Historical Site Assessment for the Elkhart, Indiana Facility

Submitted to:

Bayer HealthCare, LLC
1025 North Michigan Street
Elkhart, Indiana 46514-2215
(574) 262-6502

by:

Integrated Environmental Management, Inc.
1129 Trenton Avenue, Suite 202
Findlay, Ohio 45840
(419) 423-4701

Report No. 2007006/G-4351
October 29, 2007

TABLE OF CONTENTS

1 INTRODUCTION

1.1 Purpose

The use of radioactive material by Bayer HealthCare, LLC (Bayer) at its Elkhart, Indiana facility was approved by the U.S. Nuclear Regulatory Commission (USNRC) by the issue of Radioactive Materials License No. 13-02249-01.[1] The research and development operations were terminated by Bayer in 2006 and a request was made to terminate the radioactive materials license.[2] As part of the license termination process, Bayer must demonstrate that no residual radioactivity above allowable limits remains in any of the use areas listed on the license since the date of its original issue.[3]

This report was prepared to summarize the operations and areas named on the license in compliance with the recommendations of the USNRC and NUREG-1575, Chapter 3.[4] These documents describe the need for a Historical Site Assessment (HSA) as a tool for classifying areas that are potentially impacted and may require further investigation. The conclusions presented in this report are a result of compiling and evaluating site information provided by the Radiation Safety Officer currently listed on License No. 13-02249-01, and the Manager of the Environmental Department for Bayer.

1.2 Site Identification

Bayer conducted research operations at their facilities located at 1884 Miles Avenue in Elkhart, Indiana. The license was originally issued by the U.S. Atomic Energy Commission on March 21, 1957 to Miles Laboratory, Inc. (later known as Miles-Ames Research Laboratory) for the purpose of labeling synthetic organic compounds with Carbon-14 for metabolism studies.

Since that time, research facilities were built on the Miles-Ames campus, consisting of approximately seven (7) acres and as many as 41 buildings.[5] The campus was operated by Miles,

[1] U. S. Nuclear Regulatory Commission, Radioactive Materials License 13-02249-01, Docket Number 030-04336, expires on December 31, 2010.

[2] Bayer HealthCare, LLC, Letter from Dr. Shannon Gleason to the USNRC Region III, *License Termination*, October 23, 2006.

[3] U.S. Nuclear Regulatory Commission, *Request for Additional Information*, Mail Control Number 315794, January 10, 2007.

[4] U.S. Nuclear Regulatory Commission, *Multi-agency Radiation Survey and Site Investigation Manual*, NUREG-1575, Revision 1, August, 2000.

[5] Radioactive materials were used or stored in only four buildings on the research campus, as approved by the USNRC and the Radiation Safety Committee.

Inc. until 1978 when the property was purchased by Bayer Corporation. The company name, Bayer HealthCare, LLC, was changed in 1995.[6]

A 1989 site map is included herein as Figure 7.1. The research campus is bounded by Bristol Street (State Route 19) to the north, North Michigan Street to the east, Mishawaka Street to the south and Oak Street to the west. Building 9, the C.S. Beardsley Building, was the principal building in which radioactive materials were used. That building was demolished in 1999. The research using radioactive materials were moved to Building 18 and was in use until 2006.

Miles Laboratories also used radioactive materials at remote locations which were approved by the USNRC and added to the license via amendment. A complete list of all use locations, both on the research campus and at remote sites, is included herein as Table 6.1, with additional description given in Chapter 3, below.

[6] Miles, Inc., *Company Name Change*, License 13-02249-01, March 4, 1995.

2 HSA METHODOLOGY

2.1 Approach

This HSA was designed to obtain and review information about the potential distribution of residual radioactive materials used in areas approved and described in radioactive materials license 13-02249-01. Available information consisted of two types including, historical information regarding past operations at the facility and analytical data generated by the radiation safety officer and department managers during past characterization surveys. All information was reviewed to support the classification of buildings as impacted or non-impacted areas, as described in MARSSIM.

2.2 Documents Reviewed

Historical records provided by Bayer were reviewed. These consisted of correspondence with the Atomic Energy Commission (AEC) and the USNRC, as well as internal correspondence generated by Miles Laboratories and Bayer. Procedures and radiation surveys performed by the radiation safety staff were reviewed. Analytical records and output from the radiation survey instruments were also provided. As applicable, specific records are summarized and referenced in Section 3 of this report.

2.3 Employee Interviews

Interviews regarding the operation and use of radioactive materials were completed in April of 2007. The preponderance of the information exchange was with Dr. Shannon Gleason, the Bayer RSO, and Mr. Tom Lenz, the Manager of the Environmental Department.

3 FINDINGS

3.1 1884 Miles Avenue, Building 18, Elkhart

Building 18 is the building where radioactive materials were used most recently (i.e., from 1975 to 2006). It is located on the research campus; it is a multi-story brick building that was constructed to house various chemical research and development activities. The laboratories are equipped with cabinets, ventilation hoods and sinks. The concrete floors in each of the laboratories are covered with an industrial-grade tile to restrict the absorption of liquids. The building is currently maintained by Bayer, although no research is being performed in any laboratory and no employees work full time inside of the building. The following subsections describe Building 18 further.

3.1.1 Potential Contaminants

A wide range of research was conducted in Building 18, wherein both short- and long-lived radioisotopes were used. Several areas in Building 18 used tritium (^{3}H), Carbon-14 (^{14}C), Sulfur-35 (^{35}S), Cobalt-57 (^{57}Co), and Iodine-125 (^{125}I) during the late 1970's and into the early 1990's. These isotopes were used in quantities ranging from microcuries to millicuries, in different chemical forms. From 1995 until the present day, the use of radioactivity was limited to primarily microcurie quantities of ^{125}I.

Bayer purchased a source of Barium-133, sealed within a vial, for use in calibration and daily source checks of a liquid scintillation counter, located in Building 18. This source was disposed of by a licensed contractor. The contractor, Veolia (formerly Onyx North America), has a company-owned low-level radioactive waste processing firm called Alaron Corporation that effected the transfer of waste from Bayer, with subsequent disposal by Duratek, Inc.[7] Alaron maintains a license issued by the USNRC that authorizes the possession, storage, maintenance, repair, decontamination, storage and transport of radioactive materials at temporary job sites. As such, the transfer of Bayer's waste to Veolia was done in compliance with 10 CFR 30.41.

3.1.2 Potential Contaminated Areas

From 1995 until the present day, the use of radioactivity was limited to the waste collection area (Room 18C.B.37) and the isotope room (Room 18C.05). Work involving radioisotopes was halted on September 7, 2006. A final status survey was completed of these two rooms in August, 2007 and no radioactive material was discovered in excess of the derived concentration guidelines levels.[8]

[7] Alaron, located at 2138 State Route 18, Wampum, Pennsylvania, 16157, maintains USNRC License No. 37-20826–01 (expires December 31, 2008).

[8] Integrated Environmental Management, Inc., *Final Status Survey Report for Selected Laboratories in Building 18*, Report Number 2007006/G-4349, October, 2007.

Both rooms were classified as a Class 2 area, using the MARSSIM system for classification.[9] However, the radiation measurements were not distinguishable from background.

Other surveys were performed in other laboratories in Building 18 by the Area Radiation Safety Supervisor after specific experiments in a specific location. Surveys for radioisotope contamination were routinely performed by investigators when using any radioisotope. When radioisotope use was halted in a laboratory, a radiation survey for removable radioactivity was performed by the radiation safety staff, using either a calibrated gamma counter or a liquid scintillation counter.

In 2006, a second survey of the Building 18 laboratories was completed by the radiation safety staff. These surveys for removable activity did not identify any levels of radioactivity in excess of background.

The investigators did use the existing sewer system for routine disposal of small quantities of radioactive materials. During the closeout surveys performed by the radiation safety staff, no pipes or tanks were found to be impacted. During the survey of the Rad Lab (Room C.05), samples were collected inside of the pipe traps and no radioactivity in excess of background was reported.[10]

3.1.3 Potential Contaminated Media

The media that were potentially contaminated during operations was the laboratory benches, floors and sewer systems. The radiation safety staff performed radiation measurements periodically to verify that no contamination was transferred to unrestricted areas.

3.1.4 Related Environmental Concerns

Miles Laboratories and Bayer did not dispose of radioactive waste via on-site burial. In Building 18, radioactive materials were discharged via the sewer in concentrations below the limits specified by the USNRC and 10 CFR 20.2003.[11,12] All waste containing long-lived radioisotopes was shipped offsite to a licensed landfill. There were no related environmental concerns identified during the record search or interviews of the radiation safety staff. There were no recorded spills or loss of control that required additional investigation.

---

[9] A Class 2 survey unit is an impacted area, less than 1,000 square meters, where there are expected to be locations with concentrations of residual radioactivity detectable above background levels, but that do not exceed the DCGL.

[10] Integrated Environmental Management, Inc., *Final Status Survey Report for Selected Laboratories in Building 18*, Report Number 2007006/G-4349, September, 2007.

[11] Title 10, Code of Federal Regulations, Part 20.2003, *Disposal by Release into Sanitary Sewerage*, April, 1995.

[12] Title 10, Code of Federal Regulations, Part 20, Appendix B, Table 3, *Concentrations for Release to Sewerage*, December, 1993.

3.2 1884 Miles Avenue, Building 9, Elkhart

Building 9 or the C.S. Beardsley Research facility is the building where radioactive materials were used over the history of the Elkhart research campus, from 1971 to 1992. Building 9, demolished in 1999, was a multi-story brick building that was constructed to house various chemical research and development activities. The laboratories were equipped with cabinets, ventilation hoods and sinks. The concrete floors in each of the laboratories are covered with an industrial-grade tile to restrict the absorption of liquids. Building 9 also housed an incinerator which was used to burn organic materials containing radioactive materials.

3.2.1 Potential Contaminants

A wide range of research was conducted in Building 9, wherein both short- and long-lived radioisotopes were used. Several areas in Building 9 used radioactive tritium (^{3}H), Carbon-14 (^{14}C), Sulfur-35 (^{35}S), Cobalt-57 (^{57}Co), and Iodine-125 (^{125}I), Iodine-131 (^{131}I), and Chromium-51 (^{51}Cr) during the early 1970's and into the early 1990's. These isotopes were used in quantities ranging from microcuries to millicuries, in different chemical forms. The use of radioactive materials in Building 9 was reduced to a few selected rooms in the early 1990s, when Miles Laboratories transferred all tracer work to Building 18.

Plated sources of actinium 227 (1.5 millicuries) and curium 242 (2 millicuries) were approved for prototype testing of devices in February, 1970.[13] The sources were used as part of the development for an analyzer sensitive to Oxygen 18. Wipes tests were performed on each source, on a weekly basis, by the radiation safety staff to verify that no contamination (i.e., less than 0.005 microcuries gross alpha on any single wipe sample) was transferred to unrestricted areas. Miles Laboratories used these sealed radiation sources as part of the research effort in Building 9. Pursuant to license requirements, leak tests and physical inventories were performed as required; no leaks or transfer of removable activity was reported. The actinium sources were subsequently returned to the manufacturer, Soreq Nuclear Research Center in Israel. The curium sources were returned to the Amersham Radiochemical Center in Buckinghamshire, England.

3.2.2 Potential Contaminated Areas

Each laboratory that had previously used radioactive material was surveyed by the radiation safety officer a second time prior to requesting permission to demolish the building.[14,15] No areas were identified with elevated readings above background and none required remediation prior to demolition. The license was amended by the USNRC on November 18, 1999 (Amendment 47) to release the building.

---

[13] Miles Laboratory, *Request for Amendment*, February 18, 1970.

[14] Miles Laboratories, *Release of Buildings for Demolition*, August 24, 1999.

[15] Baker Environmental, *Buildings 3 and 9 Radiation Survey*, August 2, 1999.

Prior to 1970, any radioactive waste generated as part of licensed operations was stored in the room or laboratory where the operations took place. A central waste storage area was established in 1970 located in the parking garage attached to Building 9. The waste storage location was moved to Room B37 in the basement of Building 18 after 1995.

3.2.3 Potential Contaminated Media

The media that were potentially contaminated were the laboratory benches, floors and sewer systems. The radiation safety staff performed radiation measurements periodically to verify that no contaminated was transferred to unrestricted areas. The exhaust stack and associated ventilation equipment was surveyed for total gamma radiation and removable beta radiation before the incinerator was demolished.[16] No remediation was required based on the results of the survey.

3.2.4 Related Environmental Concerns

Miles Laboratories and Bayer did not dispose of radioactive waste via on-site burial. All waste containing long lived radioisotopes was shipped offsite to a licensed landfill, approved to receive and dispose of radioactive materials. There were no related environmental concerns identified during the record search or interviews of the radiation safety staff. There were no recorded spills or loss of control that required additional investigation.

3.3 Other Shipping Addresses, Elkhart

The addresses 1127 Myrtle Street, Elkhart, 1884 Miles Avenue, Elkhart and 1000 Randolph Street, Elkhart, all refer to the same licensed site. The mailing address for the facility was changed in 1995 to 1884 Miles Avenue. The street address for the receiving area for the site remained 1000 Randolph Street. The USNRC was notified each time the shipping address was modified and the license was amended to reflect the change. The current mailing address for the facility is 1025 North Michigan Street, Elkhart, Indiana.

3.4 Offsite Animal Facility, Elkhart

Miles, Inc., operated two animal handling facilities in Elkhart, one facility in Building 9 on three floors in the building and two barns located approximately seven miles northwest of the facility.[17] Both facilities were authorized to use radioactive tracers as part of the research being conducted. However, no radioactive materials were ever used at the offsite facility; all radioactive materials were used in Building 9.[18] Therefore, no routine or final survey records exist for the facility.

[16] Baker Environmental, *Buildings 3 and 9 Radiation Survey*, August 2, 1999.

[17] Miles, Inc., *Amendment of Radioactive Materials License 13-02249-01*, September 25, 1990.

[18] Personal communication with Dr. Shannon Gleason, Bayer RSO and Bill Thomas, IEM, March 22, 2007.

3.5 Tracon, Inc., Fort Wayne
Miles Laboratories leased storage space from Tracon, Inc., located on 641 Growth Avenue, Fort Wayne, Indiana, starting in 1979.[19] The use of licensed radioactive materials at the Tracon facility ceased in 1982. All radioactive materials therein were removed and a final status survey was performed before the building was vacated. The USNRC removed this facility from the license in 1983.[20]

3.5.1 Potential Contaminants
Miles Laboratories was authorized by the USNRC to store sealed packages containing Iodine-125 at this location.[21] The radioisotopes were shipped to the Tracon warehouse in the form of in-vitro clinical test kits. A maximum of 100 millicuries of Iodine-125 were stored at the warehouse at any given time. In addition, sealed kits containing tritium, to a maximum of 650 millicuries were also stored on-site.

3.5.2 Potential Contaminated Areas
Radiation surveys of the Tracon facility were performed periodically by the radiation safety staff using release criteria established by license conditions. Removable tritium surveys were performed using wipe tests and liquid scintillation counting. Direct radiation surveys were also performed using calibrated, end-window GM detectors equivalent to a Victoreen Model 491.

A radiation survey was completed on December 27, 1982 by the radiation safety staff after the operations manager verified that no radioactive inventory remained in the warehouse.[22] The instrument used was checked with a source of Iodine-125 of a known quantity. Any area that exhibited a reading above background (i.e. greater than 100 cpm or 0.05 mR/hr) was investigated and remediated as necessary. No elevated areas were identified during the performance of the survey, which was deemed adequate for meeting the release criteria specified in USNRC Regulatory Guide 1.86 and as shown in Table 6.2 of this report.[23]

---

[19] Miles Laboratory, *License amendment*, November 28, 1979.

[20] U.S. Nuclear Regulatory Commission, *Radioactive Material License*, Amendment 37, February 3, 1983.

[21] Iodine 125 has a radioactive half life of 60.1 days.

[22] Miles Laboratory, Internal Memo, *Closure of Fort Wayne Tracon, Inc. Warehouse*, January 6, 1983.

[23] U. S. Nuclear Regulatory Commission, *Termination of Operating Licenses for Nuclear Reactors*, Regulatory Guide 1.86, June, 1974.

3.5.3 Potential Contaminated Media
At the Tracon facility, there were no spills or breaches of the sealed containers reported by the radiation safety staff. All kits were accounted for at the time when Miles Laboratories terminated the agreement for storage at the Tracon facilities. There was no potentially contaminated media.

3.5.4 Related Environmental Concerns
There were no related environmental concerns with sealed containers of radioactive materials.

3.6 3400 Middlebury Street, Elkhart
Miles Laboratories originally assembled instruments at the Middlebury Street facility in Elkhart, Indiana, beginning in April, 1976, in Buildings 90 and 91.[24] Operations included the manufacture of Gammacord II and Thyrimeter instruments, each capable of detecting radioactive materials as a medical diagnostic tool. After July, 1976, unsealed quantities of I-125 were packaged in Building 91. Work with radioactive materials in both Buildings 90 and 91 ceased in 1992. On May 17, 1993, after confirming that the site could be released for unrestricted use, Bayer submitted an application to remove this location from the listing of permanent restricted areas on Amendment 43 of its license.[25] The USNRC approved this request in Amendment 44 on June 29, 1993,.

3.6.1 Potential Contaminants
Sealed sources, Cr-51, Co-57, Co-60, Fe-59, I-129, Ba-133, and Cs-137 were handled in Bldg 90 to calibrate the instruments, Gammacord II and Thyrimeter. After July, 1976, unsealed quantities of I-125 were packaged in Building 91.

3.6.2 Potential Contaminated Areas
Sealed and unsealed sources were used in Buildings 90 and 91. Radiation surveys were performed periodically by the radiation safety staff using release criteria established by license condition. Samples for removable tritium were analyzed via liquid scintillation counters. Direct radiation surveys were also performed with calibrated, end window GM detector equivalent to a Victoreen Model 491.

A radiation survey was completed on August 10, 1982 by the radiation safety staff after the operations manager verified that no radioactive inventory remained in the warehouse.[26] The instrument was checked with a source of iodine 125 of a known quantity. Any area that exhibited a reading above background (i.e. greater than 100 cpm or 0.05 mR/hr) was investigated and remediated as necessary. No elevated areas were identified in the radiation survey This type of

---

[24] Miles Laboratories, *Radiation Safety Committee Minutes*, January 20, 1976.

[25] Miles Laboratories, NRC License 13-02249-01, Control Number 93838, *Amendment 42 and 43*, May 17, 1993.

[26] Miles Laboratory, Internal Memo, *Area Survey Report*, August 10, 1982.

survey was adequate to detect the release criteria equivalent to the limits specified in USNRC Regulatory Guide 1.86, as shown in Table 6.2 of this report.[27]

3.6.3 Potential Contaminated Media

Unsealed quantities of I-125 were handled at different times in Buildings 91 such that there was a potential for benchtops and floors to be impacted. Surveys were performed periodically to verify that the level of contamination was less than the release criteria established in the radioactive materials license for the facility. Radiation surveys were performed when no further work with radioactivity was planned. No surfaces required decontamination or remediation. The short half life of I-125, 60.1 days, minimized the potential for long term impacts of fixed or removable contamination.

3.6.4 Related Environmental Concerns

No environmental concerns were identified. Sealed sources were packaged in accordance with the Department of Transportation requirements and shipped offsite for disposal at a facility licensed to receive and bury radioactive materials.

3.7 1301 Napanee Court, Elkhart

Miles Laboratories received permission in 1975 to store and distribute packaged quantities of I-125 at the warehouse located on 1301 Napanee Court, Elkhart, Indiana.[28] Packages of radioactive materials were received after July, 1976.[29] Work with radioactive materials at Napanee Court ceased in 1992. On May 17, 1993, after confirming that the site could be released for unrestricted use, Miles Laboratories submitted an application to remove this location from the listing of permanent restricted areas on Amendment 43 of its license. By issue of Amendment 44 on June 29, 1993, the USNRC approved this application.

3.7.1 Potential Contaminants

Miles Laboratories were authorized by the USNRC to store sealed packages containing iodine-125.[30] The radioisotopes, stored in the form of in-vitro clinical test kits, were distributed to customers authorized under a general license issued by the USNRC. A maximum of 100 millicuries were stored at the warehouse at any one time.

---

[27] U.S. Nuclear Regulatory Commission, *Termination of Operating Licenses for Nuclear Reactors*, Regulatory Guide 1.86, June, 1974.

[28] Miles Laboratory, *License amendment*, Amendment 30, Condition 10, November 25, 1975.

[29] Miles Laboratories, *Radiation Safety Committee Minutes*, July 15, 1976.

[30] Iodine 125 has a radioactive half life of 60.1 days.

3.7.2 Potential Contaminated Areas
Radiation surveys were performed periodically by the radiation safety staff using release criteria established in their license. Direct radiation surveys were performed with calibrated, end window geiger mueller detector equivalent to a Victoreen Model 491. A radiation survey was completed on February 25, 1983 by the radiation safety staff after the operations manager verified that no radioactive inventory remained in the warehouse.[31] The instrument was checked with a source of iodine 125 of a known quantity. Any area that exhibited a reading above background (i.e. greater than 100 cpm or 0.05 mR/hr) was investigated and remediated as necessary. No elevated areas were identified in the radiation survey This type of survey was adequate for detecting the release criteria equivalent to the limits specified in USNRC Regulatory Guide 1.86, as summarized in Table 6.2 of this report.[32]

3.7.3 Potential Contaminated Media
There were no spills or breaches of the sealed containers reported by the radiation safety staff. All kits were accounted for at the time when Miles Laboratories shut down operations at the warehouse. There were no potentially contaminated media.

