STATE OF MICHIGAN
DEPARTMENT OF ENVIRONMENTAL QUALITY
LANSING

JENNIFER M. GRANHOLM
GOVERNOR

STEVEN E. CHESTER
DIRECTOR

February 22, 2007

Ms. Patricia Pelke, Chief
Materials Licensing Branch
U.S. Nuclear Regulatory Commission, Region III
801 Warrenville Road
Lisle, Illinois 60532-4351

Dear Ms. Pelke:

SUBJECT: NRC License Number: 21-05199-02

We are renewing our current license and requesting an amendment to the license. We would like to install a GC-60 Beam Calibrator from Atlan-Tech, Inc. in the existing, fully-shielded calibration room at 815 Terminal Road, Lansing, Michigan. The GC-60 Calibrator with a 10-curie cesium-137 source is being acquired in response to our need to conduct enhanced portable instrument calibrations, instrument response checks, and dosimeter exposure tests to improve our radiological emergency preparedness activities.

Also, enclosed are final status surveys for our old calibration room, nuclear counting laboratory, and storage bunker.

Our administrative office has moved and our mailing address has changed. Two copies of this letter, NRC Form-313, and all attachments are enclosed.

In summary, we request the following modifications to our license:

1. **Licensee name change to:**
   State of Michigan
   Department of Environmental Quality
   Waste and Hazardous Materials Division

2. **Mailing address change to:**
   Radiological Protection Section
   525 West Allegan Street, P.O. Box 30241
   Lansing, Michigan 48909-7741

6., 7., 8. Add:

6.	7.	8.
Cesium-137	Sealed source (Amersham CDC 711m)	One source not to exceed 11 curies
Cesium-137	Sealed source (Amersham CDC 800)	One source not to exceed 150 millicuries
Cobalt-60	Sealed source	One source not to exceed 2 curies

RECEIVED FEB 2 8 2007

9. **Add:** For possession and use in an Atlan-Tech GC-60 Instrument Calibrator.

10. **Modify this condition to read:**

"Licensed material shall be used at the licensee's facility located at 815 Terminal Road, Lansing, Michigan. Licensed material listed in Subitem 6.F. may be used at temporary jobsites throughout the state of Michigan."

If you have any questions, please contact me.

Sincerely,

Robert D. Skowronek

Robert D. Skowronek, Chief
Radioactive Materials Unit
Radiological Protection Section
Waste and Hazardous Materials Division
517-241-1253

RDS:JK
Enclosures

NRC FORM 313 (10-2005) 10 CFR 30, 32, 33, 34, 35, 36, 39, and 40

U.S. NUCLEAR REGULATORY COMMISSION

APPLICATION FOR MATERIAL LICENSE

APPROVED BY OMB: NO. 3150-0120 EXPIRES: 10/31/2008
Estimated burden per response to comply with this mandatory collection request: 4.4 hours. Submittal of the application is necessary to determine that the applicant is qualified and that adequate procedures exist to protect the public health and safety. Send comments regarding burden estimate to the Records and FOIA/Privacy Services Branch (T-5 F53), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to infocollects@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0120), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

INSTRUCTIONS: SEE THE APPROPRIATE LICENSE APPLICATION GUIDE FOR DETAILED INSTRUCTIONS FOR COMPLETING APPLICATION. SEND TWO COPIES OF THE ENTIRE COMPLETED APPLICATION TO THE NRC OFFICE SPECIFIED BELOW.

APPLICATION FOR DISTRIBUTION OF EXEMPT PRODUCTS FILE APPLICATIONS WITH:

DIVISION OF INDUSTRIAL AND MEDICAL NUCLEAR SAFETY
OFFICE OF NUCLEAR MATERIALS SAFETY AND SAFEGUARDS
U.S. NUCLEAR REGULATORY COMMISSION
WASHINGTON, DC 20555-0001

ALL OTHER PERSONS FILE APPLICATIONS AS FOLLOWS:

IF YOU ARE LOCATED IN:

ALABAMA, CONNECTICUT, DELAWARE, DISTRICT OF COLUMBIA, FLORIDA, GEORGIA, KENTUCKY, MAINE, MARYLAND, MASSACHUSETTS, MISSISSIPPI, NEW HAMPSHIRE, NEW JERSEY, NEW YORK, NORTH CAROLINA, PENNSYLVANIA, PUERTO RICO, RHODE ISLAND, SOUTH CAROLINA, TENNESSEE, VERMONT, VIRGINIA, VIRGIN ISLANDS, OR WEST VIRGINIA, SEND APPLICATIONS TO:

LICENSING ASSISTANCE TEAM
DIVISION OF NUCLEAR MATERIALS SAFETY
U.S. NUCLEAR REGULATORY COMMISSION, REGION I
475 ALLENDALE ROAD
KING OF PRUSSIA, PA 19406-1415

IF YOU ARE LOCATED IN:

ILLINOIS, INDIANA, IOWA, MICHIGAN, MINNESOTA, MISSOURI, OHIO, OR WISCONSIN, SEND APPLICATIONS TO:

MATERIALS LICENSING BRANCH
U.S. NUCLEAR REGULATORY COMMISSION, REGION III
2443 WARRENVILLE ROAD, SUITE 210
LISLE, IL 60532-4352

ALASKA, ARIZONA, ARKANSAS, CALIFORNIA, COLORADO, HAWAII, IDAHO, KANSAS, LOUISIANA, MONTANA, NEBRASKA, NEVADA, NEW MEXICO, NORTH DAKOTA, OKLAHOMA, OREGON, PACIFIC TRUST TERRITORIES, SOUTH DAKOTA, TEXAS, UTAH, WASHINGTON, OR WYOMING, SEND APPLICATIONS TO:

NUCLEAR MATERIALS LICENSING BRANCH
U.S. NUCLEAR REGULATORY COMMISSION, REGION IV
611 RYAN PLAZA DRIVE, SUITE 400
ARLINGTON, TX 76011-4005

PERSONS LOCATED IN AGREEMENT STATES SEND APPLICATIONS TO THE U.S. NUCLEAR REGULATORY COMMISSION ONLY IF THEY WISH TO POSSESS AND USE LICENSED MATERIAL IN STATES SUBJECT TO U.S.NUCLEAR REGULATORY COMMISSION JURISDICTIONS.

1. THIS IS AN APPLICATION FOR *(Check appropriate item)*

- [ ] A. NEW LICENSE
- [x] B. AMENDMENT TO LICENSE NUMBER 21-05199-02
- [x] C. RENEWAL OF LICENSE NUMBER 21-05199-02

2. NAME AND MAILING ADDRESS OF APPLICANT *(Include ZIP code)*

STATE OF MICHIGAN
DEPARTMENT OF ENVIRONMENTAL QUALITY
WASTE & HAZ MAT DIV/RADIOLOGICAL PROTECTION SEC
PO BOX 30241
LANSING, MICHIGAN 48909-7741

3. ADDRESS WHERE LICENSED MATERIAL WILL BE USED OR POSSESSED

815 TERMINAL DRIVE
LANSING, MICHIGAN

4. NAME OF PERSON TO BE CONTACTED ABOUT THIS APPLICATION

ROBERT D. SKOWRONEK

TELEPHONE NUMBER

(517) 241-1253

SUBMIT ITEMS 5 THROUGH 11 ON 8-1/2 X 11" PAPER. THE TYPE AND SCOPE OF INFORMATION TO BE PROVIDED IS DESCRIBED IN THE LICENSE APPLICATION GUIDE.

5. RADIOACTIVE MATERIAL
a. Element and mass number; b. chemical and/or physical form; and c. maximum amount which will be possessed at any one time.

6. PURPOSE(S) FOR WHICH LICENSED MATERIAL WILL BE USED.

7. INDIVIDUAL(S) RESPONSIBLE FOR RADIATION SAFETY PROGRAM AND THEIR TRAINING EXPERIENCE.

8. TRAINING FOR INDIVIDUALS WORKING IN OR FREQUENTING RESTRICTED AREAS.

9. FACILITIES AND EQUIPMENT.

10. RADIATION SAFETY PROGRAM.

11. WASTE MANAGEMENT.

12. LICENSE FEES *(See 10 CFR 170 and Section 170.31)*
FEE CATEGORY 8A AMOUNT ENCLOSED $ 0.00

13. CERTIFICATION. *(Must be completed by applicant)* THE APPLICANT UNDERSTANDS THAT ALL STATEMENTS AND REPRESENTATIONS MADE IN THIS APPLICATION ARE BINDING UPON THE APPLICANT.

THE APPLICANT AND ANY OFFICIAL EXECUTING THIS CERTIFICATION ON BEHALF OF THE APPLICANT, NAMED IN ITEM 2, CERTIFY THAT THIS APPLICATION IS PREPARED IN CONFORMITY WITH TITLE 10, CODE OF FEDERAL REGULATIONS, PARTS 30, 32, 33, 34, 35, 36, 39, AND 40, AND THAT ALL INFORMATION CONTANED HEREIN IS TRUE AND CORRECT TO THE BEST OF THEIR KNOWLEDGE AND BELIEF.

WARNING: 18 U.S.C. SECTION 1001 ACT OF JUNE 25, 1948 62 STAT. 749 MAKES IT A C RIMINAL OFFENSE TO MAKE A WILLFULLY FALSE STATEMENT OR REPRESENTATION TO ANY DEPARTMENT OR AGENCY OF THE UNITED STATES AS TO ANY MATTER WITHIN ITS JURIS DICTION.

CERTIFYING OFFICER -- TYPED/PRINTED NAME AND TITLE	SIGNATURE	DATE
ROBERT D. SKOWRONEK, CHIEF RM UNIT	Robert D. Skowronek	2-22-07

FOR NRC USE ONLY

TYPE OF FEE	FEE LOG	FEE CATEGORY	AMOUNT RECEIVED	CHECK NUMBER	COMMENTS
			$		
APPROVED BY				DATE	

PRINTED ON RECYCLED PAPER

Attachment to Application for Material License 21-05199-02

5. Radioactive material.

   Add:

	Element and mass number	Chemical and/or physical form	Maximum amount which will be possessed at one time
H.	Cesium-137	Sealed source (Amersham CDC 711m)	One source not to exceed 11 curies
I.	Cesium-137	Sealed source (Amersham CDC 800)	One source not to exceed 150 millicuries
J.	Cobalt-60	Sealed source	One source not to exceed 2 curies

6. Purpose(s) for which licensed material will be used.

   For use in Hopewell Designs, Inc. Model GC-60 Instrument Calibrator and Gamma Irradiator for calibration of instruments.

7. Individual(s) responsible for radiation safety program and their training experience.

   No change from previous correspondence.

8. Training for individuals working in or frequenting restricted areas.

   In addition to the training specified in previous correspondence, specific training on the operation of the Atlan-Tech GC-60 Beam Calibrator will be provided by the installer to the Radiation Protection Officer and other authorized users during the initial installation and acceptance process. The Radiation Protection Officer will be responsible for training subsequent users of the calibrator.

9. Facilities and equipment.

   A. Calibration Room

      The Hopewell Designs, Inc. GC-60 Beam Calibrator (Sealed Source and Device Safety Evaluation GA-1138-D-102-S) will be installed in the Calibration Room at 815 Terminal Road, Lansing, Michigan. A diagram of the Calibration Room and a shielding evaluation for the 10-curie cesium-137 source are included in APPENDIX 1.

   B. Radioactive Material Storage Bunker (Building 20) and Nuclear Counting Facility (Building 44) – 3500 N. Martin L. King Jr. Blvd., Lansing, Michigan.

      The move to our new facility at 815 Terminal Road, Lansing, Michigan has been completed. The Storage Bunker and Nuclear Counting Facility have been decommissioned. Please remove reference to these locations from our license.

      This storage bunker was shared with NRC license number 21-05199-03 issued to the Michigan Department of Community Health. The bunker was cleaned out and surveyed as part of the termination of NRC license SUB-1385. Attached, as APPENDIX 2, are:

- A memorandum from Mr. Bruce Jorgensen, NRC, to Mr. John Madera, NRC, stating that the SUB-1385 license may be terminated and that a closeout survey by the NRC is not necessary;
- NRC Form 314, "Certificate of Disposition of Materials" for NRC license SUB-1385; and
- A copy of pertinent portions of the "Final Survey Report for the Michigan Biologics Products Institute" documenting the final status survey for the storage bunker.

The Nuclear Counting Facility is a radiological laboratory that analyzed special samples collected by the department with regard to its radiological protection responsibilities and environmental samples related to monitoring around Michigan's nuclear power plants. Attached, as APPENDIX 3, is the Final Status Survey Report for this facility.

C. Calibration/Sample Storage Room – 3423 N. Martin L. King Jr. Blvd., Lansing, Michigan.

The move to our new facility at 815 Terminal Road, Lansing, Michigan has been completed and the previous Calibration/Storage Sample Room at 3423 N. Martin L. King, Jr. Blvd. has been decommissioned. Please remove reference to this location from our license. This location contained sealed sources used for the calibration of portable survey instruments and laboratory samples after analysis by the Radiological Laboratory. Attached, as APPENDIX 4, is the Final Status Survey Report for this facility.

10. Radiation Safety Program

The established Radiation Safety Program will continue including the six-month leak tests, six-month physical inventories, initial and periodic radiation surveys, employee dosimetry, package receipt, waste management, and material transfer provisions. In addition, nonroutine maintenance of the GC-60 calibrator will be performed by the device manufacturer, distributor, or other person authorized by the NRC or an Agreement State.

11. Waste Management

No change from previous correspondence.

APPENDIX 1

Michigan Department of Environmental Quality
Waste and Hazardous Material Division
Radiological Protection Section

GC-60 Calibrator Shielding Evaluation

The Calibration Room and the RAM Storage Room have been constructed inside a warehouse leased by the state of Michigan. See Figure 1. The Calibration Room is 23 feet long and 15 feet wide. The primary beam will be directed toward the south wall which is 15-inch thick poured concrete. The remaining three walls in the Calibration Room and all the walls in the RAM Storage Room are 8-inch thick poured concrete. In addition to the indicated shielding, the south and west walls are exterior walls constructed of concrete blocks. The lower 56 inches of the south and west walls are below grade. The Calibration Room ceiling is nine feet high, consisting of a minimum of 3 inches of poured concrete on steel pan. There is no ready access to the roof of these rooms inside the warehouse. The area below these rooms is unexcavated.

The door to the Maintenance Room/Calibration Room and the door to the RAM Storage Room are both locked with the key access restricted to authorized users. There is one entryway into the Calibration Room. The authorized user will prevent unauthorized entry into the Calibration Room during calibration procedures. A video camera mounted on the ceiling of the Calibration Room allows the operator to view the inside of the Calibration Room from the control station outside the room. An activated radiation meter with audible signal will be placed in the Calibration Room to alert the operator if the radiation source has not returned to its shielded position. All exterior building entry doors are electronically activated by keycards possessed by individuals authorized to access the building.

Shielding Evaluation

The design of the Calibration Room ensures that occupational and non-occupational doses will be significantly below established limits. A 10-curie cesium-137 source has an output of 3.8 R/hour at one meter and 78 mR/hour at seven meters. From Figure 12 in Appendix D of NCRP Report 49, "Structural Shielding Design and Evaluation for Medical Use of X-Rays and Gamma Rays of Energies Up to 10 MeV," the transmission factor for cesium-137 through 38 cm (15 inches) of concrete is 8×10^{-3}. The exposure rate of 78 mR/hour will be reduced to 0.6 mR/hour through this shielding.

A radiation survey of the shielding effectiveness of the Calibration Room was performed using a 0.58-curie cesium-137 source at the proposed location of the GC-60 Beam Calibrator. The primary beam of the calibrator will be only directed to and completely subtended by the south wall. The calculated exposure rate at seven meters through 15 inches of concrete is 36 μR/hour. The measured gross exposure rate, based on 2-minute integrated exposures measured by an Eberline E-600 with SHP 270 probe, with the source exposed was 20 μR/hour. The measured background exposure rate was 12 μR/hour. The net increase due to the cesium source in an exposed position was approximately 8 μR/hour. As confirmed by measurements, the block exterior wall provides additional shielding not included in the original calculations.

The radiation survey using the 0.58-curie cesium-137 source included measurements outside the building to the west, in the equipment maintenance room, at the control consoles, and in the warehouse area. The highest of these measurements resulted in a net exposure rate of 19 μR/hour

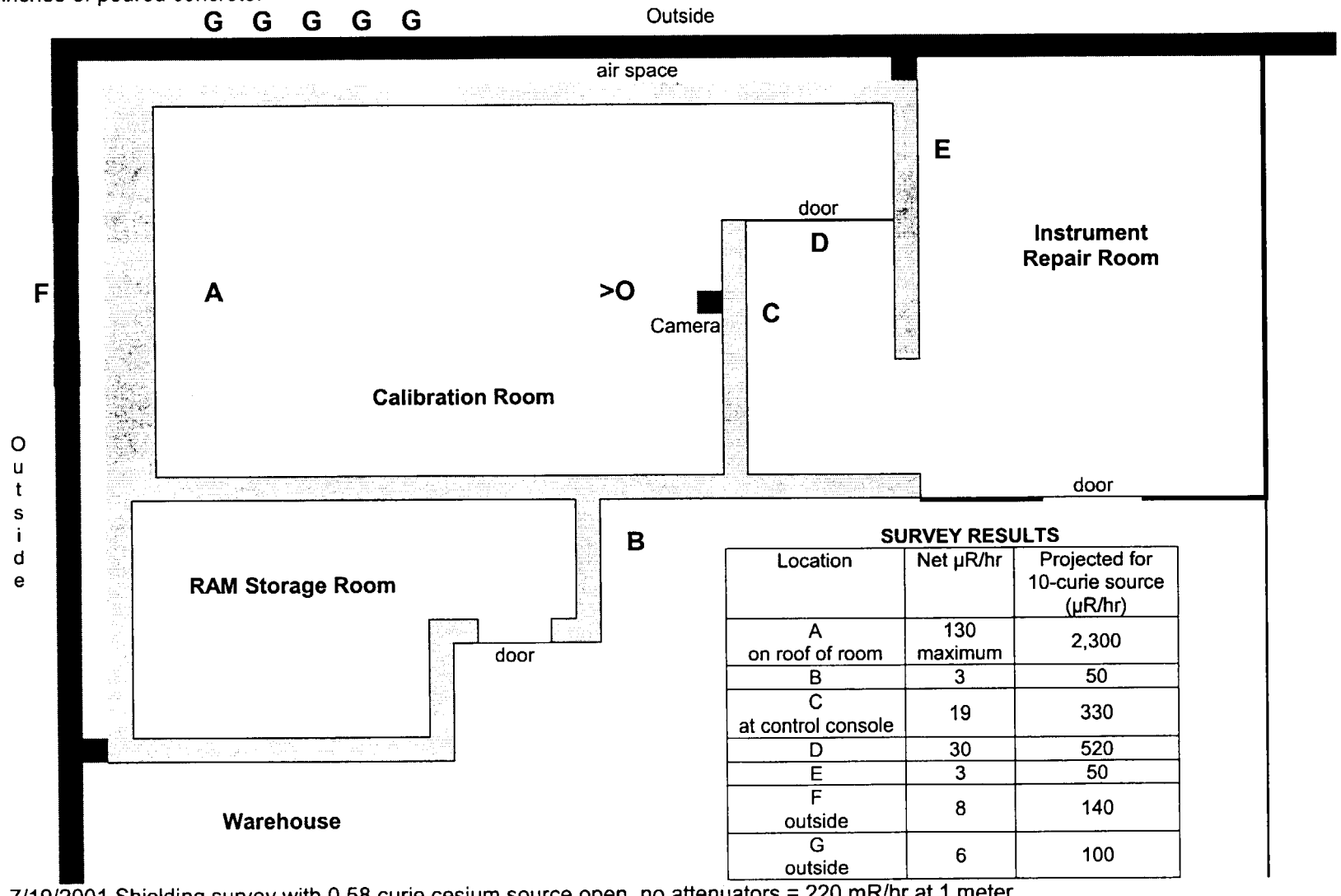
at the control consoles. The maximum reading on the roof of the Calibration Room with the source exposed was 132 μR/hour. The space over the Calibration Room is only used for long-term storage with no routine occupancy. The area is accessible by using a stepladder. The area over the Calibration Room will be surveyed when the 10-curie source is received and access restricted, as warranted.

Presuming a maximum new source strength of 10 curies of cesium-137 and using the survey results noted above for our existing 0.58-curie cesium-137 source, the maximum exposure rates can be calculated to be 0.14 mR/hour at the exterior surface of the south wall, 0.33 mR/hour at the interior control console area, and 2.3 mR/hour on the roof above the calibration room.

In conclusion, the calculations and existing survey data indicate that occupational and non-occupational doses will be significantly below established limits. Current calibration practices indicate that the nominal 10-curie cesium-137 source will be in the unattenuated exposed position less than 10 hours per year.

Figure 1: Calibration Room and RAM Storage Room
815 Terminal Road, Lansing, Michigan

South wall of Calibration Room is 15 inches poured concrete in addition to structural exterior block wall. All other walls indicated in grey are 8 inches of poured concrete.



SURVEY RESULTS

Location	Net µR/hr	Projected for 10-curie source (µR/hr)
A on roof of room	130 maximum	2,300
B	3	50
C at control console	19	330
D	30	520
E	3	50
F outside	8	140
G outside	6	100

7/19/2001 Shielding survey with 0.58 curie cesium source open, no attenuators = 220 mR/hr at 1 meter.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION III
801 WARRENVILLE ROAD
LISLE, ILLINOIS 60532-4351

DATE: January 30, 2001

TO: John R. Madera, Chief, Material Licensing Branch, Region III

FROM: Bruce L. Jorgensen, Chief, Decommissioning Branch, Region III

SUBJECT: DECOMMISSIONING BRANCH REVIEW OF MATERIAL LICENSING BRANCH NOVEMBER 9, 2000, TECHNICAL ASSISTANCE REQUEST MICHIGAN DEPARTMENT OF COMMUNITY HEALTH (NRC LICENSE NO. SUB-1385)

Based on my staff review of the above information, G. McCann's November 21 and 27, 200o, Telephone conversations with the licensee, review of the licensee's response to our request for additional information, and review of the licensee's byproduct material license 21-05199-03 (by Dr. Gill, MLB), we have determined that the SUB-1385 license may be terminated, and that a close-out survey by the NRC is not necessary.

