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February 6, 2009

George M. McCann
U.S. NRC Region III
2443 Warrenville Road
Suite 210
Lisle, IL 60532-4352

RE: NRC License 24-16273-01; Request for Additional Information Regarding Staff Review of Decommissioning Plan Dated October 22, 2008.

Dear Mr. McCann:

Pursuant to your request for Additional Information, please find the attached Sigma-Aldrich response.

Please let me know if you have additional questions or concerns.

Sincerely,

Thomas K Spencer
Radiation Safety Officer
Sigma-Aldrich Company
3500 DeKalb St.
Saint Louis, MO 63148
Phone 314/286-7686
Email tspencer@sial.com

Attachments
-Sigma-Aldrich Chemical Company REQUEST FOR ADDITIONAL INFORMATION REGARDING STAFF REVIEW OF DECOMMISSIONING PLAN DATED OCTOBER 22, 2008

-Attachment A: Copy of email sent to Peter Lee regarding number data points

-Attachment B: Copy of email sent Mike McCann and Peter Lee regarding dose assessment of a missed hot spot

cc:
Ryan P. Fahey, Project Manager, Philotechnics, Ltd.
Bob Ringering, Director of Manufacturing, Sigma-Aldrich
Cheryl Stipsits, Director of Environmental, Health & Safety, Sigma-Aldrich

Sigma-Aldrich Chemical Company
REQUEST FOR ADDITIONAL INFORMATION REGARDING
STAFF REVIEW OF DECOMMISSIONING PLAN DATED
OCTOBER 22, 2008

1. Clarify the end state of the building. Specifically, is the building to be free released and then demolished, or will portions of the building structure be disposed of as radiological waste. If portions of the building are to be demolished, then discuss the potential impacts and actions to prevent and or monitor the effluent releases during demolition.

   Response:
   Phase 1: The building and outside soil will be surveyed and decontaminated to a projected ALARA annual dose limit of 10 mrem. A final status survey will be completed. The building will then be demolished in compliance with local, state and federal requirements, leaving the concrete building pad intact. Having performed the final status survey prior to demolition, radioactive release should not be an issue.

   Phase 2: The area of the concrete pad under which an inactive septic system is believed reside will be survey to identify the exact location of the septic system components. After locating the septic tank and leach field area, a sampling survey plan will be completed to characterize the radiological status of the system and surrounding soils. Details to survey and sampling methods are provided in response to questions 2.

2. Discuss in greater detail the activities to characterize and possibly remediate the buried septic tank and related soils, and any potential impacts on ground and surface waters as follows:

   A. When is the characterization of the tank and septic field planned?

      Response:
      After demolition of the building as noted in response to question 1.

   B. What is the anticipated condition of the building when the characterization is to be performed?

      Response:
      The building will be removed. The concrete pad will be intact.

C. What has been done to localize the buried tank?

Response:
Because locating the septic tank and leach field will be best accomplished after removal of the building, nothing has been done to date.

D. What has been done to identify the septic leach field, which drained the liquids from the tank?

Response:
Because locating the septic tank and leach field will be best accomplished after removal of the building, nothing has been done to date.

E. How will characterization of soils under the building, adjoining the tank, and associated drain field be performed? Provide a written discussion and plan.

Response:
The exact location of the former septic tank and leachate field could not be identified through the historic site assessment. We propose to use a combination of ground penetrating radar and test trenching to define the locations of the tank and leachate field. We propose to develop a sample /assessment plan after the horizontal and vertical extents of the system are defined. This will allow comprehensive data to be collected in a single sampling campaign. We propose to perform this assessment after the building has been demolished and only the concrete pads remain.

F. Discuss the actions to be taken in the event significant amounts of contamination are encountered, that is significantly higher than the screening values.

Response:
The current Soil Sampling and Analysis Plan has a defined procedure for performing further sampling in the event contamination is identified in levels significantly exceeding the screening values of the site. The sampling plan defines the sample spacing both horizontally and vertically required to characterize the extent of contamination. We expect to collect

shallow soil samples using hand or powered augers to complete the soils assessment.

The comprehensive data set will be used to define the areas where removal of soils may be necessary to achieve unrestricted release of the facility. A specific soils excavation plan will be assembled if substantial quantities of soils require removal based on the sample results.

