U.S. NUCLEAR REGULATORY COMMISSION
REGION I

INSPECTION REPORT

Inspection No.	04008610/2010002
Docket No.	04008610
License No.	STC-1333
Licensee:	Stepan Company
Location:	100 West Hunter Avenue Maywood, NJ 07607
Inspection Date:	November 10, 2010
Dates additional Information provided:	December 9, 2010, January 7, 2011, February 11, 2011, February 16, 2011, March 1, and March 8, 2011
Inspectors:	Mark C. Roberts Senior Health Physicist Decommissioning Branch Division of Nuclear Materials Safety Shawn Seeley (In Training) Health Physicist Decommissioning Branch Division of Nuclear Materials Safety
Approved By:	Judith A. Joustra, Chief Decommissioning Branch Division of Nuclear Materials Safety

EXECUTIVE SUMMARY

Stepan Company
NRC Inspection Report No. 04008610/2010002

In accordance with the Memorandum of Understanding (MOU) between the U.S. Army Corps of Engineers (USACE) and the Nuclear Regulatory Commission (NRC) for Coordination on Cleanup & Decommissioning of the Formerly Utilized Sites Remedial Action Program (FUSRAP) Sites with NRC-Licensed Facilities, NRC Region I staff conducted a visit to the Stepan Company Maywood, New Jersey site to observe in-process remediation and waste transportation activities. The inspectors also observed the collection of Final Status Survey (FSS) soil samples and received aliquots of selected soil samples for confirmatory radiological analysis by the NRC's contractor, the Oak Ridge Institute for Science and Education (ORISE). Although this is an inspection report for the above-referenced license, most of the information in this report was obtained from representatives of the USACE and their contractor, Shaw Environmental Incorporated (Shaw) and their sub-contractors. This report summarizes the observations made during a visit to the Stepan Company site conducted November 10, 2010; radiological analytical data from sample results received on December 9, 2010 and January 7, 2011; and discussions held with USACE and ORISE representatives on February 11, February 16, March 1, and March 8, 2011 regarding the analytical data results and how these results would be applied to the FSS.

During the November 10, 2010 site visit, the NRC inspectors observed FSS activities, including the collection of soil samples for gamma spectrometry analysis. Aliquots of five of these samples were provided to the inspectors along with five additional FSS split soil samples that had been collected by Shaw on October 19, 2010. The inspectors submitted the samples to the NRC's contractor laboratory, ORISE, for radiological analysis. Samples were also analyzed by the USACE onsite laboratory. In a December 9, 2010 letter report to the NRC, ORISE provided their results from the analysis of the soil samples. Data for the USACE sample analysis were provided by electronic mail on January 7, 2010. A tabulation of the analytical results appears at the end of this inspection report along with maps of the sample locations

The inspectors interviewed cognizant personnel, performed field observations, and reviewed documentation during the visits. Based on this review, the inspectors noted the following:

Both the licensee's results and the NRC confirmatory results from the split soil samples from Pit # 1 met the cleanup criteria established in the Record of Decision (ROD).

Waste soil was transported to an interim storage site adjacent to the Stepan site and subsequently properly loaded into railcars for shipment to a licensed waste disposal facility. Appropriate radiological surveys and analysis of waste soil samples were conducted and appropriate records of these activities were maintained.

Remediation activities for burial pit # 1 were still in progress in accordance with routine operating procedures.

REPORT DETAILS

I. INTRODUCTION

Thorium ore was processed from 1916 to 1956 by the Maywood Chemical Works at its Maywood facility in northeastern New Jersey. Radioactive contamination resulted from these processing operations and associated material storage and waste disposal practices. In 1959, Stepan Chemical Company (now Stepan Company) purchased the Maywood Facility. In the late 1960s, Stepan Company (Stepan) took corrective measures at some of the former disposal areas by re-locating approximately 19,000 cubic yards of thorium wastes and consolidating the wastes into three onsite pits. The three onsite burial pits were subsequently licensed by the NRC. Stepan currently conducts chemical processing activities at its Maywood, NJ site that do not include the use of any licensed radioactive materials.

