Chemtura
Middlebury Connecticut Site

Building Decommissioning and Final Radiological Status Report

Radiation Safety Associates, Inc.

June 22, 2011

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EXECUTIVE SUMMARY

Chemtura Corporation has decided to terminate its radioactive material license at the Middlebury, Connecticut, site, so impacted areas at this location had to be evaluated. These consisted of twenty (20) laboratories with a connecting hallway, a walk-in freezer and a radioactive waste storage area. Also included in this Final Status Survey (FSS) is the report on the decontamination and FSS of Room T-393B (the Rat Room) that was completed on September 29, 2008. This report, then, represents the final radiological status of the Chemtura Middlebury facility.

First, contamination surveys were performed on laboratory equipment, supplies, instruments and the like that remained in the laboratories. Those objects that could be cost-effectively decontaminated were and those that could not were placed into radioactive waste for disposal.

A radiological scoping survey was then conducted in all laboratories, fume hoods, the walk-in freezer and the radioactive waste storage area. Based on the findings of this survey the following remedial action was taken:

- Eleven (11) of the 29 fume hoods had to have the outer (uncontaminated) steel portions disassembled and the Transite® (asbestos) liners removed and disposed as radioactive waste;
- All the ventilation ducting including the roof-mounted blower and discharge stack from Hood 45 in Room 1207 had to be removed and disposed as radioactive waste;
- Approximately 18 asbestos floor tiles (12 inches square) were contaminated and had to be removed;
- One laboratory deep sink was contaminated and had to be removed;
- Various sinks, countertops, drawers, cabinets and countertops were contaminated and were able to be successfully decontaminated;
- A number of objects and components present in the various laboratories and areas were disposed as radioactive waste

A minimum of two attempts were made to decontaminate areas containing residual contamination. Residual radioactive material has been reduced to levels that are less than the applicable limits and are as low as is reasonably achievable (ALARA). Chemtura's ALARA goal for this project was set to a factor of 10 below the State free-release limit.

A Final Radiological Status Survey was performed in accordance with guidelines provided by the Nuclear Regulatory Commission in the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM— NUREG-1575). The results of this survey show that levels of licensed radioactive material remaining at the Chemtura Middlebury site have been reduced to levels that are ALARA, and that they would not deliver an annual dose of more than 19 millirem (mrem) to the person in the future who is likely to receive the largest dose. Therefore this facility now meets both NRC and State DEP requirements for unrestricted release.

INTRODUCTION

Chemtura is licensed by the U.S. Nuclear Regulatory Commission (NRC) for possession of radioactive material for research and development, license number 06-00221-08. The license was initially issued to Uniroyal Chemical Company, Inc., which became Crompton & Knowles in 1996. Crompton & Knowles became Crompton Corporation in 1999 and finally Crompton Corporation became Chemtura Corporation in 2005. Chemtura intends to show by the data in this report that the portions of its building at 199 Benson Road, Middlebury, Connecticut that was used for licensed activity is now eligible for unrestricted radiological release. Chemtura is also requesting that this license be terminated since no further research will be conducted at this facility.

PURPOSE

The purpose of this document is fourfold:

1. To report the results of the scoping surveys within this building and the remediation activities that followed;
2. To document the proper disposal of radioactive waste from the building;
3. To report the results of the Final Radiological Status Survey; and
4. To show that all utilization areas within this building meet the criterion for unrestricted radiological release under the MARSSIM method.

Based on the contents of this report, Chemtura is petitioning NRC to terminate license number 06-00221-08.

FACILITY DESCRIPTION

The Chemtura-Middlebury site is located at 199 Benson Road in Middlebury, Connecticut. With one exception, all the laboratories that used licensed material were located in the laboratory wing of the facility. The single exception, Room T-393B (the so-called Rat Room), is located on the first floor of the main building. Located on the ground floor of the main building are a walk-in freezer that was used to store samples that resulted from various experiments, and a radioactive waste storage room. The floor plan of the main laboratory wing is shown in Figure 1. The approximate locations of the Rad Waste Storage Area, the Walk-In Freezer and the Rat Room are indicated in Figure 2.

HISTORICAL SITE ASSESSMENT

A Historical Site Assessment (HSA) was conducted by Chemtura, and the results were communicated to Radiation Safety Associates, Inc, (RSA). This consisted of a review of all existing records for information on radioisotopes used at the Middlebury site, locations of use, and types of experiments conducted. It also included interviewing of current Chemtura employees. The HSA showed that the only radioisotope ever used at the Middlebury site was ^{14}C (E_{max} = 156.5 keV).

Also permitted on the license were ^{3}H (E_{max} = 186 keV) and ^{36}Cl (E_{max} = 709.6 keV). While quantities of these isotopes were present at the facility, they were never utilized for any experiments. Wipe tests taken in the refrigerator and freezer where they were stored were also analyzed for ^{3}H and ^{36}Cl.

The HSA identified the following specific locations of radioisotope use (impacted areas):

1. Room 1201
2. Room 1202
3. Room 1203
4. Room 1204
5. Room 1205
6. Room 1206
7. Room 1207
8. Room 1208
9. Room 1209
10. Room 1210
11. Room 1215
12. Room 1216
13. Room 1217
14. Room 1218
15. Room 1219
16. Room 1220
17. Room 1221
18. Room 1222
19. Room 1223
20. Room 1224
21. Walk-in freezer
22. Radioactive waste storage area
23. Room T-393B (Rat Room).

An office suite, kitchenette and photocopy area are located in Room 1213, next to Room 1210 and across the hall from Room 1215. Rooms numbered 1211, 1212 and 1214 are within the office suite and are not impacted areas.

A single hallway provides access to all the laboratories except T-393B (Rat Room). These areas are indicated on the drawings in Figure 1 below. Figure 2 is an aerial photograph of the building, showing the wing where the laboratories, Walk-In Freezer, Radioactive Waste Storage Area and Rat Room are located.

