5.2) and Appendix F of NUREG-1757, Vol. 2.

### **Source term information including nuclides of interest, configuration of the source, areal variability of the source**

1. Comment: In the letter dated February 6, 2009, the licensee states, "We expect the area for the highest potential for impacting ground water will be the septic and leachate field." However, it appears the highest concentration was identified elsewhere and the leachate field location has yet to be described. In addition, Phase III FMF Open Land Soil Sampling and Analysis Report attached to Sigma's December 10, 2010, letter states that several samples collected at a depth of two meters have detectable carbon-14 levels which indicate the vertical extent of contamination has not been fully bounded.

Path Forward: Provide a cause or conceptual model which:

- a) Explains the higher level of residual contamination identified in the soil outside of the septic tank and leachate filed area. In addition, provide the technical basis that demonstrates the previous sampling depth and areal extent were adequate to identify the horizontal and vertical extent of residual contamination, and therefore potential safety issues, or provide a plan to sample at more locations and/or at a greater depth.
- b) Describes the activities or processes which resulted in the subsurface contamination, including any known spills, uncontrolled releases, and description of all on-site systems or equipment and their conditions that had potential to interact contaminate environment (e.g. septic tank system, leachate field piping, and air effluent stack system).

Enclosure

2. Comment: The leachate field location was not identified.

Path Forward: Provide the believed location of the leachate field and how it relates to previously sampled areas. If the historic leachate field location cannot be identified, provide detailed description of the search conducted to try to locate the field (e.g. blueprints or interviews) and justification that the previous sampling locations encompassed the potential areas containing the leach field. If the previous soil sampling location did not encompass this area, provide a new sampling plan to include areas with the potential to have contained the leachate field.

3. Comment: More information is needed regarding the septic tank and leachate field and its impact on the environment.

Path Forward: Provide a cause or conceptual model which describes the potential effluent pathways associated with the septic tank and leachate field. Include a description of historical effluent flow: a) quantity and levels of radioactivity, if known; b) how did the effluent flow to the septic tank; and c) how did the effluent flow to the septic leach field. Also, provide a description of the septic system, including the location and depth of the tank, associated pipes, and leachate field and how the septic tank operates.

4. Comment: Phase III FMF Open Land Sampling and Analysis Report, attached to Sigma's December 10, 2010, letter shows samples from the septic tank area were taken from 0.05 to 1 m below the surface. However, the bottom of the septic tank sludge was located approximately 2 m below the surface. Information is needed to determine the concentration of residual radioactive material below the septic tank.

Path Forward: Provide soil sample results below and near the septic tank location at depths greater than the bottom of the septic tank, with the vertical extent of impacted soil fully defined.

**Description of the conceptual model of the site including the source term, physical features important to modeling the transport pathways, and the critical group**

5. Comment: Final RESRAD modeling report dated November 11, 2010, states, "Available documentation indicates an aquifer is at least 140 feet (47 meters) below the ground surface." The provided information contained in the EDR GeoCheck Report only contains information on three wells, where only one of the wells report water depth, which was at 31 feet. This does not provide adequate justification to describe the depth of the aquifer.

Path Forward: Provide further justification to support aquifer depth and that the water located 10-20 m (30 to 60 feet) below ground surface is not a sustainable aquifer.

6. Comment: The unsaturated zone is a critical component of the RESRAD model and needs to be adequately characterized. No technical basis was provided for the statement in the final RESRAD modeling report dated November 11, 2010, "Surface and subsurface soils are

a combination of silty clay and sandy clay.” No technical basis was given for not using parameter values associated with the unsaturated bedrock (St. Louis Limestone).

Path Forward: Information is needed on the geologic characteristics of the site and the region around the site, a description of the subsurface geologic characteristics of the site and its vicinity, a description of the unsaturated zone, and the physical parameters. Provide documentation, survey results, or technical bases justifying the unsaturated zone RESRAD inputs. For example, rationale for assuming the nonconservative distribution coefficient value for sand although the sediments were basically described as clays.

7. Comment: No information is provided regarding St. Louis Limestone and other formations through which the groundwater flows. The unconsolidated material is reported to extend to a depth of 40 to 50 ft below the land surface, and the limestone formation is underlain below. The nature of aquifer in the vicinity of the facility is not provided.