In 1983, the U.S. Environmental Protection Agency (EPA) included the site on its National Priority List for cleanup under the Comprehensive Environmental Response, Compensation, and Liability Act. In 1984, the U.S. Department of Energy (DOE) assumed responsibility for remediating the Stepan, Maywood facility (including the burial pits) and 87 other designated residential, commercial, and government properties that were contaminated by the thorium processing activities at the former Maywood Chemical Works. The Stepan, Maywood site was included in the DOE's FUSRAP along with the other 87 radiologically contaminated properties. The Stepan site and the additional properties discussed above are collectively known as the FUSRAP Maywood Superfund Site. In October 1997, the management and administration of FUSRAP was transferred to the USACE. In July 2001, a Memorandum of Understanding (MOU) was executed between the NRC and the USACE to facilitate remediation of NRC-licensed sites (including the Stepan facility) that were to be remediated under FUSRAP. The purpose of the MOU was to minimize dual regulation and coordinate activities of the two agencies under their respective programs.

In September 2003, the ROD for Soils and Buildings at the FUSRAP Maywood Superfund Site was issued. The ROD is a public document that explains which cleanup alternatives will be used to clean up a Superfund site. In the ROD, the specific concentration-based cleanup criteria for the radioactive contamination in soil for commercial properties (relevant to the Stepan burial pits) is an average of 15 picocuries/gram (pCi/g) of the combined radium-226 (Ra-226) plus thorium-232 (Th-232) concentrations above background, with an as low as is reasonably achievable (ALARA) goal of 5 pCi/g. The ROD also includes a criterion of 100 pCi/g above background for total uranium, which equates to approximately 50 pCi/g of uranium-238 (U-238). On October 21, 2008, the NRC executed a Confirmatory Order to suspend Stepan's License, contingent upon USACE notifying the NRC of their intent to take physical possession of all, or part, of the licensed portions of the site. The Order provides the USACE with the mechanism to request that the NRC suspend (put into abeyance) the NRC license for the Stepan burial pits. Upon taking physical possession of the burial pits to conduct remediation activities, the USACE assumes responsibility for the public health and safety for these materials, consistent with the NRC requirements in 10 Code of Federal Regulations (CFR) Part 20. In December 2008, August 2009, and January 2010, USACE notified the NRC that it had taken physical possession of Burial Pits # 2, # 3, and # 1, respectively. The USACE has not completed action on any of the burial pits. Notification that action has been completed is required to be sent to the NRC and Stepan so that Stepan can resume responsibility for the licensed areas.

II. Final Status Survey Activities and Analysis of Confirmatory Soil Samples

a. Inspection Scope

During the site visit, the inspectors observed technicians performing walkover gamma radiation surveys and collecting soil samples in survey unit 10A-30, one of the two survey units in the burial pit #1 excavation. Aliquots from five soil samples were provided to the inspectors as split samples to be sent to the NRC's independent laboratory, ORISE, for radiological analysis. Five additional split samples that had been previously collected from survey unit 10A-29 in burial pit # 1 were also provided to the inspectors. All ten samples were also analyzed in the USACE onsite analytical laboratory. All samples were analyzed by high-resolution gamma spectrometry. The two sets of analytical results are presented in the accompanying table. Results are compared to the cleanup criteria.

b. Observations and Findings

The FSSs were conducted in accordance with a Master FSS Plan and implementing procedures. The FSS plans and procedures were, in part, developed using protocols from the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), NUREG-1575. The burial pits are classified as Class 1 Areas under MARSSIM because the areas had to be remediated to meet the cleanup criteria. The recommended MARSSIM survey methodology for Class 1 land areas includes a 100% surface scan using suitable radiation survey instrumentation and collection of a pre-determined number of soil samples that is based on the parameters of the statistical test to be used to demonstrate that the remediation criteria has been met. Because the primary contaminant at the site is Th-232, and Th-232 is also present in the background at the site, the Wilcoxon Rank Sum (WRS) Test is the statistical test used to demonstrate compliance with the cleanup criteria. However, sample results may be low enough so that the WRS test is not required, i.e., if all net sample results are less than the cleanup criteria, the actual statistical test is not required. The background activity for combined Th-232 plus Ra-226, specified in the Master FSS, is 1.7 pCi/g.

