

**DECOMMISSIONING FUNDING PLAN – COST ESTIMATE
FORT MIMS SITE**

**Nuclear Regulatory Commission
Radioactive Materials License No. 24-16273-01**

Prepared for:

Sigma-Aldrich Company
PO Box 14508
St. Louis, MO 63178

Prepared by:

DDES, LLC
345 North Ave 2nd Floor
Wakefield, MA 01880



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1.0 INTRODUCTION

Site Identification

Decontamination Decommissioning and Environmental Services (DDES) LLC was retained to update the Decommissioning Funding Plan Cost Estimate for the Sigma-Aldrich Company Fort Mims Site at 11542 Fort Mims Drive in Maryland Heights, Missouri. The funding plan update was assembled using average costs and was based on guidance provided by the U.S. Nuclear Regulatory Commission (NRC) in accordance with the guidance contained in the Office of Nuclear Material Safety and Safeguards (NMSS) NUREG 1727, NMSS Decommissioning Standard Review Plan, Section 3, Appendix F and meets Title 10 Code of Federal Regulation (CFR) 30.35(e) Financial Assurance and Recordkeeping for Decommissioning.

Currently the site is undergoing decommissioning as a Group 5 facility as defined in NUREG 1727. Current site activities include further groundwater characterization and development of a site-specific derived concentration guideline levels (DCGLs) for Carbon-14 and Hydrogen-3. RESRAD dose modeling will be used to establish that the site meets the 25 mrem/year criteria for unrestricted use. The current decommissioning schedule projects the site will be released for unrestricted use sometime in the middle of 2017.

Nature of Site

The Fort Mims Site (FMS) is an open land site in Maryland Heights, Missouri. This 3 acre parcel of land was once used by Sigma-Aldrich for the manufacture of radiolabeled chemical compounds. All structures and utilities were removed from the site in 2010. Currently only residual soils contamination exists in the upper three meters with most activity in the upper six inches of soil. Sigma-Aldrich Company currently holds Nuclear Regulatory (NRC) License No. 24-16273-01 which allows for the possession, transfer and disposal of source material from decommissioning operations.

2.0 Cost Estimate

Sigma-Aldrich Company has developed the assumptions for decommissioning based on the nature and extent of soil contamination onsite. Based on the soil sampling results, we believed that only a limited volume of soils (675 ft³) may require removal to meet the 25 mrem/year criteria for unrestricted use under site specific dose modeling. A site-specific partition coefficient is currently under development using soils data as part of a comprehensive site model. This data will be used to revise the Decommissioning Plan for the Fort Mims Site.

The Excel™ workbook for the Fort Mims Site was developed to reflect the use areas at the site. This information was incorporated into a comprehensive decommissioning cost estimate presented in Appendix A. The workbook was used to calculate the total cost of decommissioning the Sigma-Aldrich Company Fort Mims Site. The total calculated cost of decommissioning for the facility is \$711,474.00 including the 25% contingency. Table 1 presents the combined detail of the decommissioning funding estimate.

| Table 1 Fort Mims Site Total Decommissioning Costs | | |
|-------------------------------------------------------------------------------|---------------------|-------------------|
| Task/Component | Cost | Percentage |
| Planning and Preparation | \$67,829.00 | 11.9% |
| Decontamination and/or Dismantling of Radioactive Facility Components | \$0 | 0% |
| Restoration of Contaminated Areas on Facility Grounds | \$0 | 0% |
| Final Radiation Survey | \$94,735.00 | 16.6% |
| Site Stabilization and Long-Term Surveillance | \$0.00 | 0% |
| Packing Material Costs | \$3,300.00 | 0.6% |
| Shipping Costs | \$18,750.00 | 3.3% |
| Waste Disposal Costs | \$161,685.00 | 28.4% |
| Equipment/Supply Costs | \$56,200.00 | 9.9% |
| Laboratory Costs | \$62,880.00 | 11.0% |
| Miscellaneous Costs | \$103,800.00 | 18.2% |
| Subtotal | \$569,179.00 | 100% |
| 25% Contingency | \$142,295.00 | |
| Total Decommissioning Cost Estimate | \$711,474.00 | |

REFERENCES

Division of Waste Management, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission (September 2003). *Consolidated NMSS [Nuclear Material Safety and Safeguards] Decommissioning Guidance*, [NUREG-1757](#). Volume 1: *Decommissioning Process for Materials Licensees*. Volume 2: *Characterization, Survey, and Determination of Radiological Criteria*. Volume 3: *Financial Assurance, Recordkeeping, and Timeliness*. Washington D.C.: U.S. Nuclear Regulatory Commission.

