



**UNITED STATES  
NUCLEAR REGULATORY COMMISSION**

REGION III  
2443 WARRENVILLE ROAD, SUITE 210  
LISLE, ILLINOIS 60532-4352

May 12, 2009

Mr. Thomas K. Spencer, Manager and  
Radiation Safety Officer  
Sigma-Aldrich Chemical Company  
Bio-Organics Small Scale  
3500 Dekalb Street  
Saint Louis, MO 63118

**SUBJECT: APPROVAL OF SIGMA-ALDRICH COMPANY'S FORT MIMS FACILITY  
DECOMMISSIONING PLAN, MARYLAND HEIGHTS, MO, NRC  
LICENSE NO. 24-16273-01**

Dear Mr. Spencer:

In Sigma-Aldrich Company's October 22, 2008, letter you informed the U.S. Nuclear Regulatory Commission (NRC) that operations at your Fort Mims Facility ceased as of September 30, 2008, and that you were requesting approval of a Decommissioning Plan (DP) for the decontamination and decommissioning of the facility. The NRC staff has reviewed the DP, and Sigma-Aldrich Company's responses to the NRC requests for additional commitments, clarifications, and information regarding the implementation of your DP. Based on our review, the NRC concludes that your DP and supporting information are acceptable. Enclosure 1 to this letter is the NRC License Amendment No. 17, which approves and incorporates the Sigma-Aldrich Company's DP and supporting information. Enclosure 2 to this letter is a Safety Evaluation Report (SER) which supports the NRC's approval of the DP.

The NRC performed an environmental assessment for this action and noticed it in the Federal Register. The Notice of Availability of Environmental Assessment and Finding of No Significant Impact for this action was published on May 7, 2009 in the Federal Register, Volume 74, Number 87.

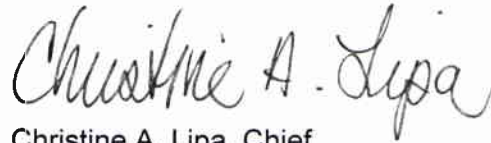
In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter and the enclosure will be available electronically in the NRC Public Document Room or from the Publicly Available Records (PARS) component of the NRC's document system (ADAMS). The NRC's document system is accessible 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, please contact Mr. Mike McCann of my staff at (630) 829-9856.

Sincerely,

A handwritten signature in black ink that reads "Christine A. Lipa". The signature is written in a cursive style with a large initial 'C' and a long, sweeping tail on the 'a'.

Christine A. Lipa, Chief  
Materials Control, ISFSI, and Decommissioning  
Branch

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

Enclosures:

1. License Amendment No. 17
2. Safety Evaluation Report

cc (w/encl): J. Langston, MDHSS  
K. Henke, MDHSS

**MATERIALS LICENSE**

Pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974 (Public Law 93-438), and Title 10, Code of Federal Regulations, Chapter I, Parts 30, 31, 32, 33, 34, 35, 36, 39, 40, and 70, and in reliance on statements and representations heretofore made by the licensee, a license is hereby issued authorizing the licensee to receive, acquire, possess, and transfer byproduct, source, and special nuclear material designated below; to use such material for the purpose(s) and at the place(s) designated below; to deliver or transfer such material to persons authorized to receive it in accordance with the regulations of the applicable Part(s). This license shall be deemed to contain the conditions specified in Section 183 of the Atomic Energy Act of 1954, as amended, and is subject to all applicable rules, regulations, and orders of the Nuclear Regulatory Commission now or hereafter in effect and to any conditions specified below.

Licensee		In accordance with letter dated <b>October 22, 2008,</b>	
1. Sigma-Aldrich Company		3. License number 24-16273-01 is <b>amended</b> in its entirety to read as follows:	
2. P.O. Box 14508 St. Louis, MO 63178		4. Expiration date December 31, 2009	
		5. Docket No. 030-10716 Reference No.	
6. Byproduct, source, and/or special nuclear material	7. Chemical and/or physical form	8. Maximum amount that licensee may possess at any one time under this license	
A. Hydrogen-3	A. residual contamination	A. As approved in decommissioning plan, see Item 9, below.	
B. Carbon-14	B. residual contamination	B. As approved in decommissioning plan, see Item 9, below.	
9. Authorized Use:			
A. and B. Possession incident to radiological survey, storage of waste awaiting disposal, decontamination and remediation of building, equipment, and materials, and outdoor areas, as described in "Sigma-Aldrich Fort Mims Facility, Maryland Heights, Decontamination and Decommissioning Plan (DP)" dated October 20, 2008 (See ADAMS Accession No. ML083010187)			

**CONDITIONS**

10. Licensed material shall be possessed, processed, and stored for disposal only at the licensee's facilities located at 11542 Fort Mims Drive, St. Louis, Missouri.
11. A. Licensed material shall be used by, or under the supervision of, individuals designated by the Radiation Safety Committee, Thomas K. Spencer, Chairperson.
- B. The Radiation Protection Officer for the activities authorized by this license is Thomas K. Spencer.

**MATERIALS LICENSE  
SUPPLEMENTARY SHEET**License Number  
24-16273-01Docket or Reference Number  
030-10716

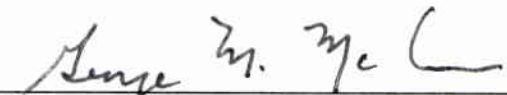
Amendment No. 17

12. Except as specifically provided otherwise in this license, the licensee shall conduct its program in accordance with the statements, representations, and procedures contained in the documents including any enclosures, listed below. The Nuclear Regulatory Commission's regulations shall govern unless the statements, representations and procedures in the licensee's application and correspondence are more restrictive than the regulations.
- A. Application dated August 24, 2001 (with attachments); and
  - B. Letters received January 28, 2002 (with attachments), and dated February 12, 2002.
  - C. Letters dated October 22, 2008, with "Sigma-Aldrich Fort Mims Facility, Maryland Heights, Decontamination and Decommissioning Plan," attached, February 6, 2009, December 15, 2008, March 19, 2009 (with attachment "NRC Follow-up Questions – Sigma Responses)."