The inspectors observed technicians performing surface scans in the survey unit using a lead-collimated, 3" x 3" sodium iodide gamma scintillation detector and data-logging rate-meter. In addition, technicians were equipped with Global Positioning Satellite (GPS) units that were integrated with the radiation detection equipment. The survey unit was marked in a grid pattern and technicians scanned the soil surface with the detector in a serpentine pattern in order to completely cover each grid survey area. Technicians indicated that they made 3-4 survey passes to cover each width of approximately one meter. Data from the radiation survey meter and the GPS system are automatically data-logged each second. The resulting information is downloaded to a computer system following completion of the survey. A color-coded map is then generated to visually display survey results for the areas. Technicians also use visual and audio indications from the radiation survey equipment to identify areas of potential localized contamination. Additional evaluations, remediation, and/or surveys are performed as needed based on the survey results. Technicians made daily performance checks of the radiation survey equipment and GPS units before and after each set of measurements. The inspectors confirmed that each radiation survey meter had been calibrated within the last year as required by operating procedures.

Based on the size of the survey unit and the parameters from the statistical test, the FSS lead engineer developed a sampling plan to collect the required number of samples in the survey unit. Using a map of the survey unit, the sampling points were positioned throughout the survey unit by first selecting a random start point and then establishing a systematic spacing grid pattern for sampling. Technicians used the GPS unit to locate each sample point and collect a sample. Samples were collected to a depth of six inches. Technicians were observed to be using clean sampling equipment and containers for each sample and legibly marking sample location on each sample container. Field duplicates (10 %), quality assurance duplicates (5%), and special split samples (e. g. NRC split samples) were collected by excavating a sufficient quantity of soil for the split samples, mixing the soil within the sample hole, and parceling out the aliquots to the sample containers.

The NRC split samples were sent to the NRC's confirmatory laboratory contractor, ORISE, for radiological analysis. Since these samples were actual FSS samples for USACE, the samples were also submitted to the USACE onsite laboratory. Each laboratory processed the samples in accordance with their procedures for high-resolution gamma spectrometry. Results from ORISE were transmitted via a letter report to the NRC. The USACE data were provided to the NRC by electronic mail. The results from the analysis of the soil samples from the Stepan site, burial pit # 1 are tabulated in the accompanying table. Results are provided for both the ORISE and the USACE onsite laboratories.

Analytical data for U-238 and Th-232 for each of the samples were in general agreement for both laboratories. Analytical data for the Ra-226 analysis by USACE were consistently higher than the ORISE results. Both the USACE and ORISE laboratories use the gamma radiations emitted by radioactive progeny of Ra-226 (radon-222 (Rn-222) and its associated decay products) to make a quantitative determination of the Ra-226 concentration in a sample. Because the USACE samples are prepared and analyzed shortly after collection, there is often an insufficient amount of time for the Ra-226 radioactive progeny to reach a radiological equilibrium condition. Using the relatively immediate measurement of the Ra-226 decay products to infer the Ra-226 concentration without allowing for a sufficient equilibrium period can thus provide an underestimation of the Ra-226 soil concentration. The USACE laboratory staff made repeated measurements over time and determined that the maximum value for any possible Ra-226 underestimation would be a factor of 1.66, and can be less if more time has elapsed between sample collection and analysis. The USACE laboratory applies this empirically determined factor of 1.66 to all Ra-226 results so that the Ra-226 concentration in a sample is not underestimated. Applying this same conservative factor to all Ra-226 results may overestimate actual concentrations, but as long as the concentrations are less than the criteria in the ROD, USACE and their contractors can continue progress on the remediation activities. All results were below the cleanup criteria established in the ROD.