Should you have any questions, please do not hesitate to contact me or Mr. McCann.

License No.: SUB-1385
Docket No.: 040-08774

License No.: 21-05199-03
Docket No.: 030-04832

Appendix 2

NRC FORM 314 (7-1998)
10 CFR 30.36(c)(1)(iv)
10 CFR 40.42(c)(1)(iv)
10 CFR 70.38(c)(1)(iv)

U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB: NO. 3150-0028 EXPIRES: 07/31/2001

Estimated burden per response to comply with this mandatory information collection request: 30 minutes. This submittal is used by NRC as part of the basis for its determination that the facility has been cleared of radioactive material before the facility is released for unrestricted use. Forward comments regarding burden estimate to the Records Management Branch (T-6 F33), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, and to the Paperwork Reduction Project (3150-0028), Office of Management and Budget, Washington, DC 20503. If an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

CERTIFICATE OF DISPOSITION OF MATERIALS

INSTRUCTIONS: ALL ITEMS MUST BE COMPLETED -- PRINT OR TYPE
SEND THE COMPLETED CERTIFICATE TO THE NRC OFFICE SPECIFIED ON THE REVERSE

LICENSEE NAME AND ADDRESS

State of Michigan
Dept. of Community Health
Bldg. 44, P.O. Box 30035
Lansing, MI 48909

T
040-08774

LICENSE NUMBER
SUB 1385
Docket # 040-08774

LICENSE EXPIRATION DATE
December 31, 1995

A. MATERIALS DATA *(Check one and complete as necessary)*

THE LICENSEE OR ANY INDIVIDUAL EXECUTING THIS CERTIFICATE ON BEHALF OF THE LICENSEE CERTIFIES THAT:
(Check and/or complete the appropriate item(s) below.)

[ ] 1. NO MATERIALS HAVE EVER BEEN PROCURED OR POSSESSED BY THE LICENSEE UNDER THIS LICENSE.

OR

[x] 2. ALL ACTIVITIES AUTHORIZED BY THE LICENSE HAVE CEASED AND ALL MATERIALS PROCURED AND/OR POSSESSED BY THE LICENSEE UNDER THE LICENSE NUMBER CITED ABOVE HAVE BEEN DISPOSED OF IN THE FOLLOWING MANNER. *(If additional space is needed, use the reverse side or provide attachments.)*

Describe specific material transfer actions and, if there were radioactive wastes generated in terminating this license, the disposal actions including the disposition of low-level radioactive waste, mixed waste, Greater-than-Class-C waste, and sealed sources, if applicable.

See final survey report for Michigan Biologics Products Institute, August, 1998, Revision 0

For transfers, specify the date of the transfer, the name of the licensed recipient, and the recipient's NRC license number or Agreement State name and license number.

July, 1998
GTS Duratek
628 Gallaher Rd, Kingston, TN 37763

Will provide manifest and agreement state name and license number upon receipt from GTS Duratek.

If materials were disposed of directly by the licensee rather than transferred to another licensee, licensed disposal site or waste contractor, describe the specific disposal procedures *(e.g., decay in storage)*.

B. OTHER DATA

[x] 1. OUR LICENSE HAS NOT YET EXPIRED; PLEASE TERMINATE IT.

2. A RADIATION SURVEY WAS CONDUCTED BY THE LICENSEE TO CONFIRM THE ABSENCE OF LICENSED RADIOACTIVE MATERIALS AND TO DETERMINE WHETHER ANY CONTAMINATION REMAINS ON THE PREMISES COVERED BY THE LICENSE.

[ ] NO *(Attach explanation)*
[x] YES, THE RESULTS *(Check one)*
  [x] ARE ATTACHED, or
  [ ] WERE FORWARDED TO NRC ON *(Date)*

3. THE PERSON TO BE CONTACTED REGARDING THE INFORMATION PROVIDED ON THIS FORM	NAME	TELEPHONE NUMBER *(Include Area Code)*
	Arthur C. Davis Radiation Safety Officer	517 335 9071

4. MAIL ALL FUTURE CORRESPONDENCE REGARDING THIS LICENSE TO

Arthur C. Davis, RSO
Dept. Of Community Health
Bldg. 44, P.O. Box 30035, Lansing, MI 48909

RECEIVED
NOV 02 2000
REGION III
308229

CERTIFYING OFFICIAL

I CERTIFY UNDER PENALTY OF PERJURY THAT THE FOREGOING IS TRUE AND CORRECT.

PRINTED NAME AND TITLE	SIGNATURE	DATE
ARTHUR C. DAVIS RADIATION SAFETY OFFICER	Arthur C. Davis	31 Oct 2000

WARNING: FALSE STATEMENTS IN THIS CERTIFICATE MAY BE SUBJECT TO CIVIL AND/OR CRIMINAL PENALTIES. NRC REGULATIONS REQUIRE THAT SUBMISSIONS TO THE NRC BE COMPLETE AND ACCURATE IN ALL MATERIAL RESPECTS. 18 U.S.C. SECTION 1001 MAKES IT A CRIMINAL OFFENSE TO MAKE A WILLFULLY FALSE STATEMENT OR REPRESENTATION TO ANY DEPARTMENT OR AGENCY OF THE UNITED STATES AS TO ANY MATTER WITHIN ITS JURISDICTIONS.

STATE OF MICHIGAN

JOHN ENGLER, Governor

DEPARTMENT OF COMMUNITY HEALTH
JAMES K. HAVEMAN, JR., Director

COMMUNITY PUBLIC HEALTH ADMINISTRATION

3423 N. MARTIN LUTHER KING JR. BLVD.
PO BOX 30195
LANSING, MI 48909

October 31, 2000

Mr. Geoffrey C. Wright
Nuclear Materials Inspection Branch
United States Nuclear Regulatory Commission
Region 111
801 Warrenville Road
Lisle, Illinois 60532-4351

Dear Mr. Wright:

This refers to NRC Form 314, "Certificates of Disposition of Materials", NRC License Number, SUB 1385, Docket Number 040-08774.

Enclosed in this packet of information is NRC Form 314 and the GTS Duratek, Final Survey Report for the Michigan Biologics Products Institute, now known as BioPort Corporation. In our communication with GTS Duratek, Kingston, TN we have been unable to obtain a Material Manifest and an Agreement State name and License Number. This information will be forwarded to NRC upon receipt from GTS Duratek

Sincerely,

Arthur C. Davis
Radiation Safety Officer

cc: R. Showronek, Chief
Radioactive Material & Standard Unit
Michigan Department of Environmental Quality

M. Tucker, Director
Legal Affairs
BioPort Corporation

E. Smith, Environmental, Health & Safety Manager
BioPort Corporation

GTS Duratek

Final Survey Report
for the
Michigan Biologics Products Institute

August 1998
Revision 0

GTS DURATEK

Radiological Engineering & Field Services

SUMMARY

Michigan State intends to remove its Michigan Biologic Products Institute (MBPI) facility located on 3500 North Martin Luther King Blvd. in Lansing, Michigan from their radioactive materials license. This required the remediation and survey of several of the labs at the facility to verify that all radioactive materials have been removed and that the facility meets the criteria for unrestricted use. Upon completion of remediation, the facility was surveyed in accordance with the Final Survey Plan for Michigan Biologic Products.

GTS Duratek developed the Survey Plan, and this Final Report, based in part on the guidance provided in current regulations including Draft NUREG/CR-5849, *Manual for Conducting Radiological Surveys in Support of License Termination*, other NRC approved survey plans, and the release guidelines established in the *Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of License for Byproducts, Source, or Special Nuclear Material*, NRC August 1987. The criteria and survey protocols specified in this report have been designed to support license termination.

Based on the review of the historical operations at the facility, removal of all known radioactive materials, the results of the surveys described in this report, and planned future use, the MBPI facility is in compliance with the applicable regulations for termination of its radioactive materials license, and release for unrestricted use.

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1.0 SITE INFORMATION

1.1 Site Description

The Michigan Biologic Products Institute is a state facility which manufactures injectable toxins for humans and animals. This facility is licensed by the NRC for the use of radionuclides. Use of radioisotopes at this facility ceased several years ago. As a result, Michigan State is taking the necessary steps to remove this facility from their active radioactive materials license.

The specific areas at the facility where radioisotopes were used or stored include the Building 4 Penthouse, Room 202 in Building 9, Room 210 in Building 5, Rooms 101 and 112 in Building 30, one room in Building 17, a previously used and decontaminated storage area in Building 10, and a small storage area in the Building 20 bunker.

Iodine-125 was used in the Building 4 and 9 labs which has a half life of about 60 days. No other radioisotopes were used in these two rooms. Since the use of Iodine ceased several years ago, residual radioactivity in these areas was not suspected; however, confirmatory surveys were performed to verify the area is free of radioactivity.

Uranium-238 was used in Building 30 Rooms 101 and 112. These rooms have since been decontaminated and free release surveys performed. Confirmatory surveys were conducted in the rooms to verify that they are free of residual radioactivity.

Tritium was used in Building 5 laboratory 210. No other rooms in Building 5 are suspected of radioactive material use. Confirmatory surveys were conducted in laboratory 210 to verify that the area is free of radioactivity.

Both Building 10 and the Building 20 bunker were used for the storage and staging of materials. There were drums and wood crates containing radioactive materials stored in one corner of the bunker. These materials were repackaged and disposed, and the areas surveyed.

One room in Building 17 had housed a Gas Chromatograph. Associated with this instrument was a sealed Nickel-63 reference source. Confirmatory surveys were conducted in this room to verify that the area is free of radioactivity.

In addition to the licensed areas of the facility, several of the lab ceilings were found to be constructed of ceramic tile containing natural radioactivity. These include Building 4 rooms 205, 207, 208, 209 and Building 16 rooms 303, 304 and 305. These areas were surveyed once the tile was removed to verify they are free of any radioactivity.

1.2 Identity of Contaminants

Based on previous analytical data of the ceramic tile and a review of the radioactive materials license, the radionuclides of concern at the facility are natural uranium and its progeny (ceramic tile glaze), tritium, Nickel-63, and Iodine-125.

2.0 SURVEY OVERVIEW

2.1 Survey Objective

The objectives of the survey were:

- To perform surveys to verify the radiological cleanliness of the site, and
- To collect sufficient data to prepare a report to support the removal of the facility from the Radioactive Materials License.

Surveys were based in part on the guidance in Draft NUREG/CR-5849 and other NRC approved survey plans and included direct surface activity measurements and measurements of removable activity.

2.2 Survey Guideline Values

The applicable survey guideline values for surfaces and structures specified in *Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of License for Byproducts, Source, or Special Nuclear Material*, NRC August 1987, are provided in Table 2-1. Project personnel compared the survey results with these values to assess the various areas around site.

Table 2-1
Guideline Values

ACCEPTABLE SURFACE CONTAMINATION LEVELS[a]			
NUCLIDE	AVERAGE[b,c]	MAXIMUM[b,d]	REMOVABLE[b,e]
U-nat, U-238, and associated decay products	5000 dpm/100 cm^2	15,000 dpm/100 cm^2	1000 dpm/100 cm^2
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125 and I-129.	100 dpm/100 cm^2	300 dpm/100 cm^2	20 dpm/100 cm^2
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above	5000 dpm/100 cm^2	15,000 dpm/100 cm^2	1000 dpm/100 cm^2

[a] Where surface contamination by both alpha and beta-gamma emitting nuclides exists, the limits established for alpha and beta-gamma emitting nuclides should apply independently.
[b] As used in this table, dpm (disintegrations per minute) means the rate of emissions 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 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 material per 100 cm^2 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 the wipe with an 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.

2.3 Organization and Responsibilities

GTS Duratek implemented an integrated management approach that included project management oversight and technical support. The full resources of GTS Duratek's Bear Creek and Gallaher Road offices, including professional engineering and quality assurance staff, supported the Project Manager and the on-site team to ensure successful project execution and completion.

The survey team consisted of an engineer/supervisor and senior HP technicians. These personnel were trained, qualified, and experienced in field radiological survey procedures.

2.3.1 Project Manager

The Project Manager was the primary point of contact and interface. The minimum requirements for the Project Manager were 5-10 years of health physics experience including prior management experience.

2.3.2 Survey Supervisor

The Survey Supervisor was responsible for the performance of the survey activities. The minimum requirements for the Survey Supervisor were 5 years of health physics experience including supervision of a survey team on at least one prior project. He was qualified in the use of the survey instruments and all aspects of surveying as described in NUREG/CR-5849 and the Survey Plan.

2.3.3 Health Physics (HP) Technician

The HP Technician was responsible for performing surveys and collecting samples. He was qualified in the use of the survey instruments and surveying in accordance with NUREG/CR-5849 as well as the Survey Plan.

3.0 SURVEY INSTRUMENTATION

Selection and use of instrumentation ensured sensitivities were sufficient to detect the identified radionuclides at the minimum detection requirements. Table 3-1 provides a list of the instruments, types of radiations detected and calibration sources. It should be noted that the hard to detect radionuclides (H-3, Ni-63, and I-125) could not be measured using this field instrumentation. They were quantified through off-site lab analysis on an as needed basis.

GTS Duratek used the Ludlum Model 2350 Data Logger with a variety of detectors for direct measurements of total alpha and beta surface activity. The Data Logger is a portable micro-processor computer based counting instrument capable of operation with NaI(Tl) gamma scintillation, gas-flow proportional, GM and ZnS scintillation detectors.

The project team normally used the 126 cm^2 gas-flow proportional detector with a thin mylar window (1 layer, 0.4 mg/cm^2) for direct alpha and beta measurements.

Analysis for low energy beta and gamma emitters such as I-125, NI-63, and tritium was performed by GTS Duratek's laboratory services at Bear Creek, in Oak Ridge, TN using liquid scintillation.

Smears for removable alpha and beta contamination were analyzed on site using a Tennelec LB5100 Low Background Alpha/Beta counter.

Table 3-1
Survey Instrumentation

Instrument/Detector	Detector Type	Radiation Detected	Calibration Source	Use
Ludlum Model 2350/43-68	Gas-flow proportional ($126cm^2$)	Alpha or beta	^{99}Tc (β) ^{230}Th (α)	Direct measurements and scanning
Packard or Beckman LS counter	Liquid Scintillation	Low energy Beta & gamma	^{3}H, ^{14}C	Low Energy Beta Smear counting
Tennelec LB5100 Alpha/Beta Counter	Shielded Gas-flow proportional	Alpha and Beta	^{99}Tc (β), ^{230}Th (α)	Alpha/Beta Smear counting
Canberra Portable Gamma Spectroscopy System	High Purity Germanium	Gamma	Mixed	Nuclide identification and quantification

3.1 Instrument Calibration

All field counting instrumentation is calibrated on a semi-annual basis using National Institute of Standards and Technology (NIST) traceable sources and calibration equipment.

Calibration labels showing the instrument identification number, calibration date and calibration due date are attached to all portable field instruments. The user checks the instrument calibration label before each use.

3.2 Calibration Sources

Sources used for calibration or efficiency determinations for the survey were representative of the instrument's response to the identified radionuclides and are traceable to NIST. The sources used during the surveys included Technetium-99 (beta), Thorium-230 (alpha), and mixed gamma sources.

3.3 Minimum Detectable Activity

Minimum Detectable Activity (MDA) is defined as the smallest amount or concentration of radioactive material in a sample that will yield a net positive count with a 5% probability of falsely interpreting background responses as true activity. The MDA is dependent upon the counting time, geometry, sample size, detector efficiency and background count rate.

As a data quality objective, the MDAs were set to less than 50% of the applicable guideline value. The equation used for calculating the MDA for field instrumentation is:

$$MDA = \frac{\frac{2.71}{t_s} + 3.29\sqrt{\frac{R_b}{t_s} + \frac{R_b}{t_b}}}{E\left(\frac{A}{100}\right)}$$

Where:

MDA	=	Minimum Detectable Activity (dpm/100 cm^2)
R_b	=	Background Count Rate (cpm)
t_b	=	Background Count Time (min)
t_s	=	Sample Count Time (min)
A	=	Detector Area (cm^2)
E	=	Detector Efficiency (c/d)

4.0 SURVEY DESIGN

4.1 Introduction

The purpose of the survey was to collect sufficient survey data to remove the Michigan Biologic Products Institute facility from the Michigan State Radioactive Materials License. The project team performed surveys according to project specific GTS Duratek procedures and the Survey Plan. The procedures identified survey instrument requirements, measurement and sample collection, and data reduction and evaluation methods, while the Plan identified the survey protocols. Implementation of the Survey Plan included the following:

- Supervisory personnel performed preliminary inspections of the areas to identify additional specific survey requirements.
- The site supervisor developed survey packages for the survey areas.
- The project team gridded the areas or marked or mapped the survey locations as applicable.
- The project team performed survey measurements and analyzed samples using appropriate calibrated instruments and performed daily source and background checks before and after each day's work.
- Survey data collected during the project was downloaded from the survey instrument into a database for storage and processing.
- Supervisory personnel reviewed the completed survey packages to ensure that all required surveys were performed and that the packages contained all necessary information.

4.2 Survey Package Development

For each survey area, the project team developed a package, or portfolio, by performing a walk-down and preparing a worksheet/tracking sheet outlining the general survey instructions, location codes, and any specific survey instructions for any abnormal conditions within the survey area. Completion and review signature blocks were used to track the progress of the surveys.

During the survey, the project team updated the survey package(s) with the survey data and results of any special surveys or sample analyses performed.

4.3 Survey Requirements

The following survey protocols, based in part on NUREG\CR-5849 and other NRC-approved survey plans used at other sites, consisted of a mix of direct alpha and beta surface activity measurements and smears for removable activity measurement.

Ceramic tiled rooms:

Ceramic tile was used in the construction of Building 4 rooms 205, 207, 208, 209 and Building 16 rooms 303, 304 and 305. These tiles contain natural radioactivity in the glaze; however, radioisotopes were not used in these labs. Since these rooms were constructed of materials containing concentrated natural activity, they were surveyed to ensure no residual activity remained. Following the removal of all the tile and cleaning of the exposed surfaces using a HEPA vacuum of the rooms, surveys were performed as follows:

- Floors, walls and ceiling were gridded at 1 meter intervals.
- A 100% surface scan for beta activity was performed using the thin window gas flow proportional detector on the floors, walls, bench tops, and ceiling.
- A 100% surface scan for alpha activity was performed using the thin window gas flow proportional detector on the floors, walls, bench tops, and ceiling.
- A direct beta measurement was performed within each grid at the highest measurement location identified during the scan.
- A direct alpha measurement was performed within each grid at the highest measurement location identified during the scan.
- A direct beta measurement was performed for each approximate 1 m^2 of surface area on the bench tops and on equipment in each room.
- A direct alpha measurement was performed for each approximate 1 m^2 of surface area on the bench tops and on equipment in each room.
- A smear was collected at each measurement location for gross beta and alpha analysis.

Building 4 Penthouse and Building 9 Room 202:

These two rooms housed operations utilizing Iodine 125. Due to the short half life (60 days) and the history of the area, no residual activity was suspected. Operations ceased several years ago so any residual activity has likely decayed. As a precaution, the following surveys were performed to verify the absence of any residual radioactivity.

- A minimum of 15 paper smears were collected from each room on the floors, bench tops and equipment for I-125 analysis by liquid scintillation.

Building 10:

A part of Building 10 had been used to store radioactive materials prior to shipment. This area was gridded, and direct and removable alpha and beta measurements performed in each grid.

Building 30 Rooms 101 and 112:

Natural Uranium was used in these rooms; however, they have previously been decontaminated, surveyed and free released. Confirmatory surveys were performed in each room as follows:

- 15 random direct beta measurements were performed on the floor.
- 15 random direct alpha measurements were performed on the floor.
- 15 random direct beta measurements were performed on the walls and overhead.
- 15 random direct alpha measurements were performed on the walls and overhead.
- 30 random beta measurements were performed on the equipment, tables and benches.
- 30 random alpha measurements were performed on the equipment, tables and benches.
- A local $1m^2$ scan was performed at each measurement location for both alpha and beta surface activity.
- A smear for gross alpha and beta analysis was collected at each measurement location.

Building 20 Bunker Storage:

Portions of the building 20 bunker storage area were used to store and house radioactive materials. The immediate storage area, and a 5 meter buffer zone were surveyed as follows:

- The immediate storage area and a 5 meter buffer zone were gridded into 1 meter grids on the floor and lower 2 meters of the walls.
- A 100% surface scan for beta activity was performed using the thin window gas flow proportional detector.
- A 100% surface scan for alpha activity was performed using the thin window gas flow proportional detector.
- A direct beta measurement was performed within each grid.
- A direct alpha measurement was performed within each grid.
- A smear was collected at each measurement location for gross beta and alpha analysis.
- 10 paper smears were collected from the floor for liquid scintillation analysis.

Building 5:

Tritium was historically used and handled in laboratory 210 within Building 5. A characterization survey of the lab was performed as follows:

- A minimum of 10 paper smears were collected throughout the lab on the floors, bench tops and equipment for H-3 analysis by liquid scintillation.

4.4 Survey Records

The project team maintained records of surveys in the survey packages for each area according to project procedures. The survey package included the following records depending upon the survey design and protocols:

- Survey Package Worksheet giving the package identification, survey location information, general survey instructions and any specific survey instructions.
- The Survey Unit Diagram of the area surveyed as available.
- Printout of laboratory analysis results (if performed).
- Ludlum Model 2350 data files and Paradox® converted values for all radiation survey measurements.

The survey team performed direct measurements for total alpha and beta surface activity using the Ludlum Model 2350 Data Logger system. Smears were analyzed for gross alpha and beta activity using the Tennelec Automatic Gas Counting System. Paper smears were collected and analyzed for hard-to-detect nuclides using liquid scintillation.