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

Date MAY 12 2009

By

  
George M. McCann  
Materials Control, ISFSI, and Decommissioning Branch  
Region III

**DOCKET NO.:** 030-10716  
**LICENSE NO.:** 24-16273-01  
**FACILITY:** Sigma-Aldrich Company  
**SUBJECT:** SAFETY EVALUATION REPORT FOR LICENSE AMENDMENT TO  
AUTHORIZE DECOMMISSIONING OF SIGMA-ALDRICH COMPANY'S  
FORT MIMS FACILITY LOCATED IN ST. LOUIS, MISSOURI

## **1.0 Executive Summary**

The Sigma-Aldrich Company (the licensee) owns the Fort Mims Facility, which was a Byproduct Materials Production and Distribution operation licensed by the NRC. On October 22, 2008, the licensee submitted the Decontamination and Decommissioning Plan (DP) (See ADAMS ML083010187) for U.S. Nuclear Regulatory Commission (NRC) approval. The NRC issued a Federal Register Notice (FRN), announcing Sigma-Aldrich Company's license amendment request and opportunity to provide public comments in a December 29, 2008 Federal Register Notice, Vol. 73, No. 249. The FRN commentary period ended February 27, 2009. The NRC did not receive any comments in response to the FRN regarding the Sigma DP.

On December 10, 2008, and March 11, 2009, the NRC staff requested additional information (ML090150318 and ML09077036, respectively) in support of its review of the DP. On December 15, 2009, February 6, 2009, and March 19, 2009, the licensee responded to the staff's request for additional information, which included revisions to the DP, see ADAMS Nos. ML083510270, ML090500166, and ML090850311, respectively. The licensee proposes to decommission the Fort Mims Facility to permit the release of the site for unrestricted use as defined in the License Termination Rule (LTR), as Subpart E to 10 Code of Federal Regulations (CFR) Part 20.1402, which specifies a dose objective of 25 millirem per year (mrem/yr) above background as an acceptable basis for demonstrating that a site can be released for unrestricted use.

This Safety Evaluation Report (SER) evaluates the licensee's proposed actions described in the Fort Mims Facility DP and determines whether the NRC's unrestricted use criteria will be met in accordance with the NRC regulations. The SER was developed in conjunction with an environmental assessment (EA) (ML091180638). On May 7, 2009, the EA was published in the Federal Register Volume 74, Number 87 with a Finding of No Significant Impact (FONSI). The approval of this license amendment will authorize the licensee to remediate the site in accordance with the Fort Mims Facility DP.

Upon completion of the proposed decommissioning activities, a Final Status Survey will be conducted to demonstrate compliance with the dose criteria for unrestricted use. The licensee will then submit a request to terminate byproduct materials license for the Fort Mims Facility in accordance with the NRC's regulatory requirements.

## **2.0 Facility Operating History**

### **2.1 Licensing History**

The NRC approved the licensee's Fort Mims Facility as an authorized location of use on November 11, 1974. The NRC issued license no. 24-16273-01 to Pathfinder Laboratories authorizing the possession of carbon-14 and hydrogen-3 for synthesis of labeled compounds for

commercial distribution at the Fort Mims Facility. On July 22, 1987, the NRC issued Amendment No. 08 to License 24-16273-01, changing the licensee name and ownership of the Fort Mims Facility from Pathfinder Laboratories to Sigma Chemical Company. License Amendment No. 15, dated March 13, 2002, changed the name from Sigma Chemical Company to Sigma-Aldrich Company. The licensee is currently operating under Radioactive Materials License Amendment No. 16, with an expiration date of March 31, 2012. The licensee in its letter dated October 22, 2008, notified the NRC that Sigma-Aldrich Company had ceased licensed activities at the Fort Mims Facility pursuant to 10 CFR Part 30.36(d) as of September 30, 2008.

## **2.2 Nuclear Operating History**

The licensee was authorized to use radioactive byproduct materials at the Facility for research and development activities as defined in 10 CFR 30.4 and for storage, processing and use in the production of labeled compounds for distribution to authorized recipients. Based on the licensee's Historical Site Assessment (HSA), the only radionuclides authorized for use in unsealed form at the Fort Mims Facility consisted of: carbon-14, hydrogen-3, chlorine-36, phosphorus-32, phosphorus-33, sulfur-35, and selenium-75. The HSA also noted that chlorine-36, phosphorus-32, phosphorus-33, sulfur-35 and selenium-75 were never used at the site.

The maximum amounts of each radionuclide possessed at one time on site were 12 curies (Ci) of hydrogen-3 in 1998 and 570 Ci of carbon-14 in 1991. The inventory of each radionuclide steadily declined each year. By the end of 2007, there were 1.7 Ci of hydrogen-3 and 21 Ci of carbon-14 present at the site. The licensee informed the NRC on April 6, 2009, that as of the end of March 2009 that all inventoriable material and accumulated remediation wastes had been transferred to authorized recipients, leaving only residual radiological contamination on interior building surfaces, materials and pipes, and ventilation ducts.

## **2.3 Past Decommissioning Activities**

Review of the licensee's HSA, and NRC licensing and inspection records, did not identify any past decommissioning activities in the facility, other than routine cleanup activities of minor radiological spills. The licensee documented minor spills of radioactive materials during the sites operational history and reported that in all cases decontamination activities were successful in reducing levels of contamination below the licensee's radiological contamination action and clean-up limit of 2,200 disintegrations per minute per 100 centimeters squared (dpm/100cm<sup>2</sup>) removable.