In addition to the systematic soil samples obtained from the randomized-start grid pattern, one or more biased samples are collected from each survey unit. The location of a biased sample is selected based on elevated gamma scanning results. Discussions with the project technical staff indicted that biased samples and scanning measurements at the west end of pit # 1 indicated elevated concentrations of primarily thorium in crevices in the bedrock at the bottom of the excavation. In this area, the excavation was approximately 17 feet deep and had reached the underlying bedrock layer. Repeated remediation attempts were unable to reduce in-process sample results to less than the criterion in the ROD of 15 pCi/g combined Ra-226 plus Th-232. The Master FSS Plan allows for the use of an Elevated Measurement Comparison (EMC) to be performed on localized surface soil areas and at the bottom of excavated areas where repeated remediation attempts have not been successful. The EMC allows for small areas of elevated residual contamination to be accepted as long as the EMC criteria are met and the overall average residual concentration in the entire survey unit (including the elevated area) meets the cleanup criteria. The EMC is performed by first measuring the physical size of the area of elevated contamination and determining the average concentration in the area by sample analysis. Based on the size of the elevated area, the corresponding tabulated value from the Master FSS is selected. This value is multiplied by the value of the cleanup criteria (15 pCi/g Ra-226 plus Th-232) to establish an EMC value for the area. The concentration in the elevated area is then compared to this result and accepted if it is less than the EMC value. An additional calculation is also performed to determine if the overall average concentration in the entire survey unit is less than the cleanup criteria in the ROD. Although the final calculation was not available, the USACE representative indicated that the EMC criteria were met for the identified elevated area and the two survey units met the cleanup criteria in the ROD.