GTS Duratek uses a proprietary computer program to download the contents and survey data from the Data Loggers memory to a database and generate a survey report that presents all raw data, converted data, and information by survey location. The survey technician and supervisor reviewed these reports for completeness, accuracy, suspect entries and compared the data to the guideline values in Table 2-1.

Any changes to the database tables such as detector efficiency and background, that could affect survey results required supervisor review and approval. In addition, changes to data in the primary table required a written explanation.

Data and document control includes the maintenance of the raw data files, translated data files (Paradox® database files) and documentation of all corrections made to the data. The databases were backed up on a daily basis.

5.0 QUALITY ASSURANCE AND QUALITY CONTROL

GTS Duratek's Quality Assurance/Quality Control Programs ensured that all quality and regulatory requirements were satisfied. All activities affecting quality were controlled by procedures and the Quality Assurance Plan. These documents include the following measures as an integral part of the survey process.

5.1 General Provisions

5.1.1 Selection of Personnel

Project management and supervisory personnel were required to have extensive experience with GTS Duratek procedures and the QA plan and be familiar with the requirements of NUREG/CR-5849 and the Survey and Sampling Plan. Management was required to have prior experience with the radionuclide(s) of concern and a working knowledge of the instruments used to detect the radionuclides on site. Project management and supervision were required to maintain OSHA safety qualifications.

GTS Duratek supervisory personnel were selected to direct the survey based upon their experience and familiarity with the survey procedures and processes. Likewise, Health Physics technicians who performed the surveys were selected based upon their qualifications and experience, especially with NUREG/CR-5849.

5.1.2 Written Procedures

All survey tasks which are essential to survey data quality were controlled by procedures and a survey plan.

5.1.3 Instrumentation Selection, Calibration and Operation

GTS Duratek selected instruments proven to reliably detect the radionuclides present at the facility. Instruments were calibrated by GTS Duratek or qualified vendors under approved procedures using calibration sources traceable to the National Institute of Standards and Technology (NIST). All detectors were subjected to daily response checks when in use.

Procedures for calibration, maintenance, accountability, operation and quality control of radiation detection instruments implemented the guidelines established in American National Standard Institute (ANSI) standard ANSI N323-1978 and ANSI N42.17A-1989.

5.1.4 Survey Documentation

The survey packages were the primary method of controlling and tracking the hard copy records of survey results. Records of surveys were documented and maintained in the survey package for each area according to GTS procedures. Each survey measurement was identified by the date, technician, instrument type and serial number, detector type and serial number, location code, type of measurement, mode of instrument operation, and Quality Control (QC) sample number, as applicable.

5.1.5 Chain of Custody

Procedures established responsibility for the custody of samples from the time of collection until results were obtained. All samples shipped off site for analysis are accompanied by a chain-of-custody record to track each sample.

5.1.6 Records Management

Generation, handling and storage of survey data packages were controlled by an approved procedure.

5.1.7 Independent Review of Survey Results

The survey package and survey data from each area received an independent review to verify all documentation was complete and accurate.

5.2 Training

All project personnel received site specific training to identify the specific hazards present in the work and survey areas. Training also included a briefing and review of the Survey Plan, GTS procedures and the Site Safety and Health Plan.

During site orientation and training, survey personnel became familiar with site emergency procedures. In the event of an emergency, personnel were required to act in accordance with all applicable site emergency procedures and the Site Safety and Health Plan.

6.0 SURVEY RESULTS

This section provides summaries of the results of surveys performed in each of the designated areas. These summaries normally consist of a written explanation, or graphs and tables of data. Complete survey results for each survey area are provided in Appendix A.

6.1 Ceramic tiled rooms

6.1.1 Building 4, Rooms 205, 207, 208, 209

Following removal of the ceiling tile and gridding the rooms, a total of 323 direct and removable alpha, and 322 direct and removable beta measurements were performed in all rooms. Figures 6-1 through 6-8 provide graphs and statistics of the direct survey results. Tables 6-1 and 6-2 are tables of the direct survey data. No removable measurement exceeded the applicable detection limit. All direct measurements were less than 50% of the applicable guideline value. Slightly elevated beta measurements (to approximately 1700 dpm/100 cm^2) were most likely due to naturally occurring beta activity associated with the tile floors and walls.

6.1.2 Building 16, Rooms 303, 304, 305

Following removal of the ceiling tile and gridding the rooms, a total of 344 direct and removable alpha, and 345 direct and removable beta measurements were performed in all rooms. Figures 6-9 through 6-14 provide graphs and statistics of the direct survey results. Tables 6-3 and 6-4 are tables of the direct survey data. No removable measurement exceeded the applicable detection limit. All direct measurements were less than 50% of the applicable guideline value. Slightly elevated beta measurements (to approximately 1900 dpm/100 cm^2) were most likely due to naturally occurring beta activity associated with the tile floors and walls.

6.2 Building 4 Penthouse

12 paper smears were collected throughout the lab on the floors, bench tops and equipment for I-125 analysis by liquid scintillation. No detectable activity was found on any smear.

6.3 Building 5, Lab 210

10 paper smears were collected throughout the lab on the floors, bench tops and equipment for Tritium (H-3) analysis by liquid scintillation. No detectable activity was found on any tritium smear.

6.4 Building 9, Room 202

15 paper smears were collected throughout the lab on the floors, bench tops and equipment for I-125 analysis by liquid scintillation. One smear indicated an elevated tritium measurement, however, the smear was dark and was repeated. In addition, 14 more paper smears were collected for tritium analysis. No detectable activity was found on the repeated smear, or the additional 14 smears.

6.5 Building 10

A total of 20 direct and removable alpha, and 20 direct and removable beta measurements were collected on the floor. No direct or removable measurement exceeded the appropriate detection limit. Figures 6-15 and 6-16 provide graphs and statistics of the direct measurements, and Tables 6-5 and 6-6 are tables of the direct measurement results.

6.6 Building 17

5 paper smears were collected on the floor of Room of the Gas Chromatograph room for Ni-63 analysis by liquid scintillation. No detectable activity was found on any smear.

6.7 Building 20 Bunker Storage:

Following gridding, a total of 35 direct and removable alpha, and 35 direct and removable beta measurements were collected on the floor and south wall. No direct or removable measurement exceeded the appropriate detection limit. Figures 6-17 and 6-18 provide graphs and statistics of the direct measurements, and Tables 6-7 and 6-8 are tables of the direct measurement results.

10 paper smears were collected from the floor for I-125 analysis, and 10 paper smears were collected for Tritium analysis by liquid scintillation. No detectable activity was found on any smear.

6.8 Building 30 Rooms 101 and 112

A total of 45 direct and removable alpha, and 45 direct and removable beta measurements were collected on the floors, walls and ceilings of each room. No removable, or direct alpha measurement exceeded the appropriate detection limit. The maximum beta measurement was 1,119 dpm/100 cm^2. Figures 6-19 and 6-20 provide graphs and statistics of the direct measurements, and Tables 6-9 and 6-10 are tables of the direct measurement results.

GTS DURATEK, INC.

FINAL SURVEY REPORT

for the

MICHIGAN BIOLOGIC PRODUCTS INSTITUTE

AUGUST 1998
REVISION 0

Prepared by: _____ Date 8/11/98
Phil Mann
Senior Radiological Engineer

Reviewed by: _____ Date 8-11-98
Michael Carr, CHP
Senior Radiological Engineer

Approved by: _____ Date 8/11/98
Robin Shult
Manager, Field Operations

Prepared By:

GTS Duratek
Radiological Engineering and Field Services
628 Gallaher Road
Kingston, Tennessee 37763

Table 6-7
Building 20 Alpha Surveys

Surface Category	File Number	Sample Number	Logged Counts	Count Time (sec)	Detector Area (cm2)	Background (CPM)	Efficiency	Net dpm/ 100 cm2	MDA dpm/ 100 cm2
Floor	5	79	3	60	126	2.2	0.221	2.9	28.9
Floor	5	80	1	60	126	2.2	0.221	-4.3	28.9
Floor	5	81	4	60	126	2.2	0.221	6.5	28.9
Floor	5	82	5	60	126	2.2	0.221	10.1	28.9
Floor	5	83	3	60	126	2.2	0.221	2.9	28.9
Floor	5	84	4	60	126	2.2	0.221	6.5	28.9
Floor	5	85	3	60	126	2.2	0.221	2.9	28.9
Floor	5	86	6	60	126	2.2	0.221	13.6	28.9
Floor	5	87	4	60	126	2.2	0.221	6.5	28.9
Floor	5	88	5	60	126	2.2	0.221	10.1	28.9
Floor	5	89	4	60	126	2.2	0.221	6.5	28.9
Floor	5	90	2	60	126	2.2	0.221	-0.7	28.9
Floor	5	91	4	60	126	2.2	0.221	6.5	28.9
Floor	5	92	9	60	126	2.2	0.221	24.4	28.9
Floor	5	93	8	60	126	2.2	0.221	20.8	28.9
Floor	5	94	2	60	126	2.2	0.221	-0.7	28.9
Floor	5	95	3	60	126	2.2	0.221	2.9	28.9
Floor	5	96	4	60	126	2.2	0.221	6.5	28.9
Floor	5	97	4	60	126	2.2	0.221	6.5	28.9
Floor	5	98	6	60	126	2.2	0.221	13.6	28.9
Floor	5	99	5	60	126	2.2	0.221	10.1	28.9
Floor	5	100	3	60	126	2.2	0.221	2.9	28.9
Floor	5	101	4	60	126	2.2	0.221	6.5	28.9
Floor	5	102	3	60	126	2.2	0.221	2.9	28.9
Floor	5	103	5	60	126	2.2	0.221	10.1	28.9
S. Wall	5	104	4	60	126	2.2	0.221	6.5	28.9
S. Wall	5	105	6	60	126	2.2	0.221	13.6	28.9
S. Wall	5	106	2	60	126	2.2	0.221	-0.7	28.9
S. Wall	5	107	2	60	126	2.2	0.221	-0.7	28.9
S. Wall	5	108	2	60	126	2.2	0.221	-0.7	28.9
S. Wall	5	109	2	60	126	2.2	0.221	-0.7	28.9
S. Wall	5	110	1	60	126	2.2	0.221	-4.3	28.9
S. Wall	5	111	1	60	126	2.2	0.221	-4.3	28.9
S. Wall	5	112	4	60	126	2.2	0.221	6.5	28.9
S. Wall	5	113	5	60	126	2.2	0.221	10.1	28.9

Table 6-8
Building 20 Beta Surveys

Surface Category	File Number	Sample Number	Logged Counts	Count Time (sec)	Detector Area (cm2)	Background (CPM)	Efficiency	Net dpm/ 100 cm2	MDA dpm/ 100 cm2
Floor	8	3	26	5	126	238	0.234	251	712
Floor	8	4	26	5	126	238	0.234	251	712
Floor	8	5	23	5	126	238	0.234	129	712
Floor	8	6	27	5	126	238	0.234	292	712
Floor	8	7	25	5	126	238	0.234	210	712
Floor	8	8	30	5	126	238	0.234	414	712
Floor	8	9	31	5	126	238	0.234	454	712
Floor	8	10	32	5	126	238	0.234	495	712
Floor	8	11	30	5	126	238	0.234	414	712
Floor	8	12	28	5	126	238	0.234	332	712
Floor	8	13	28	5	126	238	0.234	332	712
Floor	8	14	20	5	126	238	0.234	7	712
Floor	8	15	27	5	126	238	0.234	292	712
Floor	8	16	32	5	126	238	0.234	495	712
Floor	8	17	25	5	126	238	0.234	210	712
Floor	8	18	24	5	126	238	0.234	170	712
Floor	8	19	23	5	126	238	0.234	129	712
Floor	8	20	30	5	126	238	0.234	414	712
Floor	8	21	26	5	126	238	0.234	251	712
Floor	8	22	30	5	126	238	0.234	414	712
Floor	8	23	25	5	126	238	0.234	210	712
Floor	8	24	18	5	126	238	0.234	-75	712
Floor	8	25	30	5	126	238	0.234	414	712
Floor	8	26	29	5	126	238	0.234	373	712
Floor	8	27	28	5	126	238	0.234	332	712
S. Wall	8	28	29	5	126	238	0.234	373	712
S. Wall	8	29	22	5	126	238	0.234	88	712
S. Wall	8	30	26	5	126	238	0.234	251	712
S. Wall	8	31	23	5	126	238	0.234	129	712
S. Wall	8	32	22	5	126	238	0.234	88	712
S. Wall	8	33	17	5	126	238	0.234	-115	712
S. Wall	8	34	21	5	126	238	0.234	47	712
S. Wall	8	35	16	5	126	238	0.234	-156	712
S. Wall	8	36	32	5	126	238	0.234	495	712
S. Wall	8	37	24	5	126	238	0.234	170	712

7.0 RADIOACTIVE WASTE DISPOSITION

A total of 5 radioactive waste containers were generated during the project; two 96 cubic foot B-25 boxes containing waste ceramic tile, one 55 gallon drum containing soil samples and other dry waste, and two 30 gallon drums containing sources. At the time this report was submitted, all waste and source materials were scheduled to be shipped to the GTS Duratek processing facility in Oak Ridge Tennessee. Table 7-1 provides a list of waste container numbers, types, weights, and contents. Table 7-2 provides a listing of the 142 sources and materials inventoried for disposal. Of these, 72 required weighing and/or analysis to identify the nuclides present and the specified activity of unidentified sources

Table 7-1
Radioactive Waste Container Inventory

Container Number	Weight (lbs)	Container Type	Contents
MB-98-001	4000	96 cu.ft. B-25	Waste Tile and DAW waste
MB-98-002	4000	96 cu.ft. B-25	Waste Tile and DAW waste
MB-98-003	60	55 Gallon Drum	DAW Waste
MB-98-004	50	DOT Specification 7A Type A 30 Gallon Drum	Segregated sources which may require additional processing prior to disposal
MB-98-005	50	DOT Specification 7A Type A 30 Gallon Drum	Liquids requiring additional processing prior to disposal

The total activities of each of the waste samples is contained in Table 7.2.

Table 7-2
Radioactive Source Inventory

Description	Nuclide	Total Activity (pCi)	Drum Number
Vial marked Am-241	Am-241	<6.76E-04	MB-98-003
Abbott Lab, Ba-133, S-139	Ba-133	0.6E+06	MB-98-004
Ba-133 Standard #2265, 0.5 uCi, 8-3-1973	Ba-133	5.00E+05	MB-98-004
Picker Ba-133, 2941-A, GP-1A (6 buttons)	Ba-133	0.3E+06	MB-98-004
C-14, NI9443, 6 in box	C-14	8.3E+06	MB-98-003
Total of 4 bottles of liquid, Bactec, Tryptic Soybroth - Anaerobic, 2 microCi C-14	C-14	2.00E+09	MB-98-005
Tracer Lab CL-36, H-59, Plated Source	Cl-36	4.4E+04	MB-98-003

Description	Nuclide	Total Activity (pCi)	Drum Number
Warrington Laboratory, Inc Lead Paint Analyzer, Model 92-61, S.N. 99, 2.5 Co-57, date measured 10-15-1982	Co-57	2.13E+03	MB-98-003
Warrington Lead Paint Analyzer Model 9261, S.N. 87, Co-57, 3 mCi, 8-9-1985	Co-57	4.19E+04	MB-98-003
Picker Co-60, 2941-A, GP-5A 5 buttons	Co-60	1.24E+04	MB-98-003
Empty container of Cr-51 5-9-77, 1 mCi	decayed	decayed	MB-98-003
Beckman, gamma source, 0.1uCi, preparation date 10-1-84, lot 69, Fullerton, CA	Cs-137	1.00E+05	MB-98-003
Methyl H-3 Thymedine, 250 uCi, the Radioactive Chemical Centre	H-3	2.50E+08	MB-98-003
Methyl H-3, Thymedine,acqueous solution, 250 uCi. Radiochemical Center, Amersham/England, TRK 120 Batch 156.	H-3	2.50E+08	MB-98-005
Radioactive source rod, I-129, 0.2 uCi, Scientific Products, Division of American Hospital Supply, McGaw Park, IL, Manufactured by New England Nuclear	I-129	2.00E+05	MB-98-004
Picker Mn-54. 2941-A, GP-2A (6 buttons)	Mn-54	<1.14E+02	MB-98-003
Model 2941-A, Gp-4A (6 buttons)	Na-22	<7.7E+02	MB-98-003
The box had written upon it "Any questions ask Leigh or Steve Spinrad." Building 1, Room 310, Bob Welch Tracor Detectors, Model 111019-0001 Tracor Incorporated, Austin, TX S.N. 3927, dated 5-4-1978.	Ni-63	131.E+10	MB-98-003
Tracor Detector, Model 111019-0001, S.N. 3620, dated 7-27-1976.	Ni-63	1.25E+10	MB-98-003
Tracor Detector Model 111019-0001, S.N. 3995, dated 7-20-1978	Ni-63	1.31E+10	MB-98-003
Tracor Detector, Model 111019-0001, S.N. 3996, dated 7-20-1978	Ni-63	1.31E+10	MB-98-003
Tracor, Model 111019-0001, date 11-1-76, 14.5 mCi, S.N. 3664	Ni-63	1.25E+10	MB-98-003
Tracor, Model 11019-0001, date 4-10-75, 14.5 mCi, S.M. 3342	Ni-63	1.24E+10	MB-98-003
A lead pig & vial with a needle, SR-89, a little planchette and a stopper in a plastic bag. 40,000 dpm (No peaks)	Sr-89	8.88E+04	MB-98-003
Blue metal container marked "thorium nitrate, Reactive, health hazard. Made in West Germany. EM Logo. TX 0587-2 50G, EM Science - a division of EM Industries, Inc. P.O. Box 70, 480 Democrat Road, Gibbstown, NJ	Th-232	6.7	MB-98-003
	Th-234	9.5	

Description	Nuclide	Total Activity (pCi)	Drum Number
Dropper bottle of Thorium Nitrate, EMS Environmental Marketing Service Limited, 520 Lake Lansing Road, Lansing, MI 48912. Telephone (517) 372-9121. Thorium nitrate titrating solution. Near contact 13 microR/hr and 75 cpm beta/gamma. ½ liter	Th-234	<4.48E+04	MB-98-005
From Environmental Marketing Services, Limited ½ liter	Th-232	<1.45E+04	MB-98-005
For USP Sodium ID test 11-23-1993. Contains U-238 and it is a solid	U-238	4.22E+06	MB-98-003
	U-235	8.84E+04	
	Ra-226	1.46E+06	
Two brown bottles attached to one another and containing liquid and dated 12-29-1990. DAP. Contains U-238 in Cobalt Uranyl Acetate	U-238	1.13E+05	MB-98-005
	U-235	2.24E+03	
	Ra-226	3.69E+04	
Uranyl Acetate, small brown bottle, Mallindrodt Chemical (2 bottles)	U-238	4.68E+07	MB-98-003
Bag filled with vials and plastic stuff	H-3	5.00E+09	MB-98-003
Bag containing vials, towels, gloves, etc.	H-3	5.00E+09	MB-98-003
ICN vial, "Caution Radioactive Material", dated 3-1976, tried counting with the gamma spec but not peaks. Did not save the spectrum		<MDA	MB-98-003
Little jar of ground up reddish powder. No readings above background with microroentgen meter. Pancake probe readings less than twice background.		<MDA	MB-98-003
Something wrapped in foil, warning of "Danger Radiation	Ra-226	8.14E+06	MB-98-003
	U-238	1.14E+07	
	U-235	7.10E+05	
Unknown bag with black crystals	Ra-226	149E+04	MB-98-003
	U-235	9.07E+02	
Vials with some rocks and little pebbles in a bag. RA-226 on bag.	Ra-226	1.72E+02	MB-98-003
	U-238	5.17E+04	
Vial in black bag. Label on bag.	H-3	50 pCi	MB-98-003
SS-87-116, uranium radioactive materials marked on the metal.	U-238	1.75E+09	MB-98-003
SS-89-90, thorium nitrate, Baker Analytical reagent, JT Baker Chemical Co. Phillipsburg, NJ	Th-232	4.93E+06	MB-98-003
SS-91-41, Texas Nuclear Lead in paint analyzer, 2 mCi Co-57 on 4-1978, Model # 9261 S.N. 88	Co-57	4.11E+01	MB-98-003
SS-91-100, Petri dish	Ag-108m	2.87E+03	MB-98-003
	Ag-110m	2.34E+05	

Description	Nuclide	Total Activity (pCi)	Drum Number
	Co-60	2.33E+03	
	Cr-51	1.08E+04	
	Mn-54	2.16E+03	
	Sb-124	7.18E+02	
	Zn-65	6.47E+04	
Ground Contamination 1 Bag, 1 Jar	Ra226	4.71E+04	MB-98-003
53,41.4 gm		<MDA	MB-98-003
55, Black Oily Crystals, 50.0gm	U-235	1.02E+04	MB-98-003
90-14, #1, MB-001	Rq-226	1.10E+05	MB-98-003
90-14, #2, MB-002	Rq-226	9.47E+04	MB-98-003
Rocks in a bag (Uranium Ore)	U-235	7.46E+04	MB-98-003
	Ra-226	6.66E+05	
	U-238	3.96E+05	
Sampling Jar 2-7753 (396.7 total)	Ra-226	3.23E+05	MB-98-003
Separator sludge		<MDA	
Labeled Tuscola County	Ra-226	9.36E+04	MB-98-003
	U-235	5.37E+03	
SS-90-107, 50.0gm in planchette	Ra-226	7.65E+04	MB-98-003
	Ra-228	6.25E+03	
SS-90-108, 50 g, 9-790 in planchette	Ra-226	3.00E+03	MB-98-003
	Ra-228	1.00E+03	
SS-90-114, 50 gm in planchette+D25	Ra-226	3.55E+01	MB-98-003
	Ra-228	2.30E+03	MB-98-003
SS-90-115b, 38.5 gm	Ra-226	5.66E+04	MB-98-003
	Ra-228	1.89E+04	MB-98-003
SS-90-14	Ra-226	5.85E+06	MB-98-003
	Ra-228	4.20E+05	MB-98-003
SS-90-16	K-40	4.06E+02	MB-98-003
	Ra-226	3.48E+04	MB-98-003
	Ra-228	2.38E+03	MB-98-003
SS-90-16, no weight planchette	K-40	7.56E+02	MB-98-003
	Ra-226	6.54E+04	MB-98-003
	Ra-228	4.43E+03	MB-98-003