## **2.4 Ongoing Non-Nuclear Operations**

Sigma-Aldrich Company possesses two other NRC Byproduct material licenses. These Sigma-Aldrich Company operations are limited to small scale laboratory bench-top research and development, and related activities. These other licensed operations are not located at the Fort Mims site, and the licensee has indicated that they do not intend to request a new NRC license for the Fort Mims site after termination of the current NRC License No. 24-16273-01.

## **2.5 Evaluation Summary**

The NRC staff has reviewed the information in the "Historical Site Assessment" section of the Sigma-Aldrich Company's Fort Mims Facility DP according to the NRC's Consolidated Decommissioning Guidance, Vol. 1 Section 16.2 (Facility Operating History). Based on this review, the NRC staff has determined that the licensee has provided sufficient information to aid



## Safety Evaluation Report

the NRC staff in evaluating the licensee's assessment of the radiological status of the site and the licensee's planned decommissioning activities to ensure that the decommissioning can be conducted in accordance with the NRC requirements.

### **3.0 Facility Description**

#### **3.1 Site Location and Land Use**

The Fort Mims Facility is approximately 3.3 miles east southeast and 16 miles west of the city center of the city of St. Louis, Missouri. The population of the cities of Maryland Heights and St. Louis are approximately 26,000 and 356,000, respectively. The Facility is bordered by Interstates 70 to the north, 270 to the west, 170 to the east, and 44 to the south. The current land use in the area is primarily industrial and urban components. Residential use of the Sigma-Aldrich site in the near future is considered unlikely due to local zoning restrictions. The facility was constructed in two phases beginning in the late 1960s. The Sigma-Aldrich Company expanded the original Pathfinder building in 1981 to its current configuration. The only effluent discharge points were via a facility exhaust stack, and a septic tank, which was buried under subsequent building additions. The use of the septic system stopped in July 1981 when the facility was connected to the Saint Louis Metropolitan Sewer district.

The licensee purchased the facility and assumed licensed operations from Pathfinder Laboratories on July 22, 1987. The facility was constructed in two phases beginning in the late 1960s. The Sigma-Aldrich Company expanded the original Pathfinder building in 1981 to its current configuration. The only effluent discharge points were via a facility exhaust stack, and a septic tank, which was buried under subsequent building additions. The use of the septic system stopped in July 1981 when the facility was connected to the Saint Louis Metropolitan Sewer district.

The property in Maryland Heights, Missouri is a two-story building of approximately 1,858 square meters, and consisted of laboratory and office space. The building is constructed on a concrete slab. The building exterior walls are a combination of cinder block, sheet metal and wood. The building roof is sheet metal and foam. Interior floors are a combination of carpeted concrete, tile over concrete and painted concrete. Interior walls are primarily painted drywall with a few painted cinder block walls. The facility is located on an approximately 1 acre parcel in a commercial/light industrial park.

#### **3.2 Meteorology**

The climate of the area is characterized by large seasonal and daily variations in temperature with normally ample spring and summer rainfall and lighter winter precipitation. There are frequent changes in weather, often daily, as the area is dominated by cold air masses from the north in the winter and by warm air masses from the south in the summer. The annual average number of tornadoes and strong-violent tornadoes (1950-1995) in the area are twenty five and five respectively (NOAA, 2005). The state of Missouri averages 3.8 tornadoes annually per 10,000 square miles, with 70% of those occurring during a four month period from March through June.

### **3.3 Geology**

Based on reported geology of surrounding Missouri areas, including near downtown St Louis, St. Charles and Rolla, the subsurface of the site likely consists of mixtures of clay, silt and sand of variable density. Depth to bedrock in the area varies from 18 to 50 feet.

### **3.4 Surface Water Hydrology**

The Fort Mims Facility site is a finished industrial property. A small, unnamed tributary approximately 80 ft to the north of the sites north property line flows into Fee Fee creek at a point approximately 300 yards downstream to the west. Fee Fee Creek flows into the Missouri River at a point approximately 5 miles from the Fort Mims site. Run-off at the site flows mainly from north to south, away from the small tributary, and is collected in municipal storm drains.

### **3.5 Groundwater Hydrology**

The Sigma-Aldrich Company Fort Mims Facility site is located above the Ozark Plateaus Aquifer system (national) and the Saint Louis Limestone Aquifer (local). Data from Missouri Geological Survey and Water Resources (1967) indicates that the nearest free standing water level at the Site is at a ground depth of approximately 20 ft near the Fort Mims site, measured from the same ground elevation of approximately 525 feet. The licensee did not identify any private drinking water wells on or near the Fort Mims Facility. The Maryland Heights public water supplies are drawn from the Missouri and Merrimac Rivers.

### **3.6 Evaluation Summary**

The NRC staff has reviewed the information in the "Facility Description" section of the Sigma-Aldrich Company's Fort Mims Facility DP according to the NRC's Consolidated Decommissioning Guidance, Vol. 1, Section 16.3 (Facility Description). Based on this review, the NRC staff has determined that the licensee has provided sufficient information on the characteristics of the site and environs to serve as a basis for evaluating the licensee's estimated dose to workers and the public, and the impacts of the proposed decommissioning actions on the site and surrounding areas.

## **4.0 Radiological Status of Facility**

### **4.1 Structures, Systems, and Equipment**

The primary restricted areas requiring the most controls inside the Fort Mims facility consists of 4 laboratories, a Quality Control Laboratory, and the airlocks to the laboratory areas. These areas are located on the first floor of the facility and require protective clothing for entry. Other areas requiring lesser radiological controls are the shipping and receiving area, the count room and the second floor mechanical spaces. Areas classified as unrestricted in the Facility include offices and restrooms on the first floor, a break room on the second floor and the stairwell at the front entrance.