U.S. Nuclear Regulatory Commission, U.S. Environmental Protection Agency, U.S. Department of Energy, and U.S. Department of Defense (August 2000). *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*, [NUREG-1575](#), Rev. 1. Washington D.C. U.S. Nuclear Regulatory Commission.

A.3.1.3 Key Assumptions

The remaining cost for decommissioning of the Fort Mims site is based on a detailed cost estimate performed by DDES, LLC (DDES). DDES has performed decommissioning activities at the Fort Mims site since October 2016.

The current cost estimate, prepared by Sigma follows the form and function of NUREG-1757, Vol. 3, APPENDIX A. The facility structures being previously removed under previous decommissioning activities, no building structures (including concrete footings and slabs) or underground structures (septic tank and laterals) currently exist. Thus no costs have been associated with those items.

Decommissioning activities will be based on soil sampling, groundwater characterization and limited soil removal (potentially). Every effort has been made to accurately represent the decommissioning costs based on known site conditions.

The following Key Assumptions apply to the cost estimate:

Cost for labor, materials and disposal increase at 4% per year. Thus, cost elements in the DDES 2016 estimate were increased 16% to cover subsequent four years.

This cost estimate includes excavation, removal, transportation and disposal volumetrically contaminated soils found to contain C-14.

A.3.4 Facility Description Summary

| |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>NRC license numbers and types (i.e., Part 30, 40 and 70)</p> <p>Under NRC license number 24-16273-01, the Fort Mims facility was previously operated under a Type A, Broad Scope license (Ref. 10 CFR Part 33.11). Licensed materials were authorized for use in research & development as defined in CFR Part 30.4 and storage, processing and use in the production of compounds for distribution to authorized recipients. The license was amended on May 12, 2009, limiting use to decontamination and remediation activities associated with residual contamination in site soils.</p> |
| <p>Types and quantities of materials authorized under the licenses listed above.</p> <p>Hydrogen-3 and Carbon-14: Activity incident to decommissioning and remediation activities.</p> |
| <p>Description of how licensed materials are used.</p> <p>Only residual soil and ground water contamination remains. It will be left in place, or removed as necessary to meet requirements of decommissioning.</p> |
| <p>Description of facility, including buildings, rooms, grounds, and description of where particular types of materials are used.</p> <p>The Fort Mims Facility is approximately 3.3 miles east southeast of Maryland Heights and 16 miles west of the city center of the city of St. Louis, Missouri.</p> |
| <p>Quantities of materials or waste accumulated before shipping or disposal</p> <p>Only residual soil and ground water contamination remains. These soils will be left in place or removed as necessary to meet requirements of decommissioning the site.</p> |

Attachment A.3.4-1 Description of facility

The Sigma-Aldrich Fort Mims is located at 11542 Fort Mims Drive, Maryland Heights, Missouri, 63146. Sigma-Aldrich produced custom compounds labeled with H-3 or C-14 until midyear 2008. At which time Sigma-Aldrich notified the NRC of its intent to cease operations and begin decommissioning the site per the approved Sigma-Aldrich Fort Mims Facility Decontamination and Decommissioning Plan (ML083010187) dated October 20, 2008. The 20,000 square foot facility was decommissioned in accordance with the approved DP and the facility was removed from the radioactive material license. The structures, foundation and abandoned septic system of the production facility were removed from the site in 2010.