3.7.4 Related Environmental Concerns
There were no related environmental concerns.

3.8 4315 South LaFayette Street, South Bend
The facility in South Bend, Indiana was approved to manufacture radioimmunoassay test strips using I-125 in 1977. The radioactive iodine was infused on each test strip and acted as a tracer in the in vitro biochemical test.[33] Work with radioactive materials at this location ceased in 1992. On May 17, 1993, after confirming that the site could be released for unrestricted use, Bayer submitted an application to remove this location from the listing of permanent restricted areas on Amendment 43 of its license. By issue of Amendment 44 on June 29, 1993, the USNRC approved this application.

3.8.1 Potential Contaminants
Iodine-125 was infused in the test strips distributed to customers under a general license. Unsealed quantities of I1125 were used at the facility in South Bend in a manner similar to that of the facility in Building 91 in Mishawaka, Indiana.

3.8.2 Potential Contaminated Areas
Radiation surveys for I-125 were performed periodically by the radiation safety staff using release criteria established in their license. Direct radiation surveys were performed with calibrated, end

---

[31] Miles Laboratory, Internal Memo, *Area Survey Report*, February 25, 1983.

[32] U.S. Nuclear Regulatory Commission, *Termination of Operating Licenses for Nuclear Reactors*, Regulatory Guide 1.86, June, 1974.

[33] Miles Laboratory, *Amendment of Miles Laboratories*, March 9, 1977.

window GM detector equivalent to a Victoreen Model 491. A radiation survey was completed on December 14, 1989 by the radiation safety staff after the operations manager verified that no radioactive inventory remained in the laboratories.[34] The instrument was checked with a source of iodine 125 of a known quantity. Any area that exhibited a reading above background (i.e. greater than 100 cpm or 0.05 mR/hr) was investigated and remediated as necessary. No elevated areas were identified in the radiation survey This type of survey was adequate for detecting the release criteria equivalent to the limits specified in USNRC Regulatory Guide 1.86, as summarized in Table 6.2 of this report.[35]

3.8.3 Potential Contaminated Media

Unsealed quantities of I-125 were handled at different times in the South Bend facility such that there was a potential for benchtops and floors to be impacted. Surveys were performed periodically to verify that the level of contamination was less than the release criteria established in the radioactive materials license for the facility. Radiation surveys were performed when no further work with radioactive isotopes was planned. No surfaces required decontamination or remediation. The short half life of I-125, 60.1 days, minimized the potential for long term impacts of fixed or removable contamination.

3.8.4 Related Environmental Concerns

No environmental concerns were identified. All inventory was shipped to the warehouse in Elkhart for final disposition.

3.9 4718 Yender Avenue, Lisle

The facility located on 4718 Yender Avenue in Lisle, Illinois manufactured a number of different kits with radioisotopes, including I-125, C-14, H-3, and P-32. Work with radioactive materials began in 1983 and was terminated in 1985.[36] All radioactive materials were removed from the site and was inspected to verify that no radioactive materials remained at the site. The facility was sold to ICN ImmunoBiologicals on November 21, 1985.[37] After all licensed radioactivity was removed, final status surveys were performed to demonstrate that the sites could be released for unrestricted use.

3.9.1 Potential Contaminants

Four isotopes were used routinely at the Lisle facility, including tritium (H-3), C-14, I-125, and P-32. All four isotopes were used in an unsealed form.

[34] Miles Laboratory, Internal Memo, *Area Survey Report*, December 14, 1989.

[35] U.S. Nuclear Regulatory Commission, *Termination of Operating Licenses for Nuclear Reactors*, Regulatory Guide 1.86, June, 1974.

[36] Miles Laboratory, Internal Memo, *Removal of Lisle, IL facility from NRC License*, August 17, 1987.

[37] Miles Laboratory, Letter from John Engelman, *NRC License No. 13-02249-01*, August 20, 1987.

3.9.2 Potential Contaminated Areas
Sealed and unsealed sources were used previously at the Lisle facility. Benchtops and floors were potentially impacted by the work performed by Miles technicians. Radiation surveys were performed periodically by the radiation safety staff using release criteria established in their license. Samples for removable tritium activity were analyzed via liquid scintillation counters. Direct radiation surveys were also performed with calibrated, end window GM detector equivalent to a Victoreen Model 491. The instrument was checked with a source of iodine 125 of a known quantity. Any area that exhibited a reading above background (i.e. greater than 100 cpm or 0.05 mR/hr) was investigated.

3.9.3 Potential Contaminated Media
Radiation surveys were performed periodically to verify that the level of contamination was less than the release criteria established in the radioactive materials license for the facility. Radiation surveys were performed when no further work with radioactive isotopes was planned. No surfaces required decontamination or remediation. The short half life of I-125, 60.1 days, and P-32, 14.3 days, minimized the potential for long term impacts of fixed or removable contamination.

3.9.4 Related Environmental Concerns
There were no environmental concerns identified by the Miles Radiation Safety Committee nor the radiation safety officer.

3.10 30 West 475 North Aurora Road, Naperville
Miles Laboratories received permission in 1978 to store packaged quantities of tritium (H-3), C-14, and I-125 at the warehouse located in Naperville, Illinois. Work with radioactive materials at the facility ceased in 1985.[38]

3.10.1 Potential Contaminants
Miles Laboratories were authorized by the USNRC to store sealed packages containing labeled polynucleotides with H-3, C-14, or Iodine-125.[39] The radioisotopes, stored in the form of sealed test kits, were distributed to customers authorized under a general license issued by the USNRC. A maximum of 100 millicuries were stored at the warehouse at any one time.

3.10.2 Potential Contaminated Areas
Radiation surveys were performed periodically by the radiation safety staff using release criteria established in their license. Direct radiation surveys were performed with calibrated, end window GM detector equivalent to a Victoreen Model 491. This type of survey was adequate to detect the

[38] Miles, Inc., Internal Memo, *Discontinuation of Radioactive Labeled Biochemicals*, February 1, 1985.

[39] Iodine 125 has a radioactive half life of 60.1 days.

release criteria equivalent to the limits specified in USNRC Regulatory Guide 1.86.[40] The release criteria are provided in Table 6.2 of this report.

3.10.3 Potential Contaminated Media
There were no spills or breaches of the sealed containers reported by the radiation safety staff. All kits were accounted for at the time when Miles Laboratories shut down operations at the warehouse. There was no potentially contaminated media.

3.10.4 Related Environmental Concerns
There were no related environmental concerns.

3.11 430 South Beiger, Mishawaka
Miles Laboratories assembled medical instruments at the facility located at 430 South Beiger in Mishawaka, Indiana.[41] Miles Laboratories manufactured the gamma counting instruments, Gammacord II and Thyrimeter instruments, in a manner similar to the work performed at 3400 Middlebury Street in Mishawaka. Work with radioactive materials at these locations ceased in 1992. On May 17, 1993, after confirming that the site could be released for unrestricted use, Bayer submitted an application to remove this location from the listing of permanent restricted areas on Amendment 43 of its license. The USNRC approved this request in Amendment 44 on June 29, 1993.

3.11.1 Potential Contaminants
Sealed sources, Cr51, Co57, Co60, Fe59, I129, Ba133, and Cs 137 (less than 1 millicurie each source) were handled at this facility. Wipe tests of the sealed sources were collected by the radiation safety staff and analyzed by an approved laboratory.

3.11.2 Potential Contaminated Areas
The inventory of sealed sources was maintained by the radiation safety staff. Direct radiation surveys were also performed with calibrated, end window GM detector equivalent to a Victoreen Model 491. A radiation survey was completed on October 16, 1990 by the radiation safety staff after the operations manager verified that no radioactive inventory remained in the warehouse.[42] The instrument was checked with a source of iodine 125 of a known quantity. Any area that exhibited a reading above background (i.e. greater than 100 cpm or 0.05 mR/hr) was investigated and remediated as necessary. No elevated areas were identified in the radiation survey This type of

[40] U.S. Nuclear Regulatory Commission, *Termination of Operating Licenses for Nuclear Reactors*, Regulatory Guide 1.86, June, 1974.

[41] Miles Laboratories, *Amendment of Mile Laboratories License*, February 6, 1980.

[42] Miles Laboratory, Internal Memo, *Area Survey Report*, October 16, 1990.

survey was adequate to detect the release criteria equivalent to the limits specified in USNRC Regulatory Guide 1.86.[43] The release criteria are provided in Table 6.2 of this report.

3.11.3 Potential Contaminated Media

All radioactive sources were used in a sealed form and wipe tests verified that no radioactive materials leaked from the source housing. All sources were disposed of via a licensed contractor.

3.11.4 Related Environmental Concerns

There were no related environmental concerns reported by the Radiation Safety Officer or the Radiation Safety Committee.

[43] U.S. Nuclear Regulatory Commission, *Termination of Operating Licenses for Nuclear Reactors*, Regulatory Guide 1.86, June, 1974.

4 CONCLUSIONS

The radiation safety program at Miles Laboratories and Bayer was maintained from 1957 to the present, using a wide variety of radioactive materials for research as well as distribution to customers using a general license issued by the USNRC. Miles Laboratory maintained a broad scope license and the radiation safety committee, established by Miles Laboratories, was effective to manage the safe use of the radioactive materials. The USNRC inspected the program periodically to verify the effectiveness of the radiation safety program and compliance with the license requirements.

The Miles Laboratories radiation safety committee reviewed the inventory of both sealed and unsealed sources. The radiation safety officer verified that leak tests were completed for the sealed sources in use and performed periodic radiation surveys to supplement the tests performed by the research investigators. The radiation safety officer performed radiation surveys for fixed and removable radioactivity when a laboratory or work area was removed from the list of restricted areas. The following is an assessment summary for all impacted buildings, rooms and areas:

- Building 18 - Two rooms in Building 18, Room 18C.B.37 and the rad isotope room (Room 18C.05) were in use as late as 2006. Both rooms were classified as Class 2 areas as described in MARSSIM. These two rooms were surveyed by a contractor in 2007 to verify that no impacted surfaces were remaining. The derived concentration guidelines levels were established by the USNRC as screening levels to achieve a radiation dose of less than 25 millirem per year for unrestricted use. Other rooms in Building 18 were surveyed by the Miles Laboratories radiation safety staff to verify that no impacted surfaces were present. Much of the radioactive material consisted of short lived iodine 125 such that the physical decay of the radioisotope was adequate to limit the presence of radioactive contamination after a relatively short period of time. The surveys were adequate for identifying quantities of radioactive material in excess of action levels set forth in the license and as recommended in USNRC guidance, Regulatory Guide 1.86.

- Building 9 - Radioactive materials were used in Building 9 for the longest duration, from the early 1960s to the late 1990s. The incinerator was also housed in Building 9. The Miles Laboratories radiation staff completed radiation surveys for both fixed and removable activity in each room after work was completed. A contractor completed a radiation survey prior to demolition. The surveys were adequate to detect quantities of radioactive material identify quantities of radioactive material in excess of action levels set by the license and the USNRC guidance, Regulatory Guide 1.86.

- Tracon Facility - The facility leased from Tracon, Inc., located in Fort Wayne, Indiana, provided a warehouse for sealed kits containing a discrete quantity of

Iodine-125. The survey performed by the radiation safety staff in 1982 was adequate to detect quantities of radioactive material identify quantities of radioactive material in excess of action levels set by the license and the USNRC guidance, Regulatory Guide 1.86.

- 3400 Middlebury Street - The production facility operated by Miles Laboratories in Elkhart (3400 Middlebury Street) from 1976 to 1992 using Iodine-125 and a selection of sealed sources for purposes of calibration. The survey performed by the radiation safety staff in 1983 were adequate to detect quantities of radioactive material in excess of action levels set by the license and the USNRC guidance, Regulatory Guide 1.86.

- 1301 Napanee Court - The warehouse operated by Miles Laboratories in 1301 Napanee Court, Elkhart, Indiana, handled sealed packages of radioactive materials, distributed to clients who were authorized to receive general licensed quantities of radioactive materials. The survey performed by the radiation safety staff in 1992 verified that no contamination existed in quantities of radioactive material in excess of action levels set by the license and the USNRC guidance, Regulatory Guide 1.86.

- 4315 South Lafayette - The facility in South Bend, Indiana (4315 South Lafayette) used iodine 125 from 1977 to 1992. The survey performed by the radiation safety staff in 1992 verified that no contamination existed in quantities of radioactive material in excess of action levels set by the license and the USNRC guidance, Regulatory Guide 1.86.

- 4718 Yender Avenue - The facility located in Lisle, Illinois (4718 Yender Avenue) manufactured a number of different kits with radioisotopes, including I-125, C-14, H-3, and P-32, from 1983 to 1985. After all licensed radioactivity was removed, final surveys were performed to demonstrate that the sites could be released for unrestricted use as described in the USNRC license and Regulatory Guide 1.86.

- 30 West 475 North Aurora Road - The warehouse operated by Miles Laboratories in Naperville, Illinois, (30 West 475 North Aurora Road) handled sealed packages of radioactive materials, distributed to clients who were authorized to receive general licensed quantities of radioactive materials. The survey performed by the radiation safety staff verified that no contamination existed in quantities of radioactive material in excess of action levels set by the license and the USNRC guidance, Regulatory Guide 1.86.

- 430 South Beiger - The facility in Mishawaka, Indiana (430 South Beiger) handled sealed sources for purposes of calibration of medical gamma counters, manufactured by Miles Laboratories. The survey performed by the radiation safety staff in 1992 verified that no contamination existed in quantities of radioactive material in excess of action levels set by the license and the USNRC guidance, Regulatory Guide 1.86.

All radioactive material has been removed from the Elkhart facility and associated remote locations. No areas exist where impacted surfaces exist in excess of the USNRC dose criteria established in 10 CFR 20.1402. Therefore, all areas may be released for unrestricted use.

5 TECHNICAL REFERENCES

In order to facilitate regulatory review of this HSA and the Bayer Final Status Survey report, copies of the documents referenced herein have been placed on a CD that appears at the end of this Chapter for all bound copies of the report. The following table that lists the footnote number, re-states the reference and gives the file identifier for that record as it appears on the CD.

Footnote No.	Reference	CD File Identifier
1	U. S. Nuclear Regulatory Commission, Radioactive Materials License 13-02249-01, Docket Number 030-04336, expires on December 31, 2010	20070806.pdf
2	Bayer HealthCare, LLC, Letter from Dr. Shannon Gleason to the USNRC Region III, License Termination, October 23, 2006.	20061023.pdf
3	U.S. Nuclear Regulatory Commission, Request for Additional Information, Mail Control Number 315794, January 10, 2007.	20070110.pdf
4	U.S. Nuclear Regulatory Commission, Multi-agency Radiation Survey and Site Investigation Manual, NUREG-1575, Revision 1, August, 2000.	Commonly available and not included on the CD.
6	Miles, Inc., Company Name Change, License 13-02249-01, March 4, 1995	19950304.pdf
8,10	Integrated Environmental Management, Inc., Final Status Survey Report for Selected Laboratories in Building 18, Report Number 2007006/G-4349, August, 2007.	Transmitted separately and not included on the CD.
13	Miles Laboratory, Request for Amendment, February 18, 1970.	19700218.pdf
14	Miles Laboratories, Release of Buildings for Demolition, August 24, 1999.	19990824.pdf
15	Baker Environmental, Buildings 3 and 9 Radiation Survey, August 2, 1999.	19990802.pdf
16	Baker Environmental, Buildings 3 and 9 Radiation Survey, August 2, 1999.	19990802.pdf
17	Miles, Inc., Amendment of Radioactive Materials License 13-02249-01, September 25, 1990.	19900925.pdf
19	Miles Laboratory, License amendment, November 28, 1979.	19791128.pdf
20	U.S. Nuclear Regulatory Commission, *Radioactive Material License*, Amendment 37, February 3, 1983.	19830203.pdf
22	Miles Laboratory, Internal Memo, Closure of Fort Wayne Tracon, Inc. Warehouse, January 6, 1983.	19830106.pdf

Footnote No.	Reference	CD File Identifier
23	U. S. Nuclear Regulatory Commission, Termination of Operating Licenses for Nuclear Reactors, Regulatory Guide 1.86, June, 1974.	Commonly available and not included on the CD.
24	Miles Laboratories, Radiation Safety Committee Minutes, January 20, 1976.	19760123.pdf
25	Miles Laboratories, NRC License 13-02249-01, Control Number 93838, Amendment 42 and 43, May 17, 1993.	19930517.pdf
26	Miles Laboratory, Internal Memo, Area Survey Report, August 10, 1982.	19820810.pdf
27	U.S. Nuclear Regulatory Commission, Termination of Operating Licenses for Nuclear Reactors, Regulatory Guide 1.86, June, 1974.	Commonly available and not included on the CD.
28	Miles Laboratory, License amendment, Amendment 30, November 25, 1975, Condition 10.	Not included in CD
29	Miles Laboratories, Radiation Safety Committee Minutes, July 15, 1976.	19760720.pdf
31	Miles Laboratory, Internal Memo, Area Survey Report, February 25, 1983.	19830225.pdf
32	U.S. Nuclear Regulatory Commission, Termination of Operating Licenses for Nuclear Reactors, Regulatory Guide 1.86, June, 1974.	Commonly available and not included on the CD.
33	Miles Laboratory, Amendment of Miles Laboratories, March 9, 1977.	19770309.pdf
34	Miles Laboratory, Internal Memo, Area Survey Report, December 14, 1989.	19891214.pdf
35	U.S. Nuclear Regulatory Commission, Termination of Operating Licenses for Nuclear Reactors, Regulatory Guide 1.86, June, 1974.	Commonly available and not included on the CD.
36	Miles Laboratory, Internal Memo, Removal of Lisle, IL facility from NRC License, August 17, 1987.	19870820.pdf
37	Miles Laboratory, Letter from John Engelman, NRC License No. 13-02249-01, August 20, 1987.	19870820.pdf
38	Miles, Inc., Internal Memo, Discontinuation of Radioactive Labeled Biochemicals, February 1, 1985.	19850201.pdf
40	U.S. Nuclear Regulatory Commission, Termination of Operating Licenses for Nuclear Reactors, Regulatory Guide 1.86, June, 1974.	Commonly available and not included on the CD.

Footnote No.	Reference	CD File Identifier
41	Miles Laboratories, Amendment of Mile Laboratories License, February 6, 1980.	19800206.pdf
42	Miles Laboratory, Internal Memo, Area Survey Report, October 16, 1990.	19901016.pdf
43	U.S. Nuclear Regulatory Commission, Termination of Operating Licenses for Nuclear Reactors, Regulatory Guide 1.86, June, 1974.	Commonly available and not included on the CD.

6 TABLES

Table 6.1 - Locations Described in the USNRC Radioactive Materials License

	Street Address	Comments
1	Building 18, 1884 Miles Avenue, Elkhart, Indiana	Rooms in Building 18 were assigned to use radioactive materials, starting in the late 1970s. Two rooms in Building 18, Room 18C.B.37 and the rad isotope room (Room 18C.05) were the only locations using radioisotopes after 1995. The two rooms were classified as Class 2 areas as described in MARSSIM. These two rooms were surveyed by a contractor in 2007 to verify that no impacted surfaces were remaining.
2	1127 Myrtle Street, Elkhart, Indiana	An address that refers to 1884 Miles Avenue.
3	1884 Miles Avenue, Elkhart, Indiana	Mailing address for research campus that was revised in 1993.
4	Incinerator, Building 9, 1127 Myrtle Street, Elkhart, Indiana	Building 9 and the incinerator was demolished in 1999. Radiation surveys indicated that no radioactive contamination existed in excess of USNRC limits.
5	Tracon, Inc., 641 Growth Avenue, Fort Wayne, Indiana	Facility leased by Miles Laboratories to provide a warehouse for sealed kits containing a discrete quantity of Iodine-125. Radiation surveys were performed in 1983.
6	3400 Middlebury Street, Elkhart, Indiana	A manufacturing facility that operated from 1976 to 1992. Medical test kits were manufactured using Iodine-125. Radiation surveys were performed in 1993.
7	1301 Napanee Court, Elkhart, Indiana	A warehouse that handled sealed packages of radioactive materials and distributed the packages to clients who were authorized to receive general licensed quantities of radioactive materials. Radiation surveys were performed in 1993.
8	4315 South LaFayette Street, South Bend, Indiana	A manufacturing facility that used iodine 125 from 1977 to 1992. The survey performed by the radiation safety staff in 1992 verified that no contamination existed in excess of the license limits and USNRC requirements.
9	4718 Yender Avenue, Lisle, Illinois	A manufacturing facility producing a number of different kits with radioisotopes, including I-125, C-14, H-3, and P-32, from 1983 to 1985. The survey performed by the radiation safety staff verified that no contamination existed in excess of the license limits and USNRC requirements.
10	30 West 475 North Aurora Road, Naperville, Illinois	A warehouse that handled sealed packages of radioactive materials and distributed the packages to clients who were authorized to receive general licensed quantities of radioactive materials. The survey performed by the radiation safety staff verified that no contamination existed in excess of the license limits and USNRC requirements.

	Street Address	Comments
11	430 South Beiger, Mishawaka, Indiana	A manufacturing facility that handled sealed sources for purposes of calibration of medical gamma counters. Radiation surveys were performed in 1993.
12	1000 Randolph Street, Elkhart, Indiana	Shipping address for the Elkhart research campus. Refers to the same campus as 1884 Miles Avenue.
13	C.S. Beardsley Research Building	Another name for Building 9, demolished in 1999.
14	2 barns northwest of the main facility, Elkhart, Indiana	The barns were authorized to use radioactive tracers as part of the research being conducted. However, no radioactive materials were ever used at the offsite facility.