The contractor characterization survey data discussed in the licensee's DP indicates that the floors in the restricted laboratory areas are contaminated from 10,000 to 52,000 dpm/100 cm<sup>2</sup> total activity, and that there are numerous localized areas of high contamination levels on the floors ranging from 200,000 to 36,000,000 dpm/100 cm<sup>2</sup> total activity. Further, the report



indicates that removable hydrogen-3 contamination levels on the floors range from <1000 to 105,000 dpm/100 cm<sup>2</sup> and that removable carbon-14 contamination levels range from <1000 to 1,376,000 dpm/100 cm<sup>2</sup>. Lower wall surfaces were reported to be contaminated from 10,000 to 100,000 dpm/100 cm<sup>2</sup> total activity, and that localized areas of high contamination levels range from 200,000 to 98,000,000 dpm/100 cm<sup>2</sup> total activity. The lower walls had removable hydrogen-3 contamination levels ranging from <1000 to 26,400 dpm/100 cm<sup>2</sup>. The removable carbon-14 contamination levels range from <1000 to 32,600 dpm/100 cm<sup>2</sup>. The restricted laboratory bench tops and casework interior and exterior surfaces were contaminated from 10,000 to 60,000 dpm/100 cm<sup>2</sup> total activity, with localized areas of high contamination levels ranging from 200,000 to 61,700,000 dpm/100 cm<sup>2</sup> total activity, and removable hydrogen-3 contamination levels ranging from <1000 to 1,200,000 dpm/100 cm<sup>2</sup>. The removable carbon-14 contamination levels ranged from <1000 to 1,478,000 dpm/100 cm<sup>2</sup>. The upper wall and ceiling surfaces were reported to be contaminated from 10,000 to 60,000, total activity. Localized areas of high contamination levels range from 200,000 dpm/100 cm<sup>2</sup> to 2,301,000 dpm/100 cm<sup>2</sup> total activity, with removable hydrogen-3 contamination levels ranging from <1000 to 15,400 dpm/100 cm<sup>2</sup>, and removable carbon-14 contamination levels range from <1000 to 64,900 dpm/100 cm<sup>2</sup>.

A few locations in the unrestricted office areas were identified with elevated activity on floors. The total contamination levels for these locations range from 42,000 to 145,000 dpm/100 cm<sup>2</sup>. The removable activity for hydrogen-3 and carbon-14 at these locations was determined to be <500 dpm/100 cm<sup>2</sup> on the floor. There was one location detected on the men's restroom floor that was 3,482,000 dpm/100 cm<sup>2</sup> total activity. The removable carbon-14 at this location was 1588 dpm/100 cm<sup>2</sup>.

### 4.2 Soils

Based on characterization survey data, the licensee reported that low levels of surface soil radiological contamination are present in small areas around and near the Fort Mims Facility. The licensee has classified the outside soil areas to the north and west of the building as impacted. This is based on samples collected by a contractor hired by Sigma-Aldrich in 2003 and samples collected by the NRC in October 2007 and January 2008. Both sample sets indicated carbon-14 levels in the surface soils greater than 12 picocuries per gram (pCi/g), which is the radiological unrestricted use limit listed in NUREG 1757, Volume 2 Appendix B Table B.2 Screening Values of Common Radionuclides for Soil Surface Contamination Levels. The samples collected in 2003 contained concentrations of carbon-14 ranging from 13 to 140 pCi/g. The NRC samples from 2007 and 2008 had concentrations of carbon-14 ranging from 2 to 137 pCi/g.

### 4.3 Evaluation Summary

The NRC staff has reviewed the information in the "Radiological Status of the Facility" section of the Sigma-Aldrich Company's Fort Mims Facility's DP according to the NRC's Consolidated Decommissioning Guidance, Vol. 1, Section 16.4 (Radiological Status of the Facility). Based on this review, the NRC staff has determined that the licensee has described the types and activity of radioactive contamination sufficiently to allow the NRC staff to evaluate the appropriateness of the proposed remediation activities, the radiological control measures, and waste management practices.

## 5.0 Dose Analysis

### 5.1 Site Release Criteria

For the Sigma-Aldrich Building and site, the licensee proposed to remediate contaminated areas to permit unrestricted use of the site in compliance with the requirements of 10 CFR 20.1402. The residual radioactivity that is distinguishable from background must not cause the total effective dose equivalent (TEDE) to an average member of the critical group to exceed 25 mrem/yr. Residual radioactivity must also be reduced to levels that are as low as reasonably achievable (ALARA).

### 5.2 Building Surface Derived Concentration Guideline Limits (DCGLs)

A total of 2 radionuclides (carbon-14 and hydrogen-3) were identified as relevant to the decontamination activities at the Fort Mims site. The areas being released under this decommissioning effort will be surveyed in accordance with the guidance contained in Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), NUREG 1575 to demonstrate compliance with the criteria specified in Title 10, Code of Federal Regulations, Subpart E, Section 20.1402 "Radiological Criteria for Unrestricted Use." The 10 CFR 20.1402 criteria specifies that the TEDE received by an average member of the critical group from residual radioactivity does not exceed 25 mrem per year (mrem/yr) and that the residual radioactivity has been reduced to levels that are as low as reasonably achievable (ALARA). The licensee elected as a DP commitment to set an administrative dose limit of 10 mrem/yr as the basis for determining the site release criteria for decontamination and decommissioning the building. To achieve this goal, the licensee committed to limiting contamination levels on building surfaces to approximately 40 per cent of the NRC default screening values, which are published in the NRC's NUREG 1757, Volume 2, Appendix H "Acceptable License Termination Screening Values of Common Radionuclides for Building-Surface Contamination." The acceptable screening levels for unrestricted release (dpm/100 cm<sup>2</sup>) for carbon-14 and hydrogen-3, specified in NUREG 1757 are 3.7 E+6 and 1.2E+8 dpm/100 cm<sup>2</sup>, respectively. The licensee set its administrative limits for carbon-14 and hydrogen-3 to 1.48 E+6 and 4.8 E+7 dpm/100 cm<sup>2</sup> respectively