Description	Nuclide	Total Activity (pCi)	Drum Number
SS-90-17	Ra-226	8.64E+04	MB-98-003
	Ra-228	6.48E+03	MB-98-003
SS-90-17, #3	Ra-226	7.60E+04	MB-98-003
	Ra-228	5.70E+03	MB-98-003
SS-90-18	K-40	1.10E+03	MB-98-003
	Ra-226	7.39E+04	MB-98-003
	Ra-228	4.80E+03	MB-98-003
SS-90-18	K-40	9.20E+02	MB-98-003
	Ra-226	6.16E+04	MB-98-003
	Ra-228	4.00E+03	MB-98-003
SS-91-108, 20.0 gm mini planchette	Ra-226	3.46E+05	MB-98-003
	Ra-228	2.12E+04	MB-98-003
SS-91-108 from a five inch casing	Ra-226	2.08E+05	MB-98-003
	Ra-228	1.27E+04	MB-98-003

Description	Nuclide	Total Activity (pCi)	Drum Number
SS-91-115, 100 gm	Ra-226	1.52E+06	MB-98-003
	Ra-228	6.10E+04	MB-98-003
SS-91-115, abandoned well site, ~2500 mR/hr on ground when collected, ~15 kcpm sample rate	Ra-226	2.81E+06	MB-98-003
	Ra-228	1.13E+05	MB-98-003
SS-91-116, 100 gm	Ra-226	8.90E+04	MB-98-003
	Ra-228	2.00E+03	MB-98-003
SS-91-116, 8-22-1991, about 500 mR/hr on ground where collected.	Ra-226	3.56E+04	MB-98-003
	Ra-228	8.00E+02	MB-98-003
SS-91-117, 80.0 gm	Ra-226	8.96E+04	MB-98-003
	Ra-228	2.40E+03	MB-98-003
SS-91-117, 8-22-1991	Ra-226	8.50E+04	MB-98-003
	Ra-228	2.28E+03	MB-98-003
SS-91-118, 100 gm	Ra-226	3.90E+05	MB-98-003
	Ra-228	1.50E+04	MB-98-003
SS-91-118, 8-22-1991	Ra-226	1.48E+05	MB-98-003
	Ra-228	5.70E+03	MB-98-003
SS-91-4, 1-24-1991	Ra-226	3.78E+03	MB-98-003
	Ra-228	9.50E+01	MB-98-003
SS-91-54 to 55	Ra-226	1.28E+03	MB-98-003
	Ra-228	1.52E+02	MB-98-003
	U-238	1.20E+03	MB-98-003
SS-91-54, 85.3 gm, 4-12-1991	Ra-226	5.46E+03	MB-98-003
	Ra-228	6.48E+02	MB-98-003
	U-238	5.12E+03	MB-98-003
SS-91-54 to 55	Ra-226	2.39E+05	MB-98-003
	Ra-228	2.28E+04	MB-98-003
	U-238	1.73E+05	MB-98-003

Description	Nuclide	Total Activity (pCi)	Drum Number
SS-91-55, 111.8 gm, 4-12-1991	Ra-226	9.28E+03	MB-98-003
	Ra-228	8.83E+02	MB-98-003
	U-238	6.71E+03	MB-98-003
SS-91-56, 4-17-1991	Ra-226	1.40E+06	MB-98-003
	Ra-228	5.88E+04	MB-98-003
SS-91-58	Ra-226	2.48E+04	MB-98-003
	Ra-228	2.48E+04	MB-98-003
SS-91-58, 10.0 gm	Ra-226	1.24E+05	MB-98-003
SS-91-60	Ra-226	3.04E+05	MB-98-003
	Ra-228	1.08E+4	MB-98-003
SS-91-61	Ra-226	2.80E+05	MB-98-003
	Ra-228	5.20E+03	MB-98-003
SS-91-61, 17.6 gm	Ra-226	1.23E+06	MB-98-003
	Ra-228	2.29E+04	MB-98-003
SS-91-62, 13.0 gm	Ra-226	1.38E+04	MB-98-003
	Ra-228	7.80E+02	MB-98-003
SS-91-63, 14.0 gm	Ra-226	7.28E+04	MB-98-003
	Ra-228	4.62E+03	MB-98-003
SS-91-63, mini planchette	Ra-226	5.50E+04	MB-98-003
	Ra-228	7.26E+03	MB-98-003
SS-91-66	Ra-226	1.64E+06	MB-98-003
	Ra-228	7.35E+04	MB-98-003
SS-91-66, 20.0 gm	Ra-226	1.56E+06	MB-98-003
	Ra-228	7.00E+04	MB-98-003
SS-91-69	Ra-226	1.80E+04	MB-98-003
	Ra-228	3.60E+02	MB-98-003
SS-91-69, 50.0 gm	Ra-226	1.00E+05	MB-98-003
	Ra-228	2.00E+03	MB-98-003
SS-91-70, 21.8 gm	Ra-226	2.31E+06	MB-98-003
	Ra-228	9.37E+04	MB-98-003
SS-91-71 Vial	Ra-226	3.15E+06	MB-98-003
	Ra-228	1.32E+05	MB-98-003
SS-91-71, 20.0 gm	Ra-226	2.10E+06	MB-98-003

Description	Nuclide	Total Activity (pCi)	Drum Number
	Ra-228	8.80E+04	MB-98-003
SS-91-71, baggie	Ra-226	6.30E+05	MB-98-003
	Ra-228	2.70E+04	MB-98-003
SS-91-72, 50.0 gm	Ra-226	1.10E+04	MB-98-003
SS-91-72, Tope Bevea Scale, unknown well.	Ra-226	2.18E+04	MB-98-003
SS-91-81, 50.0 gm	Ra-226	1.35E+04	MB-98-003
	Ra-228	5.00E+02	MB-98-003
SS-91-96, 15.0 gm in planchette.	Ra-226	1.44E+04	MB-98-003
	Ra-228	6.00E+02	MB-98-003
SS-91-98, 14.0 gm mini planchette	Ra-226	2.34E+04	MB-98-003
	Ra-228	2.80E+02	MB-98-003
SS-91-98, 6-12-1991, Ground litter beneath pipe storage rack.	Ra-226	2.52E+03	MB-98-003
SS-91-99, 16.0 gm	Ra-226	4.32E+03	MB-98-003
SS-91-99, 6-12-1991, Ground Litter under pipe racks.	Ra-226	1.19E+04	MB-98-003
SS-92-73, smear	Ra-226	2.60E+04	MB-98-003
SS-92-85, baggie	Ra-226	1.35E+06	MB-98-003
	Ra-228	1.67E+05	MB-98-003
SS-92-85 having 20 grams in mini planchette.	Ra-226	3.54E+05	MB-98-003
	Ra-228	4.40E+04	MB-98-003
SS-92-87, filter	Ra-226	1.19E+04	MB-98-003

Description	Nuclide	Total Activity (pCi)	Drum Number
MB-032	Ra-226	4.95E+05	MB-98-003
	U-238	1.13E+06	MB-98-003
	U-235	6.69E+04	MB-98-003
MB-033	Ra-226	1.18E+06	MB-98-003
	U-235	7.24E+04	MB-98-003
MB-035	U-235	5.39E+04	MB-98-003
MB-036	Cs-137	1.76E+03	MB-98-003
MB-034		<MDA	MB-98-003
MB-017	Ra-226	1.51E+07	MB-98-003
	U-238	24.7E+06	MB-98-003
	U-235	1.95E+06	MB-98-003
Source Rod, I-129, 0.2 micro curies	I-129	2.00E+05	MB-98-003
Calibration source SN 744	Ra-226	1.67E+07	MB-98-003
Check source	Ra-226	1.30E+07	MB-98-003
Nuclear Check Source A SN SS-88-44	Ra-226	2.20E+06	MB-98-003
Nuclear Check Source A SN SS-88-47	Ra-226	1.31E+06	MB-98-003
Nuclear Check Source A-1	Ra-226	2.20E+06	MB-98-003
Nuclear Check Source A-2	Ra-226	2.00E+06	MB-98-003
Nuclear Check Source A-3	Ra-226	2.30E+06	MB-98-003
Nuclear Check Source A-4	Ra-226	2.10E+06	MB-98-003
Nuclear Check Source A-5	Ra-226	2.00E+06	MB-98-003
Nuclear Check Source A-6	Ra-226	2.30E+06	MB-98-003
Nuclear Check Source A-51	Ra-226	1.00E+06	MB-98-003
Nuclear Check Source A-MB-3	Ra-226	1.70E+06	MB-98-003
Nuclear Check Source B SN SS-88-45	Ra-226	1.26E+06	MB-98-003
Nuclear Check Source B SN SS-88-46	Ra-226	2.52E+06	MB-98-003
Nuclear Check Source B-1	Ra-226	2.20E+06	MB-98-003
Nuclear Check Source B-2	Ra-226	3.20E+06	MB-98-003
Nuclear Check Source B-3	Ra-226	2.40E+06	MB-98-003
Nuclear Check Source B-4	Ra-226	1.80E+06	MB-98-003
Nuclear Check Source B-5	Ra-226	3.20E+06	MB-98-003
Nuclear Check Source B-6	Ra-226	2.40E+06	MB-98-003
Nuclear Check Source B-7	Ra-226	2.40E+06	MB-98-003

Description	Nuclide	Total Activity (pCi)	Drum Number
Calibration Source Ser#468	Ra-226	1.63E+07	MB-98-003
Watch Dials	Ra-226	1.00E+08	MB-98-003
MB-037	Cs-137	4.13E+06	MB-98-004
Co-60 acrylic only, no detectable activity on frisker	Co-60	<4.50E+03	MB-98-004
25 grams Uranyl Acetate	U-238	4.68E+06 pCi	MB-98-005
Sample # Tritium Standard Qty 3 vials <uCi ^3H	H-3	3.00E+6 pCi	MB-98-005
Sample # (Unquenched) (2) Standard Sets(s) H-3, C-14, Bkg Vial, Liquid Scintillation Vials 1-30	H-3	9.00E+03 pCi	MB-98-005
	C-14	90.1E+03 pCi	

MICHIGAN BIOLOGIC PRODUCTS INSTITUTE
SURVEY PACKAGE

1. General instructions:

Perform surveys in accordance with the guidance provided in the Final Survey Plan Rev.1, dated June 1998.

2. Data: Technician Initials/Date

* Building # 70 _____ / _____
* Room # N/A _____ / _____
* Location Code: A2000 01F01 _____ / 6/30/98
* Location Code: 01W03 _____ / 6/31/98
* Location Code: _____ / _____
* Location Code: _____ / _____
* Location Code: _____ / _____
* Location Code: _____ / _____
* Smear Surveys yes ✓ no _____ _____ / _____
* Beta Surveys yes ✓ no _____ _____ / _____
* Alpha Surveys yes ✓ no _____ _____ / _____
* Survey Instrument Ser # 126192
* Detector Ser # 095527

Comments: 10 random liquid scintillation smears taken also. (10 for I-125, 10 for H-3)

Reviewed by: _____ Date 7/30/98

98024647.XLS

Scientific Ecology Group, Inc.			LSC Analysis		Oak Ridge, TN				
Sample Description	H-3	H-3	C-14	C-14	Alpha	Alpha	CTIME	SQPE	DATE
BKG	DPM	LLD DPM	DPM	LLD DPM	DPM	LLD DPM	180	743.69	7/10/1998
24647 #1 MT Biologics	-90	50	0	16	0	3	180	653.91	7/10/1998
2 F-125 Bunker 20	-35	50	-6	16	0	3	180	700.90	7/10/1998
3	-79	50	-8	16	0	3	180	671.54	7/10/1998
4	-64	50	-4	16	0	3	180	683.80	7/10/1998
5	-113	50	-9	16	0	3	180	648.54	7/10/1998
6	-91	50	-12	16	0	3	180	655.94	7/10/1998
7	-32	50	-3	16	1	3	180	685.03	7/10/1998
8	-47	50	-8	16	0	3	180	674.92	7/10/1998
9	-33	50	1	16	1	3	180	708.45	7/10/1998
10	-51	50	-3	16	-1	3	180	664.58	7/10/1998
	#DIV/0!	50	#DIV/0!	16	-1	3			
	#DIV/0!	50	#DIV/0!	16	-1	3			
	#DIV/0!	50	#DIV/0!	16	-1	3			
	#DIV/0!	50	#DIV/0!	16	-1	3			
	#DIV/0!	50	#DIV/0!	16	-1	3			
	#DIV/0!	50	#DIV/0!	16	-1	3			
	#DIV/0!	50	#DIV/0!	16	-1	3			
	#DIV/0!	50	#DIV/0!	16	-1	3			
	#DIV/0!	50	#DIV/0!	16	-1	3			
	#DIV/0!	50	#DIV/0!	16	-1	3			
	#DIV/0!	50	#DIV/0!	16	-1	3			
	#DIV/0!	50	#DIV/0!	16	-1	3			
QA: Keith Ogden			Cal. Due 09/30/98		Tech: Deborah Stippen			7/10/98	

Tritium Smears

(Direct)

GTS Duratek, Maxey Flats Disposal Site

	RC Number	Description	tSIE	Quenched Corrected Bkg	EFF (Fraction)	Sample cpm	Volume of Aliquot ml	CNT Time	Smear Concentration DPM / 100cm²	Error* DPM / 100cm²	MDA DPM / 100cm²	Critical Level DPM / 100cm²
Bldg 9	MBPI09 #4	Michigan Biologics Lab	311	8.44	0.274	9.63	5	30	4.348	5.548	9.334	4.502
	MBPI09 #5		326	8.88	0.290	8.60	5	30	-0.975	5.165	9.058	4.373
	MBPI09 #6		330	9.00	0.294	8.73	5	30	-0.920	5.130	8.991	4.342
	MBPI09 #7		325	8.85	0.289	8.57	5	30	-0.980	5.174	9.075	4.381
	MBPI09 #8		335	9.15	0.299	8.63	5	30	-1.731	5.052	8.910	4.304
	MBPI09 #9		341	9.32	0.305	9.2	5	30	-0.403	5.057	8.819	4.262
	MBPI09 #10		351	9.61	0.314	8.63	5	30	-3.128	4.866	8.679	4.196
	MBPI09 #11		331	9.03	0.295	11.93	5	30	9.832	5.560	8.974	4.334
	MBPI09 #12		342	9.35	0.306	8.9	5	30	-1.478	5.004	8.805	4.255
	MBPI09 #13		308	8.35	0.271	8.3	5	30	-0.173	5.387	9.394	4.531
	MBPI09 #14		252	6.64	0.209	9.53	5	30	13.851	6.894	10.923	5.245
	MBPI09 #15		287	7.71	0.249	7.6	5	30	-0.453	5.639	9.870	4.753
Bldg 20	MBPI20 #1		251	6.81	0.208	7.5	5	30	4.307	6.475	10.959	5.262

Comments: Minimum tSIE = 96

Performed by: C. Lee / J. McKenna Date: 8-4-98

Reviewed by: [illegible] Date: 8-4-98

*Error at 95% confidence

Tritiur (mears

(Direct)

GTS Duratek, Maxey Flats Disposal Site

BLDG 20

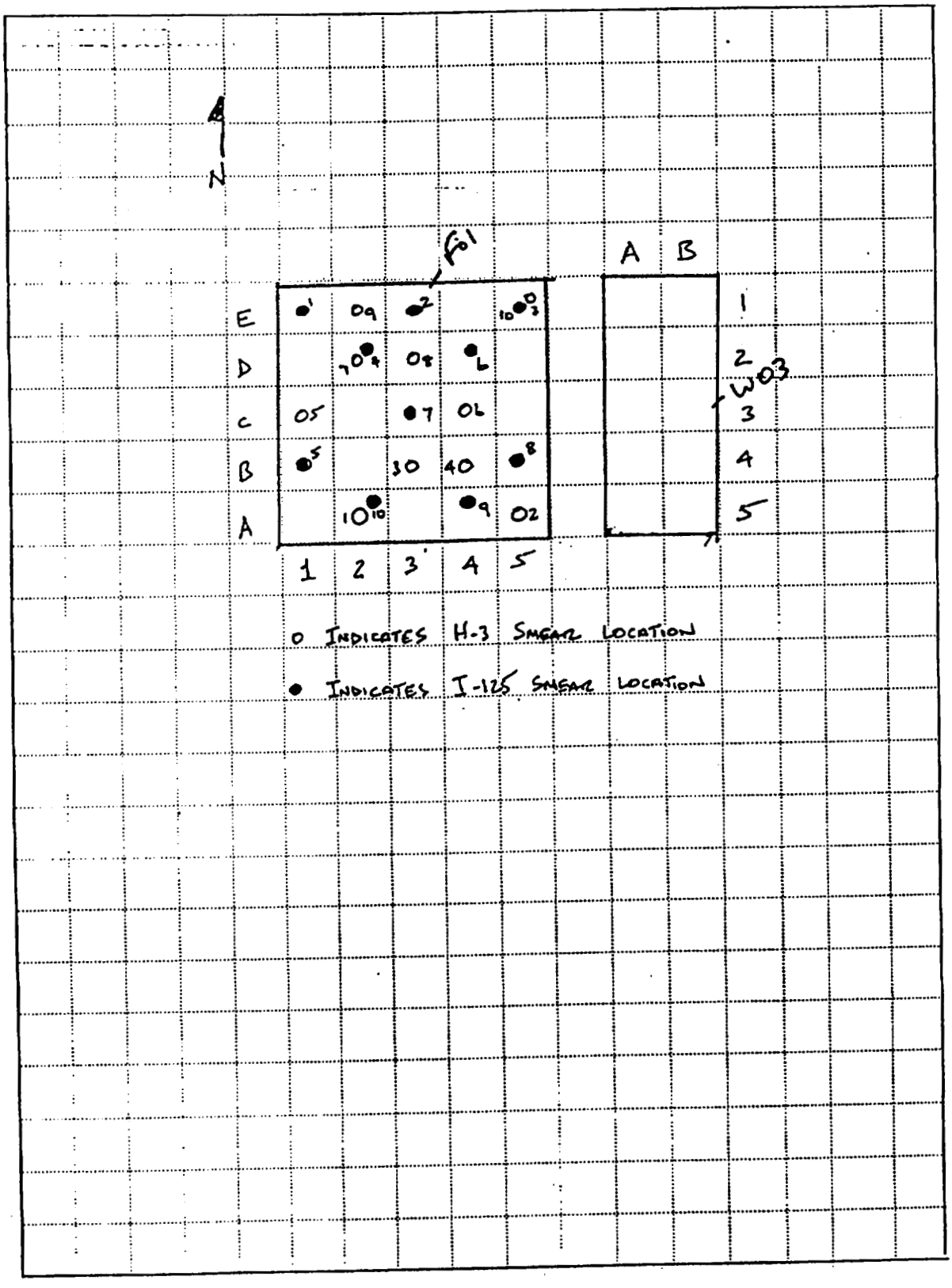
RC Number	Description	tSIE	Quenched Corrected Bkg	EFF (Fraction)	Sample cpm	Volume of Aliquot ml	CNT Time	Smear Concentration DPM / 100cm²	Error* DPM / 100cm²	MDA DPM / 100cm²	Critical Level DPM / 100cm²
MBPI20 #2	Michigan Biologics Lab	260	6.88	0.218	8.03	5	30	5.252	6.341	10.648	5.117
MBPI20 #3		312	8.47	0.275	6.73	5	30	-6.304	5.068	9.314	4.493
MBPI20 #4		261	6.92	0.219	7.80	5	30	4.035	6.266	10.615	5.101
MBPI20 #5		242	6.32	0.197	7.53	5	30	6.108	6.757	11.303	5.423
MBPI20 #6		252	6.64	0.209	7.7	5	30	5.091	6.491	10.923	5.245
MBPI20 #7		307	8.32	0.270	8.6	5	30	1.048	5.452	9.415	4.540
MBPI20 #8		307	8.32	0.270	9.13	5	30	3.009	5.537	9.415	4.540
MBPI20 #9		312	8.47	0.275	8.9	5	30	1.573	5.418	9.314	4.493
MBPI20 #10		222	5.70	0.174	7.1	5	30	8.069	7.374	12.208	5.843
			-1.39	-0.064		5	30	-21.829	ERR	ERR	ERR
			-1.39	-0.064		5	30	-21.829	ERR	ERR	ERR
			-1.39	-0.064		5	30	-21.829	ERR	ERR	ERR
			-1.39	-0.064		5	30	-21.829	ERR	ERR	ERR

Comments: Minimum tSIE = 96

Performed by: [signature] Date: 8-4-98

Reviewed by: [signature] Date: 8-4-98

*Error at 95% confidence


N
E
D
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1 2 3 4 5
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o INDICATES H-3 SMEAR LOCATION
• INDICATES I-125 SMEAR LOCATION

BLDG 20

ATTACHMENT 6.14
SURVEY DOWNLOAD DATA SHEET

Download Technician: Print Name: J. Mucia Signature: [signature] Date: 6/30/98

Download Station #: 1 Download File #: 8
Serial # Verification: Model 2350: ☑ Detector: ☑ Problems: ☐ (See Comments)

Survey Technician(s):
Print Name: J. Mucia User ID Jcm9424 Signature: [signature] Date: 6/30/98

Print Name: User ID Signature: Date:

Instrument Serial #(s): Model 2350: 126192

Survey Unit Description: Bldg 20 floor, W03 Post-SE

(Example: Survey Package + description i.e. D16, Building 43, Area 09, Room 100, Floor - Grid Locations A1 through A7)

Instrument Calibration Due Date: 12/16/98 Detector Calibration Due Date: 12/16/98

Type Of Survey: ☑ Term Survey ☐ Characterization ☐ Information Only
☐ Other (explain):

Type of Measurement	Detector Serial Number	Detector Model Number	Detector Efficiency	Source Mean BKG Value	Pre & Post Use Info	
					Pre File#	Post File#
☐ Beta β		43-106B				
☐ Beta β	095527	43-68B	23.4	5407		
☐ Alpha α		43-68A				
☐ Gamma γ		44-2	N/A	N/A		

Local Area Background Measurements							MEAN Value in cpm ↓
β Beta	1 / 198	2 / 198	3 / 190	4 / 147	5 / 231	6 / 169	238
α Alpha	1	2	3	4	5	6	

COMMENTS:

GTS DURATEK, RADIOLOGICAL ENGINEERING & FIELD SERVICES

Michigan Biologics Products

Direct Beta Survey Report, dpm/100 cm2

File Number: 8	Survey Description: BLDG 20 FLOOR,W03 POST S/C		
Survey Reason: TERMINATION	User ID: JLM/9424	Technician name: Jack Mucia	
Instrument Model: 2350-1	S/N: 126192	Calibration Due: 12/16/98	Group: 2
Detector Model: 43-68B	Detector S/N: 095527	Type: 126 cm2 Gas Proportional Detector	
Background: 238 cpm	Beta Efficiency: .234		Survey Date: 6/30/98

Pre and Post source checks are included on this download: Yes ____ No ✓
If No is answered, then list the Download Files which include the Pre and Post source checks.
Pre File #: 7 Post File #: 8

Technician Review:

I have reveiwed this cover sheet and 3 pages of the report, 0 pages of comments, and 1 graph.