Table 6.2 - Acceptable Surface Contamination Levels

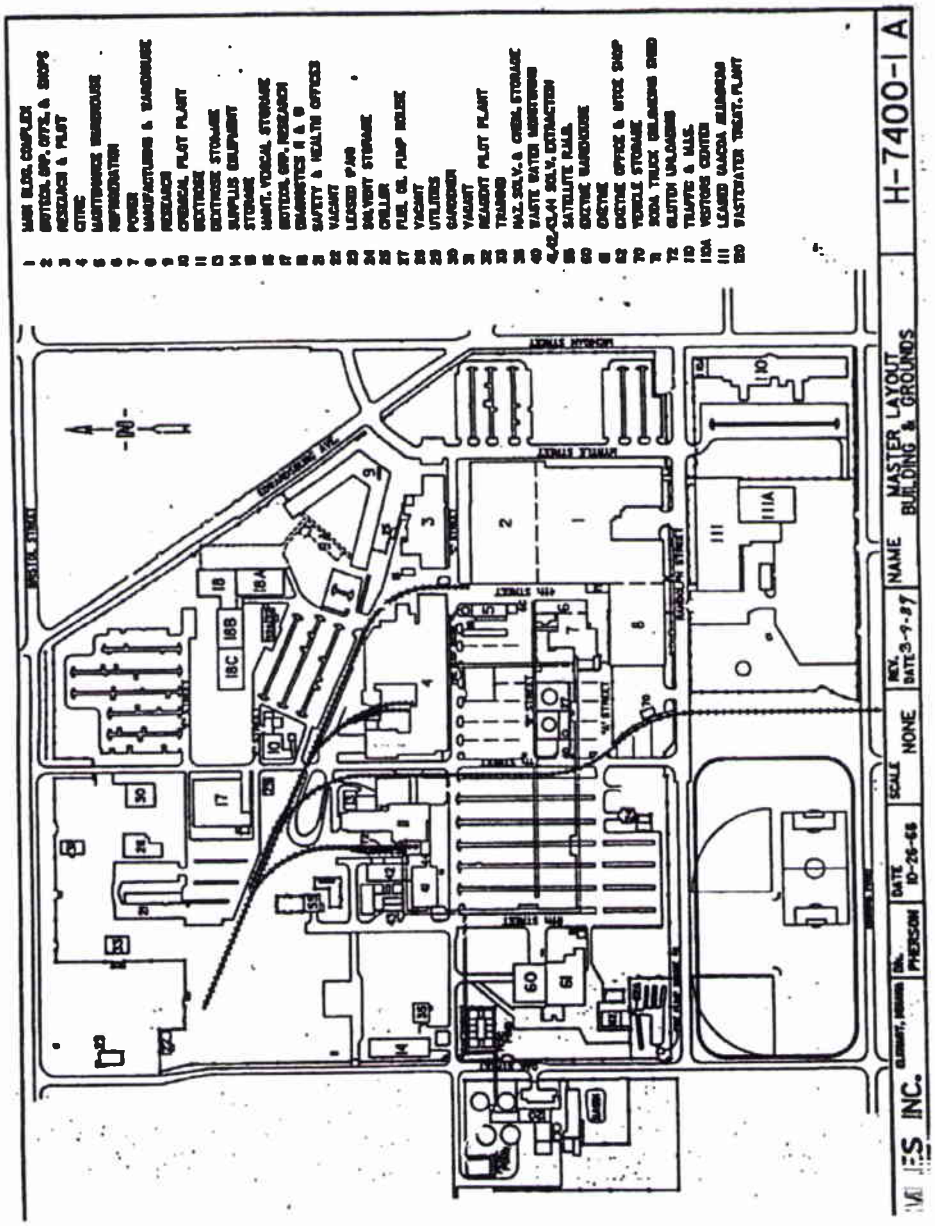
Radionuclide[a]	Average[b,c]	Maximum[b,d]	Removable[b,e]
U-nat, U-235, U-238, and associated decay products	5,000 dpm α/100cm^2	15,000 dpm α/100cm^2	1,000 dpm α/100cm^2
Transuranics, Ra-226, Ac-227, I-125, I-129	100 dpm/100cm^2	300 dpm/100cm^2	20 dpm/100cm^2
Th-nat, Th-232, Sr-90, I-131, I-133	1,000 dpm/100cm^2	3,000 dpm/100cm^2	200 dpm/100cm^2
Beta-gamma emitters (except Sr-90 and others noted above)	5,000 dpm $\beta\gamma$/100cm^2	15,000 dpm $\beta\gamma$/100cm^2	1,000 dpm $\beta\gamma$/100cm^2

Notes
a - Where surface contamination by both alpha and beta-gamma emitting nuclides exists, the limits established for alpha and beta-gamma nuclides should apply independently.
b - As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.
c - Measurements of average contaminant should not be averaged over more than one (1) square meter. For objects of less surface area, the average should be derived for each object.
d - The maximum contamination level applies to an area of not more than 100 cm^2.
e - The amount of removable radioactive materials per 100cm2 of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on te wipe with and appropriate instrument of known efficiency. When removable contamination on objects of less surface area is determined, the pertinent levels should be reduced proportionally and the entire surface should be wiped.

Reference: U.S. Nuclear Regulatory Commission, *Termination of Operating Licenses for Nuclear Reactors*, Regulatory Guide 1.86, June, 1974.

7 FIGURES

Figure 7.1 - Master Layout of Buildings and Grounds



This report was prepared under the direction of
Bayer HealthCare, LLC

by

Billy R. Thomas, CHP, CIH
Integrated Environmental Management, Inc.
1129 Trenton Avenue, Suite 202
Findlay, Ohio 45840
(419) 423-4701
BRThomas@IEM-Inc.com

http://www.iem-inc.com

Final Status Survey Report for Selected Laboratories in Building 18

Submitted to

Bayer HealthCare, LLC
1025 North Michigan Street
Elkhart, Indiana 46514-2215
(574) 262-6502

by:

Integrated Environmental Management, Inc.
6700 Baum Drive, Suite 19
Knoxville, Tennessee 37919
(865) 588-9180

Report No. 2007006/G-4349
October 29, 2007

TABLE OF CONTENTS

1 INTRODUCTION

In Building 18 at the Bayer HealthCare LLC (Bayer) facilities in Elkhart, Indiana, Bayer conducted research and development using radioactive tracers. There was a single laboratory and waste storage room that were listed as restricted areas and authorized to use the radioactive materials listed on the radioactive materials license issued by the U.S. Nuclear Regulatory Commission (USNRC) License No. 13-02249-01.

In order to terminate the radioactive materials license, the Bayer Healthcare radiation safety staff must demonstrate that there are no radiological issues of concern therein. To that end, IEM was contracted by Bayer to perform/document a final status survey demonstrating that the lab may be released for unrestricted use (i.e., without regard for their radiological constituents).[1]

The on-site portion of the project was completed between August 13 and August 15, 2007, followed by the preparation of this Final Status Survey (FSS) Report. Included herein is a description of the site, a review of the history of radiological operations in the laboratories and recent radiological conditions, an overview of the project and its objectives, a description of the procedures followed, a listing of all data acquired from the site, and a statement in regard to the release status of the selected laboratories in Building 18. Representatives of Bayer were given an opportunity to review and comment on a draft before the publication of this FSS Report.

[1] IEM is licensed by the Maryland Department of the Environment (MDE License No. MD-31-281-01), a USNRC Agreement State, to perform the types of radiation-related services required for this project. However, the final status survey was performed under the applicable terms/conditions of the Bayer license.

2 BACKGROUND

2.1 Facility History

Radioactive materials have been used in Building 18 at the Elkhart site since the late 1970's in accordance with the requirements of the U.S. Nuclear Regulatory Commission (USNRC) Radioactive Materials License 13-02249-01.[2] An historical site assessment (HSA) was performed as part of the license termination process.[3] Included in that assessment is the history of radionuclide use at Building 18, to which readers of this FSS Report are referred.

2.2 Description of Facility

Building 18 is a multi-story brick building that was constructed to house various chemical research and development activities. The laboratories are equipped with cabinets, ventilation hoods and sinks. The concrete floors are covered with an industrial-grade tile to restrict the absorption of liquids.

2.3 Contaminant Identification

As shown in the HSA, a wide range of research was conducted in Building 18, wherein both short- and long-lived radioisotopes were used. Several areas in the building used radioactive hydrogen (^{3}H or tritium), Carbon-14 (^{14}C), Sulfur-35 (^{35}S), Cobalt-57 (^{57}Co), and Iodine-125 (^{125}I) during the late 1970's and into early 1990's. From 1995 until the present day, the use of radioactivity was limited to primarily ^{125}I, with operations confined to the waste collection area (Room 18C.B.37) and the isotope room (Room 18C.05).

2.4 Results of Previous Surveys

Ambient (exposure rate) surveys were performed by the Area Radiation Safety Supervisor upon final use of a specific location. Surveys for residual contamination in those areas were routinely performed by investigators throughout the use process. When radioisotope use in the area ceased, closeout surveys in the form of wipe tests were performed by the Area Radiation Safety Supervisor, with smears counted in a calibrated gamma counter or liquid scintillation counter. These results were then submitted to the RSO for review prior to releasing the laboratory from the radioisotope use requirements. After RSO release, that laboratory was, for all intents and purposes, considered to be decommissioned.[4]

---

[2] U. S. Nuclear Regulatory Commission, Radioactive Materials License 13-02249-01, Docket Number 030-04336, expires on December 31, 2010.

[3] Integrated Environmental Management, Inc., Report No. 2007006/G-4351, *Historical Site Assessment for the Elkhart, Indiana Facility*, prepared for Bayer HealthCare, LLC, October 29, 2007.

[4] Bayer Healthcare, LLC, Letter from Dr. Shannon Gleason to the USNRC Region III, *License Termination*, October 23, 2006.

The various close-out surveys performed over the years in Building 18 demonstrate that no radionuclide remains in the various laboratories. An additional survey was performed in 2006, wherein it was confirmed that the residual radioactivity in Building 18 was not distinguishable from background.[5]

[5] Bayer Healthcare, LLC, Letter from Dr. Shannon Gleason to the USNRC Region III, *License Termination*, October 23, 2006.

3 FSS APPROACH

3.1 Project Organization

For this work, Mr. R. Alan Duff, RRPT, of IEM's Tennessee office, served as the Project Manager and coordinated the field and final status survey efforts. Mr. Jeffrey W. Sumlin, RRPT, also of IEM's Tennessee office, was the on-site Heath Physics (HP) Technician and was responsible for data acquisition and the preparation of this report. Mr. Billy R. Thomas, CHP, CIH of IEM's Ohio office served as the Project CHP and was responsible for the technical requirements associated with the project. Appendix 8.1 contains the qualifications of each member of the project team.

3.2 Survey Planning

In advance of mobilizing to the site, a survey plan was prepared and submitted to Bayer for review and approval.[6] Included in the plan were data quality objectives, instrumentation requirements, survey unit classification, data acquisition procedures and quality control and reporting requirements. Based on previous surveys and the historical site assessment, surveys were required in two (2) rooms, the previous Rad Lab (Room C.05) and the Waste Storage Room (Door 18.B.37), as described in Table 6.1. Additional detail on the remaining subsections of this Chapter can be found in the survey plan.

3.3 Release Criteria

The USNRC has established criteria for ensuring that facilities and property that were used for licensed operations present negligible radiological risk to people and the environment once licensed operations cease. The radiation dose limit that the USNRC believes presents negligible risk is published in Title 10, Code of Federal Regulations, Part 20.1402:

> *"Decommissioning with license termination shall be limited to sites considered acceptable for unrestricted release where the residual radioactivity that is distinguishable from background radiation results in a total effective dose equivalent to an average member of the critical group that does not exceed twenty-five millirem per year (25 mrem/yr), 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)..."*

[6] Integrated Environmental Management, Inc., *Final Status Survey Plan for the Elkhart, Indiana Facility*, Report No. 2007006/G-4348 (Rev. 0), August 9, 2007.

The level of residual radioactivity permissible on a building surface that would ensure compliance with USNRC's radiation dose objective is designated as the derived concentration guideline level (DCGL) as defined in MARSSIM.[7]

For the purpose of this survey effort, the DCGLs were conservatively set to the screening values presented in Table H.1 of NUREG-1757, Volume 2 and Table 5.19 of NUREG-5512,Volume 3.[8,9] These screening values were established by the USNRC based on an exposure assessment of less than 25 millirem per year to the critical population for the 1,000-year period after release for unrestricted use. Assumptions designed to maximize the resulting dose were used as input to the assessment.

Table 6.2 contains the DCGLs applicable to Building 18. For the on-site effort, the data acquired were compared to the most restrictive DCGL, which was for C-14. As such, the gross activity release criteria was 3.7×10^6 dpm (beta)/100cm^2.

3.4 Objectives

The objective of the final status survey was to release the laboratories in Building 18 in accordance with guidance established by the USNRC and MARSSIM. This objective was accomplished in general by:

- Selecting the appropriate instrumentation to adequately detect the radionuclides of concern;
- Establishing proper count times and measurement methods to verify that the release criteria are met;
- Performing surveys to verify the radiological status of the facility;
- Verifying that personnel exposure from residual contamination will not exceed 25 mrem/year based on the future use of the facility; and
- Evaluating the data to ensure that sufficient information is collected to release the rooms for unrestricted use.

---

[7] U.S. Nuclear Regulatory Commission, *Multi-agency Radiation Survey and Site Investigation Manual*, NUREG-1575, Revision 1, August, 2000.

[8] U.S. Nuclear Regulatory Commission, *Consolidated Decommissioning Guidance Characterization, Survey, and Determination of Radiological Criteria*, Table H.1, NUREG 1757, Volume 2, Rev 1, September, 2006.

[9] U.S. Nuclear Regulatory Commission, *Residual Radioactive Contamination From Decommissioning - Parameter Analysis*, Table 5.19, NUREG 5512, Volume 3, Draft, October, 1999.

In order to ensure the laboratory surfaces meet the applicable release criteria to a reasonable degree of scientific certainty, the following statistical procedures were implemented, with details on each provided in Chapter 5 of the survey plan:

- Impacted areas were classified by contamination potential as Class 2 or Class 3 areas based on use history and contamination probability. Survey unit boundaries were specified based on common history.

- Statistical testing was based on the null hypothesis, which states that the residual radioactivity in the survey unit exceeds the site dose criterion.

- The upper bound of the gray region (UBGR) was defined as the DCGL, and the lower bound of the gray region (LBGR) was set at 0.4 x DCGL.[10]

- The Type I decision error was defined as the probability of passing a survey unit that should fail. The Type II decision error was defined as the probability of failing a survey that should pass. Probability limits of 0.05 were assigned for both decision errors.

- The standard deviation was estimated as 0.2 x DCGL.

- The relative shift was set at greater than 1.5.

- The detection sensitivity for all measurement techniques (scan, direct measurements and sample analysis) was less than 10 percent of the DCGL.

3.5 Instrumentation

The radiation detection instrumentation used for this effort was selected and operated according to the type of analysis being performed, and to ensure sensitivities sufficient to detect the identified radionuclides at the minimum detection requirements. Table 6.3 is a list of the instrument types that were used for the Building 18 final status survey, along with the types of radiations they detect, and the necessary calibration sources.

The instrument detection limits are dependent upon count times, geometry, sample size, detector efficiency, background, scanning rate and the efficiency of the surveyor.[11] Nominal detection sensitivities were calculated using the guidance in NUREG 1507 and shown in the following

[10] The gray region of a population distribution is the range of possible values for which the consequences of decision errors are relatively minor.

[11] U.S. Nuclear Regulatory Commission, *Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions*, NUREG/CR-1507, December, 1997.

subsections, and are summarized in Table 6.4. The following subsections give the calculation methodologies.

3.5.1 Direct Measurements

The equation used to calculate the minimum detectable activity for direct measurements of beta radiation is:

$$MDA = \frac{\frac{2.71}{t_s} + 3.29\sqrt{\frac{R_b}{t_s} + \frac{R_b}{t_b}}}{E \times \frac{A}{100}}$$

where MDA = Minimum detectable activity (dpm/100cm^2), R_b = Background count rate (cpm), t_b = Background count time (minutes), t_s = Sample count time (minutes), A = Detector area (cm^2), and E = Detector efficiency (counts/disintegration).[12]

3.5.2 Surface Scans

The equation used for calculating the MDA for alpha and beta scans (MDA_{SCAN}) is:

$$MDA_{SCAN} = \frac{d' \times \sqrt{b_i} \times \frac{60}{i}}{E_i \times E_S \times \sqrt{p} \times \frac{A}{100}}$$

where MDA = Minimum detectable activity (dpm/100cm^2), d' = Decision error assumed to be 3.28 for Type I error (α) =0.05 and Type II error (β) =0.95, i = Observation counting interval (detector width divided by the scan speed), b_i = Background count per observation interval, E_I = Detector efficiency, E_s = Surface efficiency (assumed to be 25% for beta contamination on concrete), p = Surveyor efficiency (Assumed to be 50%), and A = Detector area (cm^2).[13,14,15]

[12] U.S. Nuclear Regulatory Commission, *Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions*, NUREG/CR-1507, December, 1997.

[13] NUREG/CR-1507, Table 6.1, *Values of d' for Selected True Positives and False Positive Proportions.*

[14] ISO-7503 recommends using a surface efficiency based on the type of radiation and radiation energy in the absence of experimentally derived values. A surface efficiency of 0.25 is recommended for beta radiation with a maximum beta energy between 150 keV and 400 keV.

[15] International Organization for Standardization (ISO), *Evaluation of Surface Contamination*, ISO 7503, 1988.

3.5.3 Uncertainty

The uncertainty to achieve a 95% confidence interval for each measurement is determined as follows:

$$\sigma = 1.96 \times \sqrt{\frac{C_{s+b}}{(t_{s+b})^2} + \frac{C_b}{(t_b)^2}}$$

where σ = uncertainty, C_{s+b} = gross sample counts, t_{s+b} = gross sample count time (minutes), C_b = background total counts, and t_b = background count time (minutes).[16]

3.6 Survey Unit Classification

The selected rooms in Building 18 (see Table 6.1) were divided into discrete survey units with a specific size and shape for which separate decisions relative to the DCGL could be made. Impacted areas were those with a potential of being contaminated (i.e., the designated laboratories). Non-impacted areas were those that did not have a potential for being contaminated and were not addressed further in the survey effort.

Survey units were classified as Class 1, 2, or 3. In general, a Class 1 survey unit is an impacted area where there are expected to be locations with concentrations of residual radioactivity that exceed the DCGL. A Class 2 survey unit is an impacted area, less than 1,000 square meters, where there are expected to be locations with concentrations of residual radioactivity detectable above background levels, but that do not exceed the DCGL. A Class 3 survey unit is an impacted areas where there are no expected locations with concentrations of residual radioactivity detectable above background.

3.6.1 Class 1 Survey Units

There are no recorded incidents of significant spills or releases of radioactive materials over the history of the license, and routine surveillance indicated no building surfaces that exceeded the DCGLs specified in Table 6.2. A survey was performed by the RSO in 2006 where approximately twenty (20) smears were collected in the rad lab (Room C.05) and the waste storage room (Door 18.B.37) and found to be indistinguishable from background.[17] Radiation surveys were conducted in the other rooms in Building 18 by the RSO and found no elevated levels of radioactive materials. These surveys were completed at the time when the investigators terminated their use of radioactive

[16] U.S. Nuclear Regulatory Commission, *Multi-agency Radiation Survey and Site Investigation Manual*, NUREG-1575, Revision 1, August, 2000.

[17] Bayer Healthcare, LLC, Letter from Dr. Shannon Gleason to the USNRC Region III, *License Termination*, October 23, 2006.

materials in that specific area.[18] Therefore, no laboratories or rooms in Building 18 were classified as a Class 1 survey unit for the purposes of this FSS.

3.6.2 Class 2 Survey Units

The two rooms in Building 18 where radioactive materials were previously used - the rad lab (Room C.05) and the waste storage room (Door 18.B.37) - were classified as Class 2 survey units. While no area was known to be impacted in excess of the DCGLs, these rooms and the waste storage building were surveyed pursuant to the requirements for a Class 2 survey unit. The walls in these rooms to a height of two (2) meters from the floor were classified as a Class 3 survey unit. The upper walls, greater than 2 meters from the floor and the ceilings in all areas were classified as non-impacted given the operation performed in each room. There was no potential for spread of contamination to these surfaces.

3.6.3 Class 3 Survey Units

The hallways outside of the two Class-2 rooms were designated as Class 3. The radiation surveys of these areas extended approximately 50 feet on either side of the door leading into the respective room.

3.7 Survey Procedures

The FSS of the rooms consisted of surface scans for beta radiation, direct measurements of beta radiation, and the collection of surface smears for assessment of removable activity. The surveys were performed as described in the following subsections.

3.7.1 Surface Scans

For Class 2 survey units, beta scans were performed over approximately 50% of the accessible building surfaces using proportional counters, Ludlum Model 43-68, while listening to the audible output of the instrument. The detector was maintained at a distance of one (1) centimeter from the surface or less, depending on surface conditions. Scan speeds, approximately 5 centimeters per second, were established such that contamination at levels of less than 50% of the applicable release criterion were detectable. For the floors, a larger area detector, Ludlum model 43-37, was employed.