Using the screening analysis approach, the DCGLs for carbon-14, and hydrogen-3 were taken directly from Table B.1 of Appendix B in NUREG 1757, Vol. 1. In accordance with guidance provided in NUREG 1757, DCGLs developed through a screening analysis are acceptable provided the following conditions are met:

1. The assumption of the screening analysis are not violated. Specifically, (a) the residual radioactivity is on wall surface (i.e., non-volumetric); and (b) the residual radioactivity on the surface is mostly fixed with the fraction of loose radioactivity not to exceed 10% of the total surface activity.
2. Only default parameters within the DandD code are used in the dose analysis.

When using the DCGLs to determine compliance, the sum of fractions rule must be used when multiple radionuclides are present so that the total dose will not exceed the dose criterion of 25 mrem/yr. The residual concentration of a radionuclide divided by its corresponding DCGL summed over all radionuclides must be less than 1. The DCGLs for building surfaces and soil represent the total 25 mrem/yr dose quantity when applying this rule.

### **5.3 Surface Soil DCGLs**

For surface soil, the licensee provided DCGL values for carbon-14 and hydrogen-3, the only 2 radionuclides identified as potential soil contaminants for the Fort Mims site. Using the screening analysis approach, the DCGLs for carbon-14 and hydrogen-3 were taken directly from Table H.2 of Appendix H in NUREG 1757, Vol. 2. The default screening values were 12 and 110 pCi/g for carbon-14 and hydrogen-3, respectively. As with the building surface DCGL values, each of the above default surface soil DCGL values represents the activity equivalent to a dose of 25 mrem/year. Accordingly, the sum of fractions rule must be used to apportion the concentrations when multiple radionuclides are present so that the total dose will not exceed 25 mrem/year.

### **5.4 Elevated Measurement Comparison DCGL values**

The licensee's DP did not request approval to use elevated measurement area factors. Instead the licensee committed to remediate all residual activity to levels below the DCGL. Additionally, the licensee committed to a reasonable effort to decontaminate any detectable contamination in compliance with the ALARA principle.

### **5.5 Evaluation Summary**

The staff has reviewed the proposed radiological dose release criteria in the Sigma-Aldrich Company's DP in accordance with the NRC's Consolidated Decommissioning Guidance, NUREG 1757, Vol. 1 Section 6 (Radiological Criteria for Decommissioning). Based on its review, the staff concludes that the dose estimates calculated using the default screening analysis are appropriate for the decommissioning scenario. In addition, these dose estimates provide reasonable assurance that the dose criterion in 10 CFR 20.1402 will be met. In determining the dose to the average member of the critical group, the licensee has used the assumptions inherent in the screening analysis and the parameter uncertainties have been previously evaluated on a generic basis by the staff as a part of establishing the default screening analysis.

### **6.0 Planned Decommissioning Activities**

The licensee's decommissioning project will transition through 4 major phases. The first phase involves the remediation of the Fort Mims building, which will include removal of all office and laboratory materials and equipment, and ventilation and waste disposal systems. The second phase involves the demolition of the Fort Mims building down to the building slab, which won't occur until verification that the building meets the NRC's unrestricted use dose limits specified in 10 CFR Part 20, Section 20.1402, "Radiological Criteria for Unrestricted use." The third phase involves the licensee's decommissioning contractor performing soil borings to localize and characterize a nonfunctional septic tank, which was buried under a portion of the subsequent building construction, which occurred during 1980. The contractor will remove the septic tank if characterization data determines that the radiological levels in the soil in and around the septic tank are above the NRC unrestricted use limits specified in NUREG 1757, Vol. 2, Appendix H, "Screening Values pCi/g of Common Radionuclides for Soil Surface Contamination Levels." The final phase is the conduct of the final status survey. The licensee projects that the total remediation and decommissioning time will require approximately 12 weeks after the licensee's decommissioning contractor has mobilized to the site.

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The NRC staff has reviewed the information in the "Planned Remediation Activities" section of the Sigma-Aldrich Company's DP according to the NRC's Consolidated Decommissioning Guidance, NUREG 1757, Vol. 1, Section 17.1 (Planned Decommissioning Activities). Based on this review, the NRC staff has determined that the licensee has provided sufficient information to allow the NRC staff to evaluate the licensee's planned decommissioning activities to ensure that decommissioning can be conducted in accordance with the NRC requirements.

### **7.0 Project Management and Organization**

An NRC Agreement State decommissioning licensee has contracted with the Sigma-Aldrich Company to conduct the decommissioning activities at the Fort Mims Facility. The decommissioning contractor Philotechnics Limited will perform the remediation and decommissioning work via reciprocity using its Massachusetts Materials License No. 56-0543, expiration date October 31, 2001. The decommissioning contractor's Massachusetts License No. 56-0543, License Condition 9, "Authorized Use," specifies that Philotechnics can perform decommissioning activities involving byproduct material contaminants (including carbon-14 and hydrogen-3) as follows:

1. Collection, handling, and packaging of radioactive waste materials at customer facilities.
2. Preparation for transportation and transfer of radioactive waste materials from customer facilities to facilities licensed by the Massachusetts Radiation Control Program, U.S. Nuclear Regulatory Commission, or another Agreement State to receive these materials. (All radioactive materials offered for transport shall meet the U.S. Department of Transportation regulations for interstate commerce. This license does not exercise jurisdiction over these radioactive materials while in transport.)
3. The collection and transfer of samples for analysis to facilities licensed by the U.S. Nuclear Regulatory Commission, or another Agreement State to perform this activity,
4. Possession, processing, decontamination, storage, packaging, shipping, transfer, characterization and radiological surveys as part of assessment, decontamination, decommissioning and/or remediation operations.