I performed this survey: Jack Mucia (Print name) / [signature] (Signature) Date: 6/30/98

and,

I performed this survey: _____ (Print name) / _____ (Signature) Date: _____

Comments or corrections required:

Comment Resolution:

Survey Reviewed and Approved by: Phil Mann (Print name) / [signature] (Signature) Date: 7/9/98

Survey Date: 6/30/98 Report Date: 6/30/98 Station: 1
File: 8 Page: 1

Comments

Survey Code	L1	L2	L3	L4	L5	L6	Setup Number 0
	A2000	01F01	TAT00	02200	FLDBK	B0002	Det Cal Due:12/16/98

L7 Code Grid ID	L8 Code Loc Num	Sample Number	Count Time	Gross Counts	Net dpm/100cm2	H i
	00000	0	300	1198	5	
	00000	1	300	1198	5	
	00000	2	300	1190	0	

Group Average: 239 cpm Average dpm: 4
Number of measurements: 3

Survey Code	L1	L2	L3	L4	L5	L6	Setup Number 0
	A2000	01F01	TAT00	02200	FLDCT	B0002	Det Cal Due:12/16/98

L7 Code Grid ID	L8 Code Loc Num	Sample Number	Count Time	Gross Counts	Net dpm/100cm2	H i
	00000	3	5	26	251	
	00000	4	5	26	251	
	00000	5	5	23	129	
	00000	6	5	27	292	
	00000	7	5	25	210	
	00000	8	5	30	414	
	00000	9	5	31	454	
	00000	10	5	32	495	
	00000	11	5	30	414	
	00000	12	5	28	332	
	00000	13	5	28	332	
	00000	14	5	20	7	
	00000	15	5	27	292	
	00000	16	5	32	495	
	00000	17	5	25	210	
	00000	18	5	24	170	
	00000	19	5	23	129	
	00000	20	5	30	414	
	00000	21	5	26	251	
	00000	22	5	30	414	
	00000	23	5	25	210	
	00000	24	5	18	-75	
	00000	25	5	30	414	
	00000	26	5	29	373	
	00000	27	5	28	332	

Group Average: 323 cpm Average dpm: 288
Number of measurements: 25

Survey Code	L1	L2	L3	L4	L5	L6	Setup Number 0
	A2000	01W03	TAT00	02200	FLDBK	B0002	Det Cal Due:12/16/98

L7 Code Grid ID	L8 Code Loc Num	Sample Number	Count Time	Gross Counts	Net dpm/100cm2	H i
	00000	38	300	1147	-29	
	00000	39	300	1231	28	
	00000	40	300	1169	-14	

Group Average: 236 cpm Average dpm: -5
Number of measurements: 3

* Hi flag set at 2500 dpm/100 cm2

Survey Date: 6/30/98 Report Date: 6/30/98 Station: 1
File: 8 Page: 2

Comments

Survey Code	L1	L2	L3	L4	L5	L6	Setup Number 0
	A2000	01W03	TAT00	02200	FLDCT	B0002	Det Cal Due:12/16/98

L7 Code Grid ID	L8 Code Loc Num	Sample Number	Count Time	Gross Counts	Net dpm/100cm2	H i
	00000	28	5	29	373	
	00000	29	5	22	88	
	00000	30	5	26	251	
	00000	31	5	23	129	
	00000	32	5	22	88	
	00000	33	5	17	-115	
	00000	34	5	21	47	
	00000	35	5	16	-156	
	00000	36	5	32	495	
	00000	37	5	24	170	

Group Average: 278 cpm Average dpm: 137
Number of measurements: 10

Survey Code	L1	L2	L3	L4	L5	L6	Setup Number 0
	A2000	01W03	TAT00	02200	PTB01	B0002	Det Cal Due:12/16/98

L7 Code Grid ID	L8 Code Loc Num	Sample Number	Count Time	Gross Counts	Net dpm/100cm2	H i
	00000	42	60	5660	18390	*

Group Average: 5660 cpm Average dpm: 18390
Number of measurements: 1

Survey Code	L1	L2	L3	L4	L5	L6	Setup Number 0
	A2000	01W03	TAT00	02200	PTB02	B0002	Det Cal Due:12/16/98

L7 Code Grid ID	L8 Code Loc Num	Sample Number	Count Time	Gross Counts	Net dpm/100cm2	H i
	00000	43	60	5870	19102	*

Group Average: 5870 cpm Average dpm: 19102
Number of measurements: 1

Survey Code	L1	L2	L3	L4	L5	L6	Setup Number 0
	A2000	01W03	TAT00	02200	PTB03	B0002	Det Cal Due:12/16/98

L7 Code Grid ID	L8 Code Loc Num	Sample Number	Count Time	Gross Counts	Net dpm/100cm2	H i
	00000	44	60	5551	18020	*

Group Average: 5551 cpm Average dpm: 18020
Number of measurements: 1

Survey Code	L1	L2	L3	L4	L5	L6	Setup Number 0
	A2000	01W03	TAT00	02200	PTBBK	B0002	Det Cal Due:12/16/98

L7 Code Grid ID	L8 Code Loc Num	Sample Number	Count Time	Gross Counts	Net dpm/100cm2	H i
	00000	41	600	2249	-44	

* Hi flag set at 2500 dpm/100 cm2

Survey Date: 6/30/98 Report Date: 6/30/98 Station: 1
File: 8 Page: 3

Survey Code	L1	L2	L3	L4	L5	L6	
	A2000	01W03	TAT00	02200	PTBBK	B0002	Setup Number 0 Det Cal Due: 12/16/98

Comments

L7 Code Grid ID	L8 Code Loc Num	Sample Number	Count Time	Gross Counts	Net dpm/100cm2	H i

Group Average: 225 cpm Average dpm: -44
Number of measurements: 1

Total Number of Measurements on this Report: 45

NOTE: This report is grouped by:
Package (L1) (Package number)
Setup number (Detector parameters)
Det Type (L4) (GM pancake-flat surface, Beta 3.5-12" pipe, gamma at 1 m, etc.)
Reason (L3-345) (Char survey, source check, final survey, etc.)
Surface Cat (L2) (Wall, floor, drain, penetration, etc.)
Count Type (L5) (Field count, bkg, pre-, post-, etc.)
Bkgd Sub (L6) (Material code, i.e., wood, iron, concr, etc.)

* Hi flag set at 2500 dpm/100 cm2

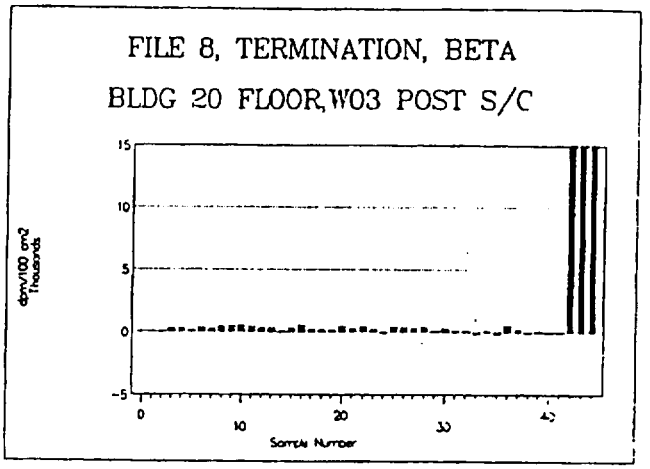
GTS DURATEK, RADIOLOGICAL ENGINEERING & FIELD SERVICES

Michigan Biologics Products

6/30/98 Graph of File 8 Station: 1

Survey Date: 6/30/98 Survey Start Time: 13:34:18

Description: BLDG 20 FLOOR,W03 POST S/C



Flag set for 2500 dpm/100 cm2. Review values greater than this value.

Review this graph for visual outliers.

Mark outliers, source checks and backgrounds on the graph on this page.

LB5100-W Low Background Counting System -- Smear Analysis

Date: 7/1/98
Counting Unit id: 1
Data file name: C:\LBXL\UNIT1\SME1E202.XLD
Batch Ended: 7/1/98 21:08
Crosstalk Correction: Not Applied

Alpha activity action level (DPM): 10.00
Beta activity action level (DPM): 100.00
Certainty level for MDA and flags: 95.00%
High Voltage Setting: 1380

Application Revision: 3
Application Version: Standard

Alpha efficiency log file: th230ab
Alpha Efficiency: 33.52%
Alpha to Beta Crosstalk: 18.84%
Alpha Background (CPM): 0.433333333
Alpha Correction Factor: 1.000

Beta efficiency log file: TC99AB
Beta Efficiency: 32.24%
Beta into Alpha Crosstalk: 0.28%
Beta Background (CPM): 2.466666667
Beta Correction Factor: 1.000

Batch ID: Bldg20 Floor (1-25) W03 (26-35)

	Alpha Activity				Beta Activity							
Carrier	DPM	σ	flags	MDA	DPM	σ	flags	MDA	Count time (min)	Alpha CPM	Beta CPM	Completion Date - Time
1	-1.293	5.98	<MDA	25.36	-1.45	6.27	<MDA	39.64	0.50	-0.433	-0.47	7/1/98 20:43
2	-1.293	5.98	<MDA	25.36	-7.65	6.27	<MDA	39.64	0.50	-0.433	-2.47	7/1/98 20:44
3	-1.293	5.98	<MDA	25.36	-1.45	6.27	<MDA	39.64	0.50	-0.433	-0.47	7/1/98 20:45
4	-1.293	5.98	<MDA	25.36	-1.45	6.27	<MDA	39.64	0.50	-0.433	-0.47	7/1/98 20:46
5	-1.293	5.98	<MDA	25.36	-1.45	6.27	<MDA	39.64	0.50	-0.433	-0.47	7/1/98 20:46
6	-1.293	5.98	<MDA	25.36	-7.65	6.27	<MDA	39.64	0.50	-0.433	-2.47	7/1/98 20:47
7	-1.293	5.98	<MDA	25.36	17.16	12.45	<AL	39.64	0.50	-0.433	5.53	7/1/98 20:48
8	-1.293	5.98	<MDA	25.36	-1.45	6.27	<MDA	39.64	0.50	-0.433	-0.47	7/1/98 20:48
9	4.674	5.98	At AL	25.36	-7.65	6.27	<MDA	39.64	0.50	1.567	-2.47	7/1/98 20:49
10	-1.293	5.98	<MDA	25.36	4.76	8.82	<MDA	39.64	0.50	-0.433	1.53	7/1/98 20:50
11	-1.293	5.98	<MDA	25.36	-1.45	6.27	<MDA	39.64	0.50	-0.433	-0.47	7/1/98 20:51
12	-1.293	5.98	<MDA	25.36	-7.65	6.27	<MDA	39.64	0.50	-0.433	-2.47	7/1/98 20:51
13	-1.293	5.98	<MDA	25.36	-1.45	6.27	<MDA	39.64	0.50	-0.433	-0.47	7/1/98 20:52
14	-1.293	5.98	<MDA	25.36	-1.45	6.27	<MDA	39.64	0.50	-0.433	-0.47	7/1/98 20:53
15	-1.293	5.98	<MDA	25.36	-1.45	6.27	<MDA	39.64	0.50	-0.433	-0.47	7/1/98 20:53
16	-1.293	5.98	<MDA	25.36	-7.65	6.27	<MDA	39.64	0.50	-0.433	-2.47	7/1/98 20:54
17	-1.293	5.98	<MDA	25.36	-7.65	6.27	<MDA	39.64	0.50	-0.433	-2.47	7/1/98 20:55
18	-1.293	5.98	<MDA	25.36	-7.65	6.27	<MDA	39.64	0.50	-0.433	-2.47	7/1/98 20:56
19	-1.293	5.98	<MDA	25.36	4.76	8.82	<MDA	39.64	0.50	-0.433	1.53	7/1/98 20:56
20	4.674	5.98	At AL	25.36	10.96	10.79	<MDA	39.64	0.50	1.567	3.53	7/1/98 20:57
21	-1.293	5.98	<MDA	25.36	4.76	8.82	<MDA	39.64	0.50	-0.433	1.53	7/1/98 20:58
22	-1.293	5.98	<MDA	25.36	-1.45	6.27	<MDA	39.64	0.50	-0.433	-0.47	7/1/98 20:59
23	-1.293	5.98	<MDA	25.36	4.76	8.82	<MDA	39.64	0.50	-0.433	1.53	7/1/98 20:59
24	-1.293	5.98	<MDA	25.36	-7.65	6.27	<MDA	39.64	0.50	-0.433	-2.47	7/1/98 21:00
25	-1.293	5.98	<MDA	25.36	10.96	10.79	<MDA	39.64	0.50	-0.433	3.53	7/1/98 21:01
26	-1.293	5.98	<MDA	25.36	-1.45	6.27	<MDA	39.64	0.50	-0.433	-0.47	7/1/98 21:01

NA

REVIEWED BY
[illegible] 7/1/98

LB5100-W Low Background Counting System -- Smear Analysis

Date: 7/1/98
Counting Unit id: 1
Data file name: C:\LBXL\UNIT1\SME1E202.XLD
Batch Ended: 7/1/98 21:08
Crosstalk Correction: Not Applied

Alpha activity action level (DPM): 10.00
Beta activity action level (DPM): 100.00
Certainty level for MDA and flags: 95.00%
High Voltage Setting: 1380

Application Revision: 3
Application Version: Standard

Alpha efficiency log file: th230ab
Alpha Efficiency: 33.52%
Alpha to Beta Crosstalk: 18.84%
Alpha Background (CPM): 0.433333333
Alpha Correction Factor: 1.000

Beta efficiency log file: TC99AB
Beta Efficiency: 32.24%
Beta into Alpha Crosstalk: 0.28%
Beta Background (CPM): 2.466666667
Beta Correction Factor: 1.000

Batch ID: Bldg20 Floor (1-25) W03 (26-35)

	Alpha Activity				Beta Activity							
Carrier	DPM	σ	flags	MDA	DPM	σ	flags	MDA	Count time (min)	Alpha CPM	Beta CPM	Completion Date - Time
27	-1.293	5.98	<MDA	25.36	-7.65	6.27	<MDA	39.64	0.50	-0.433	-2.47	7/1/98 21:02
28	-1.293	5.98	<MDA	25.36	-7.65	6.27	<MDA	39.64	0.50	-0.433	-2.47	7/1/98 21:03
29	-1.293	5.98	<MDA	25.36	-7.65	6.27	<MDA	39.64	0.50	-0.433	-2.47	7/1/98 21:04
30	-1.293	5.98	<MDA	25.36	-1.45	6.27	<MDA	39.64	0.50	-0.433	-0.47	7/1/98 21:04
31	-1.293	5.98	<MDA	25.36	4.76	8.82	<MDA	39.64	0.50	-0.433	1.53	7/1/98 21:05
32	-1.293	5.98	<MDA	25.36	-7.65	6.27	<MDA	39.64	0.50	-0.433	-2.47	7/1/98 21:06
33	-1.293	5.98	<MDA	25.36	-1.45	6.27	<MDA	39.64	0.50	-0.433	-0.47	7/1/98 21:06
34	-1.293	5.98	<MDA	25.36	4.76	8.82	<MDA	39.64	0.50	-0.433	1.53	7/1/98 21:07
35	-1.293	5.98	<MDA	25.36	10.96	10.79	<MDA	39.64	0.50	-0.433	3.53	7/1/98 21:08

NA

LB5100-W Low Background Counting System -- Smear Analysis

Date: 7/1/98
Counting Unit id: 1
Data file name: C:\LBXL\UNIT1\SME1E203.XLD
Batch Ended: 07/01/98 15:26

Alpha activity action level (DPM): 10.00
Certainty requirement for MDA and flags: 95.00%
High Voltage Setting: 637.5

Alpha efficiency log file: TH230AO
Alpha Efficiency: 30.91%
Alpha Background (CPM): 0.1
Alpha Correction Factor: 1.000

Application Revision: 3
Application Version: Standard

Batch ID: Bldg 20 Floor (1-25) W03 (26-35)

	Alpha Activity			
Carrier	DPM	σ	flags	MDA
1	-0.324	1.628	<MDA	6.835
2	-0.324	1.628	<MDA	6.835
3	-0.324	1.628	<MDA	6.835
4	-0.324	1.628	<MDA	6.835
5	-0.324	1.628	<MDA	6.835
6	1.294	1.629	<AL	6.835
7	-0.324	1.628	<MDA	6.835
8	1.294	1.629	<AL	6.835
9	-0.324	1.628	<MDA	6.835
10	1.294	1.629	<AL	6.835
11	-0.324	1.628	<MDA	6.835
12	-0.324	1.628	<MDA	6.835
13	1.294	1.629	<AL	6.835
14	1.294	1.629	<AL	6.835
15	-0.324	1.628	<MDA	6.835
16	1.294	1.629	<AL	6.835
17	-0.324	1.628	<MDA	6.835
18	1.294	1.629	<AL	6.835
19	1.294	1.629	<AL	6.835
20	-0.324	1.628	<MDA	6.835
21	-0.324	1.628	<MDA	6.835
22	-0.324	1.628	<MDA	6.835
23	1.294	1.629	<AL	6.835
24	-0.324	1.628	<MDA	6.835
25	-0.324	1.628	<MDA	6.835
26	-0.324	1.628	<MDA	6.835
27	-0.324	1.628	<MDA	6.835

Count time (min)	Alpha CPM	Completion Date - Time
2.00	-0.100	7/1/98 14:11
2.00	-0.100	7/1/98 14:13
2.00	-0.100	7/1/98 14:15
2.00	-0.100	7/1/98 14:17
2.00	-0.100	7/1/98 14:19
2.00	0.400	7/1/98 14:21
2.00	-0.100	7/1/98 14:24
2.00	0.400	7/1/98 14:26
2.00	-0.100	7/1/98 14:28
2.00	0.400	7/1/98 14:30
2.00	-0.100	7/1/98 14:33
2.00	-0.100	7/1/98 14:35
2.00	0.400	7/1/98 14:37
2.00	0.400	7/1/98 14:39
2.00	-0.100	7/1/98 14:42
2.00	0.400	7/1/98 14:44
2.00	-0.100	7/1/98 14:46
2.00	0.400	7/1/98 14:48
2.00	0.400	7/1/98 14:50
2.00	-0.100	7/1/98 14:52
2.00	-0.100	7/1/98 14:55
2.00	-0.100	7/1/98 14:57
2.00	0.400	7/1/98 14:59
2.00	-0.100	7/1/98 15:01
2.00	-0.100	7/1/98 15:04
2.00	-0.100	7/1/98 15:06
2.00	-0.100	7/1/98 15:08

REVIEWED BY
Rod Ares 7/1/98

LB5100-W Low Background Counting System -- Smear Analysis

Date: 7/1/98
Counting Unit id: 1
Data file name: C:\LBXL\UNIT1\SME1E203.XLD
Batch Ended: 07/01/98 15:26

Alpha activity action level (DPM): 10.00
Certainty requirement for MDA and flags: 95.00%
High Voltage Setting: 637.5

Alpha efficiency log file: TH230A0
Alpha Efficiency: 30.91%
Alpha Background (CPM): 0.1
Alpha Correction Factor: 1.000

Application Revision: 3
Application Version: Standard

Batch ID: Bldg 20 Floor (1-25) W03 (26-35)

	Alpha Activity			
Carrier	DPM	σ	flags	MDA
28	2.912	2.296	<AL	6.835
29	-0.324	1.628	<MDA	6.835
30	-0.324	1.628	<MDA	6.835
31	-0.324	1.628	<MDA	6.835
32	-0.324	1.628	<MDA	6.835
33	-0.324	1.628	<MDA	6.835
34	-0.324	1.628	<MDA	6.835
35	1.294	1.629	<AL	6.835

Count time (min)	Alpha CPM	Completion Date - Time
2.00	0.900	7/1/98 15:10
2.00	-0.100	7/1/98 15:12
2.00	-0.100	7/1/98 15:15
2.00	-0.100	7/1/98 15:17
2.00	-0.100	7/1/98 15:19
2.00	-0.100	7/1/98 15:21
2.00	-0.100	7/1/98 15:23
2.00	0.400	7/1/98 15:26

LB5100-W Low Background Counting System -- Smear Analysis

Date: 7/1/98
Counting Unit Id: 1
Data file name: C:\LBXL\UNIT1\SME1E199.XLD
Batch Ended: 06/30/98 13:25

Alpha activity action level (DPM): 10.00
Certainty requirement for MDA and flags: 95.00%
High Voltage Setting: 637.5