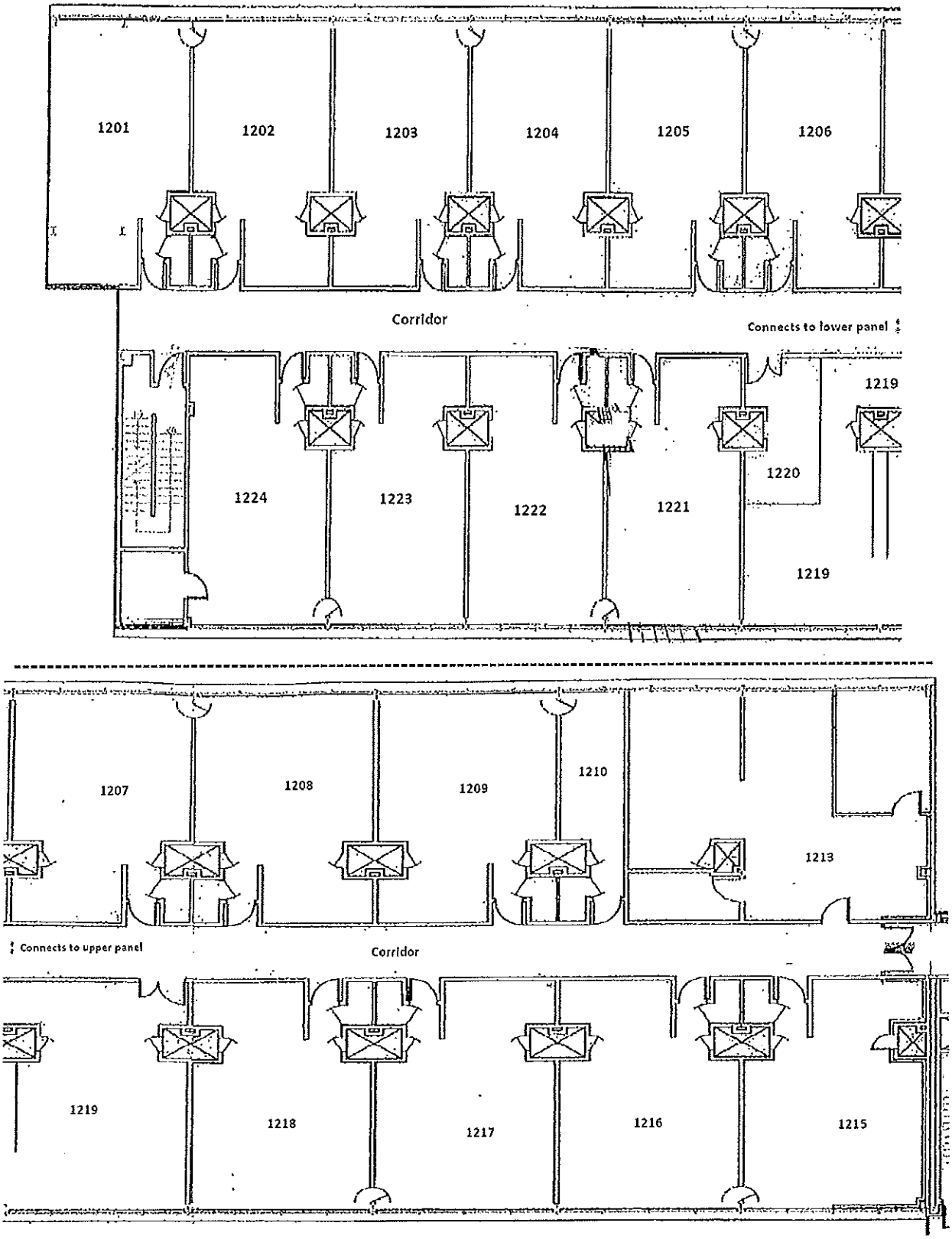

Figure 1. A floor plan of the Chemtura Middlebury Laboratory wing.

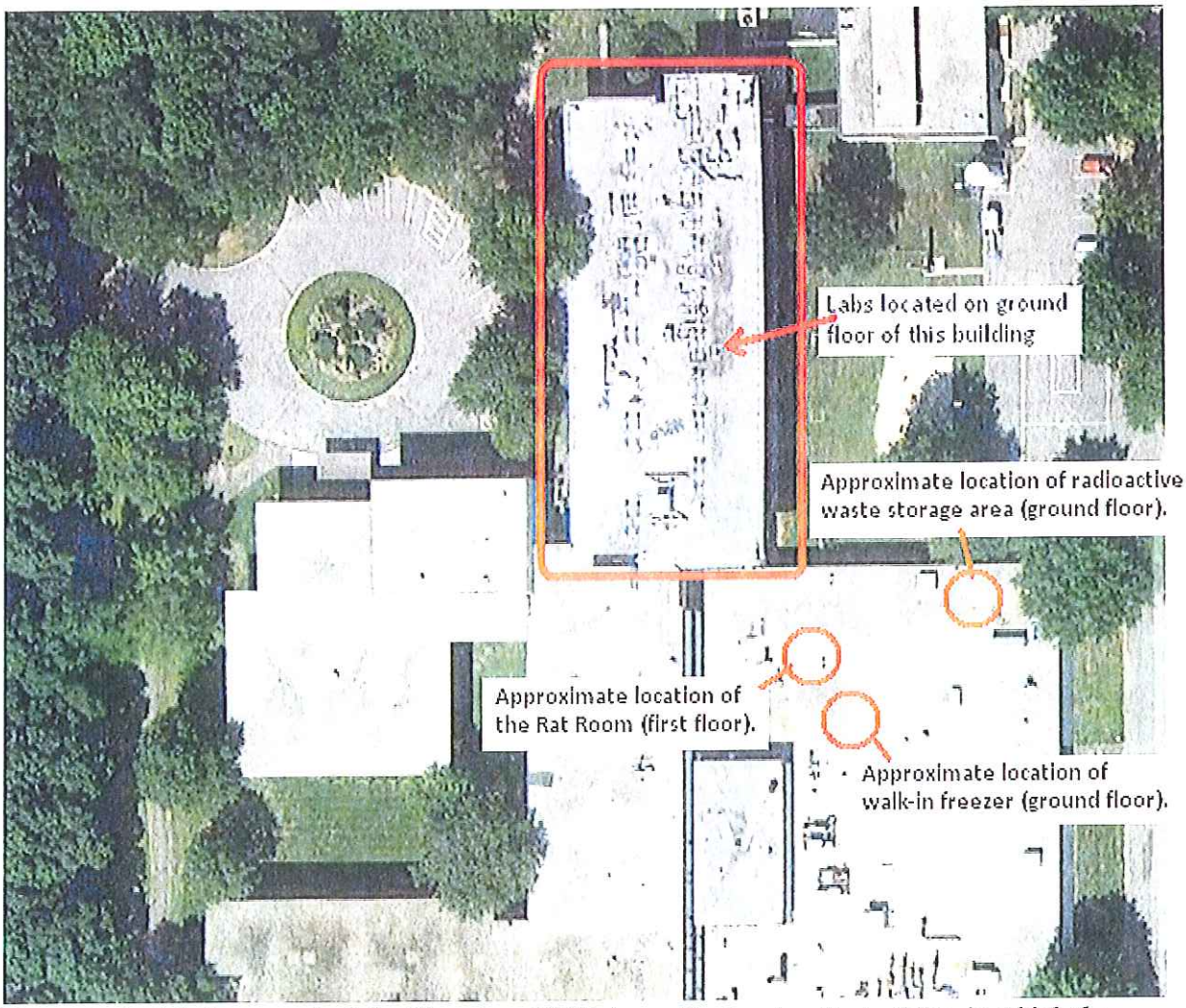

Figure 2. Aerial photograph of the Chemtura Middlebury site showing the building in which the laboratories are located. The walk-in freezer and radioactive waste storage area are in the basement of the Main Building. The so-called Rat Room (T-393B) is located on the first floor of the Main Building and was decommissioned in September of 2008.