c. <u>Conclusions</u>

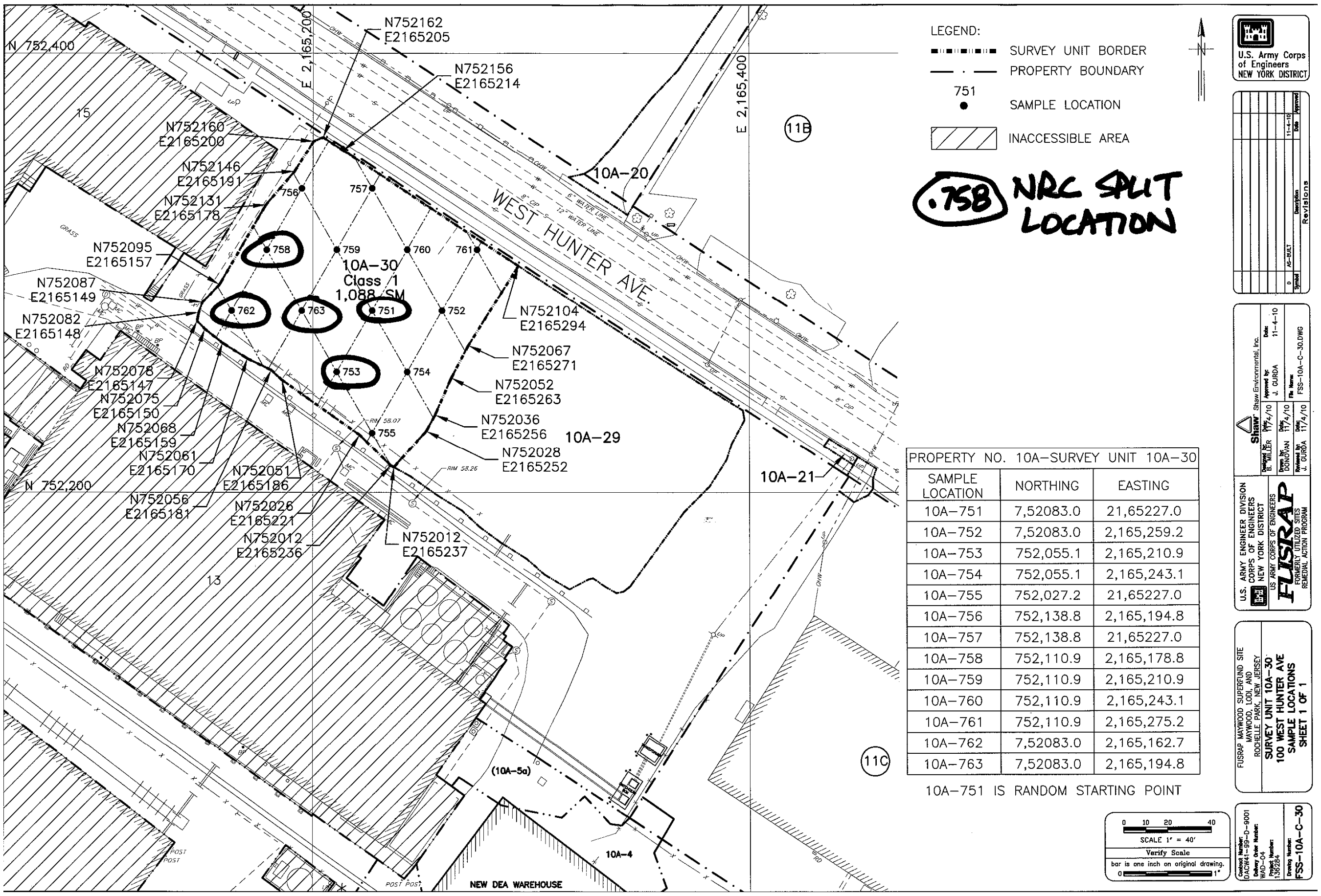
The inspectors observed technicians performing walkover gamma radiation surveys and soil sample collection in accordance with established procedures. The USACE and the NRC coordinated splitting soil samples at the completion of remediation activities for both survey units at Stepan Burial Pit # 1. Samples were analyzed for Ra-226, Th-232, and U-238 by the NRC's contractor ORISE and the USACE onsite laboratory. Data for U-238 and Th-232 for each of the samples were in general agreement. Data for the Ra-226 analysis by USACE were consistently higher than the ORISE results and likely due, at least in part, to a conservative factor applied by USACE to the Ra-226 result. All results were below the cleanup criteria established in the ROD.

STEPAN COMPANY, MAYWOOD, NJ
Gamma Spectrometry of Soil Samples – Stepan Burial Pit # 1
(Results in units of picocuries/gram (pCi/g))

Sample Location	Analytical Laboratory	Ra-226	Th-232	U-238
10A-734	USACE (1)	3.26 ± 0.21 (3)	11.94 ± 0.93	1.62 ± 1.20
	ORISE (2)	2.33 ± 0.16	12.9 ± 1.5	2.63 ± 0.57
10A-738	USACE	1.58 ± 0.11	2.88 ± 0.26	0.76 ± 0.52
	ORISE	1.04 ± 0.08	3.72 ± 0.47	1.22 ± 0.33
10A-740	USACE	1.23 ± 0.09	1.14 ± 0.15	0.99 ± 0.33
	ORISE	0.75 ± 0.08	1.17 ± 0.17	1.10 ± 0.31
10A-742	USACE	1.61 ± 0.11	1.68 ± 0.18	0.55 ± 0.66
	ORISE	1.07 ± 0.11	1.97 ± 0.28	1.31 ± 0.39
10A-744	USACE	1.00 ± 0.08	0.89 ± 0.12	0.60 ± 0.38
	ORISE	0.62 ± 0.06	1.00 ± 0.14	0.9 ± 1.4
10A-751	USACE	0.96 ± 0.08	0.77 ± 0.13	0.39 ± 0.30
	ORISE	0.61 ± 0.06	0.91 ± 0.13	< 0.71
10A-753	USACE	1.31 ± 0.10	1.86 ± 0.20	0.50 ± 0.49
	ORISE	0.89 ± 0.07	2.78 ± 0.36	1.16 ± 0.30
10A-758	USACE	1.05 ± 0.09	1.03 ± 0.13	0.87 ± 0.29
	ORISE	0.72 ± 0.07	1.14 ± 0.16	< 0.78
10A-762	USACE	1.13 ± 0.08	1.12 ± 0.15	0.97 ± 0.39
	ORISE	0.58 ± 0.07	1.03 ± 0.17	< 0.91
10A-763	USACE	1.96 ± 0.14	3.50 ± 0.34	1.01 ± 0.53
	ORISE	1.37 ± 0.11	4.28 ± 0.49	1.63 ± 0.52