Alpha efficiency log file: TH230A0
Alpha Efficiency: 30.91%
Alpha Background (CPM): 0.266666667
Alpha Correction Factor: 1.000

Application Revision: 3
Application Version: Standard

Batch ID: BLDG 20 FLOOR (1-25) WO 3 (26-35)

Carrier	Alpha Activity DPM	σ	flags	MDA	Count time (min)	Alpha CPM	Completion Date - Time
1	-0.863	1.646	<MDA	8.391	2.00	-0.267	6/30/98 12:10
2	-0.863	1.646	<MDA	8.391	2.00	-0.267	6/30/98 12:12
3	-0.863	1.646	<MDA	8.391	2.00	-0.267	6/30/98 12:15
4	-0.863	1.646	<MDA	8.391	2.00	-0.267	6/30/98 12:17
5	0.755	1.646	<MDA	8.391	2.00	0.233	6/30/98 12:19
6	0.755	1.646	<MDA	8.391	2.00	0.233	6/30/98 12:21
7	-0.863	1.646	<MDA	8.391	2.00	-0.267	6/30/98 12:24
8	-0.863	1.646	<MDA	8.391	2.00	-0.267	6/30/98 12:26
9	-0.863	1.646	<MDA	8.391	2.00	-0.267	6/30/98 12:28
10	-0.863	1.646	<MDA	8.391	2.00	-0.267	6/30/98 12:30
11	-0.863	1.646	<MDA	8.391	2.00	-0.267	6/30/98 12:32
12	0.755	1.646	<MDA	8.391	2.00	0.233	6/30/98 12:35
13	-0.863	1.646	<MDA	8.391	2.00	-0.267	6/30/98 12:37
14	-0.863	1.646	<MDA	8.391	2.00	-0.267	6/30/98 12:39
15	-0.863	1.646	<MDA	8.391	2.00	-0.267	6/30/98 12:41
16	-0.863	1.646	<MDA	8.391	2.00	-0.267	6/30/98 12:43
17	-0.863	1.646	<MDA	8.391	2.00	-0.267	6/30/98 12:46
18	0.755	1.646	<MDA	8.391	2.00	0.233	6/30/98 12:48
19	0.755	1.646	<MDA	8.391	2.00	0.233	6/30/98 12:50
20	-0.863	1.646	<MDA	8.391	2.00	-0.267	6/30/98 12:52
21	-0.863	1.646	<MDA	8.391	2.00	-0.267	6/30/98 12:54
22	-0.863	1.646	<MDA	8.391	2.00	-0.267	6/30/98 12:57
23	-0.863	1.646	<MDA	8.391	2.00	-0.267	6/30/98 12:59
24	0.755	1.646	<MDA	8.391	2.00	0.233	6/30/98 13:01
25	0.755	1.646	<MDA	8.391	2.00	0.233	6/30/98 13:03
26	2.372	2.308	<AL	8.391	2.00	0.733	6/30/98 13:05
27	0.755	1.646	<MDA	8.391	2.00	0.233	6/30/98 13:08

REVIEWED BY
[illegible] 7/1/98

LB5100-W Low Background Counting System -- Smear Analysis

Date: 7/1/98
Counting Unit id: 1
Data file name: C:\LBXL\UNIT1\SME1E199.XLD
Batch Ended: 06/30/98 13:25

Alpha activity action level (DPM): 10.00
Certainty requirement for MDA and flags: 95.00%
High Voltage Setting: 637.5

Alpha efficiency log file: TH230AO
Alpha Efficiency: 30.91%
Alpha Background (CPM): 0.266666667
Alpha Correction Factor: 1.000

Application Revision: 3
Application Version: Standard

Batch ID: BLDG 20 FLOOR (1-25) WO 3 (26-35)

	Alpha Activity			
Carrier	DPM	σ	flags	MDA
28	-0.863	1.646	<MDA	8.391
29	-0.863	1.646	<MDA	8.391
30	-0.863	1.646	<MDA	8.391
31	0.755	1.646	<MDA	8.391
32	0.755	1.646	<MDA	8.391
33	0.755	1.646	<MDA	8.391
34	0.755	1.646	<MDA	8.391
35	-0.863	1.646	<MDA	8.391

Count time (min)	Alpha CPM	Completion Date - Time
2.00	-0.267	6/30/98 13:10
2.00	-0.267	6/30/98 13:12
2.00	-0.267	6/30/98 13:14
2.00	0.233	6/30/98 13:17
2.00	0.233	6/30/98 13:19
2.00	0.233	6/30/98 13:21
2.00	0.233	6/30/98 13:23
2.00	-0.267	6/30/98 13:25

APPENDIX 3

Michigan Department of Environmental Quality
Waste and Hazardous Material Division
Radiological Protection Section

Building 44 – Nuclear Counting Facility
3500 N. Martin L. King Jr. Blvd., Lansing, Michigan
Final Status Survey Report

Historical Site Assessment

The Nuclear Counting Facility (NCF) was located in the basement of Building 44. The NCF is responsible for counting environmental samples collected as part of Michigan's nuclear power plant monitoring program. Additional "special samples," collected in support of radioactive materials incident investigations, were also counted at the NCF. Other sources at the NCF were sealed laboratory calibration standards and check sources. Radioactive samples were not stored at the NCF after laboratory analysis.

The special samples collected by staff were primarily environmental samples with low concentrations of naturally-occurring radioactive material. In addition, the following long-lived byproduct radionuclides were identified in some samples: Co-60, Cs-137, and Am-241. Any residual contamination of the lab would likely have occurred during sample preparation in the Wet Lab. Areas affected by this activity would have included the South Countertop, Central Countertop, floors, sinks (and drains), and fume hoods. During operation, the NCF was kept radiologically clean so as to not cross-contaminate samples. Based on the above information, the facility was determined to require a Group 2 decommissioning process.

Before the survey, all laboratory calibration standards, environmental samples, and special samples were removed from the NCF and relocated to the new radiological laboratory at 815 Terminal Road, Lansing, Michigan.

Final Status Survey

The NCF was surveyed for residual radioactivity by Bob Skowronek of the radiological protection staff of the Michigan Department of Environmental Quality on November 29 and 30, 2000. The surveys checked for alpha, beta and gamma radiation. The instruments used and their background readings are shown in Table 1. Figure 1 is a layout (not to scale) of the NCF. Numbered locations in the figure are referenced in the data tables. Tables 2a and 2b contain the survey data of static measurements. Wipes were counted by the NCF (Oxford/Canberra Tennelec Series 5) at its new location at 815 Terminal Road, Lansing, Michigan. Wipe results are tabulated in Table 3.

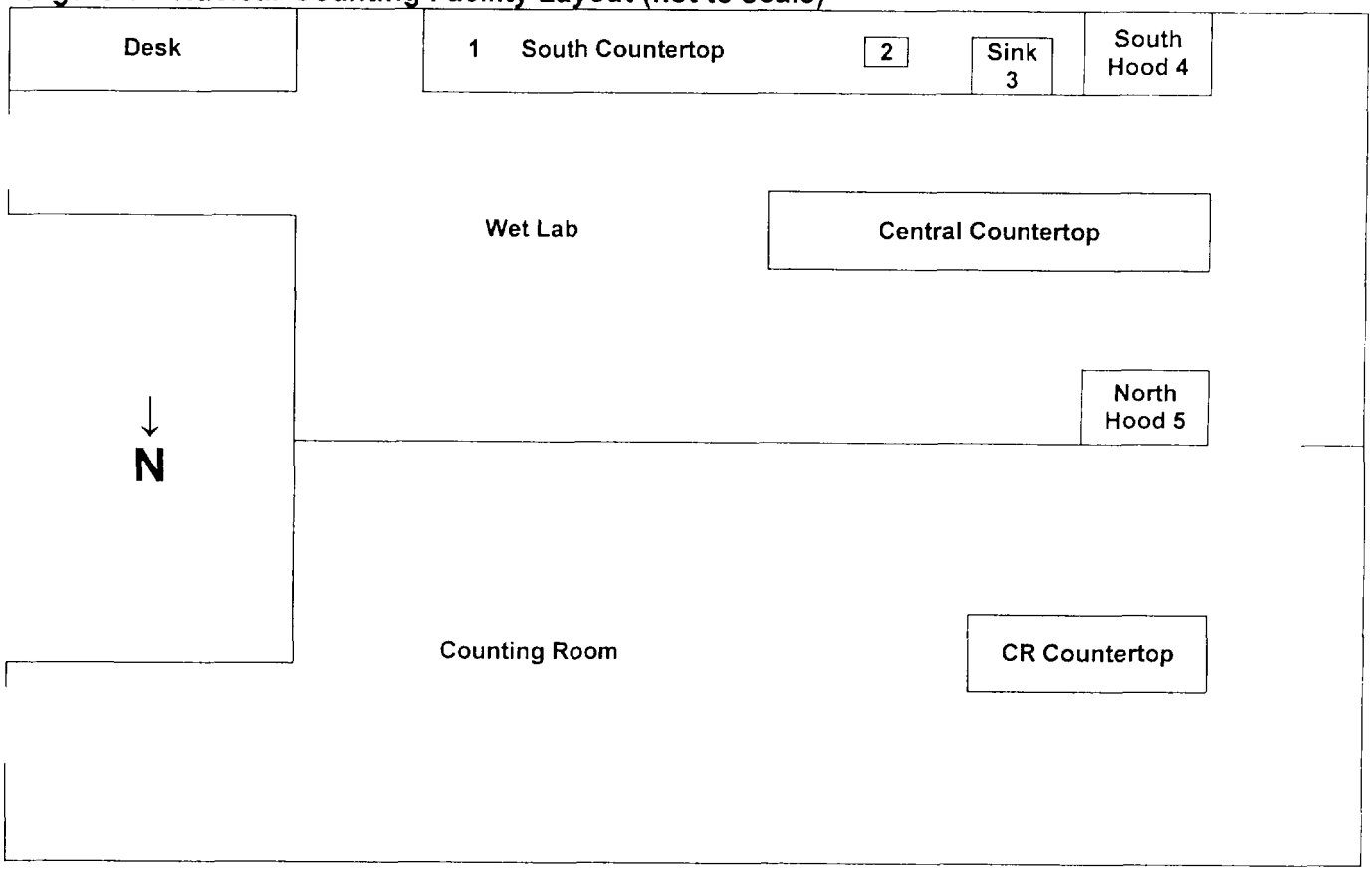
Table 1 – Survey Instrument Descriptions

Instrument Model, Calibration Date	Instrument Type	11/29 bkg	11/30 bkg
Eberline PRM-7 3/9/2000	NaI Scintillator, gamma exposure rate	7 μR/hr	7 μR/hr
Eberline E-600 w/ SHP-360 probe 6/12/2000	GM pancake probe, beta/gamma	39 cpm*	30 cpm*

Instrument Model, Calibration Date	Instrument Type	11/29 bkg	11/30 bkg
Eberline E-600 w/ SHP-380A probe 6/26/2000	ZnS Scintillator, alpha	3 cpm*	4 cpm*

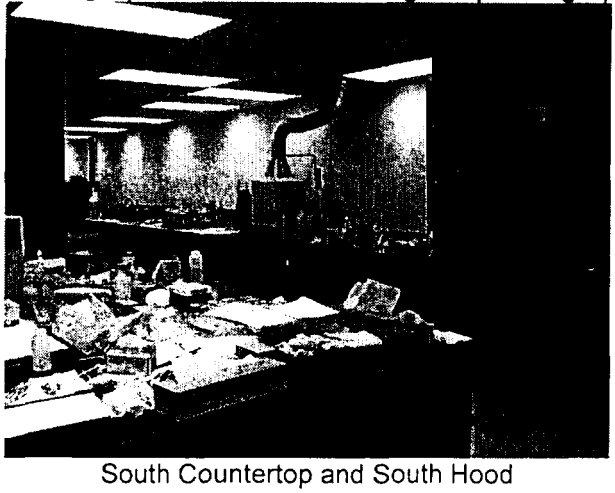
* Background rates determined by one minute integrated counts

Figure 1 – Nuclear Counting Facility Layout (not to scale)

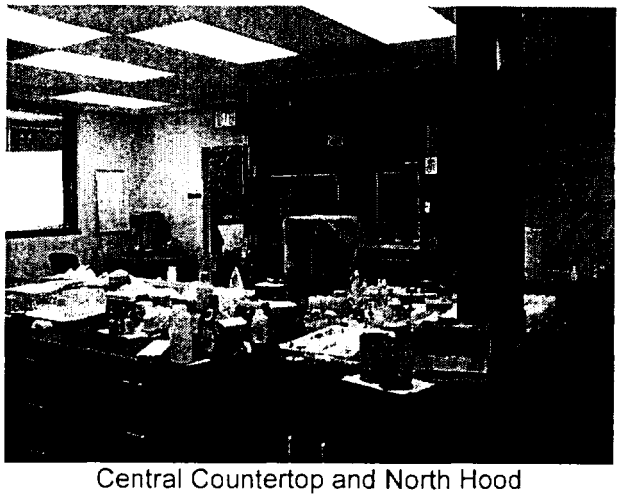


Photographs

Photographs were taken during the packing up of the NCF.



South Countertop and South Hood



Central Countertop and North Hood

Gamma Survey

A gamma radiation survey using the Eberline PRM-7 microroentgens per hour meter was performed near the following surfaces with no reading above 7 μR/hr (background):

- The desk top, drawers, and surrounding floor.
- The South Countertop, shelves and drawers, and floor in front of the countertop.
- The oven and elephant exhaust above the oven (3).
- The interior of the sink and the exterior of the trap below the sink.
- The exteriors and interiors of South Hood and the North Hood, the sink traps beneath each hood, and the floors in front of the hoods.
- The Central Countertop, shelves and drawers, and floor around the countertop.
- The Counting Room Countertop, shelves and drawers, and floor around the countertop.

In addition, a circuit was walked in both rooms approximately 1 meter from the walls. No radiation reading above 7 μR/hr (background) was noted.

Beta/Gamma Surface Scan

A beta/gamma surface scan was performed on the following surfaces using the Eberline E-600 and SHP-360 GM pancake probe. No hot spots were detected and no reading was above 50 cpm:

- The South Countertop and floor in front of this countertop.
- The elephant exhaust (3) above the oven.
- The interior of the sink and the exterior of the trap below the sink.
- The exteriors and interiors of the South Hood and the North Hood, the sink traps beneath each hood, and the floors in front of the hoods.
- The Central Countertop and floor around the countertop.
- The Counting Room Countertop and floor around the countertop.

Alpha Surface Scan

An alpha surface scan was performed on the following surfaces using the Eberline E-600 and SHP-380A probe. No elevated readings were detected.

- The South Countertop.
- The interior of the sink.
- The exteriors and interiors of the South Hood and the North Hood.
- The Central Countertop.
- The Counting Room Countertop.

Static Surveys

The formula for the derived dpm/100 cm^2 is:

$$\text{Derived (dpm/100 cm}^2\text{)} = \frac{\text{Counts in 1 minute} - \text{Background counts in 1 minute}}{\text{Efficiency from manufacturer}} \times \frac{100\ \text{cm}^2}{\text{Probe area}}$$

The efficiencies of the detectors as stated by Eberline are 0.20 for alpha and 0.15 for beta/gamma. The probe areas are 100 cm^2 for the alpha detector and 15 cm^2 for the beta/gamma detector.

Table 2a – Static Counts measured on 11/29/2000

Area	Description	Alpha (counts in 1 minute)	Derived Alpha (dpm/100cm^2)	Beta/Gamma (counts in 1 minute)	Derived Beta/Gamma (dpm/100cm^2)
	Alpha Background	3			
	Beta/Gamma Background			39	
1	South Countertop	2	0	26	0
2	Inside elephant exhaust	1	0	40	44
3	Sink	3	0	42	132
3a	Sink trap			33	0
4a	South fume hood – sink trap			24	0
4b	South fume hood – back wall	1	0	20	0
4c	South fume hood – right wall	1	0	26	0
4d	South fume hood – left wall	1	0	34	0
4e	South fume hood – work surface, left side	1	0	27	0
4f	South fume hood – work surface	1	0	34	0
4g	South fume hood – work surface, right side	1	0	34	0

Table 2b – Static Counts measured on 11/30/2000

Area	Description	Alpha (counts in 1 minute)	Derived Alpha (dpm/100cm^2)	Beta/Gamma (counts in 1 minute)	Derived Beta/Gamma (dpm/100cm^2)
	Alpha Background	4			
	Beta/Gamma Background			30	
5a	North fume hood – left sink trap			36	263
5b	North fume hood – right sink trap			31	44
5c	North fume hood – left wall	2	0	28	0
5d	North fume hood – back wall	1	0	23	0
5e	North fume hood – right wall	1	0	17	0
5f	North fume hood – work surface, left side	3	0	24	0
5g	North fume hood – work surface center	4	0	41	482
5h	North fume hood – work surface, right side	3	0	31	44

Wipe Test Results

The surface area wiped was 100 cm^2. The minimum detectable activity was 0.2 picocuries for gross alpha and 0.5 picocuries for gross beta.

Table 3 – Wipe Results

Area	Description	Lab Result Alpha (pCi)	Lab Result Beta (pCi)	Alpha (dpm/100cm^2)	Beta (dpm/100cm^2)
2	Interior of elephant exhaust	< 0.2	< 0.5	< 0.4	< 1.1
3	In sink around drain outlet	< 0.2	< 0.5	< 0.4	< 1.1
4	South fume hood – work surface	< 0.2	< 0.5	< 0.4	< 1.1

Area	Description	Lab Result Alpha (pCi)	Lab Result Beta (pCi)	Alpha (dpm/100cm^2)	Beta (dpm/100cm^2)
5	North fume hood – work surface	< 0.2	< 0.5	< 0.4	< 1.1

Data Analysis

Table H.1, "Acceptable License Termination Screening Values of Common Radionuclides for Building Surface Contamination" in NUREG-1757, Vol. 2, "Consolidated Decommissioning Guidance: Characterization, Survey, and Determination of Radiological Criteria: Final Report" gives an acceptable screening level for unrestricted release of 7,100 dpm/100 cm^2 for cobalt-60 and 28,000 dpm/100 cm^2 for cesium-137.

The maximum derived beta/gamma static measurement was 482 dpm/100 cm^2. Assuming these were entirely due to cobalt-60, the ratio of this measurement to the acceptable screening level is 0.07. The surface scans demonstrate that the residual beta/gamma contamination would result in a dose less than 25 millirems per year.

A DandD Building Occupancy Scenario was run using DandD Version: 2.1.0 at the default parameter settings. A concentration of 250 dpm/100 cm^2 of americium-241 over an area of 1 square meter was used. The DandD Summary of Results was:

> "90.00% of the 20000 calculated TEDE values are < 2.36E+01 mrem/year. The 95% Confidence Interval for the 0.9 quantile value of TEDE is 2.34E+01 to 2.38E+01 mrem/year."

Therefore, a residual surface concentration of 250 dpm/100 cm^2 of Americium-241 could be expected to give a TEDE just under 25 millirems per year.

Therefore, a residual surface concentration of 25 dpm/100 cm^2 could be expected to give a TEDE just under 25 millirems per year. No alpha radiation readings above background were detected on the surface scans. The removable alpha contamination from the areas wipes were less than 0.4 dpm/100 cm^2. The surface scans and the wipe results demonstrate that the residual alpha contamination would result in a dose less than 25 millirems per year.

Conclusion

The data collected for the final status survey demonstrates that the Nuclear Counting Facility in Building 44, 3500 N. Martin L. King Jr. Blvd., Lansing, Michigan can be released for unrestricted use.

APPENDIX 4

Michigan Department of Environmental Quality
Waste and Hazardous Material Division
Radiological Protection Section

Baker-Olin North, Room 12
3423 N. Martin Luther King Jr. Blvd., Lansing, Michigan
Final Status Survey Report

Introduction

Room 12 in the basement of the Baker-Olin North Building has been used to calibrate portable radiation survey instruments and as a storage area for radioactive materials. Mr. Russ Rotta and Mr. Kenneth Coble of the radiological protection staff of the Michigan Department of Environmental Quality performed the surveys.

Historical Site Assessment

Staff were interviewed and disposal records were reviewed to determine the radioactive material used and stored in Room 12. Sealed sources used during calibration include cesium-137, cobalt-60, and cesium-137/americium-241. Planchet sources used during calibration included americium-241, technetium-99, and plutonium-239. Other sources that have been stored in the room have included a tritium exit sign, a static gun containing a 200-millicurie tritium foil, watch parts and aircraft instruments containing radium-226, a carbon-14 check source, and smoke detector sources containing americium-241 or radium-226. Environmental samples containing one or more of the following long-lived radionuclides have been stored in the room: cobalt-60, cesium-137, radium-226, radium-228, uranium, and thorium. Uranium and thorium ores, metals, and compounds have also been stored in the room. Historically, all the wipe tests performed on the sealed cesium-137 and cobalt-60 sources resulted in gross beta analyzes less than 0.4×10^{-6} µCi/wipe and the wipe tests performed on the americium-241 source resulted in gross alpha analyzes less than 0.3×10^{-6} µCi/wipe. Based on the above information, the calibration room was determined to require a Group 2 final status survey.

Gamma Radiation Survey

All known radiation sources and environmental samples inside Room 12 were moved on November 26, 2000 to the new calibration facility at 815 Terminal Road in Lansing, Michigan. The sealed sources requiring leak testing were wipe tested on July 20, 2000 and analyzed by the Nuclear Counting Facility (NCF). The gross beta for the cesium-137 and cobalt-60 sources were less than 0.4×10^{-6} µCi/wipe and the gross alpha for the americium-241 source was less than 0.3×10^{-6} µCi/wipe. On November 28, 2000, the empty Room 12 was surveyed for gamma radiation. The survey confirmed that all radiation sources had been removed.

Instrument Model	Calibrated	Instrument Type
Eberline PRM-7	3/9/2000	NaI scintillator, gamma exposure rate
Eberline E-600 w/ SHP-360 probe	6/12/2000	GM pancake probe, beta/gamma
Eberline E-600 w/ SHP-380A probe	6/26/2000	ZnS scintillator, alpha

A diagram of Room 12 is shown in Figure 1. The ceiling is concrete. The walls are composed of grouted concrete slabs and mortared cinder blocks. The floor is tile on concrete. There is no floor drain. The walls and ceiling had been painted.

