Stepan

Stepan Company

100 West Hunter Avenue
Maywood, NJ 07607

July 20, 2015

Ms. Kimberly Conway
U.S. Nuclear Regulatory Commission
11545 Rockville Pike
Rockville, MD 20852-2746

Re: Response to Request for Additional Information ("RAI"), dated June 22, 2015, for
Stepan License Termination Request, dated August 15, 2014
Docket 40-8610, Radioactive Materials License STC-1333

Dear Ms. Conway:

I am enclosing Stepan Company's response to the NRC Staff's Request for Additional Information (RAI), dated June 22, 2015. Our response includes a radiological dose assessment with supporting RESRAD files, to supplement and support Stepan's request of August 15, 2014 for license termination. This radiological dose assessment demonstrates that the former burial areas comply with NRC radiological dose criterion for decommissioning. Accordingly, the NRC has reasonable assurance that the public health and safety will be protected if the NRC grants Stepan's request for license termination.

We look forward to your expedited review of these RAI responses and termination of the NRC license for the remediated burial areas.

If you need any additional information to evaluate our request please contact me at (201) 712-7644 or via Email at Bpeacock@stepan.com.

Sincerely,

Robert J. Peacock
V.P. & G.M., Specialty Products

Enc: Radiological Dose Assessment Report
Response to Request for Additional Information

STEPAN RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

RAI 1

Comment

Based on the conclusions made in the dose assessment provided to the U.S. Nuclear Regulatory Commission (NRC) staff, Stepan assumes that the site will continue to operate as an industrial/commercial site for the near future. Documents provided to the NRC do not provide a clear understanding of why the industrial/commercial exposure scenario is the most appropriate scenario for the site and why other, more conservative scenarios (e.g., residential scenario) were not considered to be appropriate. For example, Section 2, "Scenario Descriptions," of the report "Derivation of Uranium Residual Radioactive Material Guidelines for the Maywood Site" included in Appendix C to the "Feasibility Study for Soils and Buildings at the FUSRAP Maywood Superfund Site" (ADAMS Accession No. ML15125A165) indicates that "[c]urrent land use at properties composing the Maywood site ranges from residential to commercial/industrial to recreational." The report also discusses the close proximity of residential sites to the Stepan site.

Basis

NRC guidance dictates that the bases for the most logical exposure scenarios be included when submitting a site-specific dose assessment for NRC review. NRC staff use this information to determine whether the licensee's proposal to release the site for unrestricted use meets the requirements outlined in 10 CFR 20.1402 and its related guidance.

Path Forward

Provide the NRC with the basis for the use of the industrial/commercial scenario as the exposure scenario that represents the maximum risk associated with Stepan site. In addition, information should also be provided that demonstrates why other, more conservative scenarios (*i.e.*, resident or resident farmer) are not expected to be receptors of concern at Stepan.

Stepan Response

In its license termination application, Stepan relied on the Post-remedial Action Reports (PRAR) issued by the U.S. Army Corps of Engineers (USACE or Corps). Stepan has performed its own radiological dose assessment (RDA) using RESRAD and relying on the radionuclide concentration data of the remediated burial pits presented in the Corps' final status survey reports. A copy of Stepan's RDA report is enclosed. Stepan provides the basis requested in RAI 1 in §4 "Land Use" and §6.2 "Pathways Not Present" of the enclosed Radiological Dose Assessment (RDA). Section 4 explains the basis for, and justifies using, an industrial scenario as the scenario that represents the maximum radiological risk associated with the former burial areas. RDA §6.2 explains why neither surface nor groundwater is an exposure pathway.

NRC references a statement in the USACE Feasibility Study for Soils and Buildings at the FUSRAP Maywood Superfund Site that states, "[c]urrent land use at properties composing the Maywood site ranges from residential to industrial/commercial to recreational" and cites the close proximity of residences to the Stepan property. With regard to the former, the Maywood site is composed of 88 properties, of which the Stepan property is only one. Among those 88 properties are, indeed, residences and recreational properties, but these are not part of the property on which the license was granted. With regard to the close proximity of residences, as explained in §4 of the enclosed Radiological Dose Assessment, properties surrounding the Stepan property are industrial or commercial and the large majority of them are large in size, providing an industrial/ commercial zone surrounding the Stepan property. The nearest residence is located across an active railway and its right of way, which will be remediated to nonresidential standards under the FUSRAP cleanup.