(1) Uncertainties represent the 95% confidence level, based on counting uncertainty
(2) Uncertainties represent the 95% confidence level, based on total propagated uncertainties
(3) The USACE laboratory applies a derived factor of 1.66 to the initial Ra-226 counting result to account for incomplete radon-222 (Rn-222) progeny in-growth following sample preparation since Rn-222 progeny are used in the quantitative determination of the Ra-226 concentration.

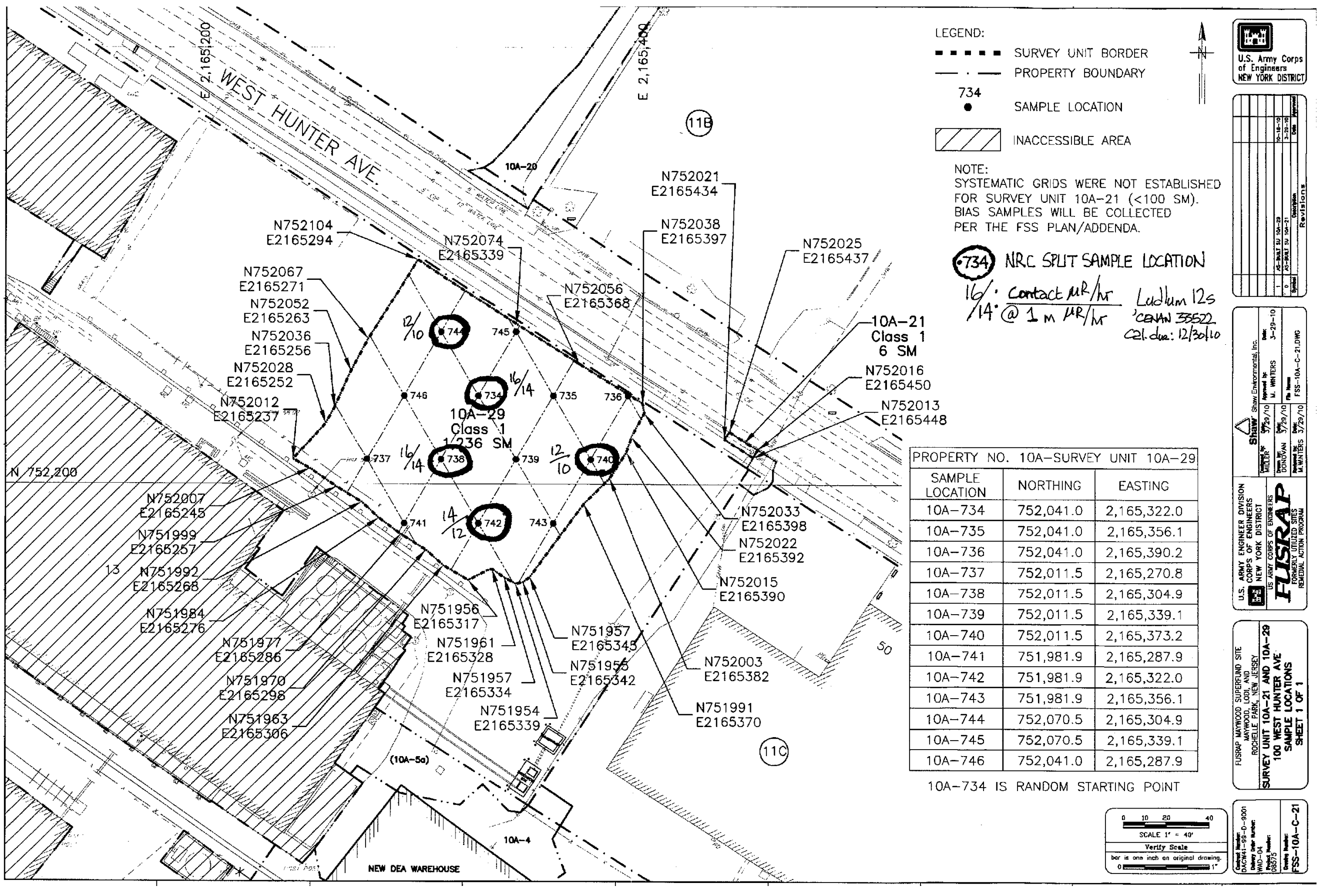
STEPAN COMPANY, MAYWOOD, NJ



PROPERTY NO. 10A–SURVEY UNIT 10A–30		
SAMPLE LOCATION	NORTHING	EASTING
10A–751	7,52083.0	21,65227.0
10A–752	7,52083.0	2,165,259.2
10A–753	752,055.1	2,165,210.9
10A–754	752,055.1	2,165,243.1
10A–755	752,027.2	21,65227.0
10A–756	752,138.8	2,165,194.8
10A–757	752,138.8	21,65227.0
10A–758	752,110.9	2,165,178.8
10A–759	752,110.9	2,165,210.9
10A–760	752,110.9	2,165,243.1
10A–761	752,110.9	2,165,275.2
10A–762	7,52083.0	2,165,162.7
10A–763	7,52083.0	2,165,194.8

Survey Unit 10A-30 Sample Locations

STEPAN COMPANY, MAYWOOD, NJ



PROPERTY NO. 10A–SURVEY UNIT 10A–29		
SAMPLE LOCATION	NORTHING	EASTING
10A–734	752,041.0	2,165,322.0
10A–735	752,041.0	2,165,356.1
10A–736	752,041.0	2,165,390.2
10A–737	752,011.5	2,165,270.8
10A–738	752,011.5	2,165,304.9
10A–739	752,011.5	2,165,339.1
10A–740	752,011.5	2,165,373.2
10A–741	751,981.9	2,165,287.9
10A–742	751,981.9	2,165,322.0
10A–743	751,981.9	2,165,356.1
10A–744	752,070.5	2,165,304.9
10A–745	752,070.5	2,165,339.1
10A–746	752,041.0	2,165,287.9

10A–734 IS RANDOM STARTING POINT

Survey Unit 10A-29 Sample Locations

III. Waste Soil Packaging for Transportation

a. Inspection Scope

The inspectors reviewed activities related to the consolidation of contaminated soil and debris at the interim waste storage site adjacent to the Stepan site and preparations for transportation of the waste soil and debris to a licensed waste disposal facility. The inspectors discussed the radiological surveys and soil analytical methodologies with cognizant personnel. Information was obtained through tours of the interim waste storage site, observations during loading of railcars, discussions with technical staff, and review of documents.