G. If subsurface contamination above the screening values are identified, then provide additional information, which indicates that the underlying site aquifers are not impacted. NUREG-1757, Volume 2, Appendix F "Ground and Surface Water Characterization," outlines the considerations and information necessary to demonstrate adequate characterization of groundwater and surface water impacts.

Response:
It has not been established that either surface or ground water has been impacted by site activities at this time. The Soil Sampling and Analysis Plan will be used as the starting point to identify any substantial areas of contamination which could serve as a source to impact either surface or ground water. We expect the area for the highest potential for impacting ground water will be the septic and leachate field. 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.

H. Discuss the potential for mixed wastes and chemical impacts in contaminated soils. The information should describe your monitoring actions and the data collected to verify that there are no chemical impacts in the subsurface soils which could be mobilized as a result of the remediation activities.

Response:
Because production activities at the Fort Mims facility were limited exclusively to manufacturing of radioactive compounds, any potential chemical contamination would be accompanied with radioactive contamination. Given the nature of the production and storage operations at the facility, we do not anticipate any chemical contamination in the soils. Chemical contamination would only be a

consideration if radioactive contamination is found to be well above the threshold limits. Therefore, additional sampling methods will not be employed outside of radioactive sampling. Should high radioactive readings be obtained, Sigma-Aldrich will perform standard chemical screening tests for common volatile organics, the most likely contaminants. Our EH&S Department will determine the proper course of action, which may or may not include contacting the appropriate federal, state and local agencies.

It has not been established that subsurface soils have been impacted at the site. The Soil Sampling and Analysis Plan will provide the data required to determine if removal of materials are required. If the current levels of radioactive contaminants meet the dose based release criteria for the site further chemical characterization would not be warranted for decommissioning the site under NUREG 1757. Any chemical contaminants in the soil/groundwater would be regulated by the Environmental Protection Agency and the Missouri Division of Environmental Quality.

If impacted soils were identified that required removal, additional samples would be obtained to characterize the chemical constituents for waste acceptance profiling at a licensed disposal facility. The soils excavation plan would include provisions to ensure mixed waste (if present) were handled appropriately and the remediation activities would not accelerate the mobilization of contaminants within the media.

3. Provide a representative sampling of the final status survey packages for the different survey classes, which have been completed in anticipation of the upcoming FSS. We need to evaluate the documentation, calculation and assumptions. For projects, lasting years, a description of the plan may be acceptable and finalized near completion, but in the case of a 2 to 4 month project the survey packages with completed calculations, diagrams, assumptions, and other need to be provided.

Response:
Document pertaining to determining the number of data points sent via email to Mike McCann and Peter Lee on 12/16/2008 at 4:07 pm from Tracie Clemons and provided as Attachment A.

4. Was the MARSSIM Compass program used in conjunction with the VSP program? The usual way to determine the number of samples is to use ORISE's COMPASS program, MARSSIM Implementation Software. This enables the user to transfer the COMPASS sample data and MDCs, etc to VSP. Provide the data used to derive the final report

Response:
Document pertaining to Dose Assessment of a Missed Hot Spot (Soil Sample) sent via email to Mike McCann and Peter Lee on 12/22/08 at 4:02 pm from Tracie Clemons and provided as Attachment B.

5. Please describe in greater detail how your decommissioning contractor will monitor potential environmental releases during the remediation Activities. Please see Item 11, in Appendix D of NUREG-1757, Vol 1.
Clarify the statement in Section 8 Effluent Control Program. It is indicated in the DP that the air exhaust system for the facility is monitored. However, comments provided to the NRC during the last inspection indicated that the facility exhaust is not monitored. If the facility exhaust is not monitored, then discuss what monitoring will be implemented.

Response:
Further remedial activities at the site will be performed with the existing local exhaust ventilation system turned off. Therefore there will not be a potential emissions source in operation at the site. The decommissioning team will use personnel and areas monitors to document airborne contamination levels in the immediate work areas using Philotechnics Workplace Personal Air Sampling Procedure.

6. Provide the Philotechnics project-specific Quality Assurance Project Plan (QAPP) provided to Sigma Aldrich as indicated in Section 15.0 Quality Assurance Program of the DP.