RAI 2

Comment

The dose assessment provided with the "Feasibility Study for Soils and Buildings at the FUSRAP Maywood Superfund Site" (USACE, 2002), considers a variety of different exposure scenarios and corresponding site-specific parameter values. Whenever possible, NRC staff requests the use of site-specific parameter values associated with the different scenarios. The RESRAD analyses included with the dose assessment provided includes site-specific values but minimal justification for their use.

Basis

NRC guidance dictates that site-specific parameter values and the basis for their use should be included when performing RESRAD analyses as part of a specific site's dose assessment. Site-specific information and the basis for their use assists NRC staff with their review of the dose assessment and helps determine whether the results meet the requirements provided in 10 CFR 20.1402 and its related guidance.

Path Forward

Provide the basis for the site-specific parameter values provided in the RESRAD analyses on which the RESRAD-calculated doses are based. If a range of values are considered for specific parameter values then a probabilistic analysis should be included as well.

Stepan Response

Stepan has performed a radiological dose assessment using RESRAD and relying on the radionuclide concentration data of the remediated burial pits presented in the Corps' final status survey reports. The results of Stepan's assessment are documented in the enclosed Radiological Dose Assessment (RDA) report. Within the accompanying RDA report, site specific values of parameters, including the probabilistic distributions, are described in §8 "Input Parameters". Summary results of probabilistic analyses are in RDA

Table 7, "Radiological Dose Computed Probabilistically". RDA Table 8 summarizes results of deterministic modeling.

RAI 3

Comment

As part of the initial review, NRC staff was unable to duplicate the results of the RESRAD analyses used in the "Feasibility Study for Soils and Buildings at the FUSRAP Maywood Superfund Site" (USACE, 2002) report to calculate doses associated with the residential and industrial/commercial scenarios. The submittal includes tables documenting the site-specific values used for the RESRAD dose assessment calculations. However, in some cases NRC staff had difficulty determining which parameters were being modified based on the descriptions provided in the tables.

Basis

In addition to the RESRAD analyses submitted with the request for unrestricted release of the Stepan site NRC guidance dictates that site-specific parameter values and the basis for their use should be included when performing RESRAD analyses as part of a specific site's dose assessment. Site-specific information and the basis for their use assists NRC staff with their review of the dose assessment and helps determine whether the results meet the requirements provided in 10 CFR 20.1402 and its related guidance.

Path Forward

Provide a detailed list of all the input parameters used in the RESRAD analyses provided with the dose assessment. Justification for the use of a specific value as well as the basis for using the default values should also be provided. Printouts of the RESRAD analyses and, if possible, copies of the actual RESRAD computer files should also be included.

Stepan Response

Copies of the RESRAD computer files supporting Stepan's Radiological Dose Assessment (RDA) are provided in the enclosed DVD as Appendix B of the RDA report. Printed output of RESRAD analyses reported in the RDA are also enclosed. The computer files and the printouts list the input parameters and their values used in the RDA. Justification of site specific values is provided in RDA §8 "Input Parameters".

Default values of parameters modeled in RESRAD are developed and described in supporting documentation.[1, 2] Site-specific parameters whose default values Stepan accepted but did not address in RDA §8 are presented in the following table:

[1] Yu, C., *et. al., User's Manual for RESRAD Version 6.* ANL/EAD-4. July 2001.

[2] Yu, C., *et.al., Development of Probabilistic RESRAD 6.0 and RESRAD-BUILD 3.0 Computer Codes.* ANL/EAD/TM-98 and NUREG/CR-6697.

Parameter	Default Value	Rationale for Use
Length parallel to aquifer flow (m)	100.	Depletion of source by aquifer and contamination of it not significant because source was removed; shallow bedrock keeps perched water from aquifer
Time since placement of material (yr)	0.0	Peak of mean dose occurs during first year
Cover Depth (m)	0.0	Assuming no cover maximizes estimated irradiation from land
Contaminated zone erosion rate (m/yr)	0.001	Minimal value conserves source in place.
Contaminated zone field capacity	0.2	Affects groundwater migration through unsaturated soil. Not a significant effect on peak of mean dose, which occurs in first year.
Evapotranspiration coefficient	0.5	Affects leaching from contaminated zone; but peak of mean dose occurs during first year
Runoff coefficient	0.2	Affects leaching from contaminated zone; but peak of mean dose occurs during first year
Distribution coefficients for elements in contaminated zone (cm^3/g)	element specific	Element-specific value conserves source in-situ. Groundwater sampling showed radionuclide migration not significant.
Leach rate of elements (/yr)	element specific	Estimated by RESRAD
Shape factor flag, external gamma	1.0 for circular area	Circular area maximizes exposure rate
Depth of soil mixing layer (m)	0.15	Affects fraction of resuspendable soil particles at ground surface that are assumed contaminated. 0.15 m assures source of contaminated dust for suspension in air for inhalation.