Site soils were evaluated in compliance with the approved Open Land Soil Sampling and Analysis Plan dated October 20, 2008. The results indicated surface soils had nuclide concentrations in a number of locations above the default screening values listed in Table B.2 of NUREG-1757, Vol.1, Rev.2 for the isotopes of concern. Another three phases of soil sampling were performed to define the horizontal and vertical extents of contamination onsite and on the southern abutting property. Shallow groundwater onsite was also evaluated and found to contain detectable levels of C-14 and H-3. Based on these results the site was upgraded to a Group 5 Decommissioning under NUREG 1757, "Consolidated NMSS Decommissioning Guidance."

A.3.5 Number and Dimensions of Facility Component

Use this table to summarize relevant features of the facility. Copy and complete the table as necessary for each room, laboratory, or area. Rooms, laboratories, or areas with similar levels of contamination may be consolidated in one table.

Name and room, laboratory or area: Restricted land plot

Level of Contamination: Low

| Component | Number of Components | Dimensions of Components (specify units) | Total Dimensions (ft3) |
|---------------------------------|----------------------|------------------------------------------|------------------------|
| Glove boxes | | | |
| Fume Hoods | | | |
| Lab Benches | | | |
| Sinks | | | |
| Drains | | | |
| Floors | | | |
| Walls | | | |
| Ceilings | | | |
| Ventilation/Ductwork | | | |
| Hot Cells | | | |
| Equipment/Materials | | | |
| Soil Plots | | | |
| Storage Tanks | | | |
| Storage Areas | | | |
| Radwaste Areas | | | |
| Scrap Recovery Areas | | | |
| Maintenance Shop | | | |
| Equipment Decontamination Areas | | | |
| Utilities/Piping | | | |
| Other (Soils) | NA | NA | 675 |

A.3.6 Planning and Preparation (Work Days)

Estimate the number of workdays, by specific labor category, that will be required to complete planning and preparation activities. Include all appropriate labor categories, including Supervisor, Foreman, Craftsman, Technician, Health Physicist, Laborer, Clerical, and others as needed.

| Activity | Project Mgr | Supervisor | Health Physicist/Shipper | HPT's/Drafting | Radiation Workers | Clerical |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|------------|--------------------------|----------------|-------------------|----------|
| Preparation of Documentation for Regulatory Agencies | 5 | | 2 | | 0 | 1 |
| Submittal of Decommissioning Planning Plan to NRC when required by 10 CFR 30.36(g)(1), 40.42(g)(1), 70.38(g)(1), or 72.54(g). | 15 | | 5 | | 0 | 1 |
| Development of Work Plans | 10 | | 0 | | 0 | 1 |
| Procurement of Special Equipment | 0 | | 3 | | 2 | 2 |
| Staff Training | 3 | | 3 | | 6 | 1 |
| Characterization of Radiological Condition of the Facility (including sampling, soil and tailings analysis, or groundwater analysis, if applicable) | 10 | | 20 | | 40 | 3 |
| Administrative fees (such as procurement fees for third party contractor, legal fees, local permits, utilities, financial assurance fees, and NRC staff review of these items) | 0 | | 0 | | 0 | 0 |
| Other (specify) Mobilization | | | | | | |
| TOTALS | 43 | 0 | 33 | 0 | 48 | 9 |

A.3.7 Decontamination or Dismantling of Radioactive Facility Components (Work Days)

Estimate the number of workdays, by specific labor category, that will be required to complete decontamination and/or dismantling activities for each facility component. Copy and complete this table as necessary for each room, laboratory, or area. Rooms, laboratories, or areas with similar levels of contamination may be consolidated in one table.