DATA QUALITY OBJECTIVES (DQO)

While there are other radioisotopes listed on Chemtura's radioactive material license, an extensive search of the records clearly indicated that Carbon-14 was the only isotope used at the Chemtura Middlebury site. Therefore the results of all measurements were compared to the C-14 limits. These DQO data for Carbon-14 are summarized in the tables below.

As part of the DQO process the objective of the survey and the null and alternate hypotheses should be clearly stated. In demonstrating that this objective is met, the null hypothesis, H_0, tested is that residual contamination exceeds the release criterion; the alternative hypothesis, H_a, is that residual contamination meets the release criterion.

While the beta-emitting contaminant that is presumed to be present in this building (C-14) is presumed to present in background, Chemtura has decided to assume that any C-14 detected on surfaces at this facility will be assumed to be the result of licensed activity. This is a conservative assumption. Therefore the Sign test will be used to determine the number of data points needed for statistical tests. The acceptable decision error rates were determined during the DQO process. The Type I error (α) was specified as 0.05 and Type II decision error (β) was set at 0.05. The shift, Δ, also referred to as the lower bound of the gray region (LBGR), was set at 50% of the derived concentration guideline level (DCGL). The square roots of the DCGLs were taken as the standard deviation values used for calculation of the sample sizes for measurement of total contamination.

C-14	NRC DCGL ($dpm/100cm^2$)	Δ (LBGR) ($dpm/100cm^2$)	σ ($dpm/100cm^2$)	Δ/σ	Number of Samples required per survey unit by the Sign Test
Removable	3.7E+5	1.85E+5	608	304	14
Direct	3.7E+6	1.85E+6	1923	962	14

Table 1. Carbon-14 DCGL and related data (from Federal Register Vol. 63, No. 222, Wed. Nov. 18, 1998, p. 64134).

The actual number of sample points in each survey unit exceeded 14.

ACCEPTANCE CRITERIA—STRUCTURES

These surveys were accomplished in accordance with the requirements stated in 10 CFR 20.1402.

> **§ 20.1402 Radiological criteria for unrestricted use.**
> A site will be considered acceptable for unrestricted use if the residual radioactivity that is distinguishable from background radiation results in a TEDE to an average member of the critical group that does not exceed 25 mrem (0.25 mSv) per year, including that from groundwater sources of drinking water, and the residual radioactivity has been reduced to levels that are as low as reasonably achievable (ALARA). Determination of the levels which are ALARA must take into account consideration of any detriments, such as deaths from transportation accidents, expected to potentially result from decontamination and waste disposal.

Guidance for this decommissioning was taken from NUREG-1757, Vol. 1, Rev. 1 (Consolidated NMSS Decommissioning Guidance – Decommissioning Process for Materials Licensees) and from NUREG-1575, Rev. 1 (the Multi Agency Radiological Site Survey and Investigation Manual—MARSSIM).

Acceptance criteria were established based on the NRC recommendations (*Federal Register* Vol. 63, No. 222, Wed. Nov. 18, 1998, p. 64134 and Vol. 64, No. 234, Tues. Dec. 7, 1999, p. 68395) for release of facilities for unrestricted use following decommissioning, for the isotope potentially present in the buildings surveyed.

Chemtura has reduced the building release criteria to conform to ALARA principles. The release criteria used for this project are summarized in Tables 3 through 5 below. The federal limits are the concentrations of each radionuclide that, if present in a building released for unrestricted use could deliver a dose of 25 mrem per year to the person likely to receive the highest dose from all pathways. The State of Connecticut has determined that this release criterion should be 19 mrem per year instead of 25 mrem per year upon which the NRC values are based. Therefore the limits have also been reduced by a factor of $19 \div 25 = 0.76$ to show compliance with State rules. Since only one isotope is involved, a more rigorous derivation of the State limit was judged to be unnecessary.

The direct survey (total contamination) DCGL for C-14 is given in the table below in units of dpm/100 cm^2 along with the State limit and Chemtura's ALARA goals.

	NRC Value[1]	State Limit	ALARA Goal
H-3	1.2E+8	9.1E+7	9.1E+6
C-14	3.7E+6	2.8E+6	2.8E+5
Cl-36	5.0E+5	3.8E+5	3.8E+4

Table 2. Derived Concentration Guideline Levels (DCGLs) for total contamination (dpm/100 cm^2).

As specified in NRC instructions, the DCGL for removable contamination (wipe survey limits) are 10% of the values shown in Table 2 above and are given in Table 3 below.

[1] From 63FR64134 table I.

	NRC Value[2]	State Limit	ALARA Goal
H-3	1.2E+7	9.1E+6	9.1E+5
C-14	3.7E+5	2.8E+5	2E+4
Cl-36	5.0E+4	3.8E+4	3.8E+3

Table 3. Derived Concentration Guideline Levels (DCGLs) for removable contamination (dpm/100cm^2)

In the calculation of all survey results, background was subtracted from the sample count rate before results were calculated and compared to the release criteria.

ACCEPTANCE CRITERIA—EQUIPMENT AND MATERIAL

The acceptance criteria for portable equipment and material of all types (e.g., balances, lab instruments, tools, equipment, etc.) were taken from NRC Regulatory Guide 1.86[3]. These release limits were also applied to the Transite®[4] panels that formed the interiors of all the fume hoods. Since Chemtura will be moving out of these laboratories it was judged to be likely that any future tenant would remove and dispose of the fume hoods. Therefore the lower limits from Regulatory Guide 1.86 were applied (see Table 4).

NUCLIDE	AVERAGE	MAXIMUM	REMOVABLE
Most beta-gamma emitters (including ^{3}H, ^{14}C, ^{36}Cl)	5,000 dpm/100cm^2 Averaged over ≤1m^2	15,000 dpm/100cm^2 Applies to 100cm^2 max.	1,000 dpm/100cm^2

Table 4. Radiological release criteria from Regulatory Guide 1.86.

[2] From 63FR64134 table I footnote 1.
[3] NRC stated in a phone call on March 14, 2011 (D. Lawyer to K.P. Steinmeyer) that they would accept the guidance provided in Regulatory Guide 1.86, Termination of Operating Licenses for Nuclear Reactors – 06/1974.
[4] Transite is an asbestos-containing material.