The NRC staff reviewed the October 20, 2008, "Sigma-Aldrich, Fort Mims Facility, Decontamination and Decommissioning Plan, Facility Management and Oversight Agreement," between Sigma-Aldrich, and Philotechnics, Limited. This Agreement detailed the two parties responsibilities for management and oversight of the Fort Mims Facility during the decommissioning project. The Agreement discussed how the 2 companies would communicate and resolve issues involving the following:

- Facility oversight and management
- Security
- Separation of different licensed activities
- Project decision authority
- Project auditing
- Non-Compliance Actions



## Safety Evaluation Report

The NRC conducted separate inspections of Sigma-Aldrich Company (ML083080152 and ML083530478), and Philotechnics, Ltd. (ML091040737 and ML091170110) at the Sigma-Aldrich Fort Mims Facility. These inspections were conducted to determine Sigma-Aldrich Company's and Philotechnics compliance with the "Sigma-Aldrich, Fort Mims Facility, Decontamination and Decommissioning Plan, Facility Management and Oversight Agreement," and to observe and evaluate the decommissioning contractor's compliance with its Massachusetts license, implementation of and compliance with decommissioning procedures, availability of required decommissioning equipment and materials, performance of work by contractor's on-site staff and their qualifications. The NRC inspectors did not identify any violations of the NRC or license requirements.

The NRC staff also conducted an on-site visit at the Fort Mims Facility on March 19, 2009 (ML090930482). The purpose of the visit was to supplement the NRC staff's review of the licensee's DP. The staff focused on the review of the licensee's quality assurance and radiation safety programs, related program procedures, and implementation of radiation work permits. The NRC staff also discussed the licensee's responses to prior NRC Requests for Additional Information. Based on the NRC staff's initial review of contractor procedures, the licensee was informed that the procedures should be sufficient to satisfy the decommissioning plan requirements necessary for performing the site remediation activities at the Ft. Mims facility.

The NRC staff reviewed the information in the "Project Management and Organization" section of the Sigma-Aldrich Company's DP according to the NRC's Consolidated Decommissioning Guidance, NUREG 1757, Vol. 1, Section 17.2 (Project Management and Organization). Based on this review, the NRC staff has determined that the licensee has provided sufficient information to allow the NRC staff to evaluate the licensee's decommissioning project management organization and structure. The NRC staff concludes that the licensee's project management and organization is adequate to decommission the site in accordance with the NRC requirements.

### **8.0 Radiation Safety and Health Program**

The NRC Staff has reviewed the Radiation Safety and Health Program described in the Sigma-Aldrich Company's DP. As indicated above, all decontamination and decommissioning activities will be conducted under the licensee's contractor's Massachusetts Radioactive Materials license No. 56-0543 under reciprocity with the NRC. Specifically, the scope of activities will be performed under Philotechnics Radiation Protection Program for Massachusetts Licensed Activities and Philotechnics Health Physics Operations Procedures. Sigma-Aldrich Company's Radiation Safety Officer or another qualified Company designee will implement daily audit and over-sight activities pursuant to the Oversight Agreement, and as the property owner, and client.

The licensee's DP discusses in general when air samples will be taken in work areas, the types of air sampling equipment to be used and where they will be located in the work areas. The licensee provided information on the minimum detectable activities of equipment to be used for analyses of radionuclides collected during sampling, and action levels for airborne radioactivity for the protection of workers and the environment. The licensee's DP provided information regarding its program to determine internal dose of a worker based upon measurements from air samples or bioassay samples, including the use of respiratory protection equipment for the protection of workers. The licensee also described the methods to measure the external dose of workers and that the licensee will sum the internal and external exposures for determining the workers' total exposure.



The licensee's DP describes the Radiation Work Permits (RWP) process, which will be employed to inform workers of radiological and industrial safety conditions in the work areas. The RWPs will specify worker requirements, precautions and actions to be performed to safely perform decommissioning activities. The licensee's DP also discusses the contamination control program to control contamination on skin, protective and personnel clothing, fixed and removable contamination on work surfaces, equipment, and on packages. The licensee's contractor's radiological instrumentation program ensures that the sensitivity and the calibration of instruments and equipment to be used to make quantitative measurements of ionizing radiation during surveys are appropriate. The licensee's and contractor's health physics audits and recordkeeping programs described the executive management and radiation safety audits that ensure that decommissioning can be conducted safely and that records will be maintained in accordance with licensee and the NRC requirements.

The NRC staff has reviewed the information in the "Radiation Safety and Health Program" of the Sigma-Aldrich Company's DP according to the NRC's Consolidated Decommissioning Guidance, NUREG 1757, Vol. 1, Section 17.3 (Radiation Safety and Health Program during Decommissioning). Based on this review, the NRC staff has determined that the licensee provided sufficient information to conclude that the licensee's radiation safety and health program will be conducted in accordance with the NRC requirements in 10 CFR 20 ensuring the protection of workers and the environment during decommissioning activities.

### **9.0 Environmental Monitoring**

The NRC staff has reviewed the licensee's proposed decontamination activities and facility and site radiological conditions described in the DP. The licensee does not project any liquid or air releases from the building during the remediation processes, which would exceed the NRC unrestricted use criteria, nor have they any evidence that either surface waters or groundwater are impacted as a result of prior activities. The licensee has committed to performing environmental air sampling when the facility exhaust stack is being removed and whenever potential decommissioning work activities could release radioactive materials to the environment outside the building. Also, if soil sampling identifies radiological contamination above surface soil release limits after the building structure and slab have been removed, the licensee will stop work and submit subsurface soil work and groundwater monitoring plans.