For Class 3 survey units, beta scans were performed for more than 10 percent of the surface area. Those areas with the highest potential for elevated residual radioactivity, based on professional judgement, were selected for scanning. The results for the surface scans are provided in Table 6.6 and Appendix 8.4.

3.7.2 Direct Measurements

Direct beta measurements were made on the floors and the structural surfaces of each survey unit. Direct measurements were also recorded on the bench tops and cabinets located in the rooms. Measurements were conducted by integrating the total counts over a count time of one (1) minute,

[18] Bayer Healthcare, LLC, Letter from Dr. Shannon Gleason to the USNRC Region III, *License Termination*, Attachment 2, October 23, 2006.

necessary to attain appropriate detection levels. The instrument-specific background was subtracted and the activity in units of dpm/100cm^2 was calculated. Measurements were made at the nodes of the grids, using a square grid pattern. The number of measurements and spacing were as outlined in the survey plan, with results shown in Tables 6.5 and Appendix 8.4 of this report.

3.7.3 Removable Activity Measurements

Smears for removable radioactivity were collected at each direct measurement location and analyzed for beta radiation by liquid scintillation counting. Each smear, a polyfoam media, was rubbed in direct contact with the surface and dissolved in the scintillation cocktail. The samples were analyzed off site by a contract laboratory, Stan A. Huber Consultants, Inc. (SAHCI).[19] The results, reported in units of dpm/100cm^2, are shown in Tables 6.7, 6.8 and Appendix 8.5.

3.7.4 Measurement Grid Spacing

Grids were established for the purpose of referencing locations of measurements and sampling, relative to structural and/or site features. The grid spacing for the measurement and samples was determined assuming a square grid pattern as follows:

$$L = \sqrt{\frac{A}{N}}$$

where L = grid spacing, A = Survey unit area (square meters), and N = the number of measurements.

The starting point for the survey was established for each survey unit by selecting a reference point for the survey unit such as the corner of the room. A random number generator was used to provide a random number between 0 and 1 for an initial offset from the reference point in both the x and y coordinates. The random number pair was multiplied by the calculated grid spacing providing the offset from the reference point for the first grid location. The grid dimensions were approximately one meter by one meter, or one square meter (m^2).

3.8 On-site Activities

The field team mobilized to the site on August 13, 2007. Appendix 8.2 contains a copy of the Field Activity Daily Log maintained by the HP Technician. After the necessary training and health safety provisions required in the survey plan were completed, the surveys commenced. Appendix 8.3 contains the instrument records (i.e., calibration certificates and daily checks).

Each room was inspected and cleared of all loose equipment and materials to the maximum extent possible prior to the start of the surveys. The background and detector response to a known quantity of radiation was documented each day before the instrument was used.

[19] Stan A. Huber Consultants, Inc., 200 North Cedar Road, New Lenox, Illinois, 60451, (815) 485-6161.

For each laboratory, the HP Technician developed a data package of results for both direct measurements and removable radioactivity. Appendix 8.4 provides the completed survey packages for each area that was surveyed.

The large area proportional detector (Ludlum Model 43-37) (i.e., floor monitor) was used to scan 100% of the floors in the laboratories, hallways and storage rooms. A hand held proportional detector (i.e., Ludlum 43-68) was used to collect direct beta measurements on the surfaces. The total counts were accumulated for one (1) minute. Smears, collected with polyfoam media by wiping approximately 100 cm^2 of the applicable surface, were sent offsite to SAHCI for analysis via liquid scintillation analysis.

Samples for removable activity were collected in the Rad Lab, the waste storage room and the hallways outside of each room. Samples were collected on the countertops located in the Rad Lab. The traps in two sinks in the Rad Lab were removed and a smear was collected inside of each of the pipes. The drain of each counter top sink was wiped after it was determined that the trap was not accessible without significantly dismantling the cabinets. The location of each smear sample is provided in Appendix 8.4. The results of the removable activity in the two rooms are summarized in Table 6.7; the results of the smears in the sinks and traps is provided in Table 6.8. The entire analytical report is provided in Appendix 8.5. These results verified that no elevated removable activity was present in either of the two rooms and that no additional samples were required in the downstream drains or sewer connections.

Completion and review signature blocks in the data packages were used to track the progress of the radiation survey. Other laboratories in the basement of Building 18 were used to establish the radiation background of the floor tiles, steel, bench countertops and concrete surfaces. Appendix 8.6 describe the instrument backgrounds that were recorded. Once all of the data were acquired, they were compared to the release criteria shown in Section 3.3, above. No survey results exceeded the DCGLs and no area required any investigation nor decontamination. The field team demobilized on August 15, 2007.

4 RESULTS

Once the surveys were complete, data were reviewed to ensure they were acquired pursuant to the provisions of the survey plan. The following requirements were confirmed:

- The instruments used to collect the data were capable of detecting the radiation of interest at or below the DCGL;
- The calibration status of the instruments used to collect the data was less than twelve months old;
- Instrument response was checked with satisfactory results before the instrument was used;
- The MDAs and assumptions to develop them are appropriate for the instruments and the survey methods used to collect the data;
- The final survey data set consisted of qualified measurement results that were representative of the current facility status and collected as prescribed in the survey plan; and
- The data were properly recorded.

No discrepancies were identified during data review, thus the data set was deemed valid by both the Project Manager and the Project CHP.

Appendix 8.4 contains the Radiation Survey Forms for each of the rooms identified in Table 6.1. Appendix 8.7 contains photographs of the FSS process. The data points, summarized in Tables 6.5 through 6.8, demonstrate that the residual radioactivity in all of the rooms, including the sinks and drains, is not distinguishable from background. All results are below the applicable release criteria.

5 SUMMARY AND CONCLUSIONS

A final status survey of selected rooms within Building 18 of the Bayer facility in Elkhart, Indiana was performed. All survey data collected during the on-site portion of this effort were validated. The on-site gross beta screening level was set to the release criterion for Carbon-14 (i.e., less than 3.7×10^6 dpm/100 cm^2). A given survey unit or room met the requirements for release for unrestricted use provided (1) an adequate number of measurements were made; and (2) no measurement results exceeded these criteria.

The data shown on the Radiation Survey Forms (Appendix 8.4) and measurement records (Tables 6.5 through 6.8) demonstrate that residual radioactivity within Building 18 is not only below the conservatively-derived release criterion, it is not distinguishable from that in the natural background. To a reasonable degree of scientific certainty, Building 18 may thus be released for unrestricted use (i.e., for any purpose without regard for radiological concerns).

6 TABLES

Table 6.1 - Listing of Rooms Subject to Survey

Building 18 Laboratory Room Number	Area (square feet)
C05	650
Waste Storage Room (Door 18.B.37)	125

Table 6.2 - Source Term and Derived Concentration Guideline Levels

Radionuclide[Note1]	Principal Radiation	Radiation Energy, E_{max} (keV)	Derived Concentration Guideline Levels (dpm/100 cm^2)[Note2]
Carbon-14	beta	156	3.7×10^6
Hydrogen-3	beta	18	1.2×10^8

Note 1: Isotopes with a radioactive half-life shorter than 120 days were omitted from this list. Iodine 125 (I125) has a half-life of approximately 60 days.
Note 2: The screening values for unrestricted use of building surfaces are provided in NUREG 1757 and NUREG 5512 such that the potential radiation dose to the critical population is less than 25 millirem per year.[20,21]

[20] U.S. Nuclear Regulatory Commission, *Consolidated Decommissioning Guidance Characterization, Survey, and Determination of Radiological Criteria*, Table H.1, NUREG 1757, Volume 2, Rev 1, September, 2006.

[21] U.S. Nuclear Regulatory Commission, *Residual Radioactive Contamination From Decommissioning - Parameter Analysis*, Table 5.19, NUREG 5512, Volume 3, Draft, October, 1999.

Table 6.3 - Survey Instrument Descriptions

Make	Rate Meter Model	Detector Model	Detector Type	Radiation Detected[22]	Calibration Source	Use
Ludlum	2224	43-68	Gas flow Proportional	Beta, 65-1,450 Kev	^{99}Tc	Direct beta surveys; Beta scan on solid surfaces
Ludlum	2224	43-37	Gas flow proportional	Beta, 65-1,450 Kev	^{99}Tc	Beta scan on solid surfaces
Packard	Model U1900		Liquid scintillation	Beta, 5-1,500 Kev	^{14}C and ^{3}H	Wipe test analysis

[22] U.S. Nuclear Regulatory Commission, *Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions*, NUREG/CR-1507, December, 1997.

Table 6.4 - Survey Instrument Detection Limits

Detector Model	Media	Background(1)	Detector Efficiency (c/dis)(2)	Sensitivity ($dpm/100cm^2$)	
				Scanning	Static Count(3) (1 minute)
43-68	Floor Tile	66.3±8.8 cpm βγ	0.21 βγ	3,409	193
	Concrete	126.5±16.1 cpm βγ		4,711	262
	Metal Drawer	166.8±17.8 cpm βγ		n.a.	299
43-37	Floor Tile	343.2±4.8 cpm βγ	0.22 βγ	1,559	95
	Concrete	510.3±12.2 cpm βγ		1,902	115
Liquid Scintillation	Polyfoam	16.3±11.2 cpm	0.95 ^{14}C 0.64 ^{3}H	n.a.	95 dpm ^{14}C 116 dpm ^{3}H

(1) Average of the beginning of shift and end of shift values over the course of the survey effort.
(2) Average of the daily efficiencies over the course of the survey effort.
(3) Polyfoam smears were counted for 5 minutes.

Table 6.5 - Stationary (Static) Count Results

Room Number[1]	Number Static Counts[2]	MDA dpm/100 cm² (β-γ)	Highest Static Readings dpm/100 cm² (β-γ)	Exceed the DCGL?
Bldg 18 Basement, Room C05	32	193	60.5 ± 23.6	No
Hallway outside of C05	14	95	77.3 ± 52.0	No
Metal drawers in storage cabinets, Room C05	103	193	28.6 ± 36.1	No
Waste Storage Room	30	262	178.6 ± 33.4	No
Hallway outside of Waste Storage Room	19	95	60.9 ± 53.4	No

1 - Survey results for the counter tops in the rooms were all below the applicable DCGL. See Appendix 8.4 for results.
2- Each static count was accumulated for 1 minute.

Table 6.6 - Scan Results (Floor Monitor)

Room Number	Number Observed Readings[1]	Scanning MDA dpm/100 cm² (β-γ)	Highest Scan Readings dpm/100 cm² (β-γ)	Any Result Exceed the DCGL?
Bldg 18 Basement, Room C05	26	1,559	77.3±52.0	No
Hallway outside of C05	14	1,559	-15.0±51.2	No
Waste Storage Room	12	1,902	409.0±65.3	No
Hallway outside of Waste Storage Room	7	1,559	259.1±38.4	No

Note 1 : The floor monitor (Model 43-37) was used to scan the entire floor in Room C05, the Waste Storage Room and the hallways outside of each room. A scanning result was recorded approximately every six (6) feet as the floor monitor was pushed along the floor. See Appendix 8.4 to review the survey maps.

Table 6.7 - Removable Contamination Results

Room Number[1]	Number Smears Floor	Number Smears Wall	Highest Smear Result Floor dpm/100 cm² (H-3/C-14)	Highest Smear Result Wall dpm/100 cm² (H-3/C-14)	Any Result Exceed the DCGL?
Bldg 18 Basement, Room C05	28	6	16.0±14.8	5.5±14.5	No
Hallway outside of C05	6	0	7.9±14.5	NA	No
Waste Storage Room	9	6	7.6±14.5	9.4±14.6	No
Hallway outside of Waste Storage Room	3	0	6.9±14.5	NA	No

1 - Survey results for the counter tops in the rooms were all below the applicable DCGL. See Appendix 8.4 for locations of samples and Appendix 8.5 for results.

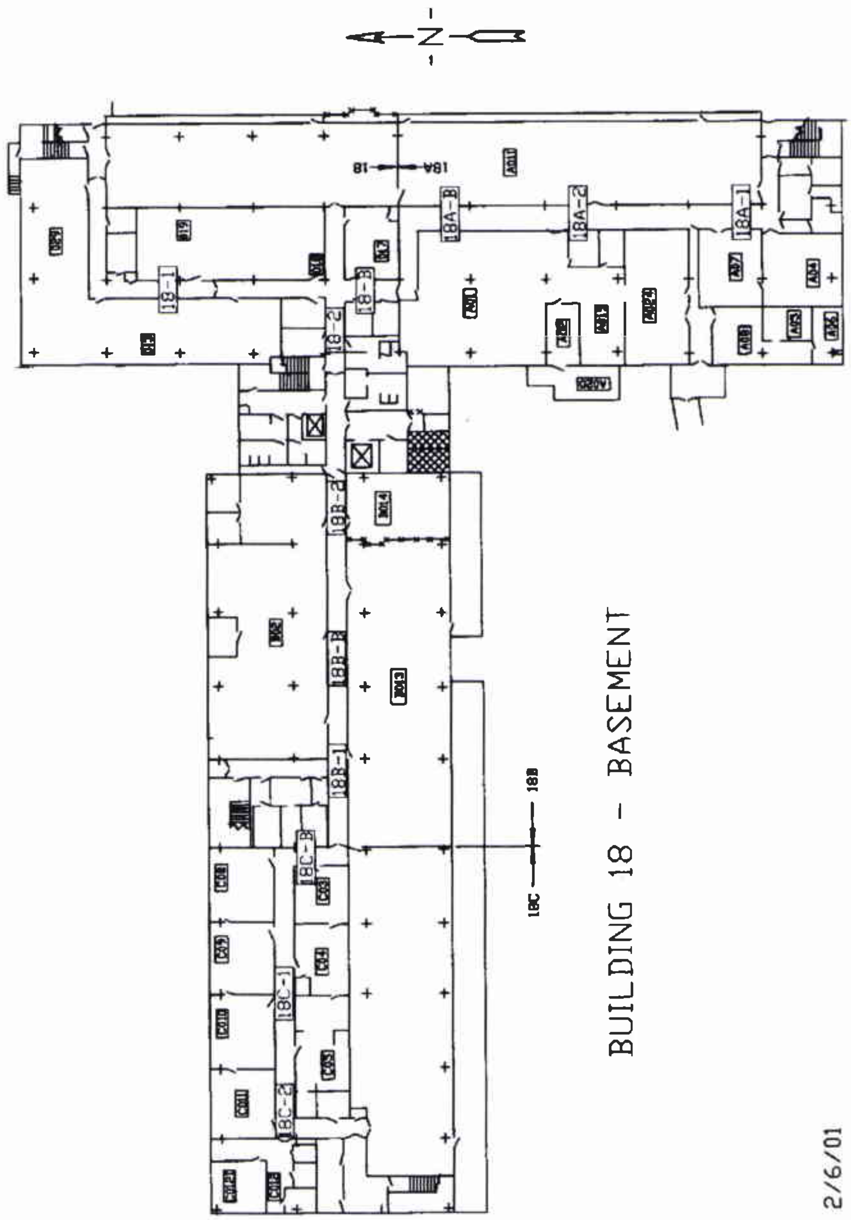
Table 6.8 - Removable Contamination Results for Sinks and Fume Hood

Sample Number[1]	Location	LSC Smear Result dpm/100 cm² (H-3/C-14)
26	Sink Drain	4.9±12.5
27	Sink Trap	4.0±12.5
39	Countertop sink drain	4.5±13.6
54	Countertop sink drain	1.3±11.5
57	Countertop sink drain	2.3±13.5
60	Countertop sink drain	-1.0±13.5
62	Sink drain	7.8±11.4
63	Sink trap	-1.0±13.5
84	Fume hood sink drain	5.2±11.3
85	Fume hood duct exhaust	2.5±11.3
92	Fume hood	0.7±13.5

Note 1: Smears were collected on the floor, countertops and in the sinks of Room C05, in the basement of Building 18. See Appendix 8.4 for the survey maps and locations of all samples. The locations of samples are provided in Appendix 8.4 and the analytical results are provided in Appendix 8.5.

7 FIGURES

Figure 7.1 - Building Floor Plan



8 APPENDICES

Appendix 8.1 - Qualifications of Project Personnel

R. Alan Duff - Project Manager

Professional Qualifications

Mr. Duff has over 27 years of experience in nuclear and hazardous materials project management, design support, surveillance, operational health physics, training, and decommissioning activities. He has prepared numerous plans, procedures, and license documents for U. S. Department of Energy facilities, U. S. Department of Defense facilities, U. S. Nuclear Regulatory Commission licensees, and commercial client facilities that are regulated by agreement states. Mr. Duff is well versed in the area of civilian and government radioactive and mixed waste transport and disposal requirements. He is registered by the National Registry of Radiation Protection Technologists (NRRPT).

Education

Advanced Mixed Waste Shipper Certification Training, 2003.
Confined Space Entry Training, 1998
CNSI Advanced Radioactive Material Transportation and Disposal Class, 1989 and 1993
IT Corporation Project Management Course (40 hours), 1992.
40-Hour OSHA HAZWOPER (29 CFR 1910.120) Training, 1987.
Eight-hour Supervisor Training, 1990
Eight-hour OSHA Annual Refresher (29 CFR 1910.120), 2005.
Canberra Multichannel Analyzer Operations Class, 1988.
Operational Water Chemistry and Radiological Controls, U.S. Navy, 1982
Engineering Laboratory Technician School, U.S. Navy, 1980.
Nuclear Power Training Unit (prototype), U.S. Navy, 1980.
Naval Nuclear Power School, U.S. Navy, 1978.

Registrations/Certifications

Registered Radiation Protection Technologist (RRPT), National Registry of Radiation Protection Technologists

Radiation Safety Officer - MDE Radioactive Materials License No. MD-31-281-01.

Authorized User - MDE Radioactive Materials License No. MD-31-281-01.

Experience and Background

2002-Present *Vice President of Nuclear Services, Integrated Environmental Management, Inc., Knoxville, Tennessee* - As the director of IEM's Nuclear Services Division, which operates as a compliment to our consulting capability by providing support services and on-site project management for major client initiatives, Mr. Duff is responsible for turn-key decontamination and decommissioning of nuclear facilities - including the preparation of all planning documentation, characterization surveys and sampling - facility and equipment decontamination, final status survey performance, waste packaging/transport/disposal coordination, routine facility surveillance services, emergency response, leak testing of sealed sources, instrument rental, employee monitoring services for internal and/or external exposures, training, and a host of other applied health physics operations. Mr. Duff also serves as the Radiation Safety Officer (RSO) for IEM operations pursuant to Maryland Department of the Environment Radioactive Materials License No. MD-31-281-01.

1995-2002 *Program/Project Manager, Integrated Environmental Management, Inc., Knoxville, Tennessee* - Provided high-quality project management and remediation services to commercial and government clients. As a member of the client's response team, worked with clients to: Develop scopes-of-work and bid packages for specialty subcontractors handling highly focused assignments; identify those subcontractors who will provide the greatest value to the client; manage teams of specialty subcontractors to ensure that the client's goals and expectations (technical, regulatory, and financial) are met from the beginning until project completion; provide insights into future regulatory issues and their impact as input to the client's long-range business planning and cost forecasting process; provide site remediation/decommissioning services for radioactive and hazardous materials; advise and train clients on waste transportation and disposal issues; and develop project specific plans and procedures to conduct on site activities.

1994-1995 *Senior Environmental Specialist, AWK Consulting Engineers, Inc., Pittsburgh, Pennsylvania* While assigned to the Oak Ridge, Tennessee office, was responsible for performing technical and administrative duties required to satisfy customer needs on site characterization and pre-remedial design support projects and for all aspects of D&D projects. Responsible for preparing project plans, project work plans, task specific Health & Safety Plans, and budgets/schedules for these projects. Also responsible for identifying and implementing decommissioning and decontamination methods for these projects.

1987-1994 *Project Manager, Health Physics Supervisor, Nuclear/Mixed Waste Engineering Services, IT Corporation, Knoxville, Tennessee.* Provided project management and health physics support services for nuclear and mixed waste projects throughout the United States.

1978-1987 *Engineering Laboratory Technician (ELT), Leading Petty Officer, Radiological Controls Shift Supervisor*, United States Navy. Supervised a division of 40 personnel, provided support for nuclear powered submarines, and performed over 250 error-free shipments of radioactive materials. Served as Leading ELT and Engine Room Supervisor on the USS Grayling, SSN 646.

Professional Society Memberships

Health Physics Society (Plenary Member)

American Nuclear Society

Conference of Radiation Control Program Directors (Advisor to the Radioactive Waste Management Committee E-5 and to the D&D Committee E-24)

Awards

Navy Achievement Medal for conducting the first Trident Class submarine ion exchange resin discharge and solidification.

IT Corporation Project Management Associate

Example Project Descriptions

Project Manager for health physics field activities during characterization, remediation and survey of several oil production sites with soil contaminated with Naturally-Occurring Radioactive Materials (NORM) for multiple clients in support of litigation defense.

Project Manager for the radiological characterization (MARSSIM surveys) of a facility that manufactured thorium fluoride for use as an optical surfacing product. Conducted radiation and contamination surveys and obtained analytical samples of building materials. Returned to the facility to conduct surveys in support of property ownership transfer. Supervised radiological remediation of facility including floor and wall contamination, underground tank removal, drain line removal, roof decontamination, and equipment demolition including ventilation systems, fume hoods, and scrubber systems. Responsible for coordination for treatment and disposal of radioactive and mixed wastes generated during the project and conducted final status surveys at the facility upon completion of work.

Project Manager for Phase 1 Environmental Assessments conducted at five radioactive waste processing and disposal facilities.