SURVEY METHODS AND EQUIPMENT

Direct Surveys
All direct scoping surveys (scan surveys) and final status surveys (fixed or static measurements) of impacted areas at Chemtura Middlebury were made with gas proportional detectors. These measurements were made with the detector at a maximum distance of 1cm from the surface being surveyed, and the scan speed no greater than one detector width per second. The statistical information for these detectors is described in Attachment Z. Calibration certificates are provided in Attachment AA.

Wipe Samples
Traditional 100cm^2 wipes were used for scoping surveys of laboratory equipment, refrigerators, freezers and other objects. The 100 cm^2 wipes were analyzed using Chemtura's liquid scintillation analyzer (LSC-05, Wallac/Perkin Elmer, Model No. 1409, Serial No. 4090499).

Large-Area Wipes (LAW)
Each LAW sampled approximately 6m^2 (6E+4 cm^2 or 65ft^2) and were taken on floors, counter tops and walls as part of the scoping survey. The large area wipes were analyzed with the Ludlum 43-37 gas proportional detector connected to a Ludlum Model 2224 scaler-rate meter. Positive results, if any, would have been followed up with more intensive 100 cm^2 wipes and direct measurements. Refer to Attachments Z and AA for information on instruments.

MDAs/LLDs OF LABORATORY AND PORTABLE INSTRUMENTS

Wipes
The lower limit of detection for Chemtura's Wallac/Perkin Elmer liquid scintillation analyzer is 47.9 dpm/100cm^2. This is far less than the 20,000 dpm/100cm^2 ALARA goal for free release of facilities, and the 1,000 dpm/100cm^2 Regulatory Guide 1.86 limit for release of equipment and material. Refer to Attachment Z for details.

Scan Surveys
All scan surveys and direct measurements were performed with gas proportional detectors, specifically the Ludlum Model 43-68 (126 cm^2) with the Ludlum Model 2224-1 scaler-rate meter, and the Ludlum Model 43-37 (584 cm^2) with the Ludlum Model 2224-1 scaler-rate meter. Statistical methods described in NRC documents were used for calculating minimum detectable activities (MDA) or lower limits of detection (LLD) at the 95% confidence interval for both static (direct) contamination measurements and for dynamic (scan) surveys. The MDA for the Ludlum 43-37 floor monitor (3,630 dpm/100 cm^2) is roughly 75 times smaller than the more restrictive DCGL for removable contamination (2.8E+5 dpm/100 cm^2 for Connecticut compliance). Even the Ludlum 43-68 (MDA = 12,000 dpm/100 cm^2) is roughly 20 times smaller than the Connecticut limit. (The NRC DCGL value for ^{14}C is 3.7E+5 dpm/100cm^2, while Connecticut requires that this be reduced by a factor of 19/25 for a single isotope to 2.8E+5 dpm/100 cm^2.) Since virtually all accessible surfaces in the impacted areas were scanned using

this detector, there is an extremely small probability that undetected residual contamination remains in these areas.

Static Surface Measurements
Direct measurements on all surfaces were made using gas proportional detectors. The MDA for the Ludlum 43-37 floor monitor (227 dpm/100 cm^2) is roughly 1,200 times smaller than the more restrictive DCGL for removable contamination (2.8E+5 dpm/100 cm^2 for Connecticut compliance). Even the MDA of the Ludlum 43-68 (547 dpm/100 cm^2) is roughly 500 times smaller than the Connecticut limit. (The NRC DCGL value for ^{14}C is 3.7E+5 dpm/100cm^2, while Connecticut requires that this be reduced by a factor of 19/25 for a single isotope to 2.8E+5 dpm/100 cm^2.) In the unlikely event that some ^{36}Cl had been present in Rooms 1206, 1207 and the Rad Waste Storage Room, the proportional counters would have included it in the gross count and count rate. The ^{14}C efficiency used for converting net count rate to dpm/100cm^2 units would have over-reported any ^{36}Cl that might have been present, so it would therefore have been adequately accounted for.

Summary
The MDAs for the instruments used are summarized in Table 5 below. Details are contained in Attachment Z.

Survey Type	Instrument	MDA (dpm/100cm^2)	NRC DCGL (Removable)		CT Limit (Removable)	
			Structures	Equip	Structures	Equip
Wipe Analysis	LSC	47.9	370,000	5,000	280,000	3,800[5]
Scan	43-68+2224-1	12,000	370,000	5,000	280,000	3,800[6]
Scan	43-37+2224	3,630	370,000	5,000	280,000	3,800[7]
Direct measurement (static)	43-68+2224-1	547	370,000	5,000	280,000	3,800[8]
Direct measurement (static)	43-37+2224	227	370,000	5,000	280,000	3,800[9]

Table 5. Minimum detectable activities at 95% confidence for the detection equipment used on thisproject.

[5] Since the NRC limit in this category is not dose based, the NRC value was reduced by a factor of 19/25 in an attempt to accommodate the State requirement.
[6] Ibid.
[7] Ibid.
[8] Ibid.
[9] Ibid.

AREA CLASSIFICATION AND SURVEY UNITS

Even though the HSA indicated (p. 2) that only ^{14}C had been used at this facility, seven small vials containing solutions of ^{3}H (8.84mCi total) and one containing a solution ^{36}Cl (0.225mCi) were stored in the building but never used for any experiment or for any other purpose. These were initially stored in a freezer in Room 1206 and later moved to a freezer in Room 1207. They were finally placed in a container in the Radioactive Waste Room and were disposed as part of this project. As a precautionary measure, a number of wipes from Rooms 1206, 1207 and the Radioactive Waste Room were recounted using a protocol that looked for both ^{3}H (E_{max} = 18.6keV) and for any isotope with E_{max} greater than 14C's 156keV (i.e., 709.55keV for ^{36}Cl). No ^{3}H or ^{36}Cl were detected. See Attachment PP.

Chemtura's routine contamination surveys indicated that contamination of hoods and surfaces was infrequent and involved very little radioactive material.

MARSSIM describes the three area classifications as follows:

- A Class 1 area has the highest potential for contamination, and is impacted (with a possibility of containing residual radioactivity in excess of natural background or fallout levels); has the potential for delivering a dose above the release criterion; has a potential for small areas of elevated activity; and there is insufficient evidence to support reclassification as Class 2 or Class 3. Area up to 100 m^2 or 1076 ft^2 for structures.
- A Class 2 area is impacted; has a low potential for delivering a dose above the release criterion; and has little or no potential for small areas of elevated activity. Area from 100 to 1000 m^2 or 1076 to 10,764 ft^2.
- A Class 3 area is impacted; has little or no potential for delivering a dose above the release criterion; and has little or no potential for small areas of elevated activity. Area is unlimited.