Name of room, laboratory, or area: Site Soils
 Level of Contamination: Low

| Component | Decon. Method | Project Mgr | Supervisor | Health Physicist/ Shipper | HPT's/Drafting | Radiation Workers | Clerical |
|---------------------------------|---------------|-------------|------------|---------------------------|----------------|-------------------|----------|
| Glove Boxes | Remove/Disp | | | | | | |
| Fume Hoods | Remove/Disp | | | | | | |
| Lab Benches | Remove/Disp | | | | | | |
| Sinks | Remove/Disp | | | | | | |
| Drains | Remove/Disp | | | | | | |
| Floors | Scabble | | | | | | |
| Walls | Remove/Disp | | | | | | |
| Ceilings | Vac/Wipe | | | | | | |
| Ventilation/Ductwork | Remove/Disp | | | | | | |
| Hot Cells | Remove/Disp | | | | | | |
| Equipment/Materials | Sur/Rem/Disp | | | | | | |
| Soil Plots | Sample | | | | | | |
| Storage Tanks | N/A | | | | | | |
| Storage Areas | Remove/Disp | | | | | | |
| Radwaste Areas | Remove/Disp | | | | | | |
| Scrap Recovery Areas | N/A | | | | | | |
| Maintenance Shop | Remove/Disp | | | | | | |
| Equipment Decontamination Areas | Remove/Disp | | | | | | |
| Other (specify) | Remove/Disp | | | | | | |
| TOTALS | | 0 | 0 | 0 | 0 | 0 | 0 |

A.3.8 Restoration of Contaminated Areas on Facility Grounds (Work Days)

Estimate the number of work days, by specific labor category, which will be required to restore contaminated areas on facility grounds.

| Activity | Project Mgr | Supervisor | Health Physicist/ Shipper | HPT's/Drafting | Radiation Workers | Clerical |
|---------------------------|-------------|------------|---------------------------|----------------|-------------------|----------|
| Backfill and Restore Site | | | | | | |
| Restore Walls | | | | | | |
| Restore Roof | | | | | | |
| Restore Utilities | | | | | | |
| | | | | | | |
| TOTALS | 0 | 0 | 0 | 0 | 0 | 0 |

A.3.9 Final Radiation Survey (Work Days)

Estimate the number of work days, by specific category, which will be required to conduct a final radiation survey.

| Activity | Project Mgr | Supervisor | Health Physicist/ Shipper | HPT's/Drafting | Radiation Workers | Clerical |
|-----------------|-------------|------------|---------------------------|----------------|-------------------|----------|
| FSS Setup | 7 | | 7 | 7 | | 7 |
| Survey Packages | 5 | 5 | 5 | 10 | 5 | 5 |
| Class 1 | 7 | 7 | 7 | 25 | 10 | 5 |
| Class 2 | | | | | | |
| Class 3 | | | | | | |
| Final Report | 10 | 10 | 10 | 20 | 1 | 10 |
| TOTALS | 29 | 22 | 29 | 62 | 16 | 27 |

A.3.10 Site Stabilization and Long-term Surveillance (Work Days)

Estimate the number of work days, by specific labor category, which will be required to complete site stabilization and long-term surveillance activities.

| Activity | Supervisor | Foreman | Craftsman | Technician | Health Physicist | Laborer | Clerical |
|----------|------------|---------|-----------|------------|------------------|---------|----------|
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| TOTALS | | | | | | | |

A.3.11 Total Work Days by Labor Category

Enter the total work days estimated for each specific labor category from the applicable table above (i.e., from the bottom rows of Tables A.3.6 through A.3.10)

| Task | Project Mgr | Supervisor | Health Physicist/ Shipper | HPT's/Drafting | Radiation Workers | Clerical |
|---------------------------------------------------------------------------------------------------------------------|-------------|------------|---------------------------|----------------|-------------------|----------|
| Planning and Preparation (TOTALS from Table A.3.6) | 43 | 0 | 33 | 0 | 48 | 9 |
| Decontamination and/or Dismantling of Radioactive Facility Components (Sum of TOTALS from all copes of Table A.3.7) | 0 | 0 | 0 | 0 | 0 | 0 |
| Packaging, Shipping, and Disposal of Radioactive Wastes | 0 | 0 | 0 | 0 | 0 | 0 |
| Restoration of Contaminated Areas on Facility Grounds (TOTALS from Table A.3.8) | 0 | 0 | 0 | 0 | 0 | 0 |
| Final Radiation Survey (TOTALS from Table A.3.9) | 29 | 22 | 29 | 62 | 16 | 27 |
| Site Stabilization and Long-Term Surveillance (TOTALS from Table A.3.10) | 0 | 0 | 0 | 0 | 0 | 0 |