b. Observations and Findings

The FUSRAP Maywood Superfund Site consists of 88 commercial, residential, and government properties that were contaminated by Th-232 from activities conducted at the former Maywood Chemical Works. Although many of the properties have been cleaned up, cleanups are still underway at not only the Stepan site, but at some of the other contaminated commercial properties. The Department of Energy procured property at the west end of the current Stepan site to serve as an interim waste storage site for the contaminated soil and debris collected from remediation of the contaminated properties (including the Stepan site). This property, the Maywood Interim Storage Site (MISS), is serviced by a rail spur that allows gondola railcars to be loaded with contaminated soil and debris that had been stockpiled at the MISS. Representative soil samples are collected and analyzed to support the required documentation for the shipments. Technicians were observed to be securing covers on loaded railcars and performing required radiological surveys. Technicians also make a photographic record of each loaded railcar to document each shipment. A pool of approximately 150 railcars is in continuous use by the project. The transportation manager indicated that it takes approximately six weeks for a loaded railcar to make the trip to one of the licensed disposal sites and return to the site. Approximately 900 railcars were shipped in the last year. The inspectors reviewed selected shipment documentation and found the records to be in order. Trucks that bring contaminated soil and debris from offsite properties to be stockpiled for the railcar shipments are surveyed before being allowed to be released from the MISS.