The impacted laboratory areas are located in the laboratory wing of the complex. The walk-in freezer, Radioactive Waste Room and the Rat Room (T-393B) are located in the Main Building (indicated on Figure 2).

Based on the evidence evaluated during the HSA, all the laboratories, the Walk-in Freezer and the Radioactive Waste Storage Area were all initially classified as Class 3 areas.

SCOPING SURVEY

The scoping survey consisted of the following components.

1. Scan surveys of virtually 100% of accessible floors, approximately 80% of all accessible shelves and countertops, and approximately 100% of drawers and under-bench cabinets were made concentrating on under-hood cabinets and drawers in proximity to identified contaminated areas.
2. The interiors of all fume hoods were sprayed and wiped down prior to direct survey as a precautionary measure to prevent contamination of personnel, radiation detectors and other parts of the labs. Direct scan surveys were then performed and Transite® panels that

were contaminated to more than twice background were removed. Wipe surveys were performed on all remaining hood interiors. (See the section below on ***Fume Hoods***).
3. Large-Area Wipe (LAW) tests, each covering approximately $6m^2$ ($65ft^2$), of floors, walls and countertops;
4. Wipe tests of all sink drains and accessible traps;
5. Standard wipe surveys (100 cm^2) and direct surveys of all removable fume hood components and the interiors of all fume hoods;
6. Standard wipe surveys (100 cm^2) and direct surveys on fume hood exteriors;
7. Standard wipe surveys (100 cm^2) were taken in 18% of drawers and cabinets.

Scan Surveys
A direct contamination scan survey was performed on the floors of all laboratories and the connecting hallway. This encompassed nearly 100% of the accessible floor area of the laboratory wing, limited only by the size of the Ludlum Floor Monitor Model 239-1F (consisting of a Ludlum Model 43-37 + Model 2224). Each of the 803 drawers and cabinets was individually numbered for sample/measurement location purposes. Results are contained in Attachment FF.

Large-Area Wipes
A series of Large-Area Wipes (LAW) were taken, each covering approximately $6m^2$ ($65ft^2$), on the floors of each room, laboratory benches, shelves and walls. Locations and results of these samples are contained in Attachment X to this report. No significant[10] contamination was found.

Sinks and Drains
Each of the 225 sinks in the laboratory wing was numbered. This included deep sinks, cup sinks, eyewash stations and any other type of sink found. A minimum of two wipe tests were taken in each sink, one in the sink drain and one down inside the drain tailpiece (with a long wooden cotton-tipped applicator). Where sink traps were accessible and could be disassembled, a wipe was taken inside the trap. Sample results for sinks and drains are contained in Attachment W.

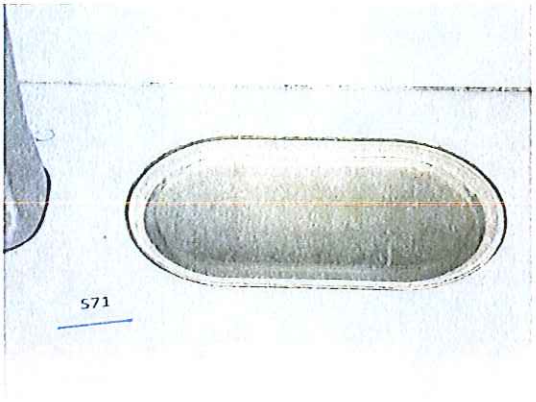

Figure 3. Typical hood cup sink labeled S71.

[10] Greater than 10% of the applicable release limit (structures or equipment/materials) as described in this report.

Fume Hoods

Fume hood interiors are constructed of Transite®, a product that contains asbestos. They were surveyed as described below. (Eight-foot hoods have two vent openings.)

1. Remove the easily removable interior components of the air flow direction system. See Figure 4.

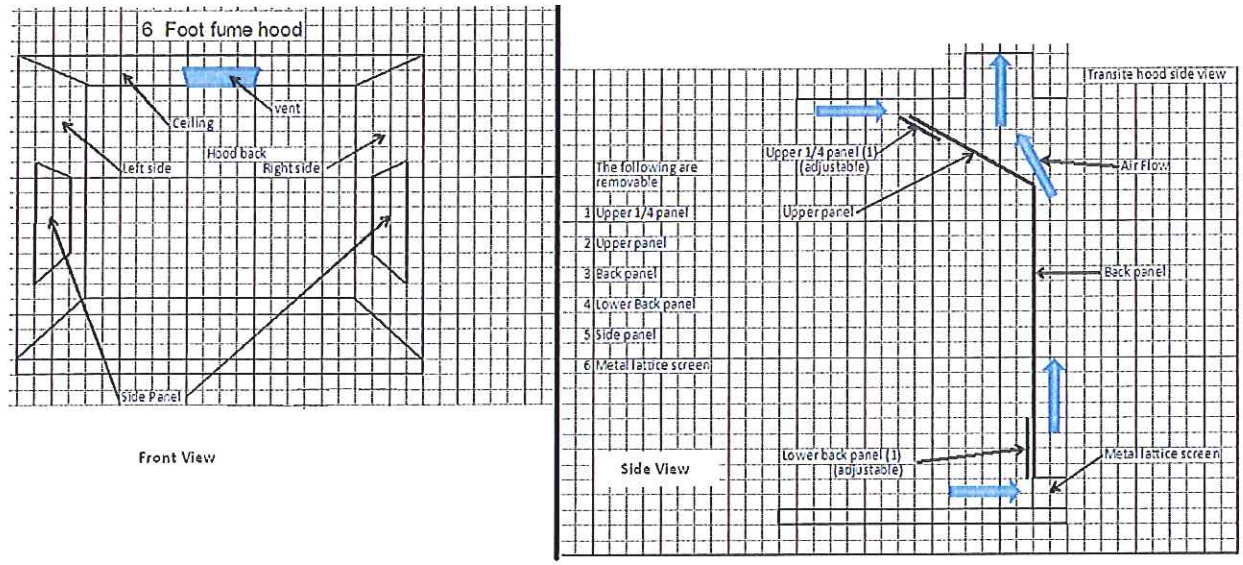

Figure 4. Interior of a typical fume hood showing removable components of the air direction system. Eight-foot hoods have two vent suctions in the top of the ceiling panel (as in Figure 5 below).