Response:
Due to the proprietary nature of the project-specific Quality Assurance Project Plan, a copy of the plan will be kept at the Fort Mims facility, available for review by the NRC. The plan may be checked out and returned by the NRC during inspections, but not taken upon completion of the inspection.

7. Confirm that the procedures cited in the index submitted with Sigma's DP will not be changed. If a change to a procedure is necessary, discuss how the licensee and NRC will be made aware of the change prior to the implementation of any procedural change.

Response:
Procedures will not be changed during the course of decommissioning. This does not preclude making minor changes such as procedure numbering, minor title modifications, and the like, provided no change to the procedure is made. In the event a procedure change is considered necessary, the change will not be implemented until Sigma-Aldrich and the NRC are notified and agree to the change.

8. Philotechnics Procedures

A. Procedure Review and Approval .Section 4.4 Procedure Manuals Section 4.4.1 = current copy of license application = provide

Response:
A current copy of Philotechnics Radioactive Materials License application will be kept onsite for NRC review.

B. Radiation Work Permits HP-AC-03

Page 3 .Applicability, clarify, this statement regarding license issued from the State of Tennessee. The license that is being worked under is from the State of Massachusetts

Response:
The license has been corrected. Tennessee has been replaced with Massachusetts.

Attachment A

From: Tracie M. Clemons
Sent: Tuesday, December 16, 2008 4:07 PM
To: 'mike.mccann@nrc.gov'; 'gmccann1@ameritech.net'; 'pjl2@nrc.gov'
Cc: Ryan P. Fahey; Gary S. Nadeau
Subject: Additional Information Regarding Sigma-Aldrich Decommissioning Plan

Attachments: Determining the Number of Data Points.doc
Good afternoon,

Mike and Peter per your request via the Staff Review Meeting at Sigma-Aldrich on December 10, 2008, attached is information regarding how we determine the number of survey locations for a survey unit. In addition to this information, you also asked for information regarding a dose assessment of a hot spot using the Visual Sampling Plan (VSP) for the Soil Sampling Plan. Currently, we are still working on that portion of your request. We will have this for you by Thursday at the latest.

Thank you,

Tracie M. Clemons
Sr. Health Physicist
Philotechnics, Ltd.
Office: 781-222-5044
Fax: 781-229-0732
Email: tmclemons@philotechnics.com

Website: http://www.philotechnics.com

Determining the Number of Data Points/Survey Locations

The number of data points (direct measurements) for a particular survey unit, employing the Sign Test, is determined from MARSSIM Table 5.5, which is based on the following equation (MARSSIM equation 5-2):

$$N = \frac{(Z_{1-\alpha} + Z_{1-\beta})^2}{4(SignP - 0.5)^2}$$

Where:
N = number of samples needed in the survey unit
$Z_{1-\alpha}$ = percentile represented by the decision error α
$Z_{1-\beta}$ = percentile represented by the decision error β
*Sign*P = estimated probability that a random measurement will be less than the DCGL when the survey unit median is actually at the LBGR
Note: *Sign*P is determined from MARSSIM Table 5.4

MARSSIM recommends increasing the calculated number of measurements by 20% to ensure sufficient power of the statistical tests and to allow for possible data losses. MARSSIM Table 5.5 values include an increase of 20% of the calculated value.