Project Manager and Health Physicist for the remediation and final status surveys/sampling of a former oilfield pipe scale facility. Supervised the demolition of the site building, excavation and disposal of ten truckloads of NORM- contaminated soil, and excavation and release of over 20 truckloads of clean soil. Interfaced with the client and state regulators on the planning and final release of the facility. Work performed under the terms/conditions of License No. MD-31-281.01.

Project Manager and Health Physicist for the remediation and final status survey of a pharmaceutical company's radiological laboratories contaminated with Hydrogen-3 and Carbon-14. Supervised the on site demolition of the labs including fume hoods, lab furniture and ventilation systems. Supervised the disposal of radioactive and mixed wastes from the site and the performance of the final status survey of the facility.

Project Manager for the decommissioning of an oven contaminated with mercury and thorium (mixed waste). Arranged for subcontractors to conduct decontamination and disposal activities, prepared project plans, supervised all field activities, and conducted all radiological surveys during the decommissioning. Responsible for coordination for treatment and disposal of mixed and hazardous wastes generated during the project. Later conducted removal of a central vacuum system that was contaminated with mercury and thorium at the same facility.

Conducted audits of a client's radiation protection program including tour of the site, interviews with employees to verify radiological and respirator training, review of shipping, waste disposal, sealed source, training, and survey records. Also conducted leak tests of client's radioactive sealed sources.

Project Manager for escalated decommissioning a State-licensed site that manufactured, tested, and distributed gauging devices in anticipation of the sale of the company and the possibility of its moving its operations to another location. Responsible for preparation of work plans, negotiations with regulatory agencies, decontamination of indoor and outdoor areas, performance and documentation of a final status survey, shipment of waste, and project-specific health and safety.

Project Manager and health physicist for the remediation of a building foundation drainage system and the processing of over 100,000 gallons of water contaminated with cobalt-60 up to levels of one (1) microcurie per liter for a commercial client. Responsible for coordination of a water processing subcontractor, an excavation subcontractor, and off-site analytical laboratory activities. Also interfaced with on-site U. S. Nuclear Regulatory Commission, U. S. Environmental Protection Agency, and a variety of state and local agencies. Follow up work at the same facility included development of decommissioning funding plans and site decommissioning plans.

Technical writer for the development of a logic flow diagram for identifying radioactive and mixed wastes at the U. S. Department of Energy's Portsmouth (Ohio) Gaseous Diffusion Plant.

Technical writer for the Fernald Remedial Investigation/Feasibility Study (RI/FS). Provided technical guidance to engineering staff, generated reports on radioactive and mixed waste packaging, transport, and disposal.

Site Manager for the characterization survey of an EPA Superfund site three story warehouse that had been used in the past as a lantern mantle manufacturing facility and had been contaminated with thorium. Assisted in the development of project plans and final reports, supervised a crew of Health Physics technicians performing characterization surveys, interfaced with the facility owner and EPA personnel while on site.

Project Manager for the decommissioning and decontamination of three facilities at Sandia National Laboratory contaminated with radioactive and mixed waste. Responsible for the coordination of resources for the development of project plans, development of Project Work Plan, and maintaining project budget and schedule commitments.

Health Physics Supervisor for a transuranic (TRU) waste repackaging project. Supervised the characterization, repackaging and shipment of 130 containers of high-activity americium-241 and plutonium-238 hot cell waste. The waste was packaged to meet the WIPP waste acceptance criteria and was transported (highway route controlled quantity) to the Idaho National Engineering Laboratory (INEL) for storage.

Project Manager for the excavation and disposal of radium waste cells for the Corps of Engineers at Bergstrom Air Force Base in Austin, TX. Developed all project plans, supervised field efforts, and coordinated waste transport and disposal activities.

Project Manager for the decontamination and final release survey of a 70,000 ft^2 facility that manufactured cesium-137 level gauges. Decontamination efforts involved overhead areas, work area concrete floors, and removal of soil under the floor slab. Facility was released from their license following a verification survey by the state radiological licensing agency. Developed state approved decommissioning plan and final status survey report.

Project Manager for the packaging and disposal of 55,000 Curies of cobalt-60 teletherapy sources. Sources were loaded into cask liners in the facility hot cell and loaded into Type B casks for shipment for disposal. Also supported the packaging and disposal of several low level waste drums and HEPA filters that required the use of shielded Type A and B shipping containers.

Project Manager for the decommissioning and decontamination of IT Corporation's Oak Ridge Mixed Waste Analytical Laboratory. Developed the decommissioning and decontamination plan that was approved by the State of Tennessee. Also supervised the field crew during final surveys of facility.

Project Manager for the decommissioning and decontamination of a magnesium-thorium waterfall grinding booth at Tinker Air Force Base in Oklahoma. Responsible for the development of project plans, schedule and budget management, and disposal of radioactive and mixed wastes.

Project Manager for the decommissioning of a commercial facility which had previously processed ores containing uranium and thorium. Generated the decommissioning plan submitted to and approved by the U. S. Nuclear Regulatory Commission, and was responsible for schedule, budget, and on site activities.

Project Manager for the removal of a 22 MeV particle accelerator from a major university medical center. Developed State-approved decommissioning and decontamination plans, arranged for waste disposal and transfer of the accelerator to a university in Beijing, China, and was responsible for budget, schedule and all on site activities.

Project Manager for the decommissioning and decontamination of two radioactive source manufacturing laboratories at Chevron Research and Technology. The laboratories housed a neutron generator and were contaminated with tritium, carbon-14, cesium-134, and cobalt-60. Negotiated plan approvals with the State agency, and was responsible for budget, schedule, and all on site activities including waste transport and disposal.

Project Manager for the routine quarterly surveillance and special radiological projects at a metallurgical facility licensed by the NRC. Conducted radiation, contamination, and airborne radioactivity surveys as well as personnel bioassay and dosimetry program and environmental monitoring program each quarter. Provided health physics coverage for non-routine activities such as baghouse and stack testing, heats of specialty materials, final release surveys of an excavated road area, storage yard, and a warehouse formerly used for storage of radioactive materials, and recovery of radioactively contaminated equipment improperly released from site. Responsible for the generation of quarterly surveillance reports.

Project Manager for the development of a conceptual decommissioning plan for a maintenance facility located in South Carolina. The plan was generated to provide support for the facility's decommissioning funding plan.

Health and Safety Manager/Project Manager at the U. S. Department of Energy's Fernald site thorium silo and bins decommissioning and decontamination project. Developed the project-specific health and safety plan, and interfaced with the client on health physics and health/safety issues. This project received safety and quality awards from the client.

Health Physics Supervisor responsible for the sampling of underground storage tanks with radioactive and mixed wastes at Brookhaven National Laboratory.

Health and Safety Manager for the U. S. Department of Energy's Fernald Plant K-65 Silo sampling project. Developed the health/safety and sampling plans. The silos contained up to 0.5 microcurie of Radium-226 per gram and were the largest single source of radon gas in the U.S.

D&D Technical Manager for the decommissioning of the U. S. Department of Energy's LEHR facility at the University of California at Davis. Developed project decommissioning and decontamination plans and field procedures.

Health Physics Supervisor for the excavation of waste materials which included mixtures of uranium and explosives.

Project Manager for the MARSSIM type final status survey of a potentially contaminated 10 acre property on Staten Island, New York. Developed site characterization/survey plans, supervised the on site characterization survey and soil sampling at the site, and developed the project report for submittal to regulators.

Developed numerous business proposals for nuclear decommissioning and decontamination projects including job walk downs, cost estimation, scheduling, and technical content of proposals.

While in the US Navy, acted as radioactive materials shipper for the Trident Submarine Refit Facility. Performed over 250 error-free shipments of radioactive materials including Type B quantity radiography source shipments and radioactive waste shipments to the naval shipyard.

Jeffery W. Sumlin - Health Physics Technician

Professional Qualifications

Mr. Sumlin has over 25 years of experience in the radiation protection field, with emphasis on decontamination, site surveillance and applied health physics. His extensive field and management experience, interpersonal skills, and technical abilities in the decontamination, decommissioning, and radiation protection fields are accompanied by excellent qualifications in project coordination, regulatory compliance, site characterization and radiological oversight and verification.

Education

AA, Nuclear Technology - University of Phoenix, 1991
AS, Liberal Arts - University of the State of New York, 1989
BS, Sociology and Nuclear Technology - University of the State of New York, 1990
Naval Nuclear Power School, 1980
Nuclear Power Training Unit (prototype), 1981
40-Hour OSHA HAZWOPER Training (29 CFR 1910.120), 1996
8-Hour OSHA Annual Refresher (29 CFR 1910.120), 2005
Confined Space Training, 2003
Fall Protection Training, 2005

Certifications and Licenses

Registered Radiation Protection Technologist (RRPT), National Registry of Radiation Protection Technologists
Qualified U. S. Department of Energy Health Physics Technician
Authorized User - Maryland Department of the Environment Radioactive Materials License No. MD-31-281-01.

Experience and Background

2006-Present *Project Manager and Health Physics Technician, Integrated Environmental Management, Inc., Knoxville, Tennessee* - Duties include surveillance activities, instrumentation usage/control, decontamination, site characterization, documentation, report preparation, cost/schedule assessment, research/analysis, and general health physics duties. Mr. Sumlin is also qualified as a Health Physics Technician pursuant to Radiation Safety Procedure No. RSP-006, "Training and Qualification of Radiation Protection Personnel".

2004-2005 *Lead Radiological Controls Technician, Oak Ridge National Laboratory, Oak Ridge, Tennessee* - Duties involved environmental remediation and transuranic legacy waste recovery.

2001-2004 *Radiological Controls Technician, Sandia National Laboratory, Albuquerque, New Mexico* - Duties included support for decommissioning and decontamination activities and the Mixed Waste Management Facility.

1995-2001 *Senior Health Physics Technician, Pacific Northwest National Laboratory, Hanford, Washington* - Served in the Hanford Site Health Physics Department as an ALARA Coordinator, Radioactive Source Custodian, and first-line supervisor for various USDOE contractors and projects.

1980-1995 *U. S. Navy Nuclear Propulsion Program* - Duties included positions as Mechanical Operator, Engine Room Supervisor, Engineering Watch Supervisor, Radiological Controls Shift Supervisor, and Quality Assurance Supervisor.

Example Accomplishments

Senior Health Physics Technician during the initial emergency response, subsequent recovery and decontamination of the Hanford Plutonium Reclamation Facility after it was damaged from an explosion, Plutonium Finishing Plant, Hanford Nuclear Reservation, 1997.

Senior Health Physics Technician for the start up of Hanford Plutonium Finishing Plant Muffle Furnace for plutonium waste stabilization, Plutonium Finishing Plant, Hanford Nuclear Reservation, 1998.

Senior Health Physics Technician for the decontamination, decommissioning, and turn over of Hanford B Plant Canyon, Hanford Nuclear Reservation, 1998.

After selection as the ALARA Coordinator for the Hanford Plutonium Finishing Plant, rebuilt the ALARA program after five years of neglect resulting in an annual exposure reduction of 35%, Hanford Nuclear Reservation, 1997.

Radiological Controls Supervisor for the Hanford Tank Farms Required Surveillance Program and Radioactive Liquid Waste Cross-Site Transfer System at the Hanford Nuclear Reservation, 1999.

Extensive experience with alpha, low energy beta, beta and gamma contamination, high energy beta, gamma and neutron radiation, and airborne radioactivity.

As Radiological Control First Line Supervisor, revised and administered Hanford Tank Farms Environmental Surveillance Program, including stack emissions monitoring, contamination control and workplace air monitoring at the Hanford Nuclear Reservation, 1999.

Radiological Controls First Line Supervisor for several ground water migration wells at the Hanford Nuclear Reservation, 1999.

Lead Senior Health Physics Technician for the decommissioning and decontamination of several Cold War era plutonium producing reactors at the Hanford Nuclear Reservation, 2000.

Senior Radiological Controls Technician for the decommissioning and decontamination and final release of over 500,000 ft^2 of structures at Sandia National Laboratories, 2004.

Sandia National Laboratories Decommissioning and Decontamination Radiological Controls Technician authorized to act independently at the Tonopah Test Range, Nevada Test Site, 2003.

Lead Radiological Controls Technician for the remediation of radioactive injection wells and equipment at Oak Ridge National Laboratory, Tennessee, 2005.

Radiological Controls Technician for the recovery of 202 containers of transuranic waste buried over 30 years ago at Oak Ridge National Laboratory, Tennessee, 2005.

Billy R. Thomas - Project CHP

Professional Qualifications

Mr. Thomas has over 28 years of senior-level experience in radiological and industrial hygiene activities with emphasis on systems to minimize personnel exposures to radioactive and hazardous materials, compliance with federal and state regulations, site and facility audits. Mr. Thomas has developed and implemented comprehensive programs for radiation and chemical protection programs. Mr. Thomas is actively involved in all aspects of health and safety including regulatory compliance, site decommissioning, program evaluation, applied health physics, occupational safety, training and project management.

Education

M.S., Environmental Health, University of Oklahoma, 1981
B.S., Health Physics, Oklahoma State University, 1976

Certifications

Certified Health Physicist (Comprehensive Practice), American Board of Health Physics, 1988. Recertified: 1992, 1996, 2000 and 2004.

Certified Industrial Hygienist (Comprehensive Practice), American Board of Industrial Hygiene, 1984. Recertified : 1990, 1996 and 2002.

OSHA Hazardous Waste Operations and Emergency Response (HAZWOPER) Training. Initial training 1987 and updated each year.

Lead Abatement Training for Supervisors, University of Cincinnati. 1996.

Asbestos Abatement Supervisor Course, Asbestos Consulting and Training Systems, 1997.

Authorized User - Maryland Department of the Environment Radioactive Materials License No. MD-31-281-01.

Experience and Background

2002-Present *Vice President, Consulting Division, Integrated Environmental Management, Inc. Findlay, Ohio.* As the director of the company's consulting division, Mr. Thomas is responsible for selecting and coordinating the services of senior-level consultants in the areas of radiation safety and industrial hygiene. In addition, he maintains and ensures all members of the division maintain a track record of technical excellence, cost and schedule control, and innovation in solving environmental and health/safety problems for both government and commercial clients.

1999-2002 *Senior Health Physicist, Integrated Environmental Management, Inc. Findlay, Ohio.* Provides high-quality radiation protection services to commercial and government clients. As a member of the client's response team, works with clients to promote an understanding of what is required to achieve and/or maintain compliance in the eyes of all pertinent regulatory agencies, individually or jointly; develop an overall strategy for achieving compliance and reduce liabilities in a technically-sound, legally defensible, and fiscally-conservative business manner; recommend specific solutions that are compatible with the client's operating philosophy; and provide insights into future regulatory issues and their impact as input to the client's long-range business planning and cost forecasting process.

Mr. Thomas served as the task manager to develop a baseline human heath risk assessment for a confidential client who previously processed enriched uranium and manufactured fuel pellets. The risk assessment was developed for potential exposures to both hazardous chemicals and radioactive materials found in soil and groundwater. The assessment incorporated the requirements of the USEPA Risk Assessment Guidance for Superfund (RAGS) as well as requirements established by the State authorities.

Mr. Thomas developed a Emergency Response and Preparedness Manual for a Canadian client who manufactured uranium pellets for nuclear power reactors. The manual was prepared in accordance with the guidance provided by the Canadian Nuclear Safety Commission (CNSC) and the U.S. Nuclear Regulatory Commission (USNRC). The manual addressed the resources to mobilize to an emergency, involving both hazardous chemicals and radioactive uranium in several different chemical forms. The manual was implemented by the client and approved by the CNSC.

A commercial client, licensed by the Nuclear Regulatory Commission, required an evaluation of their internal dosimetry program. Mr. Thomas prepared a procedure to measure both internal and external exposure. The procedure satisfied the recommendations established by the NCRP and ANSI as well as requirements established by the USNRC.

Mr. Thomas worked as part of a project team to develop decommissioning plans for four (4) different facilities licensed to process radioactive materials. The decommissioning plans established the derived concentration guidelines levels for a variety of radioactive isotopes, including enriched uranium, thorium and byproduct radioactive materials. The potential exposures to future residents were limited to less than twenty-five millirem per year and evaluated over a period of 1,000 years. The plans were compliant with the requirements established by the USNRC and NUREG 1757. Each plan was approved by the USNRC and implemented by the client in order to decommission the facility and terminate the license.

A commercial client required a plan to survey, remediate and ultimately release the building surfaces for unrestricted use. Mr. Thomas established the release criteria using RESRAD and developed a procedure to complete the radiation survey. The procedure was consistent with the requirements established by the USNRC and NUREG 1575, MARSSIM.

Mr. Thomas completed radiation surveys to evaluate potential exposures to electromagnetic frequency (EMF) radiation in commercial manufacturing facilities. The evaluation of personal exposures were compared to recommendations published by the ACGIH and OSHA. Recommendations were provided to the clients to limit personnel radiation exposures and verify that exposures were acceptable.

1993-1999 *Director of Health and Safety, The IT Group, Findlay, Ohio.* Originally joined OHM Remediation Services in 1993. The IT Group purchased OHM in 1998. Duties including conducting site and facility health and safety audits, determination of personal protective equipment and respiratory protection equipment, supervising the development and implementation of site specific health and safety plans, and providing industrial hygiene training and services. He had direct accountability for health and safety compliance, including regulatory compliance with federal, state and local agencies. He implemented a comprehensive health and safety program for demolition and remediation activities by the Midwest region, which accumulated 2.3 million man-hours from March, 1994 to July, 1997 without a single lost time injury.

Safety and Health Manager, Kansas City PRAC II, Kansas City District. Duties on this HTRW contract included the development of safety and health plans as well as procedures to be implemented at each of the KC PRAC projects. Developed SSHP for specific KC PRAC projects including, Ottawa, Illinois, Galena, Kansas, Mead Nebraska, and Fort Riley, Kansas. Mr. Thomas provided specific support on the KC PRAC projects including:

Project CIH, Project CHP, Ottawa Radiation Sites, Ottawa, Illinois September 1994 – August 1997. Developed the site specific health and safety plan and radiation protection plan to excavate soil containing radioactive radium generated by a luminous processing company. This project involved the excavation of radioactive contamination from nearby residences and selected sites in the city. Worked with State of Illinois and the EPA to implement an effective contamination control program, including air sampling and personnel monitoring for radium. Provided radiation worker training for the work crew and directed the on-site health physics and industrial hygiene program for the initial phases of the project. Conducted site inspections and project audits on a periodic basis.

Safety and Health Manager, USACE, Omaha District Rapid Response II. Duties on this HTRW contract included the development of program procedures and policies to work on multiple USACE projects. Developed SSHP for specific Rapid projects, including work at Joliet, Illinois, Ames, Iowa and Des Moines, Iowa. Mr. Thomas conducted site inspections and provided technical support for the implementation of the site safety and health program for RR/IR task orders. Mr. Thomas provided support on each Rapid project, including:

Project CIH, Project CHP; Ames Laboratory Chemical Disposal Site, Ames, Iowa. July 1994 – November 1994. Developed the site specific health and safety plan for the excavation and disposal of approximately 1,000 cubic yards of radioactive uranium wastes and contaminated soils. Developed the radiation protection program to be implemented by project employees to reduce exposures to ionizing radiation to as low as reasonably achievable. Contaminated materials were packaged and shipped for disposal in Clive, Utah.

Safety and Health Manager, USACE, TERC Number 1. Duties on this contract included the development of SSHP for work at Ellsworth AFB in Rapid City SD and KI Sawyer AFB in Michigan. Mr. Thomas provided support for some of the TERC projects including:

Project CIH, Ellsworth AFB, OU2 and OU7, Rapid City South Dakota. November 1996 – September 1997. Developed the site specific health and safety plan to excavate radioactive materials from disposal trenches at OU2 and OU 7. Developed radiation protection plan as well as the release criteria to be implemented to document that the site was free of contamination. Worked with the USAF Radiation Safety Committee to establish protocols to identify plutonium in soil and verify that debris was handled correctly.

Project CIH, Tarracorp Industries, Granite City, Illinois April, 1993 – May, 1997. USACE Omaha PRAC II. Developed the site specific safety and health plan for this project to excavate and treat lead-contaminated soil from smelter emissions. Treatment was completed by stabilizing the soil using a pugmill. This process delists the soils to a "special waste" classification, resulting in key cost savings in disposal. To date, over 300 residential sites have been remediated, and over 100,000 tons of soil have been processed. Excavation, transportation, and disposal of wastes containing battery chips have also taken place. Developed the elements of the air monitoring program. The air monitoring program was sufficient to evaluate the personnel exposures to airborne lead dust, as well as the fugitive emission from the exclusion zone. Performed periodic site visits to review results of the air sampling program and confirm that exposures were acceptable.

Health and Safety Manager, Department of Energy, Weldon Spring Site Remedial Action Program (WSSRAP), April 1993 – July, 1995. OHM was contracted to excavate contaminated construction debris from the WSSRAP quarry. Materials in the quarry were accumulated from a munitions manufacturing facility at Weldon Spring, as well as the demolition of buildings from the Mallinckrodt site used during the Manhattan project. Personnel exposures to uranium and thorium were documented, as well as nitroaromatics and asbestos. Mr. Thomas completed site inspections to evaluate the effectiveness of the health and safety plan and review the results of employee exposure monitoring.

Health and Safety Manager during the demolition of selected manufacturing buildings at the WSSRAP. The demolition projects involved the controlled demolition of nine buildings. Employees encountered radioactive uranium as well as asbestos containing materials and cadmium based paints. Mr. Thomas evaluated the construction safety program as well as industrial hygiene program during the demolition tasks.