RAI 4

Comment

Documents provided to NRC staff include site-specific cleanup criteria values (*i.e.*, derived concentration guideline levels (DCGLs)) that do not appear to be related to a dose assessment process used to evaluate the site against the NRC requirements in 10 CFR 20.1402. Furthermore, there does not appear to be any evidence that the NRC was involved in the development and approval of these values. Initial analyses using these cleanup

criteria values result in doses below 25 mrem/yr when considering a general industrial scenario but exceed the 25 mrem/yr regulatory value established in 10 CFR 20.1402 for general unrestricted use of a site for residential purposes.

Basis

The NRC staff review process for accepting the release of a site for unrestricted use under 20.1402 may include doses calculated using site-specific parameter values and RESRAD or the use of site-specific cleanup criteria values (*e.g.*, DCGLs) which document the concentrations of radionuclides required to meet the 25 mrem/yr dose values for the specific site.

Path Forward

Provide further details as to how these site-specific cleanup criteria values (aka, DCGLs) were developed and a basis for their use in meeting the 20.1402 requirements for unrestricted use. Additional information is also required to explain the development and use of the combined Ra-226 + Th-232 DCGL, including how it is calculated, the basis for its use, and further discussion on how to apply it when calculating the overall dose associated with the site. If Stepan chooses to revise these site-specific cleanup criteria values, include the new values and justification for their use.

Stepan Response

The U.S. Department of Energy (DOE), the Corps, the USEPA, and the NJDEP negotiated and agreed to site-specific cleanup criteria values for the Stepan property based on Applicable or Relevant and Appropriate Requirements (ARAR), including the requirements at 10 CFR 20.1402. The criteria were agreed upon after a dispute resolution process initiated under the Federal Facilities Agreement between the DOE and USEPA. NRC has known of these criteria and has been provided opportunities to evaluate and provide its input on these criteria. This included a letter in 2002 from the Corps to the NRC, soliciting comments on the Corp's Proposed Plan for remediating soils and buildings at the FUSRAP site, including the burial pits. *See* Letter from Allen Roos, Corps of Engineers, to NRC, dated August 12, 2002. The NRC's response notes that the Proposed Plan "provides for USACE's cleanup of the NRC licensed burial pits to the requirements for unrestricted release in 10 CFR 20.1402" and makes no objection to the cleanup criteria. Letter from Amir Kouhestani, NRC, to Allen Roos, Corps of Engineers, October 22, 2002 (ADAMS Accession No. ML022730514). Furthermore, Stepan understands that the NRC has been involved in meetings and consultations with the Corps regarding the cleanup, including evaluation of the cleanup criteria. *See, e.g,* J. Moore and D. Hays, "Remediation of Nuclear Regulatory Commission Burial Pits No. 1, 2, and 3 and Lessons Learned at the FUSRAP Maywood Superfund Site, Maywood, New Jersey," presented at Waste Management Conference, February 27 – March 3, 2011 (copy enclosed); letter from Larry W. Camper, NRC, to Colonel William H. Pearce, Corps of Engineers, dated February 28, 2001 (ADAMS Accession No. ML010590407); letter from Colonel William H. Pearce, Corps of Engineers, to John T. Greeves, NRC, dated May 19, 2000.

Stepan agrees with the NRC that the Corps' dose modeling using these values results in postulated doses below 25 mrem/yr, when evaluating a general industrial scenario. Considering post-remediation, final status survey data of the areas of former licensed burials already exist, Stepan has demonstrated compliance with the 10 CFR Part 20.1402 dose criterion by computing potential radiological dose directly from these already-measured radionuclide concentrations. This is recognized as an acceptable approach in NRC *Consolidated Decommissioning Guidance*, document NUREG-1757, vol. 2, rev. 1, §2.5 in lieu of deriving DCGL. Stepan's RDA report is enclosed. The bases of the assessment are described in detail in that report.