2. Spray the removed components with a solution of Simple Green® and water and wipe dry. This was done to remove gross dust and dirt to prevent possible contamination of the Ludlum 43-68 gas proportional detector that was used for direct surveys.
3. Perform a direct survey on the removed components. If contaminated to greater than the Regulatory Guide 1.86 levels, put into radioactive waste. If not, perform a wipe test and compare the results to the Regulatory Guide 1.86 levels. If not contaminated dispose as asbestos waste. Transite is a very porous material and experience has shown that if one spray and wipe effort does not effectively decontaminate it, repeated attempts will be ineffective. Since it is made from asbestos, more aggressive decontamination methods were judged to be imprudent.
4. Spray the interior of the fume hood with a solution of Simple Green® and water and wipe dry. See Figure 5.

Figure 5. Interior of an 8-foot fume hood (Room 1205) with most of the metal components removed. The Transite® (asbestos) side panel as well as all the gas fittings has been removed. The clean area in the back shows that decontamination has been attempted. Non-abrasive decontamination of the Transite material was largely unsuccessful.

5. Perform a direct survey on the hood interior. If contaminated to greater than the Regulatory Guide 1.86 levels, designate for disassembly and disposal as radioactive waste. If not, perform wipe tests. If within limits, mark as clean and leave in place.
6. Survey ducting leading out of the hood. If removable or total contamination exceeded Regulatory Guide 1.86 levels, decontaminate and resurvey. If contaminated to greater than Regulatory Guide 1.86 levels after two decon attempts, designate for disassembly and disposal as radioactive waste. If within limits, leave in place.

   Attachment OO provides information about all the hoods in the laboratory wing.

All the ducting from fume hood #45 in Room 1207 had to be removed. This included the hood damper, the blower on the roof and the discharge stack on the blower outlet. Wipe surveys taken on the roof indicated that no contamination was present. See Figure 6 for a view of the roof-mounted components, and Attachment DD for the results of roof contamination surveys. The ducting between hood #51 in Room 1206 and the damper was removed. The damper and ducting from the equipment chase to the roof met the acceptance criteria.

Figure 6. Roof-top ventilation ducting, blower and chimney for hood #45 in Room 1207 (left). Photo on right shows that the blower and ducting have been removed. The motor was not contaminated and was not removed.

Flexible Ventilation Ducts

Flexible ducts were present in several of the laboratories though most were in room 1219. All were wipe tested and none were contaminated. See Figure 7 for a view of Room 1219 and Attachment EE, page 3, Lab ID #5-15 for wipe test results.

Figure 7. Room 1219 showing the flexible ducts referred to in this report. None of these ducts were contaminated.

Corridor

Virtually 100% of the corridor outside the laboratories was scanned directly with the gas proportional floor monitor and a number of wipe samples was obtained. These results are shown in Attachment EE, page 5.

SCOPING SURVEY RESULTS

The results of all Scoping Survey measurements are contained in Attachments A through X on a room by room basis.

SURVEYS OF OBJECTS

Numerous objects remained in the laboratories and these were surveyed by 100cm^2 wipe test and directly with a Ludlum Model 43-68 gas proportional detector. Those that were found to be contaminated to a level greater than 1,000 dpm/100cm^2 on wipe or direct survey were decontaminated and re-surveyed. If they were still contaminated to more than this screening level after two decontamination attempts, they were placed into radioactive waste. Where reasonable, portions of large contaminated components were removed and disposed while the remainder was released. Also, portions of HPLC instruments and portions of other equipment that could not be effectively surveyed (e.g., disposable tubing) were removed from such devices and disposed as radioactive waste.

The following rooms contained objects, and wipe survey results are provided in the indicated attachments.

- 1205, Attachment E
- 1206, Attachment F
- 1207, Attachment G
- 1208, Attachment H
- 1210, Attachment J
- 1215, Attachment K
- 1216, Attachment L
- 1218, Attachment N
- 1219, Attachment O
- 1220, Attachment P
- 1221, Attachment Q

Rooms 1201-4, 1209, 1217 and 1222-1224 contained no objects for survey.

Wipe results for some miscellaneous objects are provided in Attachment CC. This includes wipe tests of rubber floor mats (page 3 of the attachment) that were free released.

REMEDIAL ACTIONS BASED ON SCOPING SURVEY RESULTS

Fume Hoods

After decontamination of accessible hood interiors using a water solution with Simple Green®, RSA personnel removed the easily accessible air flow-directing panels from the inside rear and top of the hoods. This provided access to the air flow channels in order to perform meaningful scoping surveys. Removal of the Transite® (asbestos) panels was done under the provisions of Connecticut Department of Environmental Health interpretation[11] (Attachment BB). All guidance and stipulations in this document were rigorously adhered to. No Transite panels were broken during this phase of the work. As a precautionary measure, workers wore N-95 NIOSH-certified dust masks on a voluntary basis. This practice is permitted by OSHA and NRC rules.

The interiors of eleven (11) of the 29 fume hoods present in the laboratories contained levels of fixed contamination greater than the ALARA goal. In order to save time a licensed asbestos abatement contractor[12] was used to disassemble the rest of the Transite portion of the contaminated hoods. The hood interiors were decontaminated to remove loose contamination prior to the asbestos contractor's arrival so that there was no need for any protective clothing in addition to what they wore for the asbestos work. Decontamination did not significantly decrease the amount of contamination fixed on the Transite. See Figure 8. Attachment OO provides hood locations and other information.

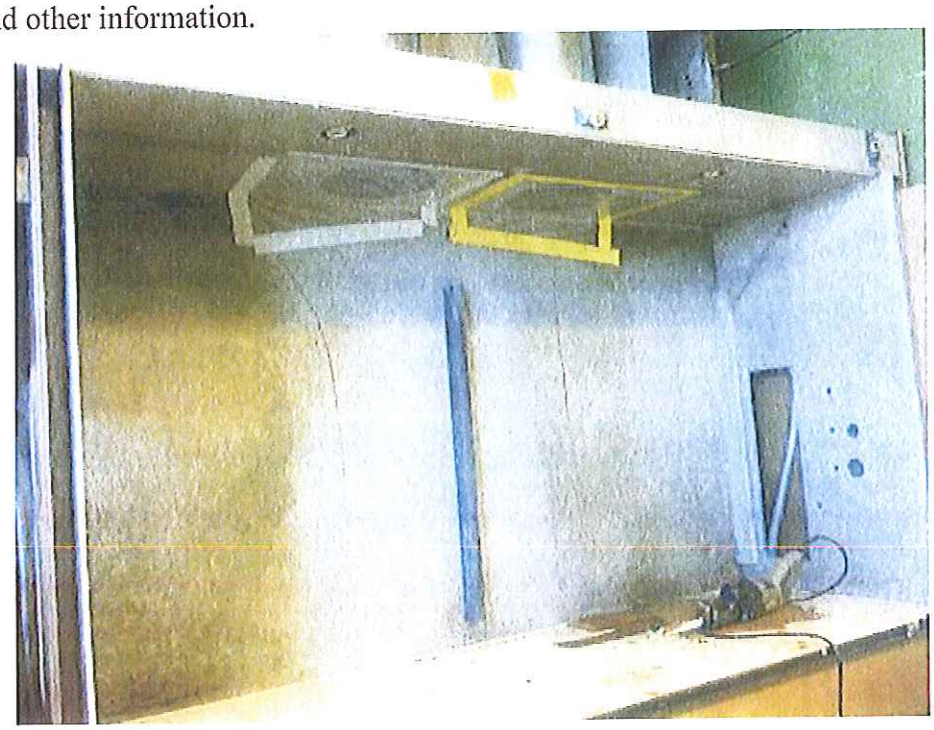

Figure 8. A typical fume hood with steel casing and glass sash removed showing the Transite lining. The bright area on the rear wall is where decontamination was performed. The dark curved lines running from top to bottom indicate the boundaries of the contamination.