A.3.12 Worker Unit Cost Schedule

Estimate labor costs (including salary, fringe benefits, and corporate overhead). Include all appropriate labor categories, including Supervisor, Foreman, Craftsman, Technician, Health Physicist, Laborer, Clerical and others as needed.

| Labor Cost Component | Project Mgr | Supervisor | Health Physicist/ Shipper | HPT's/Drafting | Radiation Workers | Clerical |
|--------------------------------------------------------------------------------|-------------|------------|---------------------------|----------------|-------------------|-----------|
| Salary & Fringe (\$/year) | \$ 98,600 | \$ 69,600 | \$ 69,600 | \$ 44,080 | \$ 37,120 | \$ 25,520 |
| Overhead Rate (%) | 50% | 50% | 50% | 50% | 50% | 50% |
| Total Cost Per Year | \$ 147,900 | \$ 104,400 | \$ 104,400 | \$ 66,120 | \$ 55,680 | \$ 38,280 |
| (1)Living expenses (PD*7/5) | \$ 244 | \$ 244 | \$ 244 | \$ 244 | \$ - | \$ - |
| (2)Total Cost Per Work Day* | \$ 812 | \$ 645 | \$ 645 | \$ 498 | \$ 214 | \$ 147 |
| Note: (1)Per Diem Rate of \$174 per day; (2)Based on 260 work days per year | | | | | | |

A.3.13 Total Labor Costs by Major Decommissioning Task

Multiply the estimated work days for each specific labor category (from Table A.3.11) by the total cost per work day for the corresponding labor category (from Table A.3.12), and enter the results in the table below. Then, add across all labor categories to determine the total labor costs for each major decommissioning task.

| Task | Project Mgr | Supervisor | Health Physicist/ Shipper | HPT's/Drafting | Radiation Workers | Clerical | Total Labor Cost |
|-----------------------------------------------------------------------|-------------|------------|---------------------------|----------------|-------------------|----------|------------------|
| Planning and Preparation | 34,935 | 0 | 21,290 | 0 | 10,279 | 1,325 | 67,829 |
| Decontamination and/or Dismantling of Radioactive Facility Components | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Packaging, Shipping, and Disposal of Radioactive Wastes* | | | | | | | |
| Restoration of Contaminated Areas on Facility Grounds | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Final Radiation Survey | 23,561 | 14,193 | 18,709 | 30,870 | 3,426 | 3,975 | 94,735 |
| Site Stabilization and Long-Term Surveillance | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

A.3.14 Packaging, Shipping, and Disposal of Radioactive Wastes (Excluding Labor Costs)

If labor is included in these costs, add a note to the cost estimate that these costs include labor.

(a) Packing Material Costs

Estimate the types and volumes of waste expected to be generated, along with the number and types of containers required for packaging the waste. Multiply the number of containers required by the unit cost per container.

| Waste Type | Volume (m3) | Number of Containers | Type of Container | Unit Cost of Container | Total Packaging Costs |
|------------|-------------|----------------------|-------------------|------------------------|-----------------------|
| Soils | 75 | 3 | Intermodal | \$1,100 | \$3,300 |
| | | | | | \$0 |
| | | | | | \$0 |
| | | | | | \$0 |
| TOTAL | | | | | \$3,300 |

(b) Shipping Costs

Estimate the number of truckloads of waste to be shipped. Multiply shipping costs per mile (including truckload costs, surcharges, and overweight charges) by the total distance shipped.

| Waste type | Number of Truckloads | Unit Cost (\$/mile/truck-load) | Surcharges (\$/mile) | Overweight Charges (\$/mile) | Distance shipped (miles) | Total Shipping Costs |
|------------|----------------------|--------------------------------|----------------------|------------------------------|--------------------------|----------------------|
| DAW | 0 | \$0.00 | 1 | 1 | | \$0 |
| Soil | 3 | \$12.50 | 1 | 1 | 500 | \$18,750 |
| | | | | | | \$0 |
| | | | | | | |
| | | | | | | |
| TOTAL | | | | | | \$18,750 |