Background Reference Areas

In order to evaluate the residual surface contamination in the Calibration Room, suitable background reference areas were chosen. The north, south, and west calibration room walls are constructed of cinder blocks with ceramic masonry near the floor, while the ceiling, floor and west walls are poured concrete. The south wall is constructed of cinder blocks that are visually and radiologically different from the north and west cinder block walls. GM pancake readings on the south cinder block walls were twice as high as the readings on the north and west walls. A survey of the other side of the south cinder block wall in an unaffected room (Room 14) demonstrates that the elevated readings are due to natural radioactivity in the block and not from surface contamination on the walls.

The instrumentation used included an Eberline-600 instrument coupled to a SHP-380A (alpha) smart probe or to a SHP-360 (beta-gamma) smart probe. The SHP-380A probe was calibrated on June 26, 2000 and the SHP-360 probe was calibrated on June 12, 2000. Table 2 summarizes the reference area measurements for the various surfaces. The average counts per minute (cpm) for each surface will be subtracted from the gross cpm measured in the Calibration Room to determine contamination levels on the walls and floor.

Table 1: Reference Area Measurements

Background Reference Area	**Alpha Probe**			**B/γ Probe**			**Calibration Room Surface Location**
	Reading (counts)	**Time (min)**	**Calculated cpm**	**Reading (counts)**	**Time (min)**	**Calculated cpm**	
Hallway Cinder Block Wall	5	2	2.5	847	22	38	**North Wall West Wall**
Room 14 North Wall	4	3	1.3	1,724	22	78	**South Wall**
Room 14 East Wall	3	2	1.5	1,033	22	47	**East Wall**
Room 14 Ceiling	4	3	1.3	1,254	22	57	**Ceiling**
Room 14 Floor	3	2	1.5	1,032	22	47	**Floor**

Alpha and Beta/Gamma Scanning Surveys

The Class 1 and Class 2 areas of the former calibration room were divided into scanning areas. The Class 1 areas consisted of the floor and walls up to a 2 meter height and the Class 2 areas consisted of the wall above 2 meters and the ceiling. See Figures 2 and 3 for visual depictions of the areas. These areas were surveyed for alpha and beta-gamma contamination with 100% coverage for Class 1 and 10% coverage for Class 2 areas. The detector was moved over the scan area within the time indicated. No radioactive contamination or "hot spots" were found during the scanning survey of Class 1 or 2 areas. The results of the scanning surveys are found in Table 2 for the Class 1 areas and Table 3 for the Class 2 areas.

Static Measurements

We chose 20 data points for the Class 1 Survey Unit and 15 data points for the Class 2 Survey Unit. When we actually selected the random-start point and filled in the grid pattern, we ended up with 21 and 16 points for the two Survey Units, respectively. The locations are depicted in Figures 4 and 5. The alpha and the beta/gamma survey results are in Table 4 for the Class 1 unit and in Table 5 for the Class 2 unit.

Area Wipes

Dry wipes sampling 100 cm^2 areas of the floor, walls, and shelving units were collected at the same locations that the static measurements were taken. The NCF analyzed the wipes for gross alpha and gross beta-gamma contamination with a gas-flow proportional counter (Oxford/Canberra Tennelec Series 5). If significant removable activity was found on a wipe, the wipe would then have been analyzed for gamma emitters using gamma spectroscopy (GENIE-2000). The locations are depicted in Figures 4 and 5. The gross alpha and gross beta-gamma results are in Table 4 for the Class 1 unit and in Table 5 for the Class 2 unit.

Tritium

Because tritium is not easily detected, 100 cm^2 areas were smeared using wipes moistened with distilled water. The locations and results are listed below. These wet wipes were analyzed by liquid scintillation counting (Packard Tri-Carb 2100TR) at the Nuclear Counting Facility. If significant contamination had been found on a wet wipe, additional areas of the Calibration Room would have been wiped to assess potential tritium contamination.

Scintillation Results for Tritium

Results (µCi/wipe)	Location
LT 2×10^{-8}	D7 – Exit Sign Storage Location
LT 2×10^{-8}	A3 – Wall Cabinet Where Static Gun Stored
LT 2×10^{-8}	C3 – Radioactive Material Storage Area
LT 2×10^{-8}	Hallway
LT 2×10^{-8}	Control – only distilled water

Contamination Limits

Table H.1, "Acceptable License Termination Screening Values of Common Radionuclides for Building Surface Contamination" in NUREG-1757, Vol. 2, "Consolidated Decommissioning Guidance: Characterization, Survey, and Determination of Radiological Criteria: Final Report" gives an acceptable screening level for unrestricted release for the some radionuclides. For other radionuclides, a DandD Building Occupancy Scenario was run using DandD Version: 2.1.0 at the default parameter settings with the contamination spread over an area of one square meter.

Radionuclide	Surface Activity
Hydrogen-3	120,000,000 dpm/100 cm^2 from Table H.1 in NUREG-1757, Vol. 2.
Cobalt-60	7,100 dpm/100 cm^2 from Table H.1 in NUREG-1757, Vol. 2.
Cesium-137	28,000 dpm/100 cm^2 from Table H.1 in NUREG-1757, Vol. 2.

Radionuclide	Surface Activity
Americium-241	A DandD Building Occupancy Scenario was run using DandD Version: 2.1.0 at the default parameter settings. A concentration of 250 dpm/100 cm^2 of americium-241 over an area of 1 square meter was used. The DandD Summary of Results was: "90.00% of the 20000 calculated TEDE values are < 2.36E+01 mrem/year. The 95% Confidence Interval for the 0.9 quantile value of TEDE is 2.34E+01 to 2.38E+01 mrem/year." Therefore, a residual surface concentration of 250 dpm/100 cm^2 of Americium-241 could be expected to give a TEDE just under 25 millirems per year.
Radium-226 + Progeny	A DandD Building Occupancy Scenario was run using DandD Version: 2.1.0 at the default parameter settings. A concentration of 3,000 dpm/100 cm^2 of radium-226 plus progeny over an area of 1 square meter was used. In order to maximize the calculated dose, the program was directed to not distribute the initial activity over the progeny. The DandD Summary of Results was: "90.00% of the 20000 calculated TEDE values are < 2.41E+01 mrem/year. The 95% Confidence Interval for the 0.9 quantile value of TEDE is 2.39E+01 to 2.43E+01 mrem/year." Therefore, a residual surface concentration of 3,000 dpm/100 cm^2 of radium-226 could be expected to give a TEDE just under 25 millirems per year.
Radium-228 + Thorium-228 + Progeny	A DandD Building Occupancy Scenario was run using DandD Version: 2.1.0 at the default parameter settings. Concentrations of 320 dpm/100 cm^2 of radium-228 and 320 dpm/100 cm^2 of thorium-228 plus progeny over an area of 1 square meter was used. In order to maximize the calculated dose, the program was directed to not distribute the initial activity over the progeny. The DandD Summary of Results was: "90.00% of the 20000 calculated TEDE values are < 2.37E+01 mrem/year. The 95% Confidence Interval for the 0.9 quantile value of TEDE is 2.35E+01 to 2.39E+01 mrem/year." Therefore, a residual surface concentration of 320 dpm/100 cm^2 of radium-228 and of thorium-228 plus progeny could be expected to give a TEDE just under 25 millirems per year.
Thorium-nat + Progeny	A DandD Building Occupancy Scenario was run using DandD Version: 2.1.0 at the default parameter settings. Inputting a concentration of 55 dpm/100 cm^2 of Thorium-nat over an area of 1 square meter, the DandD Summary of Results was: "90.00% of the 20000 calculated TEDE values are < 2.32E+01 mrem/year. The 95% Confidence Interval for the 0.9 quantile value of TEDE is 2.30E+01 to 2.34E+01 mrem/year." Therefore, a residual surface concentration of 55 dpm/100 cm^2 of Thorium-nat could be expected to give a TEDE just under 25 millirems per year.

Radionuclide	Surface Activity
Uranium nat + Progeny	A DandD Building Occupancy Scenario was run using DandD Version: 2.1.0 at the default parameter settings. A concentration of 200 dpm/100 cm^2 of natural Uranium plus progeny over an area of 1 square meter was used. The 200 dpm/100 cm^2 was distributed in the 0.49/0.02/0.49 ratio of U-238/U-235/U-234 found in nature as follows: 98 dpm/100 cm^2 of U-238 plus progeny, 4 dpm/100 cm^2 of U-235 plus progeny, and 98 dpm/100 cm^2 of U-234. In order to maximize the calculated dose, the program was directed to not distribute the initial activity over the progeny. The DandD Summary of Results was: "90.00% of the 20000 calculated TEDE values are < 2.24E+01 mrem/year. The 95% Confidence Interval for the 0.9 quantile value of TEDE is 2.22E+01 to 2.26E+01 mrem/year." Therefore, a residual surface concentration of 200 dpm/100 cm^2 of natural Uranium in equilibrium with its progeny could be expected to give a TEDE just under 25 millirems per year.

Using the above information, limits on surface measurements can be determined for the various radionuclides that would demonstrate that future TEDEs are below 25 mrem.

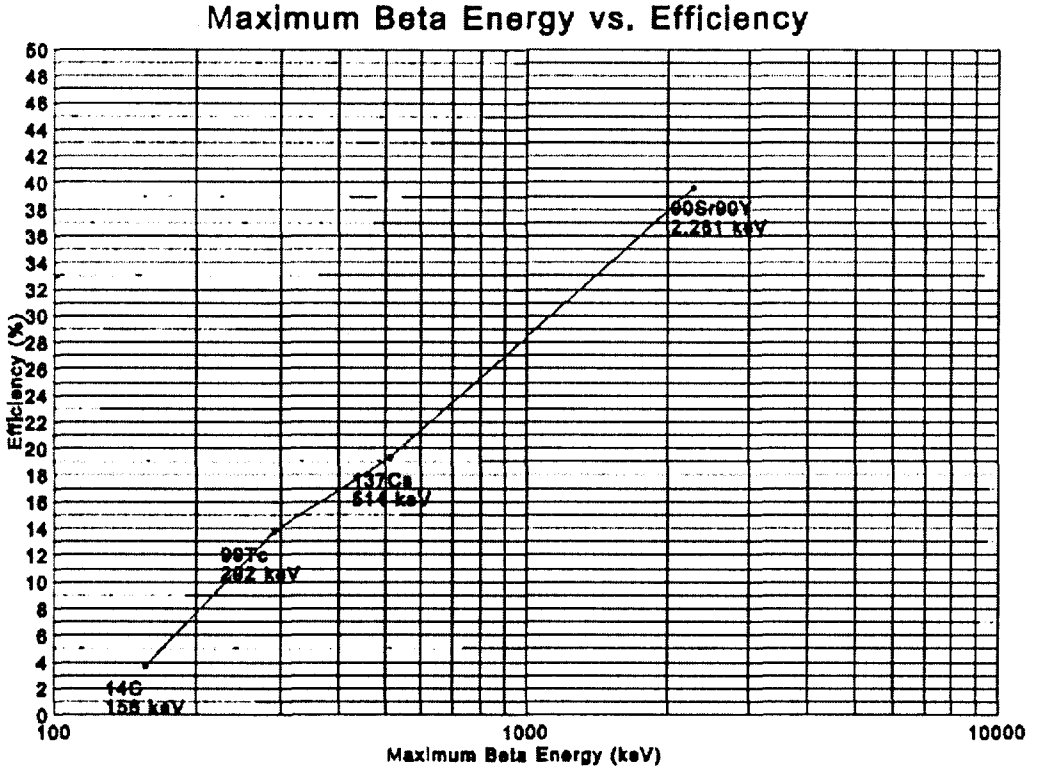
Radionuclide	Activity (dpm/100 cm^2)	Detection Method	# Emissions (includes progeny)	Activity x # Emissions x 0.5 Correction Factor for 2π Geometry (cpm/100 cm^2)
Americium-241	250	Alpha	1 Alpha Particle (Am-241)	125
Radium-226 + Progeny	3,000	Alpha	5 Alpha Particles per dpm of Ra-226: Ra-226, Rn-222, Po-218, Po-214, Po-210	7,500
Radium-228 + Thorium-228 + Progeny	320	Alpha	5 Alpha Particles per dpm of Ra-228 in equilibrium with progeny: Th-228, Ra-224, Rn-220, Po-216, Bi-212 (0.35), Po-212 (0.64)	800
Natural Uranium + Progeny	200	Alpha	4 Alphas For U-238 in equilibrium with its progeny including U-234 and its progeny: U-238, U-234, Th-230, Ra-226, Rn-222, Po-218, Po-214, Po-210 = 8 Alphas x 0.49 factor = 4 Alphas For U-235 in equilibrium with its progeny: U-235 (0.83), Pa-231 (0.98), Th-227 (0.76), Ra-223 (0.95), Rn-219, Po-215, Bi-211 = 6.52 Alphas x 0.04 factor = 0.26 Alphas	400

Radionuclide	Activity (dpm/100 cm^2)	Detection Method	# Emissions (includes progeny)	Activity x # Emissions x 0.5 Correction Factor for 2π Geometry (cpm/100 cm^2)
Natural Thorium + Progeny	55	Alpha	6 Alpha Particles per dpm of Th-232 in equilibrium with progeny: Th-232, Th-228, Ra-224, Rn-220, Po-216, Bi-212 (0.35), Po-212 (0.64)	165

Radionuclide	Activity (dpm/100 cm^2)	Detection Method	Calculations	Cpm/100 cm^2
Cobalt-60	7,100	Beta – 0.318 MeV max	From chart below, 0.14 cpm/dpm	990
Cesium-137	28,000	Beta – 0.512 MeV max	From chart below, 0.19 cpm/dpm	5,300

Radionuclide	Activity (dpm/100 cm^2)	Detection Method	Calculations	Dpm/100 cm^2
Hydrogen-3	120,000,000	Wipe – Beta, Liquid Scintillation	10% of 120,000,000	12,000,000

Beta particle energy vs. efficiency for a G-M pancake detector



Comparison of Contamination Limits with Surface Scans, Static Measurements, and Wipe Results

The most restrictive limit for alpha contamination is the 125 cpm/100 cm^2 calculated for americium-241. Since the alpha probe detection area is 100 cm^2, any alpha reading over 125 cpm could indicate that the dose constraints would be exceeded. The maximum net alpha reading for the surface scans was 4.9 cpm in location C2. The maximum net static alpha measurement was 3.7 cpm at location 31 on the south wall and at locations 32 and 34 on the ceiling. The maximum gross alpha reading on a wipe was 0.4 ± 0.3 picocuries. The surface scans, static measurements, and wipe results demonstrate that the residual alpha contamination would result in a dose less than 25 millirems per year.

The most restrictive limit for beta/gamma contamination is the 990 cpm/100 cm^2 calculated for cobalt-60. Since the beta/gamma probe detection area is 15 cm^2, the limit must be reduced by a factor of 15/100. Therefore, any beta/gamma reading over 148 cpm could indicate that the dose constraints would be exceeded. The maximum net beta/gamma reading for the surface scans was 49 cpm in location I4 on the ceiling. The maximum net beta/gamma static measurement was 11 cpm at location 13 on the north wall. The maximum gross beta reading on a wipe was 1.3 ± 0.6 picocuries. The surface scans, static measurements, and wipe results demonstrate that the residual beta/gamma contamination would result in a dose less than 25 millirems per year.

The wipes for tritium were analyzed by liquid scintillation counting. All results were less than 2 x 10^{-8} microcuries (0.04 dpm) which is well below the 12,000,000 dpm/100 cm^2 limit.

Conclusion

The data collected for the final status survey demonstrates that Room 12 in the basement of Baker-Olin North, 3423 N. Martin Luther King Jr. Blvd., in Lansing, Michigan can be released for unrestricted use.

Figure 1
Calibration Room (Room 12)