Table 5.5 Values of N for Use with the Sign Test

	α=0.01					α=0.025					α=0.05					α=0.10					α=0.25				
	β					β					β					β					β				
Δ/σ	0.01	0.025	0.05	0.10	0.25	0.01	0.025	0.05	0.10	0.25	0.01	0.025	0.05	0.10	0.25	0.01	0.025	0.05	0.10	0.25	0.01	0.025	0.05	0.10	0.25
0.1	4095	3476	2904	2463	1704	3476	2907	2459	1969	1313	2984	2459	2048	1620	1018	2463	1969	1620	1244	728	1704	1313	1018	725	345
0.2	1035	879	754	623	431	879	735	622	503	333	754	622	518	410	258	623	503	410	315	184	431	333	258	184	88
0.3	468	398	341	282	195	398	333	281	227	150	341	281	234	185	117	282	227	185	143	83	195	150	117	83	40
0.4	270	230	197	162	113	230	1921	162	131	87	197	162	136	107	68	162	131	107	82	48	113	87	68	48	23
0.5	178	152	130	107	75	152	126	107	87	58	130	107	89	71	45	107	87	71	54	33	75	58	45	33	16
0.6	129	110	94	77	54	110	82	77	63	42	94	77	65	52	33	77	63	52	40	23	54	42	33	23	11
0.7	99	83	72	59	41	83	70	59	48	33	72	59	50	40	26	59	48	40	30	18	41	33	26	18	9
0.8	80	68	58	48	34	68	57	48	39	26	58	48	40	32	21	48	39	32	24	15	34	26	21	15	8
0.9	66	57	48	40	28	57	47	40	33	22	48	40	34	27	17	40	33	27	21	12	28	22	17	12	6
1.0	57	48	41	34	24	48	40	34	28	18	41	34	29	23	15	34	28	23	18	11	24	18	15	11	5
1.1	50	42	36	30	21	42	35	30	24	17	36	30	26	21	14	30	24	21	16	10	21	17	14	10	5
1.2	45	38	33	27	20	38	32	27	22	15	33	27	23	18	12	27	22	18	15	9	20	15	12	9	5
1.3	41	35	30	26	17	35	29	24	21	14	30	24	21	17	11	26	21	17	14	8	17	14	11	8	4
1.4	38	33	28	23	16	33	27	23	18	12	28	23	20	16	10	23	18	16	12	8	16	12	10	8	4
1.5	36	30	27	22	15	30	26	22	17	12	27	22	18	15	10	22	17	15	11	8	15	12	10	8	4
1.6	34	29	24	21	15	29	24	21	17	11	24	21	17	14	9	21	17	14	11	6	15	11	9	6	4
1.7	33	28	24	20	14	28	23	20	16	11	24	20	17	14	9	20	16	14	10	6	14	11	9	6	4
1.8	32	27	23	20	14	27	22	20	16	11	23	20	16	12	9	20	16	12	10	6	14	11	9	6	4
1.9	30	26	22	18	14	26	22	18	15	10	22	18	16	12	9	18	15	12	10	6	14	10	9	6	4
2.0	29	26	22	18	12	26	21	18	15	10	22	18	15	12	8	18	15	12	10	6	12	10	8	6	3
2.5	28	23	21	17	12	23	20	17	14	10	21	17	15	11	8	17	14	11	9	5	12	10	8	5	3
3.0	27	23	20	17	12	23	20	17	14	9	20	17	14	11	8	17	14	11	9	5	12	9	8	5	3

Determination of Class 1 and Class 2 survey units are accomplished first by determining sample spacing and then systematically plotting the sample locations from a randomly generated start location. The random starting point of the grid provides an unbiased method for obtaining measurement locations to be used in the statistical tests. Class 3 survey locations are determined from computer-selected randomly generated x and y coordinates. After determining the number of samples needed in the survey unit, sample spacing is determined from MARSSIM equation 5-7 for Land Areas and equation 5-8 for Building Areas:

MARSSIM equation 5-7 (triangular grid):

$$L = \sqrt{\frac{A}{0.866\ n}} \quad \textit{for a triangular grid}$$

MARSSIM equation 5-8 (square grid):

$$L = \sqrt{\frac{A}{n}} \quad \textit{for a square grid}$$

Where:
L = sample spacing interval
A = the survey unit area
N = number of samples needed in the survey unit

A random starting point is determined using computer generated random numbers coinciding with the x and y coordinates of the total survey unit. A grid is plotted across the survey unit surfaces based on the random start point and the determined sample spacing. A measurement location is plotted at each intersection of the grid plot. An example Sample Spacing Worksheet (Excel) for Building Structures is provided below.

Philotechnics, Ltd. for
Sigma-Aldrich - Fort Mims Facility
D&D Random Sample Start Location and
Sample Spacing Worksheet

Building: FMF Survey Unit: 16 Class: 3

Survey Unit Description: Building Surfaces and Structures <2m in Height

Survey Unit Area: 64.97 m^2
Floor Area: N/A m^2
Number of Samples Required per Survey Unit: 40

X-axis dimension: 9.19 m
Y-axis dimension: 7.07 m

X-Axis Start Location[2]: 3.05 m
Y-Axis Start Location[2]: 1.62 m

Sampling Spacing: 1.27 m

Replacement Sample Locations[3]

Survey Location	Random Number Generation*		X-Coordinate Location	Y-Coordinate Location
	X Coordinate	Y Coordinate		

Note 1: Random Numbers between 0 and 1 were generated using the =RAND() Function of MS Excel. The value of the calculation is saved using the F9 Function rather than the formula to prevent recalculation during any document edit.