(c) Waste Disposal Costs

Estimate the volume of waste to be disposed. Multiply the volume of waste disposed by the unit disposal cost (including any volume-based surcharges). Add any surcharges that are based on the number of containers of waste.

| Waste type | Disposal Volume (ft3) | Density (lb/ft3) | Disposal Mass (lbs) | Unit Cost (\$/lb) | Surcharges (\$/m3 or \$/container) | Total Disposal Costs |
|------------|-----------------------|------------------|---------------------|-------------------|------------------------------------|----------------------|
| DAW | 30 | 6 | 180 | \$9.50 | 1 | \$1,710 |
| Soils | 675 | 60 | 40,500 | \$3.95 | 1 | \$159,975 |
| | | | | | | \$0 |
| | | | | | | \$0 |
| TOTAL | | | | | | \$161,685 |

A.3.15 Equipment/supply Costs (Excluding Containers)

Estimate the quantity of equipment required for decommissioning and multiply that quantity by the appropriate unit costs

| Equipment/Supplies | Quantity | Unit Cost | Total Equipment/Supply Cost |
|---------------------|----------|-----------|-----------------------------|
| Protective clothing | 1 | \$3,500 | \$3,500 |
| Misc Equipment | 1 | \$44,100 | \$44,100 |
| Misc Tools | 1 | \$2,800 | \$2,800 |
| Consumables | 1 | \$5,800 | \$5,800 |
| TOTAL | | | \$56,200 |

A.3.16 Laboratory Costs

If applicable, estimate costs for analyses to be performed by an independent third-party laboratory

| Activity | Quantity | Unit Cost | Total Cost |
|----------------------|----------|-----------|------------|
| Sampling | 300 | \$205 | \$61,380 |
| Transport of samples | 12 | \$125 | \$1,500 |
| Testing and analysis | | | \$0 |
| Other (Specify) | | | \$0 |
| TOTAL | | | \$62,880 |

A.3.17 Miscellaneous Costs

Estimate any other applicable costs

| Cost Item | Total Cost |
|------------------------------|--------------|
| License Fees | \$3,800.00 |
| Insurance | |
| Taxes | |
| Other (Specify) (NRC Review) | \$100,000.00 |
| TOTAL | \$103,800.00 |

A.3.18 Total Decommissioning Costs

Enter the total costs reported in Tables A.3.13, A.3.14(a)-(c), A.3.15, A.3.16, and A.3.17 into the appropriate cells below, and add them to obtain a subtotal. Add to the subtotal a contingency allowance in the amount of 25 percent of the subtotal to obtain the total decommissioning cost estimate. Also, calculate for each task/component the percentage it represents of the subtotal.

| Task/Component | Cost | Percentage |
|----------------------------------------------------------------------------------------------|------------------|-------------------|
| Planning and Preparation (From Table A.3.13) | \$67,829 | 11.9% |
| Decontamination and/or Dismantling of Radioactive Facility Components (From Table A.3.13) | \$0 | 0.0% |
| Restoration of Contaminated Areas on Facility Grounds (From Table A.3.13) | \$0 | 0.0% |
| Final Radiation Survey (From Table A.3.13) | \$94,735 | 16.6% |
| Site Stabilization and Long-Term Surveillance (From Table A.3.13) | \$0 | 0.0% |
| Packing Material Costs (TOTAL from Table A.3.14(a)) | \$3,300 | 0.6% |
| Shipping Costs (TOTAL from Table A.3.1.4(b)) | \$18,750 | 3.3% |
| Waste Disposal Costs (TOTAL from Table A.3.14(c)) | \$161,685 | 28.4% |
| Equipment/Supply Costs (TOTAL from Table A.3.15) | \$56,200 | 9.9% |
| Laboratory Costs (TOTAL from Table A.3.16) | \$62,880 | 11.0% |
| Miscellaneous Costs (TOTAL from A.3.17) | \$103,800 | 18.2% |
| Contractor Overhead and Profit | \$0 | 0.0% |
| SUBTOTAL | \$569,179 | 100.0% |
| 25% Contingency | \$142,295 | |
| TOTAL DECOMMISSIONING COST ESTIMATE | \$711,474 | |