Health and Safety Manager during the remediation of facilities at the Piketon Gaseous Diffusion Plant in Portsmouth, Ohio. OHM was contracted to remediate a chromic acid tank, including the removal of the lead liner in Building X700. OHM also demolished the incinerator in Building X705A. Mr. Thomas prepared the health and safety plan to document the methods necessary to reduce employee exposure to hazardous materials, both chemical and radiation exposures. OHM employees encountered hot environments in Building X700 where chromic acid and uranium were present.

Health and Safety Manager during the remediation of mixed waste that was buried in several burial pits at the Ames Laboratory in Ames, Iowa. Mr. Thomas participated in the planning and execution of the project, including presentations at the public hearings that were provided by the DOE to the public. The waste in the burial pits contained a variety of hazardous materials, including radioactive uranium, thorium, and asbestos as well as volatile organics including methyl ethyl ketone and trichloroethylene. Mr. Thomas prepared the health and safety plan for the project which described the industrial hygiene practice, the construction safety requirements, and the elements of the health physics program. Mr. Thomas evaluated the controls that were implemented and verified that employee exposures were reduced to as low as reasonably achievable.

1990 - 1993 *Health and Safety Manager, IT Corporation, St. Louis, Missouri.*
Provided direction day-to-day for laboratory operations in the areas of health physics, industrial hygiene, hazardous waste management, and laboratory safety. Served as the Radiation Safety Officer for the USNRC Broad Scope license for the use of by-product and source material at the laboratory .

Collateral assignment as Department Manager of a radiochemistry laboratory to analyze samples from a variety of commercial and government facilities, including facilities operated by the DOE. Services were provided to a variety of DOE facilities including Fernald, Idaho National Energy Laboratory, Lawrence Livermore National Laboratory, Nevada Test Site, Oak Ridge National Laboratory, Paducah Gaseous

Diffusion Plant, Rocky Flats, WSSRAP, and the Y12 Production Facility. Supervised the analysis of various environmental media to be analyzed for specific radioactive isotopes including uranium, plutonium, thorium, and radium. Other analyses were performed for fission products and gross methods including alpha and beta analysis. Served as the RSO for the broad-scope license issued to the laboratory by the NRC.

Performed waste management assessment for four different DOE facilities. Principal investigator for hazardous and mixed waste policies, procedures and practices. Recommended program changes and upgrades. Worked at the following facilities, including: Portsmouth Gaseous Diffusion Plant, Piketon, Ohio; K25 Gaseous Diffusion Plant, Oak Ridge, Tennessee; Paducah Gaseous Diffusion Plant, Paducah, Kentucky; and Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Served as project manager for the Industrial Hygiene department at Los Alamos National Laboratory (HSE-5). Responsibilities included reviewing and making recommendations for several of the programs being implemented by HSE-5 for the National Laboratory. These programs included asbestos controls, carcinogen control, sampling strategies and hazardous waste site characterization. Mr. Thomas also developed a sampling strategy to evaluate personnel exposures to hazardous materials. Mr. Thomas evaluated the asbestos management program at Los Alamos Laboratory. He reviewed the work performed by the IH department, including project oversight and air monitoring. He inspected work sites established by contractors including Pan American Services to assess compliance with LANL procedures and OSHA regulations.

Served as project manager to prepare mixed waste and radioactive waste management plans and programs for waste generated during the remedial investigation at the Nevada Test Site. The programs required coordination between the Remedial Investigation contractor, the DOE Operations Area office and the facility receiving the waste for disposal.

1988 - 1990 *Director of Corporate Health and Safety, Burlington Environmental,* Columbia, Illinois. Responsible for designing and implementing health and safety programs to limit exposures to hazardous chemicals and radioactive material during sampling and remediation activities. Developed procedures and conducted training classes for field service personnel to correctly use personal protective equipment and perform air monitoring to evaluate personnel exposures.

Mr. Thomas also served on several audit teams to review the health physics programs at DOE site, including Rocky Flats, Los Alamos and the Nevada Test Site. The criteria for the audits were based on the DOE Technical Safety Appraisal objectives. Mr. Thomas worked with the program personnel to correct deficiencies and measure the effectiveness of the programs.

Member of Technical Advisory Group for Martin-Marietta Energy Systems. The Advisory Group provided oversight of the Federal Facility Agreement regarding the operation of the Low Level Radioactive Waste Tank Systems implemented for Oak Ridge National Laboratory. Made recommendations to implement standard industry practices for the purposes of reducing personnel exposures to hazardous and radioactive materials. Reviewed the elements of the industrial hygiene relating to the engineering controls and administrative controls implemented to reduce exposures to hazardous materials. Evaluated the effectiveness of the health physics programs for the purposes of reducing personnel exposures to radiation to as low as reasonably achievable.

Mr. Thomas reviewed the industrial hygiene and health physics programs being implemented at each facility. Used the Technical Safety Appraisal guidelines developed by DOE to critique the effectiveness of the programs begin implemented. Worked with each respective program manager, responsible for the H&S program, to develop an action plan to upgrade the program and track the progress of the changes.

Member of the Management Advisory Team for Martin Marietta Energy Systems Gaseous Diffusion Plants. The Advisory team reviewed the effectiveness of the health and safety programs being implemented including the health physics and industrial hygiene programs. The Advisory Group was responsible for reviewing each of the health and safety programs and making recommendations for areas of improvement.

1983 - 1988 *Senior Health Physicist, IT Corporation, Oak Ridge, Tennessee.* Provided health physics and industrial hygiene consulting to government and commercial clients. Served as the project manager for several remedial decontamination projects involving hazardous and radioactive materials. His experience included:

Project CIH, Fernald Feed Materials Production Center, US Department of Energy Cincinnati, Ohio. May, 1987 – June, 1988. Performed health-and-safety review of engineering improvements at DOE uranium metals production facility. Improvements included new ventilation systems, radioactive materials handling systems, and decontamination of the facility. Recommended health physics and industrial hygiene controls to minimize worker's exposure, and updated air monitoring programs for both workplace exposures and effluent sampling.

Task Manager, Fernald Feed Materials Production Center, US Department of Energy Cincinnati, Ohio. August, 1985 – June, 1986. Mr. Thomas developed and implemented the collection and analysis of radiation measurement to assess the concentration of uranium in the soil surrounding the manufacturing facility. This work was performed as part of the site wide Remedial Investigation/ Feasibility study.

Health Physics Supervisor, Joliet, Illinois, Commonwealth Edison, September, 1984 – December, 1985. Provided support for the chemical cleaning of the primary cooling system at Dresden Nuclear Power Station, Unit 1. Mr. Thomas was responsible for assessment of engineering controls to reduce personnel exposures to radiation. The techniques were successful to remove more than 750 curies of cobalt-60 and other activation corrosion products. Personnel exposures were less than 7 man-Rems for the total project.

Health Physics Supervisor, Confidential Client, August 1983 - July, 1984. Provided support to decommission a facility that manufactured neutron sources (Am-Be) for nuclear power plants and radiography applications. The hot cells and glove boxes were segmented and packages in Type B shipping containers; the TRU waste shipped to Idaho Falls for storage and ultimate disposal by the USDOE. Drums of remote handled TRU were repackaged and characterized in order to satisfy the waste acceptance criteria for the USDOE. All work was performed in containments designed to minimize the spread of radioactive contamination, both airborne and surface contamination. Exposures to remediation workers was maintained below 1,000 millirem per person for the 15 month project; external exposures to gamma and neutron radiation were minimized. Internal exposures to TRU, including plutonium and americium were evaluated and verified to satisfy the requirements of the USNRC.

1976-1983 *Senior Research Industrial Hygienist, Dow Chemical, Midland, Michigan and Tulsa, Oklahoma.* Provided health and safety support for employees in manufacturing facilities, including plastic and other intermediate chemical production. Assigned as lead health physicist for decontamination projects at several nuclear power plants. From 1977 to 1980, Mr. Thomas served as the radiation safety officer for a NRC broad scope license to authorize the use of mixed fission products and special nuclear material used in manufacturing and research applications at Dow Chemical. The program included a TRIGA reactor, two small accelerators, sealed radioactive sources and tracers for a variety of research programs. Mr. Thomas directed all elements of the health physics program including training, standard operating procedures, exposure assessment and documentation. Mr. Thomas later (1981 - 1983) served as the radiation safety officer for the field services division where sealed sources and mixed fission products were used in treatment systems. This assignment had responsibilities in 22 states for approximately 3,000 employees. Mr. Thomas directed the use of radioactive materials licenses in 16 different states and a NRC license for the use of these radioactive materials.

Professional Society Membership

Health Physics Society (Plenary member)

American Academy of Health Physics

American Industrial Hygiene Association

American Academy of Industrial Hygiene

Bibliography

Mr. Thomas has authored/coauthored a number of papers and technical reports. In addition, he has developed/presented training courses in the field of health physics, industrial hygiene and safety.

Other Appointments/Awards

Ohio Radiation Advisory Council. Appointed by Governor Taft in 2002. Elected Chair of the Council in 2004 and 2005.

Ohio Utility Radiological Safety Board, Citizen's Advisory Council. Elected Chair in 2001 and 2002.

Director of the State of Ohio Low Level Radioactive Waste Facility Development Authority Board. Appointment by the Speaker of the Ohio State Legislature in 1997.

Chairman's Award for Safety Excellence, OHM Remediation Services, 1996, 1997

Senior Technical Associate, International Technology Corporation, 1991.

Member of the People to People Ambassador Delegation visiting the People's Republic of China, 1987. Invited speaker to review health physics practices.

Appendix 8.2 - Field Activity Daily Logs

INTEGRATED ENVIRONMENTAL MANAGEMENT, INC.
FIELD ACTIVITY DAILY LOG

Facility: Bayer Healthcare Bldg 18	
Date: 8/13/2007	Job/Task Number: 2007006.04
Client Name: Bayer	
Address of Work Site: 1025 N Michigan Elkhart IN 46514	
Description of Work: Final Status Survey	

DESCRIPTION OF DAILY ACTIVITIES AND EVENTS

Arrived on site at (insert date and time):

1245 Arrive at Bldg 110 to meet w/ Tom Lenz and kick off survey

1400 Tour Bldg 18 to review safety features and set up equipment

1445 Set up floor monitor and survey equipment

Tom Lenz 574 849 0212 cell
Channel 01 radio Call sign 19

1600 left bldg. offsite

Departed site at (insert date and time): 1600 hrs

Changes from Plans and Specifications, and Other Special Orders and Important Decisions:	
Weather Conditions: Indoors 85°F	Important Telephone Calls and Interactions:
Personnel on Site: Jeffrey Sumlin Bill Thomas	
Name (print): Jeffrey W. Sumlin	Signature

INTEGRATED ENVIRONMENTAL MANAGEMENT, INC.
FIELD ACTIVITY DAILY LOG

Facility: Bayer Healthcare	
Date: 8/14/2007	Job/Task Number: 2007006.04
Client Name: Bayer	
Address of Work Site: Bldg 18 1025 N Michigan	
Description of Work: Final Status Survey	

DESCRIPTION OF DAILY ACTIVITIES AND EVENTS

Arrived on site at (insert date and time):

0720 Onsite. Setup equipment and instrument response
Notified Tom Lenz that we were onsite.
Door to storage room opened by Security.

Calibrate survey instruments

0910 Survey labs and storage room

1100 Measure background on floor tiles and bare concrete

1140 Break for lunch
1220 Resume surveys in storage room and Rad lab

1500 Reviewed progress with Tom Lenz
Should be completed by Wednesday
1545 Off site

Departed site at (insert date and time): 1545

Changes from Plans and Specifications, and Other Special Orders and Important Decisions:	
Weather Conditions:	Important Telephone Calls and Interactions:
Personnel on Site: Jeffrey Sumlin / Bill Thomas	
Name (print): Jeffrey W. Sumlin	Signature JWS

INTEGRATED ENVIRONMENTAL MANAGEMENT, INC.
FIELD ACTIVITY DAILY LOG

Facility: Bayer Healthcare Bldg 18	
Date: 8/15/2007	Job/Task Number: 2007006.04
Client Name: Bayer	
Address of Work Site: 1025 N Michigan	
Description of Work: Final Status Survey	

DESCRIPTION OF DAILY ACTIVITIES AND EVENTS

Arrived on site at (insert date and time): 0735 Contacted Tom Lenz to begin the day

Set up survey equipment and instrument response

0800 Collect smears in Rad Lab

Measure background response on cabinets

1045 collected smears in rad lab

1400 Jeff Sumlin off site to FedEx

1600 Bill Thomas off site

Departed site at (insert date and time): 8/15/07 1600

Changes from Plans and Specifications, and Other Special Orders and Important Decisions:	
Weather Conditions:	Important Telephone Calls and Interactions:
Personnel on Site: Jeffrey Sumlin / Bill Thomas	
Name (print): Jeffrey W. Sumlin	Signature JWS

Appendix 8.3 - Instrumentation Records

Table 9.2 - Minimum Detectable Concentration for Survey Instruments

Detector Model	Beta Background(1)	Detector Efficiency (c/dis)(2)	Sensitivity (dpm/100cm^2)	
			Scanning(3)	Static Count (1 minute)(3)
43-68	145 cpm	0.29		267
43-68	76 cpm	0.23		191
239-1F	315 cpm	0.21		93

(1) Background values are the average of all daily pre-shift and post-shift values.
(2) Efficiencies are the average of the daily values
(3) Sensitivities are the average of the daily values

Table 9.1 - Radiation Survey Instrument Descriptions

Make	Rate Meter Model	Detector Model	Detector Type	Radiation Detected[1]	Calibration Source	Use
Ludlum	2224	43-68	Gas flow Proportional	Alpha, 1-5 Mev Beta, 65-1,450 Kev	^{230}Th, ^{99}Tc	Direct beta surveys; Beta scan on solid surfaces
Ludlum	2224	239-1F	Gas flow proportional	Alpha, 1-6 Mev Beta, 65-1,450 Kev	^{230}Th, ^{99}Tc	Beta scan on solid surfaces

[1] U.S. Nuclear Regulatory Commission, *Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions*, NUREG/CR-1507, December, 1997.

Table 9.3 - Summary of Survey Requirements

Area Classification	Surface Scans	Surface Activity Measurements
Class 1	100% using a grid, 4 m^2 in area	One direct reading and one smear from the center of each grid unit
Class 2	50% of floor and lower wall surfaces using a 4 m^2 grid units	One direct reading and one smear from the center of each grid unit
Class 3	10% of the locations as directed by the HP technician	One direct reading and one smear from 30 locations (20 from floors, 10 from walls) within each survey unit.

Table 9.4 - Investigation Action

Action if Investigation Results Exceed:			
Class	**$DCGL_{EMC}$**	**DCGL**	**0.5 x DCGL**
1	Future remediation and resurvey	Verify the result is less than the $DCGL_{EMC}$	Acceptable
2	Future remediation and reclassify	Verify the result is less than the $DCGL_{EMC}$. Reclassify portions of the survey unit as necessary	Acceptable
3	Future remediation and reclassify	Increase scan coverage and reclassify	Increase scan coverage and reclassify

Table 9.5 - List of Rooms to be Surveyed

Laboratory Room Number	Area (square feet)
C05	660
Hallway north of C05	252
Storage Room 2	150
Hallway south of Storage Room 2	120

Table 9.6 - Source Term and Derived Concentration Guideline Levels

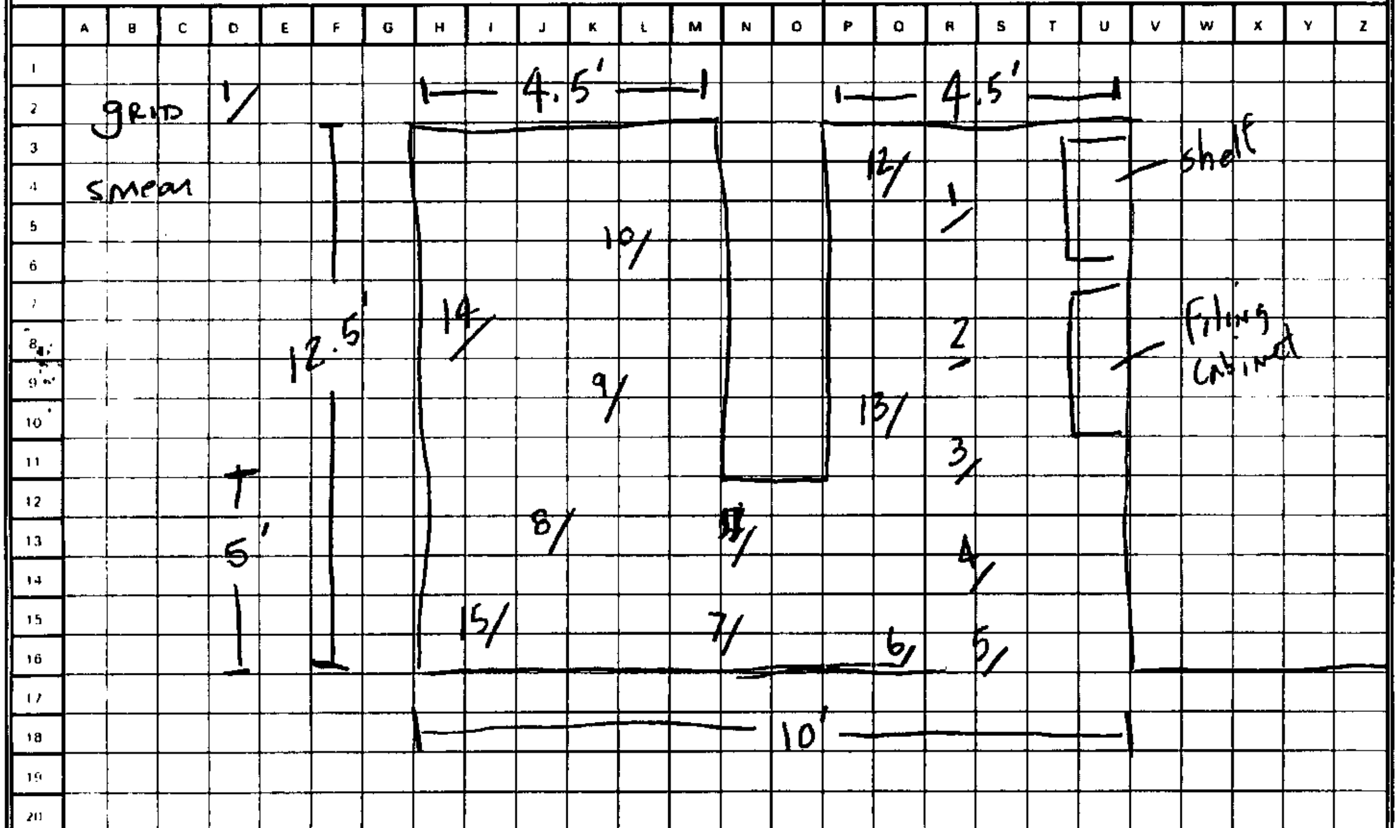
Radionuclide	Principal Radiation	Radiation Energy, E_{max} (keV)	Derived Concentration Guideline Levels (dpm/100 cm^2)
Carbon-14	beta	156	$3.7x10^6$
Hydrogen-3	beta	18	$1.2X10^8$

Appendix 8.4 - Field Survey Records

INTEGRATED ENVIRONMENTAL MANAGEMENT, INC.
RADIOLOGICAL SURVEY FORM

Survey Number 0814-01 Page 1 of 2

Instrument/SN: 2224 ~~146717~~	Calibration Due: BQT 3-7-08	Site Name: Bayer / Date: 8/14/07 / Time: 0900
Instrument/SN: 4368 PR ~~190477~~	Calibration Due: BQT 7-12-09	Location: Bldg 18 18.B.37
Instrument/SN:	Calibration Due:	Purpose: Final Status Survey
Survey Performed By (Print): Bill Thomas		Survey Performed By (Signature): Bill Thomas
☒ Battery OK ☒ HV OK	☒ Source Check OK	Grid Dimensions: ☐ meters ☐ inches ☐ feet ☐ centimeters



Notes

1 min counts
gross beta results
bare concrete floors
wall cinderblock w/paint ~3' from floor