Note 2: X-Axis and Y-Axis start locations were calculated by multiplying the appropriate dimension by the corresponding random number.

Note 3: Some randomly chosen survey locations do not fall on surface that can be surveyed. In this case, new simple random coordinates are generated to replace the original coordinates.

Note 4: The actual survey unit area will always be less than what is stated above. False areas are included in calculating the survey unit area. Area is determined by multiplying the X-Axis by the Y-Axis dimension.

Calculations Performed By:

Printed Name

Signature Date

Review Performed By:

Printed Name

Signature Date

Attachment B

Tracie M. Clemons

From: Tracie M. Clemons
Sent: Monday, December 22, 2008 4:02 PM
To: gmccann1@ameritech.net; mike.mccann@nrc.gov; pjl2@nrc.gov
Cc: Gary S. Nadeau; Ryan P. Fahey; Glenn R. Marshall; Jon T. Dillon; Matt D. Norton
Subject: Sigma-Aldrich Dose Assessment of a Missed Hot Spot (Soil Sample)
Attachments: Sigma Dose Eval.xls; Multiple runs with RESRAD as per Dr.doc

Good afternoon,

Dr. Lee and Mike, attached is the Visual Sampling Plan information regarding the potential dose contribution of a single missed hot spot. Please review and let me know if you have any additional questions.

Tracie M. Clemons
Sr. Health Physicist
Philotechnics, Ltd.
Office: 781-222-5044
Fax: 781-229-0732
Email: tmclemons@philotechnics.com

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Multiple runs with RESRAD as per Dr. Lee's request regarding the potential dose contribution to hot spot areas depending on number of samples taken and the size of the hot spot have been completed. A series of runs based upon the default parameters of RESRAD (Resident Farmer Scenario), only changing the area of the hot spot and the nuclide concentrations. The first series of runs was completed at the proposed DCGLs and the second series was completed based upon the maximum concentrations for H-3 and C-14 as indicated in the ORISE report.

As you can see from the attached information, the maximum annual doses are much less than the 25 mrem/yr limit in all cases. Unless there was no remediation completed, then we are around the 40% level. With our proposed sampling plan, it is reasonable to expect that the dose contribution of a single missed hot spot at the DCGL limits will result in less than 5% of the overall total dose. With additional sampling results, Philotechnics will be able to better refine the numbers; however this does appear to directly support our approach and shows that we are able to achieve a potential dose reduction of over 100% as compared to the typical MARSSIM survey design regarding the dose from hot spot.

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ORISE Data: Letter Dated March 5, 2008

	H-3 (pCi/g)	C-14 (pCi/g)
	11.1	62.9
	14.2	38.5
	8.4	23.3
	58	1.9
	28.8	3.2
	83	36.6
	36	18.7
	20.9	20.6
	10.2	15.3
AVE:	30.07	24.56
Peak:	**83.00**	**62.90**

First Series: Proposed DCGLs

# Samples	H-3 (pCi/g)	C-14 (pCi/g)	Area (ft2)	Dose (mrem/yr)	% of 25 mrem/yr
14	**110**	**12**	455.28	2.66	10.64%
35	**110**	**12**	182.113	1.038	4.15%
50	**110**	**12**	127.48	0.723	2.89%
100	**110**	**12**	63.74	0.36	1.44%

Second Series: ORISE Maximum Concentrations

# Samples	H-3 (pCi/g)	C-14 (pCi/g)	Area (ft2)	Dose (mrem/yr)	% of 25 mrem/yr
14	**83**	**62.9**	455.28	10.29	41.16%
35	**83**	**62.9**	182.113	4.011	16.04%
50	**83**	**62.9**	127.48	2.8	11.20%
100	**83**	**62.9**	63.74	1.39	5.56%

T. Spencer

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