[11] Division of Environmental Health Circular Letter # 2001-10. While this was published in 2003, it is still posted on the Connecticut DEH web site and has not been withdrawn.
[12] Talevi Enterprises, Inc., P, O. Box 461, Berlin, CT 06037.

The asbestos workers were checked for contamination before going on breaks and before leaving at the conclusion of work for the day by a qualified health physicist. No contamination was detected.

Subsequent to the Transite removal, all the ducting from Hood 45 in Room 1207 had to be removed all the way to the roof. The blower and discharge stack were also removed and disposed as radioactive waste. Wipe tests taken on the roof, in a downwind direction, showed no detectable contamination. Refer to Attachment DD for results of wipe samples from all ventilation discharges and from the roof.

Asbestos Floor Tile

A total of approximately 18 asbestos floor tiles in a number of labs were contaminated in excess of the ALARA goal and several attempts at scrubbing did not reduce them sufficiently. The contaminated tiles were easily pried loose with a flat bar, in accordance with Division of Environmental Health Circular Letter # 2001-10 (Attachment BB). They were disposed as radioactive waste.

DESIGNATION OF SURVEY UNITS

The Scoping Survey revealed that the interior of Hood 45 in Laboratory 1207 (Figure 9) contained fixed contamination (6M to 7Mdpm/100cm^2) in excess of the DCGL. Therefore, the entire Room 1207 was conservatively reclassified as a Class 1 area, even though no significant[13] contamination was found anywhere else in the laboratory. Room 1207 was therefore considered to be one survey unit. Since the laboratories were all located in one corridor, half the labs on each side of the corridor were considered to be a survey unit. There are five (5) survey units located in the laboratory wing. Another laboratory (Room T-393B) called the Rat Room was decommissioned in 2008 and is considered to be Survey Unit 8. The report of that decommissioning is Attachment Y to this report.

[13] Greater than 10% of the applicable release limit (structures or equipment/materials) as described in this report.

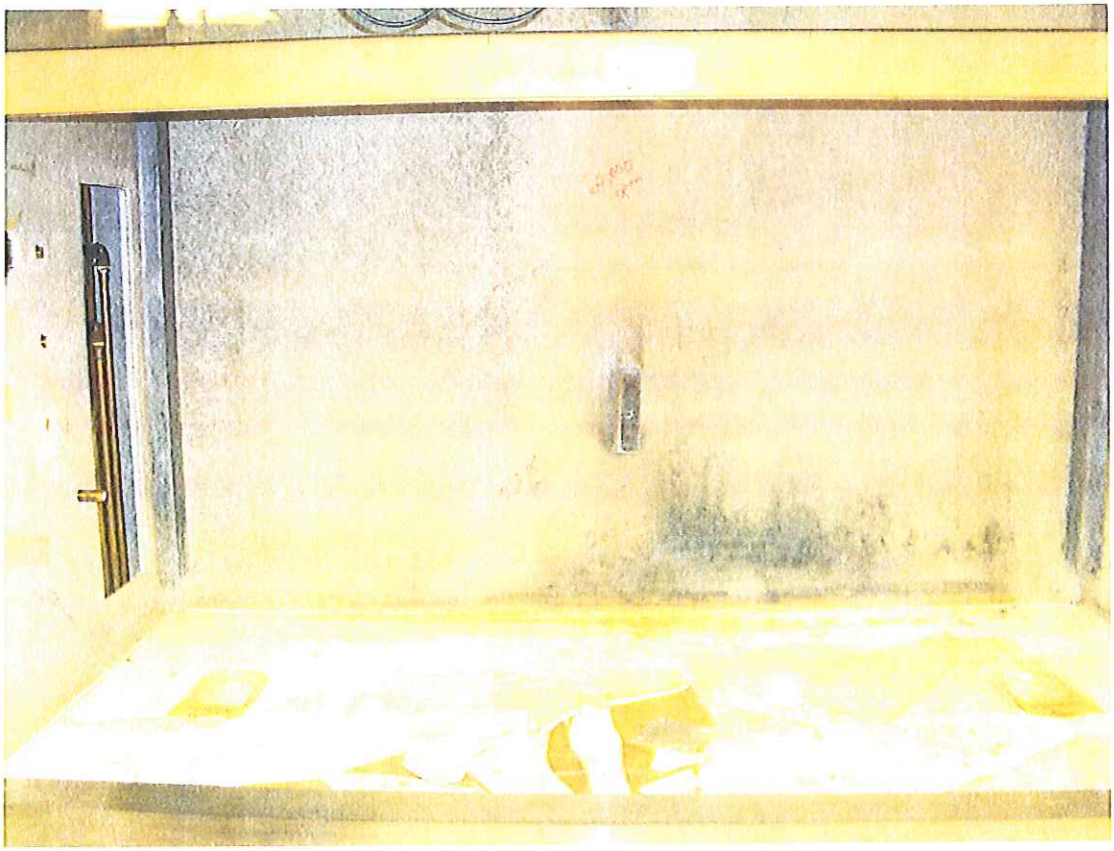

Figure 9. Hood #45 in Room 1207 just prior to removal.

The survey units consist of the following rooms (refer to Figures 1 and 2 for locations):

Unit #	Class	Description	m^2	ft^2
1	3	Rooms 1215, 1216, 1217, 1218, 1219 (except for the small NMR area)	306	3294
2	3	Rooms 1219 (only the small NMR area), 1220, 1221, 1222, 1223 and 1224	263	2831
3	3	Rooms 1201, 1202, 1203, 1204 and 1205	284	3057
4	1	Room 1207	56	603
5	3	Rooms 1206, 1208, 1209 and 1210	191	2056
6	3	Walk-in freezer	11	118
7	3	Radioactive Waste Storage Area	31	334
8	1	Room T-393 (Rat Room)	46	500

Table 6. Identification of MARSSIM Survey Units.