2224 116239
43-68 PR 190483

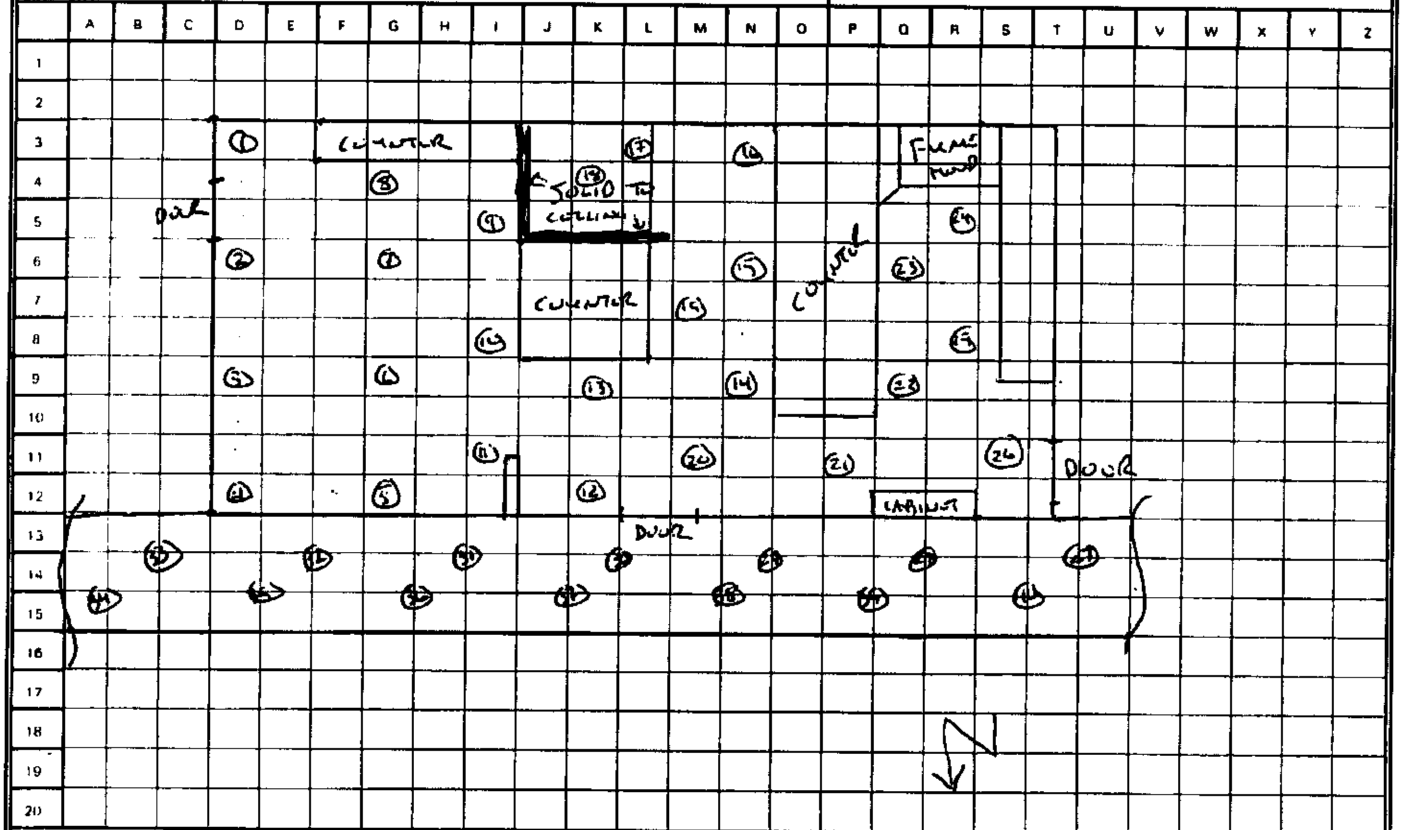
0814-01
2 of 2

Grid	Floor	Wall
1	111	132
2	135	101
3	132	129
4	139	130
5	133	122
6	130	122
7	136	124
8	121	117
9	123	139
10	124	129
11	118	133
12	133	138
13	164	122
14	127	112
15	122	138

INTEGRATED ENVIRONMENTAL MANAGEMENT, INC.
RADIOLOGICAL SURVEY FORM

Survey Number 0814-02

Instrument/SN: 2224/ 170347	Calibration Due: 6/7/08	Site Name: BAYER HEALTHCARE	Date: 8/14/07	Time: 1015
Instrument/SN: 43-37/ PR177476	Calibration Due: 6/7/08	Location: ROOM C05 DOOR 18C-B-13 AND HALLWAY		
Instrument/SN: N/A	Calibration Due: N/A	Purpose: FSS		
Survey Performed By (Print): SMULIN		Survey Performed By (Signature): [signature]		
☒ Battery OK ☒ HV OK ☒ Source Check OK		Grid Dimensions: 2x2 ☐ meters ☒ feet ☐ inches ☐ centimeters		



Notes: SCANNED 100% OF FLOOR. TOOK READINGS EVERY 6 FT. FLOOR IS TILE

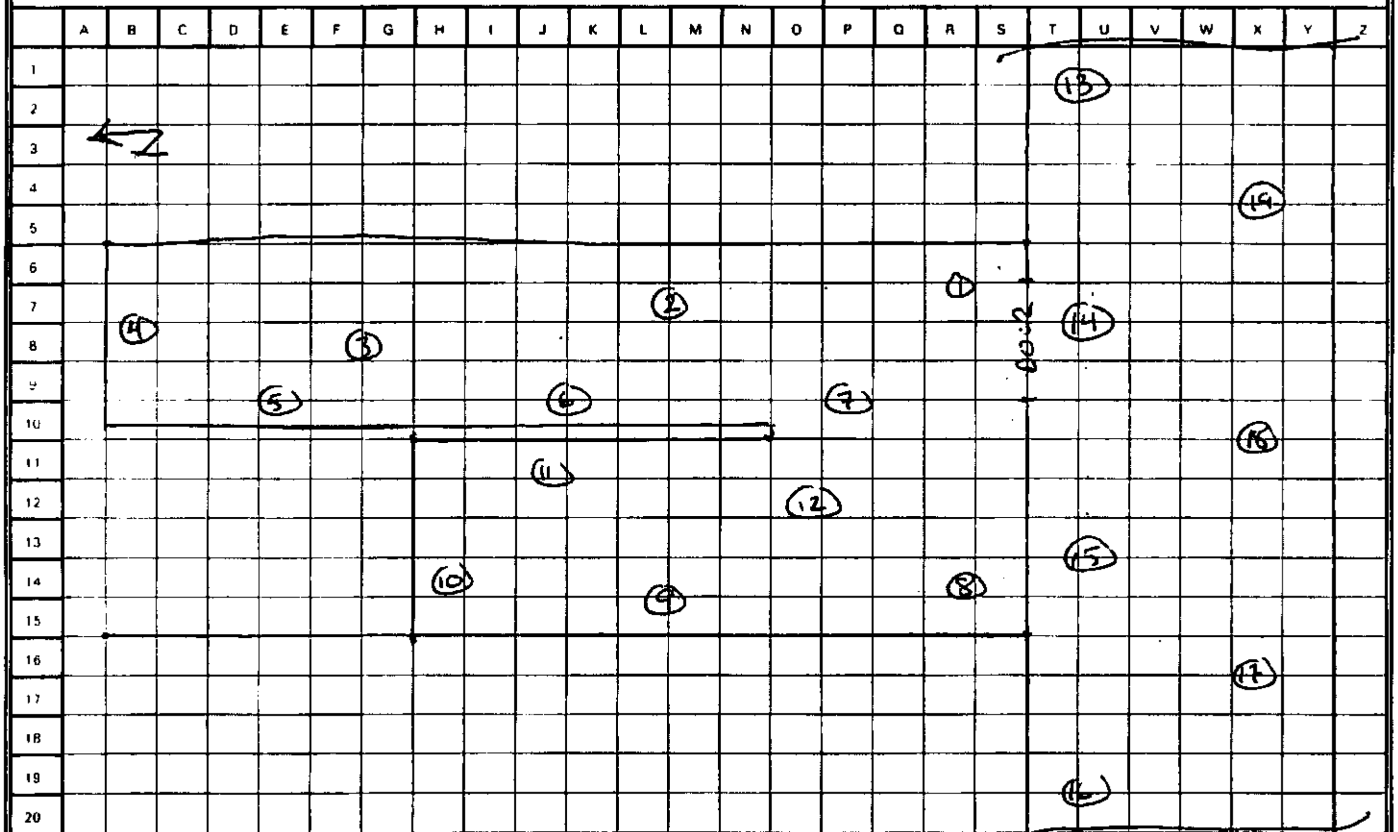
0814-02

1	320
2	320
3	340
4	340
5	360
6	340
7	340
8	320
9	320
10	340
11	340
12	360
13	360
14	340
15	340
16	360
17	360
18	320
19	320
20	340
21	340
22	360
23	320
24	340
25	360
26	340
27	320
28	320
29	320
30	320
31	320
32	320
33	340
34	340
35	360
36	320
37	320
38	340
39	340
40	340

INTEGRATED ENVIRONMENTAL MANAGEMENT, INC.
RADIOLOGICAL SURVEY FORM

Survey Number 0814-03

Instrument/SN: 43-37 / PR177476	Calibration Due: 6/7/08	Site Name: BAYER HEALTHCARE	Date: 9/14/07	Time: 1300
Instrument/SN: 2224 / 170347	Calibration Due: 6/7/08	Location: STORAGE ROOM 2 AND HALLWAY		
Instrument/SN: N/A	Calibration Due: N/A	Purpose: FSS		
Survey Performed By (Print): SWAIN		Survey Performed By (Signature):		
☑ Battery OK	☑ HV OK	☑ Source Check OK	Grid Dimensions: 1x1 ☐ meters ☑ feet ☐ inches ☐ centimeters	



Notes: PERFORMED SCAN OF 100% OF FLOOR, STORAGE AREA 2 IS CONCRETE, THE HALLWAY IS TILE. TOOK READINGS EVERY 6 FEET.

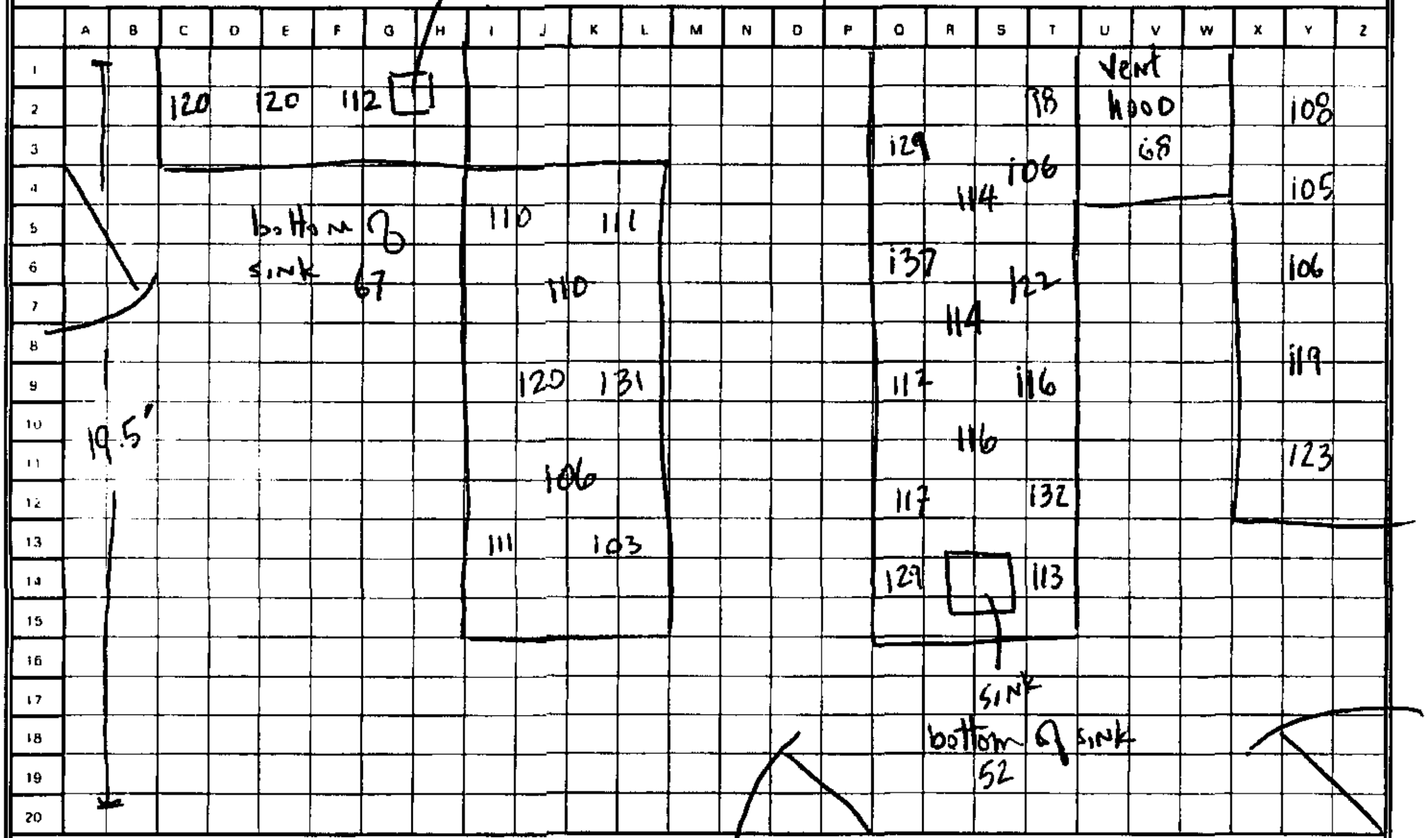
0814-03
2 of 2

1	500
2	550
3	550
4	550
5	600
6	550
7	500
8	500
9	550
10	550
11	550
12	550
13	360
14	380
15	380
16	400
17	340
18	360
19	340

INTEGRATED ENVIRONMENTAL MANAGEMENT, INC.
RADIOLOGICAL SURVEY FORM

Survey Number 0814-04 Page 1 of ______

Instrument/SN: 2224 116239	Calibration Due: 10-13-07	Site Name: Bayer	Date: 8/14	Time: 1240
Instrument/SN: 43-68 PR 190483	Calibration Due: 10-13-07	Location: Bldg 18 18C.B.13 Rm C05		
Instrument/SN:	Calibration Due:	Purpose: Final Status Survey		
Survey Performed By (Print): BR Thomas		Survey Performed By (Signature): BR Thomas		
☒ Battery OK ☒ HV OK ☒ Source Check OK Results in total counts		Grid Dimensions: ______ ☐ meters ☐ inches ☐ feet ☐ centimeters		



Notes:

Survey countertops — 33' — DOOR

Chemical resistant tops

1 min cnts

N ↓

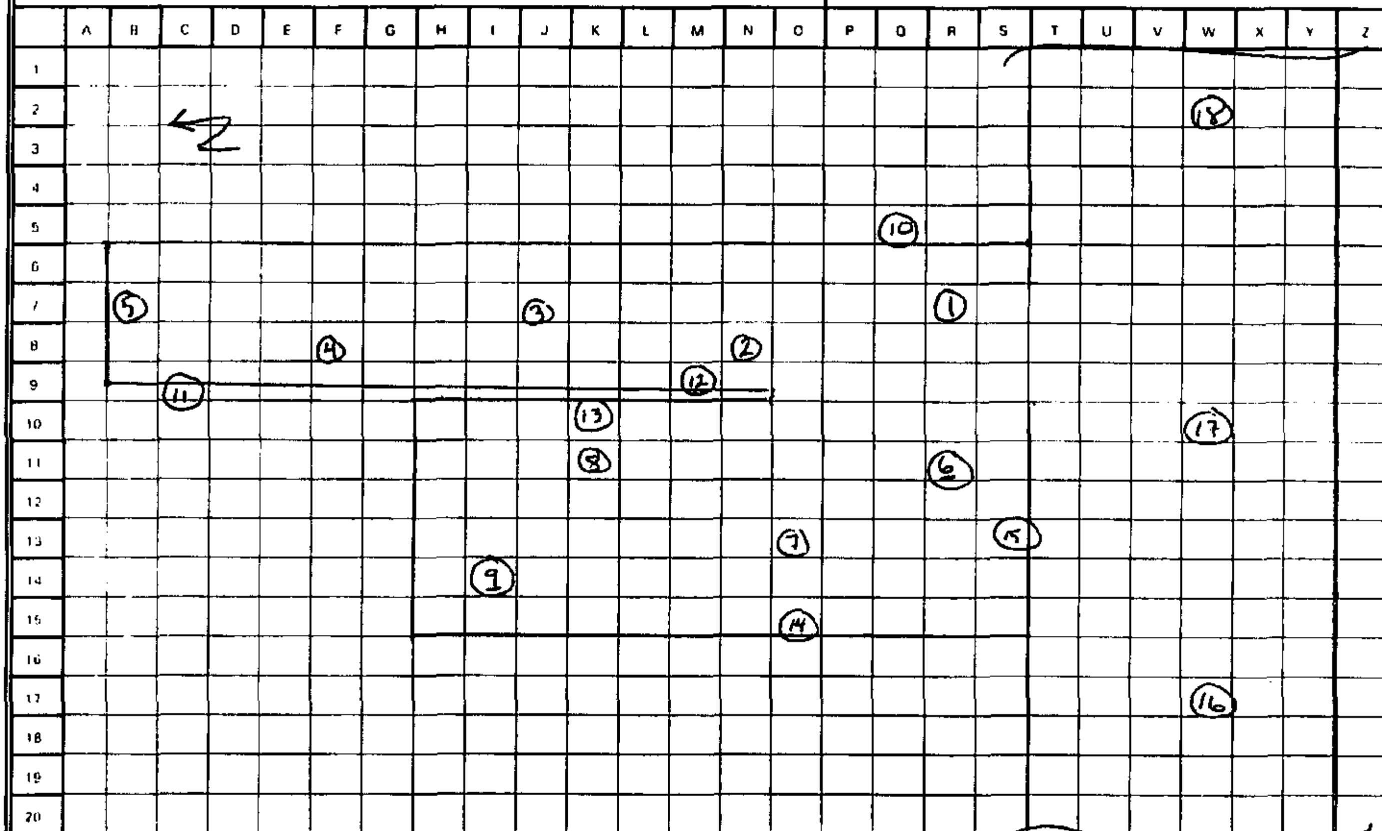
Copyright © Integrated Environmental Management, 1998
RSP-018 (Rev. 001) - Attachment 1

INTEGRATED ENVIRONMENTAL MANAGEMENT, INC.

RADIOLOGICAL SURVEY FORM

Survey Number 0814-05 Page 1 of 2

Instrument/SN: N/A	Calibration Due: N/A	Site Name: BAYER HEALTHCARE	Date: 8/14/07	Time: 1530
Instrument/SN: N/A	Calibration Due: N/A	Location: STORAGE ROOM 2 AND HALLWAY		
Instrument/SN: N/A	Calibration Due: N/A	Purpose: FSS		
Survey Performed By (Print): Sumner		Survey Performed By (Signature):		
☐ Battery OK ☐ HV OK ☐ Source Check OK		Grid Dimensions: 1x1 ☐ meters ☒ feet ☐ inches ☐ centimeters		



Notes: SMEAR LOCATIONS

RSP-018 (Rev. 001) - Attachment 1

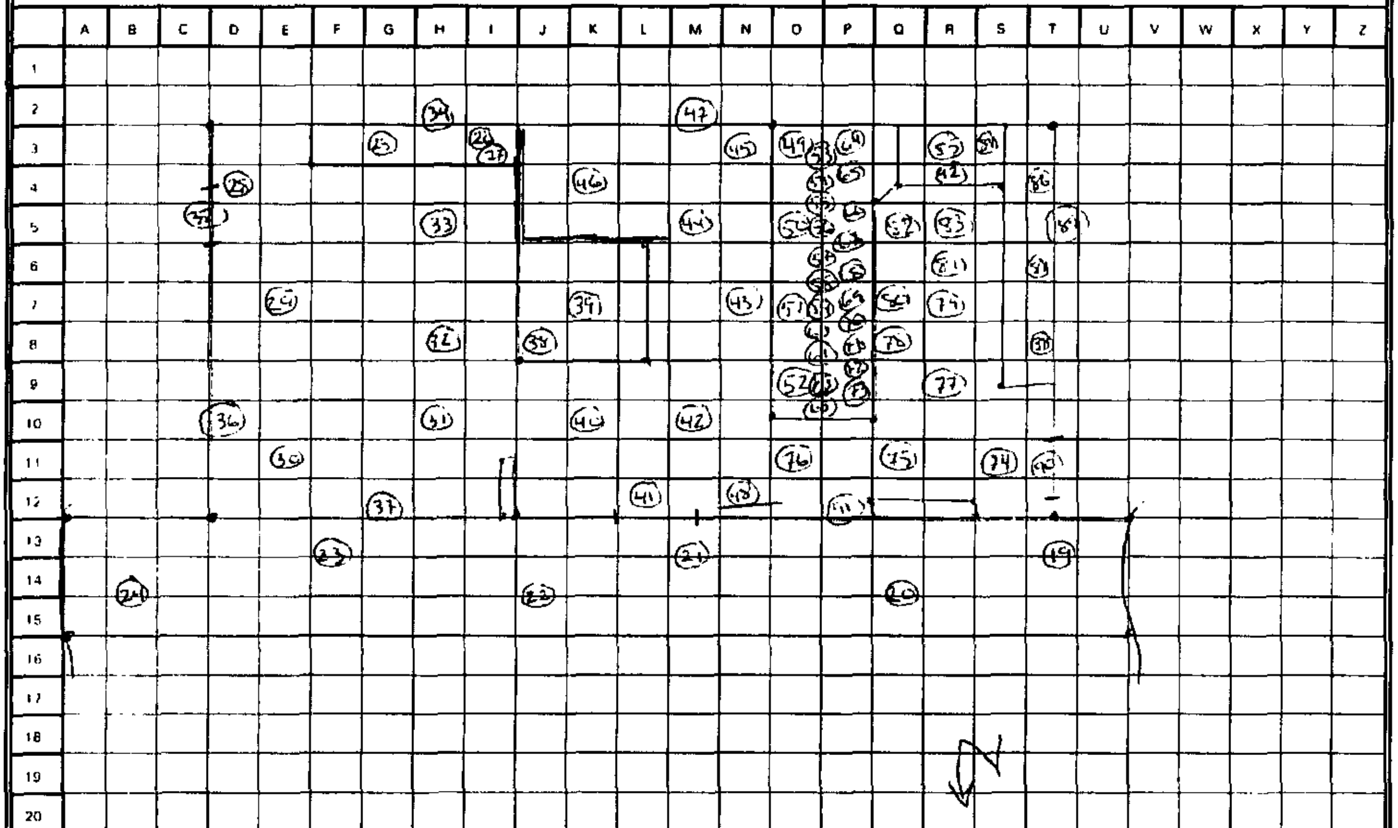
0814-05
2 of 2

1	R7
2	N8
3	J7
4	F8
5	B7
6	R11
7	O13
8	K11
9	I14
10	O5/6 up 4 feet
11	C9 up 6 feet
12	M9 up 2 feet
13	K9/10 up 3 feet
14	O15/16 up 4 feet
15	S/T13 up 6 feet
16	W17
17	W10
18	W2