Stepan computed radiological dose directly from final survey measurements of Th^{232}, Ra^{226}, and U^{238} reported separately in the USACE Post-Remedial Action Reports. Measurements are summarized in accompanying RDA Appendix A. Reduction of those data into source terms entered into RESRAD is described in RDA §3 "Source Term". Stepan used RESRAD to compute dose directly from those source terms. Consequently, Stepan did not rely on combined Ra^{226} + Th^{232} concentration to compare with a DCGL.

For completeness, we note that the Corps did rely on combined Ra^{226} + Th^{232} concentration to compare with a cleanup concentration limit. The basis of rationale to combine Ra^{226} + Th^{232} concentration is in the origin of 40 CFR Part 192. Therein, provisions applicable to elemental uranium also apply to elemental thorium.[3] Provisions applicable to Ra^{226} also apply to Ra^{228}.[4] In that instance, the thorium series is assumed in secular equilibrium and Th^{232} is surrogate for Ra^{228}. The USDOE, prior to USACE involvement, and the USEPA negotiated the cleanup criterion, or DCGL, to be the same concentration for each of Ra^{226} and Ra^{228}, thereby allowing the unity equation, *aka.*, sum-of-fractions, to simplify to the sum of Ra^{226} + Th^{232} concentrations to be compared to the DCGL.

Nevertheless, Stepan entered radionuclides concentrations measured in final status surveys separately into RESRAD to compute potential radiological dose directly; thus, summing Ra^{226} + Th^{232} concentration was not relevant to Stepan's assessment.

RAI 5

Comment

Survey Unit 10A-30, associated with Burial Pit 1, required an elevated measurement comparison (EMC) analysis. However, the EMC equations in Section 5.6.2.3 (Final Status Survey Data Evaluation) of the Post Remedial Action Report for Burial Pit 1, which describe the EMC unity rule and dose analyses, are blank.

Basis

The analysis of elevated areas of residual radioactivity is described in NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)," Section 5.5.2.4 (Determining Data Points for Small Areas of Elevated Activity). Section 8.5.2

[3] 40 CFR 192.41(a)
[4] 40 CFR 192.4(c)

(Interpretation of Statistical Test Results) of MARSSIM describes the assessment of the total dose within a survey unit.

Path Forward

Provide the equations used by Stepan to assess elevated areas of contamination, per the $DCGL_{EMC}$, and to assess the total dose from all sources in a survey unit.

Stepan Response

An equation for unity rule accounting for an area of elevated measurement within a survey unit is mentioned but not displayed in the USACE Post-Remedial Action Reports (PRAR) discussing the final status surveys of the former burial areas. However, the equivalent equation appears in the MARSSIM[5] §8.5.2, equation 8-2 as:

$$\frac{\delta}{DCGL_W} + \frac{(average\ concentration\ in\ elevated\ area - \delta)}{(area\ factor\ for\ elevated\ area)x(DCGL_W)} < 1$$

where:

δ = average residual radionuclide concentration in the survey unit;

$DCGL_W$ = Derived Concentration Guideline Level for the Wilcoxon Rank Sum statistical test; and

Area factor for elevated area = area factor for the area of elevated concentration

The PRAR for final status survey of burial pit 1, page 5-11 reports data:

DCGL = 15 pCi/g;

δ = 2.61 pCi/g = average Ra^{226} + Th^{232} concentration in the survey unit, net after subtracting background concentration;

EMC_{avg} = 18.36 pCi /g = average Ra^{226} + Th^{232} concentration in the area of elevated measurements, net after subtracting background concentration; and

AF_{EMC} = 2.3 = area factor for the area of elevated measurements, estimated to be 30 m^2

Entering these data into the equation:

$$\frac{2.61}{15} + \frac{18.36-2.61}{2.3\ x\ 15} = 0.63$$

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[5] MARSSIM Committee. *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*. NUREG-1575 and EPA 402-R-97-016. Dec. 1997.

The result, 0.63, is the value reported in the PRAR, page 5-12, thereby verifying MARSSIM equation 8-2 as the intended equation representing the unity rule for this application.

Stepan has performed its own radiological dose assessment using RESRAD and relying on the radionuclide concentration data of the remediated burial pits presented in the Corps' final status survey reports. In Stepan's analysis, however, Stepan did not differentiate the single elevated area of contamination identified by the Corps when determining the radionuclide concentration source term entered into RESRAD in order to estimate radiological dose. Rather, Stepan gave equal weight to each systematic, bias, and elevated measurement made during the final status survey and reported in the Corps' PRAR for a burial pit. These data are summarized in RDA Appendix A and in RDA §3, Table 1.