The NRC staff reviewed the licensee and the NRC soil sampling data, as well as the licensee's proposed soil release values, and compared the residual contamination levels against the trigger values for soil in the October 9, 2002, "Memorandum of Understanding (MOU) between the U.S. Environmental Protection Agency and the NRC on Consultation and Finality on Decommissioning and Decontamination of Contaminated Sites." Based on this review, staff believes that the USEPA trigger values for soil will not be exceeded.

### **10.0 Radioactive Waste Management**

The NRC staff has reviewed the information in the "Radioactive Waste Management" section of the Sigma-Aldrich Company DP according to the NRC's Consolidated Decommissioning Guidance, NUREG 1757, Vol. 1, Section 17.5 (Radioactive Waste Management Program). Based on this review, the NRC staff has determined that the licensee's program for the management of radioactive waste generated during the decommissioning operations ensures that the waste will be managed in accordance with the NRC requirements and in a manner that is protective of the public health and safety.

## **11.0 Quality Assurance Program**

The NRC staff has reviewed the information in the "Quality Assurance Program" section of the Sigma-Aldrich Company DP and subsequent responses to the NRC requests for additional information, according to the NRC's Consolidated Decommissioning Guidance, NUREG 1757, Volume 1, Section 17.6 (Quality Assurance Program). Based on this review, the NRC staff has determined that the licensee's Quality Assurance program is sufficient to ensure that information submitted to support decommissioning of the site will be of adequate quality to allow the NRC staff to determine if the licensee's planned decommissioning activities are conducted in accordance with the NRC requirements.

## **12.0 Facility Radiation Surveys**

The licensee provided detailed information describing development of the final status survey design. The characterization information ensures that the planned decommissioning activities will be effective and will not endanger the remediation workers. Additionally, the report demonstrates that significant quantities of radioactivity have not gone undetected, and provides information that will be used to design the final status survey.

In Section 14.0, "Design and Performance of Final Status Surveys" of the licensee's DP, the licensee summarized the final status survey design to ensure compliance with the radiological criteria for license termination. Based on the staff's review, the DCGLs are consistent with the NRC dose modeling criteria and the guidance in NUREG 1575, Multi-Agency Radiological Survey and Site Investigation Manual (MARSSIM). The licensee provided technical information, such as instrumentation to be used for final status surveys as well as detailed instrument performance calculations demonstrating the minimum detectable count rates for scan surveys and the minimum detectable activities for static measurements. The instruments selected by the licensee are appropriate for the measurements of the residual radioactive contamination at the Fort Mims site. The Final Status Survey Plan describes methods to be employed that are consistent with MARSSIM and are adequate to demonstrate compliance with the release criteria in 10 CFR 20.1402.

## **13.0 Financial Assurance**

The NRC staff reviewed the Sigma-Aldrich Company Decommissioning Funding Plan filed with the NRC on February 19, 1992, to verify if the licensee's funding guarantees are sufficient for the estimated decommissioning cost for the Fort Mims Facility. The licensee's decommissioning cost estimate for the Fort Mims Facility and site is estimated to be approximately \$1,600,000. Based on this review, the NRC staff has determined that the licensee has adequate funding guarantees in place to carry out all required decommissioning activities prior to license termination.

## **14.0 Agencies and persons contacted**

### **14.1 Local Radiation Control Authorities**

The NRC staff consulted with the Missouri Department of Health and Senior Services on December 1, 2008, regarding review of the DP, and on April 15, 2009, regarding this Environmental Assessment (EA) for the license amendment to authorize decommissioning activities. The State Department of Health and Senior Services is the State's Radiation

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Protection Agency, and has been routinely informed of the NRC's intention to approve the completion of decommissioning at the Sigma-Aldrich Company Site. The State informed the NRC on April 15, 2009, that they had no comments on either the Sigma-Aldrich Company DP or EA.

### 14.2 Endangered Species Act

The NRC staff consulted with the Missouri Department of Conservation, Wildlife Division, Endangered Species, on March 5, 2009, (ML090640890) as required by Section 7 of the Endangered Species Act. The purpose of the call was to ensure that the licensing action is "not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of the habitat of such species. The Missouri Endangered Species staff indicated that based on his review and knowledge of current documents relating to possible endangered species that the decommissioning and release of the Sigma-Aldrich Company located in Maryland Heights, Missouri building as discussed would not affect any endangered species.

### 14.3 National Historic Preservation Act

The NRC staff consulted with the Missouri Department of Natural Resources, as required by Section 106 of the National Historic Preservation Act. The Act requires the NRC to meet certain requirements in the protection of cultural and historical resources. In a March 19, 2009 (ML090860375) letter from the Department of Natural Resource's State Historic Preservation Office, Director and Deputy State Historic Preservation Officer, the State indicated that "We have reviewed the information provided concerning the above referenced project. Based on this review we concur that the Sigma-Aldrich Chemical Company is not eligible for inclusion in the National Register of Historic Places. In our opinion, the property has been extensively disturbed, and there is little potential for the occurrence of archaeological sites. We concur that there will be no historic properties affected and we have no objection to the initiation of project activities."

### 14.4 Conclusions

Based on the considerations discussed above, the NRC staff concludes that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by the proposed decommissioning activities; and (2) such activities will be conducted in compliance with the NRC regulations.