INTEGRATED ENVIRONMENTAL MANAGEMENT, INC.
RADIOLOGICAL SURVEY FORM

Survey Number 0814-06

Instrument/SN: N/A	Calibration Due: N/A	Site Name: BAYER HEALTHCARE	Date: 7/15/07	Time: 0930
Instrument/SN: N/A	Calibration Due: N/A	Location: ROOM CUT DOOR 18C-B-13 AND HALLWAY		
Instrument/SN: N/A	Calibration Due: N/A	Purpose: FSS		
Survey Performed By (Print): [illegible]		Survey Performed By (Signature): [illegible]		
☐ Battery OK ☐ HV OK ☐ Source Check OK		Grid Dimensions: 2 x 2 ☐ meters ☒ feet ☐ inches ☐ centimeters		



Notes: SAMPLE LOCATIONS

RSP-018 (Rev. 001) - Attachment 1

0814-06
2063

19	T13/14
20	Q14/15
21	M13/14
22	J14/15
23	F13/14
24	B14/15
25	G3 countertop
26	I3 sink drain
27	I3 sink trap
28	D4
29	E7
30	E11
31	H10
32	H8
33	H5
34	H2/3 4 feet up on wall
35	C/D5 3 feet up on lab side of door
36	C/D10 6 feet up on wall
37	G12/13 4 feet up on wall
38	J8 countertop
39	K7 countertop sink drain
40	K10
41	L12
42	M10
43	N7
44	M5
45	N3
46	K4
47	M2/3 4 feet up on wall
48	N12 3 feet up on lab side of door (door is off frame)
49	O3 countertop
50	O5 countertop
51	O7 countertop
52	O9 countertop
53	O/P3 countertop
54	O/P 4 countertop sink drain
55	O/P4/5 countertop
56	O/P5 countertop
57	O/P6 countertop sink drain
58	O/P6/7 countertop
59	O/P7 countertop
60	O/P8 countertop sink drain
61	O/P8/9 countertop
62	O/P9 sink drain
63	O/P9 sink trap

64	P3 countertop
65	P4 countertop
66	P5 countertop
67	P5/6 countertop
68	P6 countertop
69	P7 countertop
70	P7/8 countertop
71	P8 countertop
72	P9 countertop
73	P9/10 countertop
74	S11
75	Q11
76	O11
77	R9
78	Q8
79	R7
80	Q7
81	R6
82	Q5
83	R5
84	S3 fume hood sink drain
85	R3 fume hood exhaust duct
86	T4 countertop
87	T6 countertop
88	T8 countertop
89	T5 4 feet up on wall
90	T11 3 feet up on lab side of door
91	P12/13 6 feet up on wall
92	R4 fume hood

INTEGRATED ENVIRONMENTAL MANAGEMENT, INC.
RADIOLOGICAL SURVEY FORM

Survey Number 0814-07

Instrument/SN: 2224 (146712)	Calibration Due: 3/7/08	Site Name: BAYOR	Date: 8/14/07 / Time: 1600
Instrument/SN: 43-68 (PR 190477)	Calibration Due: 7/12/08	Location: BLDG 18 Room C05	
Instrument/SN: N/A	Calibration Due: N/A	Purpose: FSS	
Survey Performed By (Print): Smith		Survey Performed By (Signature):	
☒ Battery OK	☒ HV OK	☒ Source Check OK	Grid Dimensions: N/A ☐ meters ☐ inches ☐ feet ☐ centimeters

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
1																										
2																										
3																										
4																										
5																										
6																										
7																										
8																										
9																										
10																										
11																										
12																										
13																										
14																										
15																										
16																										
17																										
18																										
19																										
20																										

Notes: PERFORMED 1 MINUTE STATIC COUNTS INSIDE ALL DRAWERS

RSP-018 (Rev. 001) - Attachment 1

0814-07
2 of 4

8/14/07
Performed 1 minute static counts of inside drawers in Room C05.
2224 (146712) w/43-68 (PR190477)
Results are in gross cpm β/100 cm².
148
164
146
161
167
160
140
156
173
169
149
138
146
152
133
141
142
140
143
136
144
139
142
143
141
137
144
147
143
132
144
144
139
145
141
149
151
147
142
138
149

0814-07
304 F

154
144
141
137
151
141
136
150
144
146
138
149
144
154
143
139
136
148
145
146
159
154
146
143
145
160
153
147
150
133
134
142
145
139
157
146
151
139
144
141
140
146
145
142
148

146
144
151
138
152
147
142
144
145
168
150
157
151
149
145
143
144

Appendix 8.5 - Analytical Results for Removable Activity

Stan A. Huber Consultants, Inc.
Health Physics and Radiation Safety Services

200 North Cedar Road – New Lenox, Illinois 60451-1751 – (800) 383-0468 or (815) 485-6161 – FAX (815) 485-4433 – Email sahci@sahci.com – Home Page www.sahci.com

August 28, 2007

Carol D. Berger
President
Integrated Environmental Management, Inc.
8 Brookes Avenue, Suite 205
Gaithersburg, MD 20877

Subject: Sample Analysis for ^3H and ^{14}C Detection

Dear Ms. Berger:

Per your request we have completed the analysis of the initial wipes that you provided. All samples were analyzed on August 23, 2007 using a Packard Liquid Scintillation Counter, Model U1900, Serial No. 101464. Each sample was counted for five (5) minutes. The DPM results are provided on the attached document.

If you have further questions or need additional information please feel free to contact me or Glenn Huber at 1-800-383-0468.

Sincerely,
Stan Huber Consultants, Inc.

James Hatten
Radiation Safety Officer, SAHCI

Enclosure

IEM Wipe Analysis
8/28/2007

Instrument Identification:	Manufacturer	Model	Serial	Analyze Date	BKG H3 cpm	BKG C14 cpm	H3 Eff	C14 Eff
LSC	Packard	U1900	101464	8/23/2007	16.35	23.57	0.6419	0.9473

Protocol Information: H3 Window: 1-18.6keV, C14 Window: 1-156keV, Count time: 5 minutes

Sample #	H3 DPM	C14 DPM
Blank 1	6.07	0.00
Blank 2	0.24	0.00
1	3.66	2.74
2	0.00	0.00
3	0.00	0.00
4	0.00	1.97
5	0.00	2.20
6	0.00	0.00
7	4.20	0.00
8	5.42	0.00
9	7.61	0.00
10	0.00	0.00
11	0.02	0.00
12	1.37	0.00
13	2.22	3.77
14	9.38	0.00
15	0.00	0.89
16	6.86	0.00
17	1.73	0.00
18	0.00	0.00
19	0.00	0.00
20	0.00	0.00
21	0.00	1.96
22	0.92	0.00
23	0.00	0.00
24	7.97	0.00
25	1.77	0.94
26	4.88	0.00
27	3.99	0.00
28	7.36	0.00
29	0.00	0.00
30	0.00	0.92
31	2.21	0.00
32	0.61	1.17
33	0.00	0.00
34	1.70	0.00
35	5.89	0.00
36	0.00	0.00
37	5.50	2.68
38	0.00	0.00
39	0.00	4.50
40	2.62	0.33
41	6.73	3.46
42	4.11	0.00
43	7.05	0.00
44	2.25	0.00
45	1.04	0.00
46	5.19	0.00

Sample #	H3 DPM	C14 DPM
47	4.08	0.00
48	0.00	0.00
49	1.75	0.00
50	5.11	0.00
51	2.88	0.00
52	0.99	2.10
53	0.00	0.00
54	1.26	0.00
55	3.81	0.00
56	3.35	2.44
57	0.00	2.29
58	0.00	0.00
59	0.52	0.00
60	0.00	0.03
61	0.00	0.00
62	7.76	3.67
63	0.00	0.00
64	0.00	0.00
65	0.00	0.00
66	0.00	0.00
67	0.00	1.92
68	7.68	0.00
69	4.38	0.00
70	2.57	0.00
71	8.18	0.00
72	0.00	0.00
73	0.14	0.27
74	0.00	0.00
75	16.01	0.60
76	0.00	0.00
77	0.00	0.00
78	0.46	0.00
79	0.00	0.00
80	1.59	0.00
81	6.51	0.00
82	6.42	0.00
83	2.67	0.00
84	5.21	0.00
85	2.54	0.00
86	1.00	0.00
87	0.00	0.00
88	1.12	0.00
89	4.77	1.60
90	8.11	0.00
91	0.00	0.00
92	0.74	0.00
Blank 3	0.00	1.05

Protocol #:14 Name:3H/14C 23-Aug-2007 15:36
Region A: LL-UL= 0.0-12.0 Lcr= 0 Bkg= 0.00 %2 Sigma=0.00
Region B: LL-UL=12.0-156. Lcr= 0 Bkg= 0.00 %2 Sigma=0.00
Region C: LL-UL= 0.0- 0.0 Lcr= 0 Bkg= 0.00 %2 Sigma=0.00
Time = 5.00 QIP = tSIE/AEC ES Terminator = Count
Conventional DPM Quench set H3
Nuclide 1 = 270100 Nuclide 2 = 120500 Quench set C14

10 min count Time

System
16.35 - 60min
23.57 - 60 min

S#	TIME	CPMA	DPM1	CPMB	DPM2	tSIE	FLAG	C:2S%	
1	10.00	10.81		16.69		430.	B	0.00	
(6 missing vials)									
8	5.00	2.08	6.07	0.00	0.00	442.		0.00	Blk1
9	5.00	0.08	0.24	0.00	0.00	442.		0.00	Blk 2
(1 missing vial)									
11	5.00	1.58	3.66	2.32	2.74	437.		0.00	#1
12	5.00	0.00	0.00	0.00	0.00	433.		0.00	2
13	5.00	0.00	0.00	0.00	0.00	434.		0.00	
14	5.00	0.00	0.00	1.54	1.97	433.		0.00	
15	5.00	0.00	0.00	1.73	2.20	433.		0.00	
16	5.00	0.00	0.00	0.00	0.00	426.		0.00	
17	5.00	1.41	4.20	0.00	0.00	432.		0.00	
18	5.00	1.82	5.42	0.00	0.00	433.		0.00	
19	5.00	2.59	7.61	0.00	0.00	439.		0.00	
20	5.00	0.00	0.00	0.00	0.00	440.		0.00	
21	5.00	0.01	0.02	0.00	0.00	442.		0.00	
22	5.00	0.47	1.37	0.00	0.00	443.		0.00	
23	5.00	1.21	2.22	3.09	3.77	440.		0.00	
24	5.00	3.18	9.38	0.00	0.00	437.		0.00	
25	5.00	0.00	0.00	0.70	0.89	439.		0.00	
26	5.00	2.32	6.86	0.00	0.00	434.		0.00	
27	5.00	0.59	1.73	0.00	0.00	437.		0.00	
28	5.00	0.00	0.00	0.00	0.00	436.		0.00	
29	5.00	0.00	0.00	0.00	0.00	433.		0.00	
30	5.00	0.00	0.00	0.00	0.00	432.		0.00	
31	5.00	0.00	0.00	1.53	1.96	435.		0.00	
32	5.00	0.31	0.92	0.00	0.00	433.		0.00	
33	5.00	0.00	0.00	0.00	0.00	434.		0.00	
34	5.00	2.68	7.97	0.02	0.00	432.		0.00	
35	5.00	0.69	1.77	0.81	0.94	411.		0.00	
36	5.00	1.62	4.88	0.00	0.00	426.		0.00	
37	5.00	1.35	3.99	0.00	0.00	436.		0.00	
38	5.00	2.45	7.36	0.00	0.00	428.		0.00	
39	5.00	0.00	0.00	0.00	0.00	432.		0.00	
40	5.00	0.00	0.00	0.72	0.92	438.		0.00	
41	5.00	0.74	2.21	0.00	0.00	434.		0.00	
42	5.00	0.35	0.61	0.95	1.17	436.		0.00	
43	5.00	0.00	0.00	0.00	0.00	438.		0.00	
44	5.00	0.57	1.70	0.00	0.00	436.		0.00	
45	5.00	2.01	5.89	0.00	0.00	439.		0.00	
46	5.00	0.00	0.00	0.00	0.00	439.		0.00	
47	5.00	2.22	5.50	2.35	2.68	439.		0.00	
48	5.00	0.00	0.00	0.00	0.00	439.		0.00	
49	5.00	0.00	0.00	3.53	4.50	436.		0.00	
50	5.00	0.94	2.62	0.36	0.33	435.		0.00	
51	5.00	2.70	6.73	3.00	3.46	431.		0.00	
52	5.00	1.40	4.11	0.00	0.00	438.		0.00	
53	5.00	2.38	7.05	0.00	0.00	435.		0.00	

S#	TIME	CPMA	DPM1	CPMB	DPM2	tSIE	FLAG	C:2S%	
54	5.00	0.76	2.25	0.00	0.00	435.		0.00	54
55	5.00	0.35	1.04	0.00	0.00	434.		0.00	55
56	5.00	1.76	5.19	0.00	0.00	436.		0.00	
57	5.00	1.39	4.08	0.00	0.00	439.		0.00	
58	5.00	0.00	0.00	0.00	0.00	435.		0.00	
59	5.00	0.59	1.75	0.00	0.00	438.		0.00	
60	5.00	1.72	5.11	0.00	0.00	435.		0.00	
61	5.00	0.98	2.88	0.00	0.00	437.		0.00	
62	5.00	0.59	0.99	1.71	2.10	437.		0.00	
63	5.00	0.00	0.00	0.00	0.00	420.		0.00	
64	5.00	0.42	1.26	0.00	0.00	432.		0.00	
65	5.00	1.27	3.81	0.00	0.00	430.		0.00	
66	5.00	1.43	3.35	2.07	2.44	433.		0.00	
67	5.00	0.00	0.00	1.80	2.29	432.		0.00	
68	5.00	0.00	0.00	0.00	0.00	423.		0.00	
69	5.00	0.18	0.52	0.00	0.00	434.		0.00	
70	5.00	0.00	0.00	0.02	0.03	408.		0.00	
71	5.00	0.00	0.00	0.00	0.00	434.		0.00	
72	5.00	3.09	7.76	3.21	3.67	434.		0.00	
73	5.00	0.00	0.00	0.00	0.00	432.		0.00	
74	5.00	0.00	0.00	0.00	0.00	433.		0.00	
75	5.00	0.00	0.00	0.00	0.00	437.		0.00	
76	5.00	0.00	0.00	0.00	0.00	437.		0.00	
77	5.00	0.00	0.00	1.51	1.92	432.		0.00	
78	5.00	2.61	7.68	0.00	0.00	438.		0.00	
79	5.00	1.45	4.38	0.00	0.00	426.		0.00	
80	5.00	0.86	2.57	0.00	0.00	429.		0.00	
81	5.00	2.76	8.18	0.00	0.00	435.		0.00	
82	5.00	0.00	0.00	0.00	0.00	435.		0.00	
83	5.00	0.08	0.14	0.22	0.27	430.		0.00	
84	5.00	0.00	0.00	0.00	0.00	438.		0.00	
85	5.00	5.62	16.01	1.08	0.60	440.		0.00	
86	5.00	0.00	0.00	0.00	0.00	439.		0.00	
87	5.00	0.00	0.00	0.00	0.00	435.		0.00	
88	5.00	0.15	0.46	0.00	0.00	434.		0.00	
89	5.00	0.00	0.00	0.00	0.00	436.		0.00	
90	5.00	0.54	1.59	0.00	0.00	435.		0.00	
91	5.00	2.21	6.51	0.00	0.00	438.		0.00	
92	5.00	2.18	6.42	0.00	0.00	437.		0.00	
93	5.00	0.90	2.67	0.00	0.00	431.		0.00	
94	5.00	1.76	5.21	0.00	0.00	435.		0.00	
95	5.00	0.85	2.54	0.00	0.00	428.		0.00	
96	5.00	0.34	1.00	0.00	0.00	435.		0.00	
97	5.00	0.00	0.00	0.00	0.00	437.		0.00	
98	5.00	0.38	1.12	0.00	0.00	437.		0.00	
99	5.00	1.84	4.77	1.46	1.60	441.		0.00	
100	5.00	2.74	8.11	0.00	0.00	434.		0.00	
101	5.00	0.00	0.00	0.00	0.00	441.		0.00	
102	5.00	0.25	0.74	0.00	0.00	428.		0.00	
(1 missing vial)									
104	5.00	0.07	0.00	0.83	1.05	443.		0.00	Blk 3

Appendix 8.6 - Radiation Background for Different Media

Response of Radiation Detector to Background

Ratemeter Ludlum 2224, Serial Number 116239
Detector Ludlum 43-68, Serial Number PR 190483
Media Floor tiles

Result, counts	Comment	Result, counts	Comment
59	Room B02	66	Room B02
71	"	72	"
68	"	55	"
58	"	66	"
65	"	72	"
52	"	55	"
56	"	66	"
74	"	53	"
61	"	80	"
80	"	82	"
75	"	75	"
68	"	61	"
64	"	63	"
72	"	60	"
81	"	58	"

The detector was placed in direct contact with the floor tiles and the total counts were accumulated for one (1) minute.

Statistics		
	Average	66.3 counts
	Std Deviation	8.8 counts
	Minimum	52 counts
	Maximum	82 counts

Response of Radiation Detector to Background

Ratemeter Ludlum 2224, Serial Number 116239
Detector Ludlum 43-68, Serial Number PR 190483
Media Concrete

Result, counts	Comment	Result, counts	Comment
130	Room B02	120	Room C010
123	"	146	"
135	"	118	"
142	"	123	"
163	"	124	"
121	"	101	Room 017
129	"	130	"
136	"	112	"
148	"	119	"
145	"	107	"
120	Room C010	107	"
141	"	105	"
119	"	112	"
160	"	114	"
136	"	108	"

The detector was placed in direct contact with the concrete and the total counts were accumulated for one (1) minute.

Statistics	Average	126.5 counts
	Std Deviation	16.1 counts
	Minimum	101 counts
	Maximum	163 counts

Response of Radiation Detector to Background

Ratemeter Ludlum 2224, Serial Number 146712
Detector Ludlum 43-68, Serial Number PR 190477
Media Metal drawers

Result, counts	Comment	Result, counts	Comment
157	Room B02	183	Room B02
187	"	153	"
178	"	193	"
183	"	204	"
160	"	191	"
174	"	176	"
166	"	160	"
159	"	149	"
188	"	174	"
165	"	165	"
173	"	145	"
167	"	161	"
182	"	134	"
154	"	143	"
145	"	135	"

The detector was placed in direct contact with the metal drawers and the total counts were accumulated for one (1) minute.

Statistics	Average	166.8 counts
	Std Deviation	17.8 counts
	Minimum	134 counts
	Maximum	204 counts

Response of Radiation Detector to Background

Ratemeter Ludlum 2224, Serial Number 170347
Detector Ludlum 43-37, Serial Number PR 177476
Media Floor tiles

Result	Comment	Result	Comment
339	Room C07	346	Room C09
344	"	338	"
341	"	344	"
342	"	341	"
341	"	339	"
347	Room C012	344	Room C03
336	"	338	"
339	"	339	"
344	"	346	"
341	"	349	"
357	Room C010	344	Outside C06
339	"	348	"
342	"	341	"
349	"	350	"
336	"	346	"

The detector was placed in direct contact with the floor tiles and the total counts were accumulated for one (1) minute.

Statistics		
	Average	343.0 counts
	Std Deviation	4.7 counts
	Minimum	336 counts
	Maximum	357 counts

Response of Radiation Detector to Background

Ratemeter Ludlum 2224, Serial Number 170347
Detector Ludlum 43-37, Serial Number PR 177476
Media Concrete

Result	Comment	Result	Comment
494	Room C010	498	Room 017
522	"	511	"
513	"	506	"
519	"	499	"
516	"	517	"
496	Room C03	493	Room A020
514	"	501	"
508	"	506	"
511	"	504	"
498	"	512	"
536	Room B02	499	Room C09
528	"	504	"
534	"	501	"
531	"	512	"
527	"	494	"

The detector was placed in direct contact with the concrete and the total counts were accumulated for one (1) minute.

Statistics		
	Average	343.0 counts
	Std Deviation	4.7 counts
	Minimum	336 counts
	Maximum	357 counts

Appendix 8.7 - Photographs of the FSS Process


Hallway into Waste Storage Room


Waste Storage Room


Rad Lab


Rad Lab


Rad Lab Drain


Floor Monitor Measurements


Static Measurements


Static Measurement in Drawer

This report was prepared under the direction of
Bayer Healthcare, LLC

by

Jeffrey W. Sumlin, RRPT
R. Alan Duff, RRPT
Integrated Environmental Management, Inc.
6700 Baum Drive Suite 19
Knoxville, Tennessee 37919
(865) 588-1693
RADuff@IEM-Inc.com

and

Billy R. Thomas, CHP, CIH
Integrated Environmental Management, Inc.
1129 Trenton Avenue, Suite 202
Findlay, Ohio 45840
(419) 423-4701
BRThomas@IEM-Inc.com

http://www.iem-inc.com