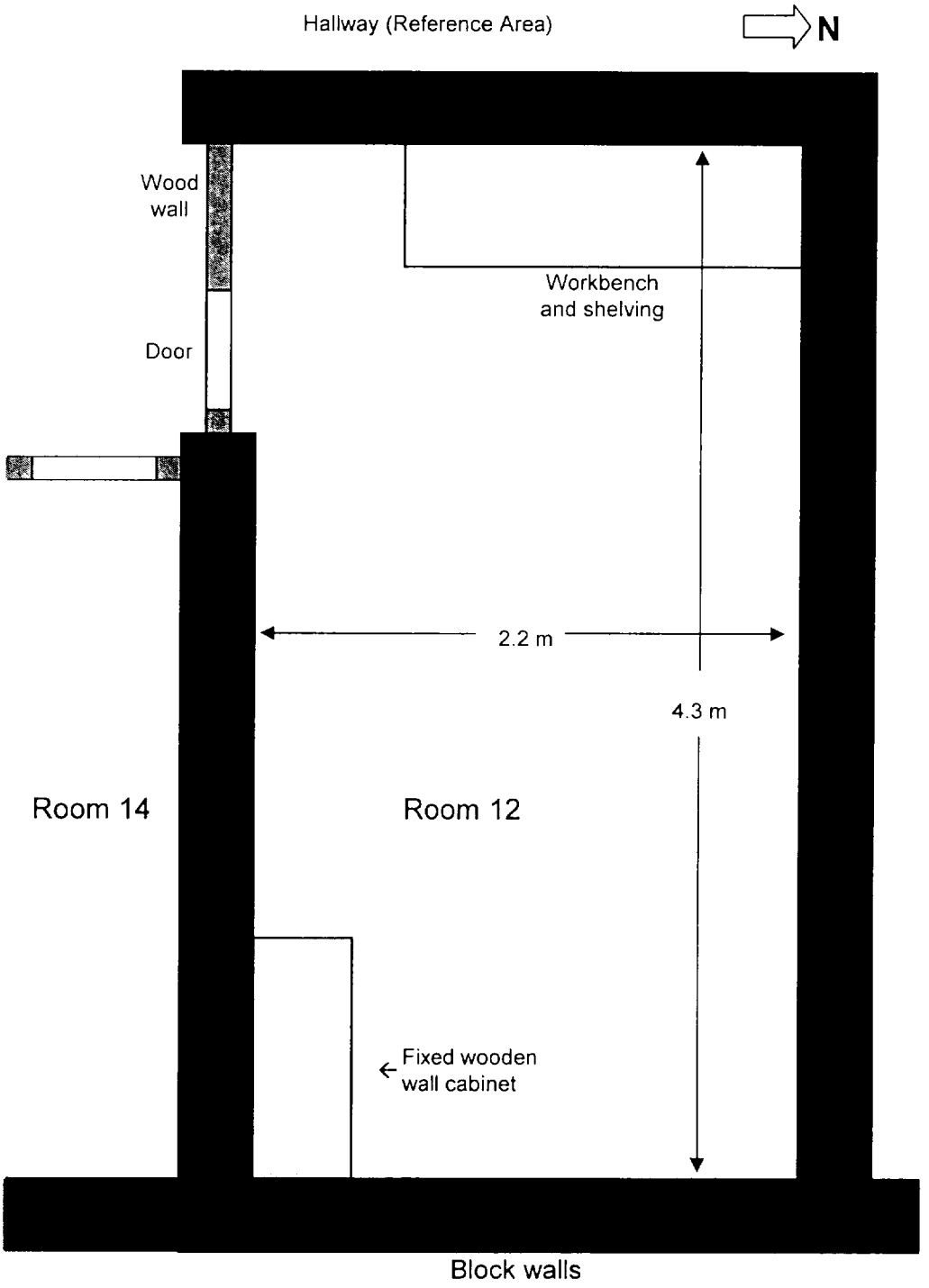


Figure 2
Class 1 Area, Floor and Walls to 2 Meters

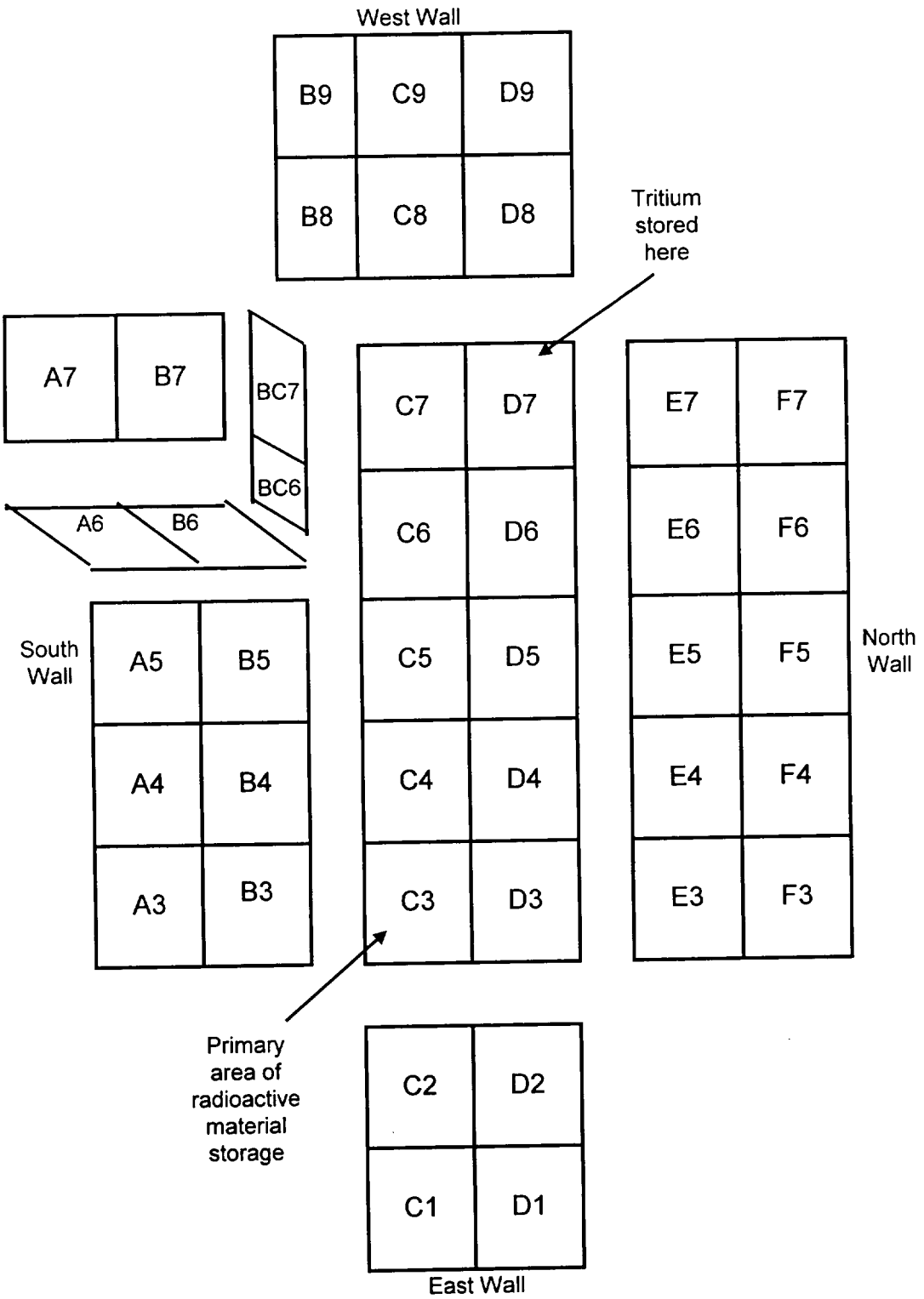


Table 2
Class 1 Area Surveys, Floor and Walls to 2 Meters

SHP380A – Alpha				Location	Area (m^2)	SHP360 – Beta/Gamma			
Counts	Time (min)	Count Rate (cpm)	Net Count Rate (cpm)			Counts	Time (min)	Count Rate (cpm)	Net Count Rate (cpm)
Background 1.3 cpm				South Wall		Background 78 cpm			
3	1	3	1.7	A3	1	72	1	72	0
3	1.2	2.5	1.2	A4	1	144	2	72	0
3	1	3	1.7	A5	1	223	2.6	86	8
3	1	3	1.7	A6	1.7	73	1	73	0
4	1	4	2.7	A7	0.8	45	1.2	38	0
4	1	4	2.7	B3	1	145	1.5	97	19
4	1	4	2.7	B4	1	88	1	88	10
2	1	2	0.7	B5	1	83	1	83	5
2	1	2	0.7	B6	1.7	118	1	118	40
0	1	0	0	B7	0.8	55	1.2	46	0
Background 1.5 cpm				East Wall		Background 47 cpm			
6	1.1	5.5	4	C1	1	90	1.8	50	3
7	1.1	6.4	4.9	C2	1	100	1.9	53	6
1	1.1	0.9	0	D1	1.2	66	1.8	37	0
1	1	1	0	D2	1.2	114	2.3	50	3
Background 2.5 cpm				North Wall		Background 38 cpm			
1	1.4	0.7	0	E3	1	117	2.2	53	15
4	1.2	3.3	0	E4	1	90	1.9	47	9
6	1.2	5	0	E5	1	103	2.1	49	11
3	1.3	2.3	0	E6	1	69	1.5	46	8
2	1	2	0	E7	0.8	57	1	57	19
4	1	4	0	F3	1	76	1.7	45	7
4	1	4	0	F4	1	70	1.4	50	12
5	1.3	3.8	0	F5	1	89	1.9	47	9
4	1.5	2.7	0	F6	1	90	2.1	43	5
6	1	6	0	F7	0.8	44	1	44	6
Background 2.5 cpm				West Wall		Background 38 cpm			
3	1.3	2.3	0	B8	0.7	48	1.2	40	2
2	1	2	0	B9	0.7	58	1.2	48	10
1	1.5	0.7	0	C8	1	22	0.5	47	9
4	1	4	1.5	C9	1	62	1.4	44	6
5	1.1	4.5	2.0	D8	1	83	1.5	55	17
5	1	5	2.5	D9	1	40	1	40	2
Background 1.5 cpm				Floor		Background 47 cpm			
2	1	2	0.5	C3	1	60	1	60	13
4	1	4	2.5	C4	1	48	1	48	1
1	1	1	0	C5	1	53	1	53	6
4	1	4	2.5	C6	1	62	1.2	52	5
1	1	1	0	C7	0.8	28	0.6	44	0
2	1	2	0.5	D3	1.2	55	1	55	8
4	1	4	2.5	D4	1.2	40	1	40	0
1	1	1	0	D5	1.1	23	0.5	46	0
3	1.3	2.3	0.8	D6	1.1	57	1.2	48	1
4	1.2	3.3	1.8	D7	0.9	47	1	47	0
1	1.2	0.8	0	BC6	0.6	48	1	48	1
2	1	2	0.5	BC7	0.5	45	1.1	41	0

Figure 3
Class 2 Area – Ceiling and Walls Above 2 Meters

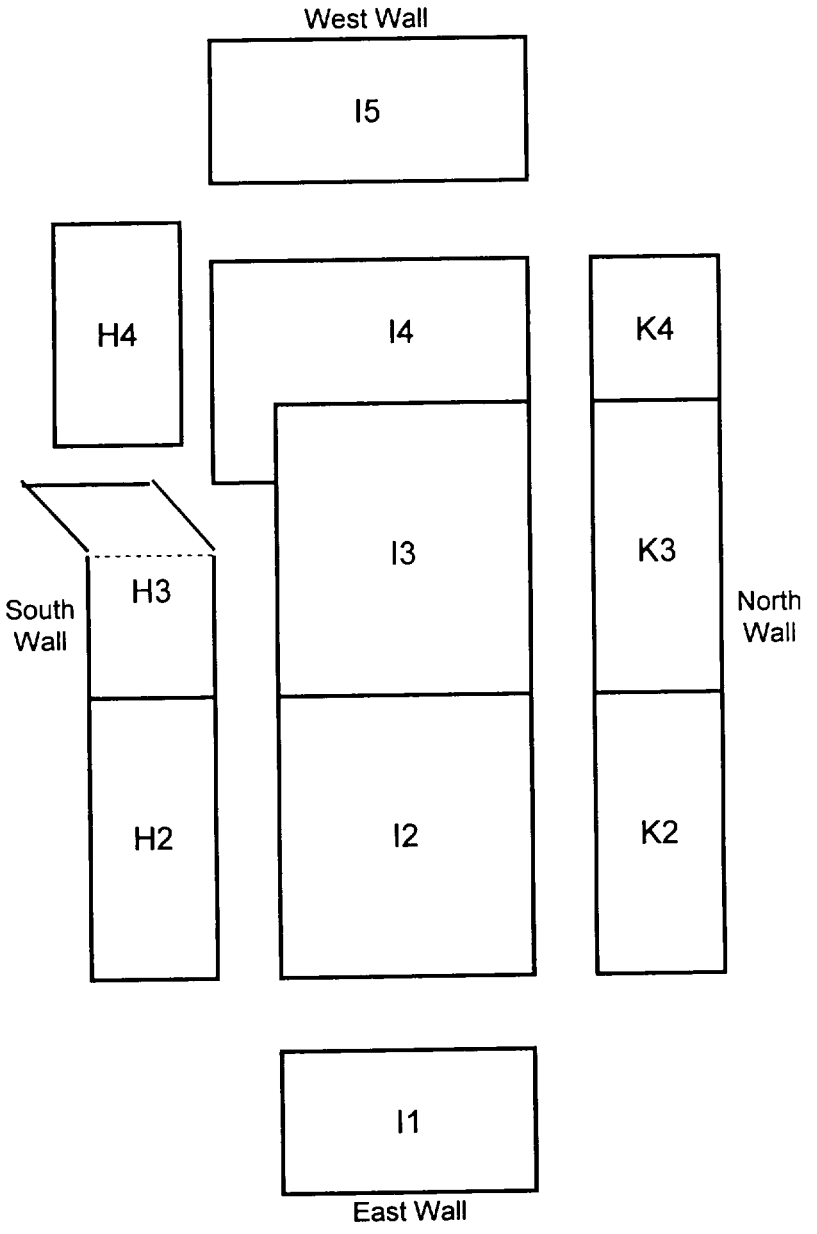


Table 3
Class 2 Area Survey Results

SHP380A – Alpha				Location	SHP360 – Beta/Gamma			
Counts	Time (min)	Count Rate (cpm)	Net Count Rate (cpm)		Counts	Time (min)	Count Rate (cpm)	Net Count Rate (cpm)
Background 1.3 cpm				**South Wall**	**Background 78 cpm**			
4	1	4	2.7	H2	61	1	61	0
3	1	3	1.7	H3	75	1	75	0
2	1	2	0.7	H4	38	1	38	0
Background 1.5 cpm				**East Wall**	**Background 47 cpm**			
2	1	2	0.5	I1	56	1	56	9
Background 2.5 cpm				**North Wall**	**Background 38 cpm**			
1	1	1	0	K2	50	1.5	33	0
3	1	3	0	K3	47	1	47	9
3	1	3	0	K4	49	1	49	11
Background 2.5 cpm				**West Wall**	**Background 38 cpm**			
6	1	6	2.7	I5	39	1	39	1
Background 1.3 cpm				**Ceiling**	**Background 57 cpm**			
6	1	6	4.7	I2	57	1	57	0
3	1	3	1.7	I3	47	1	47	0
1	1.3	0.8	0	I4	106	1	106	49

Figure 4
Class 1 Area, Floor and Walls to 2 Meters
Static Measurement and Wipe Locations

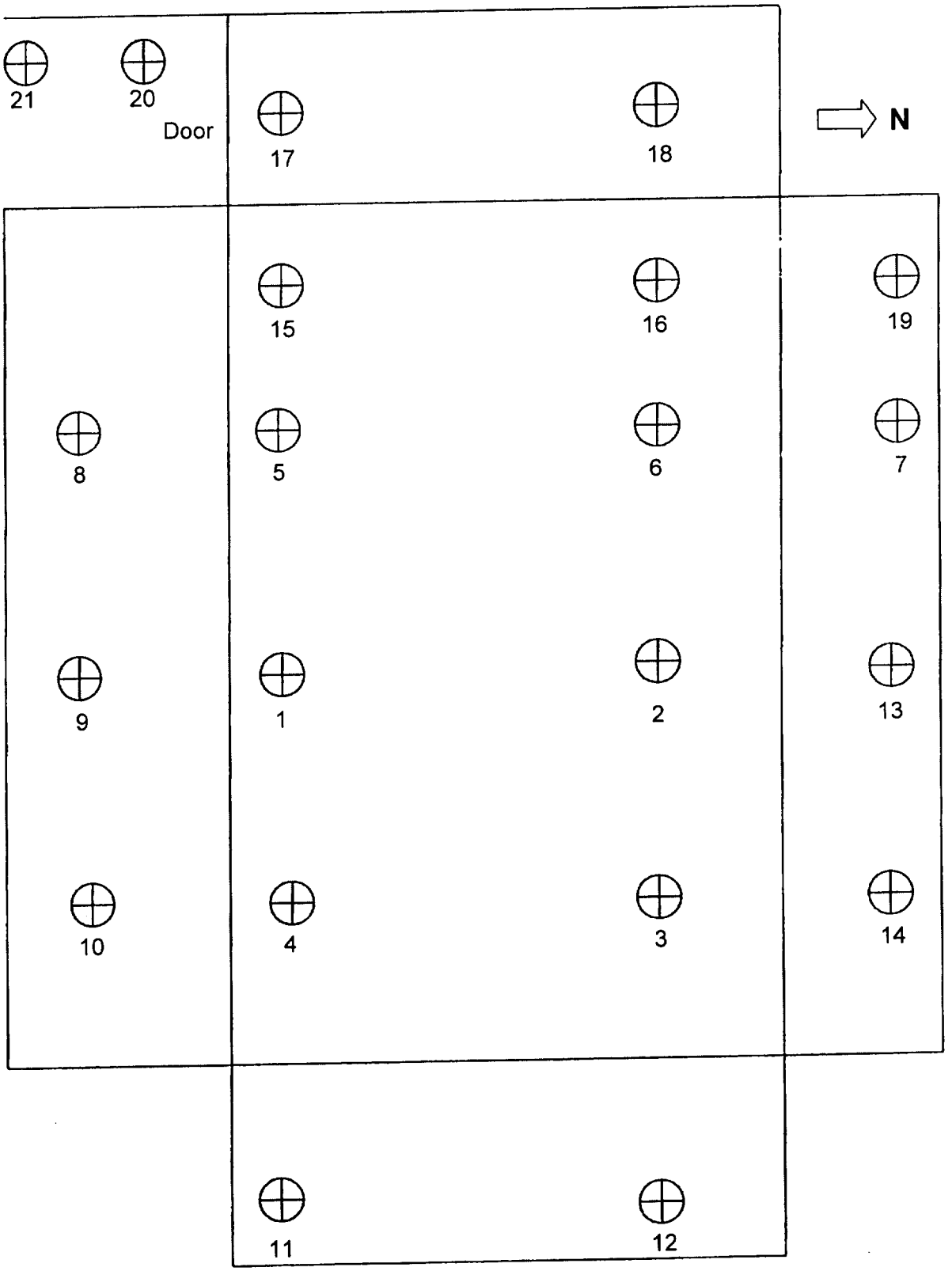


Table 4
Class 1 Area Static Measurements and Wipe Results

SHP380A - Alpha				Location	SHP360 – Beta/Gamma				Wipes	
Counts	Time (min)	Count Rate (cpm)	Net Count Rate (cpm)		Counts	Time (min)	Count Rate (cpm)	Net Count Rate (cpm)	Gross Alpha (pCi)	Gross Beta/Gamma (pCi)
Background 1.5 cpm				Floor	Background 47 cpm					
1	1	1	0	**1**	1,142	22	52	5	LT 0.3	LT 0.5
1	1	1	0	**2**	1,022	22	46	0	LT 0.3	LT 0.5
3	1	3	1.5	**3**	921	22	42	0	LT 0.3	LT 0.5
1	1	1	0	**4**	1,036	22	47	0	LT 0.3	LT 0.5
1	1	1	0	**5**	1,021	22	46	0	LT 0.3	0.5 ± 0.5
4	1	4	2.5	**6**	1,010	22	46	0	0.4 ± 0.3	0.9 ± 0.5
2	1	2	0.5	**15**	1,046	22	48	1	LT 0.2	LT 0.5
1	1	1	0	**16**	958	22	44	0	LT 0.2	LT 0.5
Background 2.5 cpm				North Wall	Background 38 cpm					
1	1	1	0	**7**	1,084	24	45	7	LT 0.3	LT 0.5
2	1	2	0	**13**	1,068	22	49	11	LT 0.2	LT 0.5
1	1	1	0	**14**	1,016	22	46	8	LT 0.2	LT 0.5
3	1	3	0.5	**19**	950	22	43	5	LT 0.2	LT 0.5
Background 1.3 cpm				South Wall	Background 78 cpm					
4	1	4	2.7	**8**	1,641	22	75	0	LT 0.3	LT 0.5
5	1	5	3.7	**9**	1,822	22	83	5	LT 0.3	LT 0.5
4	1	4	2.7	**10**	1,656	22	75	0	LT 0.3	LT 0.5
Background 1.5 cpm				East Wall	Background 47 cpm					
1	1	1	0	**11**	1,167	22	53	5	LT 0.2	LT 0.5
2	1	2	0.5	**12**	1,050	22	48	0	LT 0.2	LT 0.5
Background 2.5 cpm				West Wall	Background 38 cpm					
0	1	0	0	**17**	1,008	22	46	8	LT 0.2	LT 0.5
3	1	3	0.5	**18**	988	22	45	7	LT 0.2	LT 0.5
4	1	4	1.5	**20**	881	22	40	2	0.4 ± 0.3	1.3 ± 0.6
1	1	1	0	**21**	813	22	37	0	LT 0.2	LT 0.5

LT = Less Than

Figure 5
Class 2 Area – Ceiling and Walls Above 2 Meters
Static Measurements and Wipe Locations

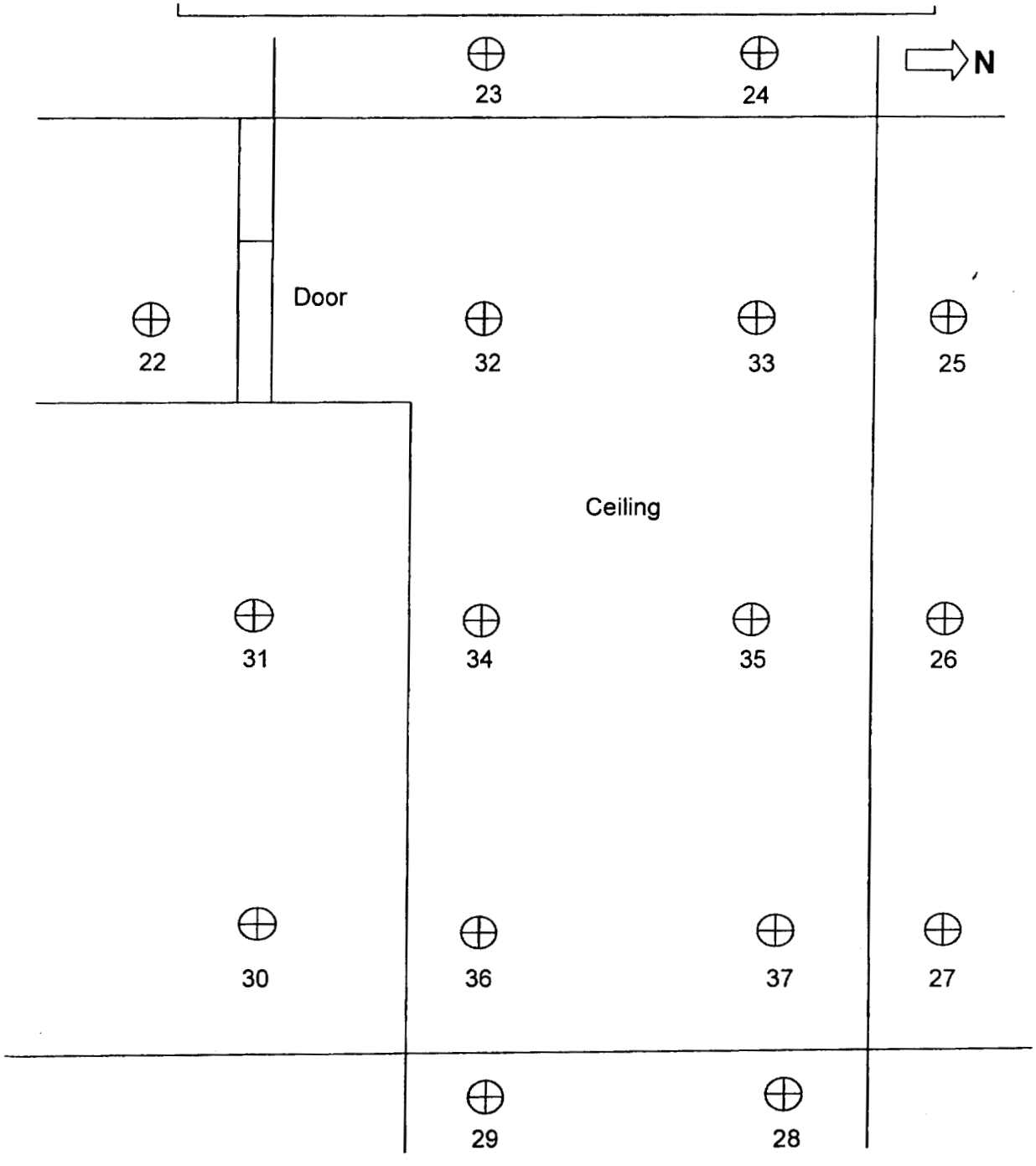


Table 5
Class 2 Area Static Measurements and Wipe Results

SHP380A - Alpha				Location	SHP360 – Beta/Gamma				Wipes	
Counts	Time (min)	Count Rate (cpm)	Net Count Rate (cpm)		Counts	Time (min)	Count Rate (cpm)	Net Count Rate (cpm)	Gross Alpha (pCi)	Gross Beta/Gamma (pCi)
Background 1.3 cpm				**South Wall**	Background 78 cpm					
3	1	3	1.7	**22**	893	22	41	0	LT 0.2	LT 0.5
3	1	3	1.7	**30**	1,210	22	55	0	LT 0.2	LT 0.5
5	1	5	3.7	**31**	1,820	22	83	5	LT 0.2	LT 0.5
Background 2.5 cpm				**West Wall**	Background 38 cpm					
2	1	2	0	**23**	1,002	22	46	8	LT 0.2	LT 0.5
3	1	3	0.5	**24**	940	22	43	5	LT 0.2	LT 0.5
Background 2.5 cpm				**North Wall**	Background 38 cpm					
1	1	1	0	**25**	973	22	44	6	LT 0.2	LT 0.5
4	1	4	1.5	**26**	1,034	22	47	9	LT 0.2	LT 0.5
3	1	3	0.5	**27**	1,065	24	44	6	LT 0.2	LT 0.5
Background 1.5 cpm				**East Wall**	Background 47 cpm					
3	1	3	1.5	**28**	1,110	22	50	3	LT 0.2	LT 0.5
3	1	3	1.5	**29**	1,065	22	48	1	LT 0.2	LT 0.5
Background 1.3 cpm				**Ceiling**	Background 57 cpm					
5	1	5	3.7	**32**	1,084	22	49	0	LT 0.2	LT 0.5
2	1	2	0.7	**33**	1,070	22	49	0	LT 0.2	LT 0.5
5	1	5	3.7	**34**	1,127	22	51	0	LT 0.2	LT 0.5
2	1	2	0.7	**35**	1,111	22	51	0	LT 0.2	LT 0.5
2	1	2	0.7	**36**	1,190	22	54	0	LT 0.2	LT 0.5
3	1	3	1.7	**37**	1,147	22	52	0	LT 0.2	LT 0.5

LT = Less Than

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