### References

1. U.S. NRC, "Consolidated Decommissioning Guidance, Decommissioning Process for Materials Licensees," NUREG 1757:
  - Volume 1, Decommissioning Process for Materials Licensees (ML063000243)
  - Volume 2, Characterization, Survey, and Determination of Radiological Criteria (ML053260027)
  - Volume 3, Financial Assurance, Record Keeping, and Timeliness (ML032471471)
2. U.S. NRC, "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)," NUREG 1575, Revision 1, August 2000 (ML082470583)

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3. October 1, 2008, NRC Region III Trip Report regarding Sigma-Aldrich Company, "Subject: October 1, 2008, PRE-DECOMMISSIONING PLAN LICENSE MEETING" (ML083050591)
4. October 22, 2008, Letter from Sigma-Aldrich Company to NRC Region III, "Subject: Timely Notification of Cessation of Licensed Activities and Submittal of Decontamination and Decommissioning Plan" (ML083010187)
5. October 22, 2008, Document from Sigma-Aldrich Company to NRC Region III, "Subject: Sigma-Aldrich - Health Physics and Instrument Operations Procedures - Table of Contents" (ML083010203)
6. October 22, 2008, Document from Sigma-Aldrich Company to NRC Region III, "Subject: Sigma-Aldrich, Decommissioning Plan Checklist" (ML083010210)
7. October 23, 2008, NRC Region III Inspection Report for Sigma-Aldrich Company, IR 03010716-08-001 on 10/22-24/2008, Sigma-Aldrich Company (ML083080152)
8. November 24, 2008, NRC Region III letter to Sigma-Aldrich Company, "Subject: Acknowledgement of Receipt of DP for the Fort Mims Facility and Acceptance for Technical Review for Amendment to License, Control No. 317645" (ML083450660)
9. December 10, 2008, NRC Region III Trip Report and Request for Additional Information (RAI) regarding Sigma-Aldrich Company, "Subject: December 10, 2008, Decommissioning Plan License Meeting and NRC RAI" (ML090150318)
10. December 15, 2008, Sigma-Aldrich Company letter to NRC Region III, "Subject: Request to NRC for Permission to Proceed with the Open Land Soil Sampling and Analysis Plan" (ML083510259)
11. December 15, 2008, Sigma-Aldrich Company letter to NRC Region III, "Subject: Notification of Revised Decommissioning Plan to Incorporate Phased Remediation" (ML083510270)
12. December 16, 2008, NRC Region III Inspection Report for Sigma-Aldrich Company, IR 03010716-08-002 on 12/10/08 & 12/11/08, Sigma-Aldrich Company (ML083530478)
13. December 19, 2008, NRC Region III issued Federal Register Notice, "Subject: Notice of Amendment Request for Decommissioning of the Sigma-Aldrich Chemical Company's Fort Mims Facility, Maryland Heights, Missouri and Opportunity to Request a Hearing" (ML083430580)
14. January 23, 2009, NRC Region III letter to Sigma-Aldrich Company, "Subject: Approval indication for Sigma-Aldrich Fort Mims facility to proceed with Soil Sampling and Analysis Plan under authority of Philotechnics license" (ML090270093)
15. February 6, 2009, Sigma-Aldrich Company letter to NRC Region III, "Subject: Response to Request for Additional Information Regarding Staff Review of Decommissioning Plan Dated October 22, 2008" (ML090500166)

## Safety Evaluation Report

16. February 25, 2009, NRC Region III Telephone Conversation Record with Sigma-Aldrich Company, "Subject: Request for Information for Sigma-Aldrich Decommissioning Project to Complete Missouri Department of Natural Resources, State Historic Preservation Office, Section 106 Project Information Form" (ML090680339)
17. March 5, 2009, NRC Region III Telephone Conversation Record with State of Missouri Department of Conservation, "Subject: Consultation with State of Missouri Department of Conservation, Regarding Endangered Species" (ML090640890)
18. March 5, 2009, NRC Region III Telephone Conversation Record with Missouri Department of Natural Resources, "Subject: Consultation with State Historic Preservation Office Regarding Sigma-Aldrich Decommissioning Activities' Effects on Historic Properties" (ML090680637)
19. March 11, 2009, NRC Region III Telephone Conversation Record with Sigma-Aldrich Company, "Subject: Request for Additional Information regarding Sigma-Aldrich Decommissioning Project to complete Missouri Department of Natural Resources, State Historic Preservation Office, Section 106 Project Information Form" (ML090710056)
20. March 6 & 11, 2009, NRC Region III Telephone Conversation Record with Sigma-Aldrich Company, "Subject: Discussion Regarding Request for Additional Information Responses from Sigma-Aldrich for Review of Decommissioning Plan" (ML090770368)
21. March 12, 2009, NRC Region III package to Missouri State Historic Preservation Office (SHPO), "Subject: Section 106 Project Information Package to the Missouri SHPO" (ML090710287)
22. March 12, 2009, NRC Region III letter to Missouri State Historic Preservation Office (SHPO), "Subject: NRC Request for Concurrence on the Determination of Effects on Historic Properties for the Sigma-Aldrich Chemical Company's Ft. Mims, Maryland Heights, MO Facility" (ML090710998)
23. March 19, 2009, State of Missouri Department of Natural Resources letter to NRC Region III, "Subject: Completion of the Section 106 Review for Sigma-Aldrich Decommissioning Project by the State Historic Preservation Office with No Findings of Historic Properties Affected" (ML090860375)
24. May 1, 2009, NRC Region III issued Federal Register Notice, "Subject: Notice of Environmental Assessment and Finding of No Significant Impact (FONSI) related to License Amendment for the Sigma-Aldrich Company, [NRC-2008-0662]" (ML091180638)



T. Spencer

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If you have any questions, please contact Mr. Mike McCann of my staff at (630) 829-9856.

Sincerely,

Christine A. Lipa, Chief  
Materials Control, ISFSI, and Decommissioning  
Branch

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

Enclosures:

1. License Amendment No. 17
2. Safety Evaluation Report

cc (w/encl): J. Langston, MDHSS  
K. Henke, MDHSS

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