That is, Stepan derived the source term as the arithmetic average of all measurements in survey units covering a former burial pit, without adjustment, in three categories: Ra^{226}, Th^{232}, and U^{238} and did not rely on the unity rule.

RAI 6

Comment

It was indicated in the Post Remedial Action Report for Burial Pit 1 that an area factor of 2.3 was selected for the corresponding 30 m^2 elevated area. Per the Master Final Status Survey Plan, this area factor was taken from the New Jersey Department of Environmental Protection Sample Procedures Manual, Chapter 12. The referenced Sample Procedures Manual was reviewed, and it appears that the area factors provided in the manual were generated using RESRAD software for a specific example in the manual. In a similar fashion, NRC's MARSSIM guidance provides example area factors in Section 5.5.2.4, but also notes that the MARSSIM user should consult with the responsible regulatory agency for guidance on acceptable techniques to determine area factors. NRC guidance does not provide default area factors, but rather expects them to be developed on a site specific basis.

Basis

Area factors are described in Section 5.5.2.4 (Determining Data Points for Small Areas of Elevated Activity) of MARSSIM.

Path Forward:

Justify the usage of an area factor of 2.3 or determine a site specific area factor.

Stepan Response

The area factor of 2.3 is an artifact of the Corps' evaluation of its measurements in Survey Unit 10A-30. When interpreting the radionuclide source term entered into its own RDA, Stepan did not employ an area factor. Rather, Stepan gave equal weight to each systematic, bias, and elevated measurement made during the final status survey and reported in the Post-Remedial Action Report for a burial pit. As explained in response to

RAI 5, Stepan derived the source term as the arithmetic average of all those measurements, without adjustment, in three categories: Ra^{226}, Th^{232}, and U^{238}.

We note that the elevated measurements area factors and approach were mandated by the NJDEP as requisite to approve of the USACE final status survey plan.

The origin of the EMC area factor = 2.3 representing an elevated measurements area = 30 m^2 in burial pit area 1 is specified as 2.4 in the NJDEP *Field Sampling Procedures Manual*, ch. 12. §12.1, Table 12.1 (August 2005):

> The stated purpose of this chapter is to provide guidance on conducting and documenting environmental radiological surveys and sampling episodes and demonstrating compliance with N.J.A.C. 7:28-12, *Soil Remediation Standards for Radioactive Materials*.

Provisions in this guidance are:

> $DCGL_{EMC}$ must be determined using the equation below:
>
> $DCGL_{EMC}$ = (Area Factor) x ($DCGL_W$)

Area factors were calculated using RESRAD (version 6.2.1) and are presented in NJDEP Table 12.1.

> These area factors were determined by running RESRAD for each nuclide and varying the lot size and the length parallel to the aquifer. The area factors were then computed by taking the ratio of the dose per unit concentration generated by RESRAD for the default values (10,000 m^2) to that generated for the other areas listed. For sites with multiple radionuclides, the most conservative area factor (the smallest) can be used. Ref. NJDEP Field Sampling Procedures Manual. Chapter 12, p. 11.

Table 12.1 Outdoor Area Dose Factors

	Grid Area								
Nuclide	**1 m^2**	**3 m^2**	**10 m^2**	**30 m^2**	**100 m^2**	**300 m^2**	**1000 m^2**	**3000 m^2**	**10,000 m^2**
Ra-226, Po-210	26.5	11.9	5.6	3.9	2.8	2	1	1	1
Th-232, Th-228, Ra-228	15	6.9	3.3	2.4	1.8	1.5	1.1	1	1
U-238, Th-230, U-234	48.8	22.1	10.1	6.2	3.4	2.1	1.1	1	1

ref. NJDEP *Field Sampling Procedures Manual.* Chapter 12. Radiological Assessment. §12.1 Introduction. Table 12.1 Outdoor Area Dose Factors, p. 13. August 2005.

The most restrictive value occurs for the thorium series, applicable in this instance. Earlier versions of this document Table 12.1 stated an area factor of 2.3 for Th-232 and 30 square meters, thus the value the USACE used.

Nevertheless, as explained above, in the source term entered into its RDA, Stepan used measurements made by the USACE in its final status surveys without weighting by any area factor.