This is a very conservative approach. These Class 1 and Class 3 areas are much smaller than the MARSSIM guidelines allow so the number of samples per square meter is high.

WALK-IN FREEZER

All of the accessible floor area was scan surveyed using the gas proportional floor monitor. Shelves and racks were also scanned with a gas proportional instrument. Wipe samples were also taken and analyzed. No detectable contamination was found. See Figure 10 for a view of the freezer interior and Attachment LL for Final Status Survey results.

Figure 10. Interior of the Walk-In Freezer.

RADIOACTIVE WASTE STORAGE AREA

Wipe tests performed as part of the scoping survey showed no detectable removable contamination on the painted floor, walls or shelves. A direct scan scoping survey of this small area (approximately 10 feet by 13 feet) showed fixed contamination on the floor in the range of 3,000 dpm/100 cm^2 in the general area. Aggressive decontamination only reduced this to approximately 2,000dpm/100cm^2. A flatbed hand truck in this area was contaminated to levels in the range of 9,000 to 19,000dpm/100cm^2. This was disposed as radioactive waste. See Figure 11 for a view of this area and Attachment MM for Final Status Survey results.

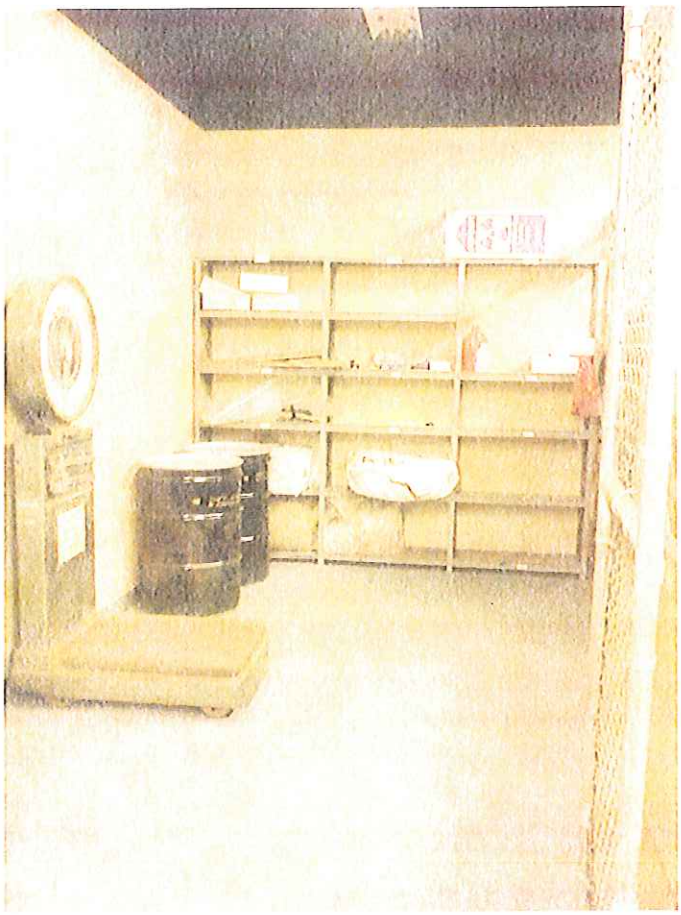

Figure 11. The Radioactive Waste Storage Area after waste removal and decontamination.

RADIOACTIVE WASTE AND MATERIAL DISPOSAL

1. The bulk of the radioactive waste was picked up by Philotechnics, Inc. on Thursday April 21, 2011. Three additional containers of radioactive waste were picked up on Tuesday May 24, 2011 by the same broker. Waste manifests are contained in Attachment NN.

2. The license-exempt liquid scintillation ^{3}H and ^{14}C standards were taken by Radiation Safety Associates, Inc. for their own use.

3. Radiation Safety Associates, Inc. removed a ^{137}Cs source and a ^{133}Ba source from two of your liquid scintillation counters. Details of these sources are provided below.

   Packard LSC Model #A230000, s/n 418326
   Chemtura number LSC-06
   ^{133}Ba source ID #D614, 18.8μCi on 4/1/98. Current activity is 7.853μCi.

   Beckman LSC Model LS-6000IC, s/n 7060209, Catalog #500602
   Chemtura number LSC-04
   ^{137}Cs source, p/n 598860, 30μCi on 2/26/05. Current activity is 25.95μCi.

   RSA has taken temporary possession of these sources in order to perform sealed source leak tests and to prepare them for shipment and ultimate disposal as radioactive waste. This is done under the terms of Condition 6J through 9J of our NRC license.

4. Chemtura's final remaining LSC, a Wallac Model 1409, s/n 4090499 with a 20μCi 152Eu source, is being purchased by Radiation Safety Associates, Inc. and will be removed from the building by the end of June, 2011.

FINAL RADIOLOGICAL STATUS

The results of the Final Status Survey (FSS) are contained in Attachments GG through MM. Attachment Y contains the results of the decommissioning of Room T-393B (Rat Room).

Little contamination remains at this facility. Anywhere contamination was detected, reasonable efforts were made to remove it, which included:

- Eleven fume hoods were completely disassembled and the contaminated components disposed as radioactive waste;
- Approximately 18 contaminated floor tiles were removed and disposed as radioactive waste;
- One laboratory deep sink was removed and disposed as radioactive waste;
- Portions of various other deep sinks, cup sinks, counter tops and so on were decontaminated in place;
- Any floor indicating the presence of contamination was scrubbed with wax stripper and a rotary power scrubber equipped with an abrasive pad, then wiped dry and resurveyed.

Any areas or components remaining with detectable contamination have been scrubbed a minimum of two times with a mixture of Simple Green (wax stripper for floors) and water and an abrasive pad, so the ALARA requirement has been met. Any residual contamination is a small fraction of the free-release limits specified[14] for C-14 in buildings (Tables 2 and 3 above), or of the lower limits specified[15] for equipment and material and listed in Table 4 above. No ^{3}H or ^{36}Cl was found.

A Final Radiological Status Survey was performed in accordance with guidelines provided by the Nuclear Regulatory Commission in the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM— NUREG-1575). The results of this survey show that levels of licensed radioactive material remaining at the Chemtura Middlebury site have been reduced to levels that are ALARA, and that they would not deliver an annual dose of more than 19 millirem (mrem) to the person in the future who is likely to receive the largest dose from these materials. Therefore this facility now meets both NRC and State DEP requirements for unrestricted release.

K. Paul Steinmeyer, RRPT
Senior Health Physicist

6/22/11
Date

[14] *Federal Register* Vol. 63, No. 222, Wed. Nov. 18, 1998, p. 64134.
[15] *Regulatory Guide* 1.86 Termination of Operating Licenses for Nuclear Reactors, 06/1974.