c. Conclusions

Waste soil and debris was transported to an interim waste storage site adjacent to the Stepan site and subsequently properly loaded into railcars for shipment to a licensed waste disposal facility. Appropriate surveys and analysis of waste soil samples were conducted and appropriate records of these activities were maintained.

IV. Exit Meeting

The inspector discussed his observations from the inspection with the Stepan Plant Manager and the USACE health physicist in separate telephone calls on March 8, 2010.

ATTACHMENT: SUPPLEMENTAL INFORMATION

ATTACHMENT: SUPPLEMENTAL INFORMATION

PARTIAL LIST OF PERSONS CONTACTED

Licensee

Mark Stanek, Plant Manager

USACE and Contractors

Jack Bills, SEC, Laboratory Manager
David Hays, USACE, Health Physicist (via phone)
James Imbornoni, Shaw, Transportation & Disposal Manager
Mike Johnson, USACE, Contract Representative
Thomas Kelley, USACE, Project Engineer
David Lawrence, SEC, Site Health Physicist
Brian Miller, SEC, FSS Lead Engineer
Michael Winters, Shaw, Site Radiation Safety Officer

Oak Ridge Institute for Science and Education

Dale Condra, Laboratory Manager (via phone)

LIST OF ACRONYMS

ADAMS	Agencywide Documents Access and Management System
ALARA	as low as is reasonably achievable
CFR	Code of Federal Regulations
DOE	Department of Energy
EMC	Elevated Measurement Comparison
EPA	U.S. Environmental Protection Agency
FSS	Final Status Surveys
FUSRAP	Formerly Utilized Sites Remedial Action Program
GPS	Global Positioning Satellite
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MOU	Memorandum of Understanding
NRC	Nuclear Regulatory Commission
ORISE	Oak Ridge Institute for Science and Education
pCi/g	picocuries/gram
Ra-226	Radium-226
Rn-222	Radon-222
ROD	Record of Decision
Th-232	Thorium-232
U-238	Uranium-238
USACE	U.S. Army Corps of Engineers

WRS Wilcoxon Rank Sum (Test)

INSPECTION PROCEDURES (IP) USED

IP 87104 Decommissioning Inspection Procedure for Materials Licensees

PARTIAL LIST OF DOCUMENTS REVIEWED

Record of Decision for Soils and Buildings at the FUSRAP Maywood Superfund Site, Maywood, New Jersey, U.S. Army Corps of Engineers, September 22, 2003.

Master Final Status Survey Plan, FUSRAP Maywood Superfund Site, Maywood, New Jersey, Prepared by Stone & Webster, Inc. for the U.S. Army Corps of Engineers, November, 2001, Revision 1.

ORISE Letter Report for Analytical Results for Ten Soil Samples from Stepan Company, Maywood, New Jersey, December 9, 2010. [ML110750085]

Split Sample Analysis Results for FSS at Stepan Burial Pit # 1, Electronic Mail from D.. Lawrence, Shaw Environmental, Inc. to M. Roberts, USNRC, Region I, January 7, 2011. [ML110750088

Memorandum of Understanding Between the U.S. Nuclear Regulatory Commission and the U.S. Army Corps of Engineers for Coordination on Cleanup & Decommissioning of the Formerly Utilized Sites Remedial Action Program (FUSRAP) Sites with NRC-Licensed Facilities, 66 FR 36607-36609, July 12, 2001.

Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), NUREG-1575, Rev. 1, August 2000.