Path Forward: Information is needed on the saturated zone, descriptions of subsurface materials observed in borings and monitoring wells, a description of ground water flow directions and velocities, and physical parameters. Provide documentation or survey results justifying the saturated zone RESRAD inputs. Provide a conceptual model on the hydrogeology and the residual radioactive material transport, including information on how fast pathways to and through the limestone can be excluded.

8. Comment: Response to the request for information in Sigma’s letter dated February 6, 2011, states that the Soil Sampling and Analysis Plan will be used as a starting point to identify any substantial areas of contamination which could serve as a source to impact either surface or ground water. If significant levels of contamination are identified that have the potential for impacting water at the site, a specific groundwater monitoring plan will be assembled to address the site specific issues identified. During the three phases of soil sampling at the site, residual radioactive material was identified in surface and subsurface soil and in the septic tank, but no groundwater monitoring has been reported.

Path Forward: Provide groundwater monitoring data demonstrating the ground water beneath the facility has not been impacted or justification that the residual radioactive material identified at the site, would not lead to a potential for significantly impacting the ground water at the site.

### **Description of the parameters used in the analysis**

9. Comment: By letter received on April 12, 2011, Sigma provided a RESRAD model with current septic tank concentration and size as inputs to provide a modeled dose from groundwater pathway. The current radiological status of the aquifer was not considered in the dose modeling.

Path Forward: Provide justification to demonstrate that the RESRAD model is conservative and adequately addresses potential safety concerns regarding water dependent pathways. As stated in the letter dated February 6, 2009, a groundwater monitoring plan was considered to demonstrate the impact site operations had on the groundwater or provide

justification that the model's source term input and size conservatively addresses all groundwater contamination pathways.

10. Comment: Rationale needed for each non-default RESRAD parameter, including saturated zone parameter values.

Path Forward: Provide individual rationale for each non-default RESRAD parameter. For example, rationale for using RESRAD saturated zone parameter values based on silt, sand, and clay when the saturated zone is located in limestone.

11. Comment: Rationale needed for *significant* RESRAD parameters including those left at default.

Path Forward: Provide individual rationale for significant RESRAD parameters including those left at default. For example, rational for leaving RESRAD irrigation rate parameter value at 0.2 m/yr, or the rational for keeping the circular shape factor although the site is not circular.

12. Comment: Clarification needed for RESRAD modeling of the contents of the septic tank.

Path Forward:

- a) Clarify how the "Area of the contaminated zone" and "Length Parallel to Aquifer Flow" RESRAD inputs were obtained;
- b) demonstrate the relative depth of the top of the septic tank, the thickness of the air inside the tank, the water inside the tank, the sludge, and the bottom of the tank through use of a diagram or map.

### **Discussion about the effect of uncertainty on the results**

13. Comment: Sensitivity analysis is needed to determine significant RESRAD parameters and the rational for default values for significant parameters. The purpose of a sensitivity analysis is to identify the input parameters that are the major contributors to the variation or uncertainty in the calculated dose. Therefore the identification of these key parameters is essential for building a defensible case in support of the assessment. Thus far, the uncertainty analyses provided have not shown which processes or parameters are significant (e.g., infiltration, distribution coefficients, fast pathways through the limestone, dilution, etc.)

Path Forward: Provide a sensitivity analysis of RESRAD parameters and provide a list of the significant RESRAD parameters for each model [NUREG-1757, Vol. 2, App. I, Sec. 7].

14. Comment: Clarification needed on the uncertainty analysis on scope and results.

Path Forward: Provide an expanded explanation on the uncertainty analysis to demonstrate the influence of the *key assumptions* on the variability of the estimated dose and the effects of the uncertainty. Provide the justification for the *range of values* used to represent these key parameters in the uncertainty analyses. The *results may be presented* using diagrams,

graphs, figures, tables, etc., with explanatory paragraphs to give insight into the important features and processes. For example, providing an explanatory paragraph with a figure in Appendix A of the final RESRAD modeling results presented in letter dated November 30, 2011, would clarify the results greatly. Additionally, diagrams in the appendices of the January 25, 2011, Modeling and Uncertainty Analysis Report could lend to easier interpretation if accompanied with explanatory paragraphs and different scales.