Performance of Final Status Survey:

1 PURPOSE:

This procedure specifies the process by which the Final Status Survey (FSS) will be performed, producing radiological survey data for the facility's structures and installed components, which can be incorporated into a report that will be used to support a request for termination of WPI's R-61 NRC reactor license. This procedure also specifies the process by which all extraneous items within the facility will be checked for radioactive content, to assure that radioactive material is not inadvertently released from, or left in the facility after license termination. The process will be carried out as three sub-activities:

- Part A- "Prepare Facility for FSS and Check for Extraneous Radioactive Materials"
- Part B- "Perform FSS Field Work"
- Part C- "Perform Data Reduction and Evaluation"

This procedure controls the methods by which this work will be performed, to provide reasonable assurance that the requirements of WPI's NRC license, as amended by their Final Status Survey Plan and Decommissioning Plan are adequately satisfied. This procedure also provides for the radiological, environmental and safety controls and precautions to be implemented by WPI for this process. The scope of this procedure corresponds to Tasks 12 and 13: "Demobilize and Prepare Reactor Rooms for Final Status Survey" and "Perform License Termination Activities" presented in WPI's Decommissioning Plan.

Part A of this procedure, "Prepare Facility for FSS," will include removal and clearance of encumbrances, such as ceiling tiles and furniture, placement of location grids on the facility's structural surfaces, and systematic checks to locate and find extraneous radioactive materials that might not otherwise be found by Part B of the FSS. Part B of this procedure, "Perform FSS Field Work," will include scanning of structures for radioactive surface contamination, making time-integrated direct surface contamination measurements and removable surface contamination determinations at a statistically significant number of systematically chosen locations throughout the facility; collection, screening and gamma spectral analysis of concrete and Aluminum core samples from regions within the biological shield likely to contain neutron-induced radioactivity; collection, screening and gamma spectral analysis of soil samples where underlying soil was exposed under the reactor core region; and determination of the presence of, and semi-quantification of residual radioactive contamination within conduits, pipes and ducts that were identified as having a potential for containing radioactive material. Part C of this procedure, "Perform Data Reduction and Evaluation," will include entry of the generated data onto pre-prepared EXCEL spreadsheets (Attached to this procedure),

which will convert the raw data into recognized units, generate additional inferential data, compare the data to the license termination criteria and, perform various statistical analyses to test the validity of the data and the conclusions made from that data.

2 APPLICABILITY

This is a one-time use procedure that will be used by WPI for performance of the Final Status Survey of the reactor facility. Upon completion of that work this procedure will expire.

3 REFERENCES

3.1 Final Status Survey Plan for the Leslie C. Wilbur Nuclear Reactor Facility at the Worcester Polytechnic Institute, rev. 0, January 2013 (Approved by USNRC June 17, 2013)

3.2 Decommissioning Plan for the Leslie C. Wilbur Nuclear Reactor Facility at the Worcester Polytechnic Institute, rev. 1, September 2009

3.3 Nuclear Regulatory Commission Operating License, No. R-61, Docket No. 50-134

3.4 10CFR20, “Standards for Protection Against Radiation”

3.5 Multi-Agency Radiation Survey and Site Investigation manual (MARSSIM), NUREG-1575, December 1977

3.6 GWP- 1 “Clearance of Extraneous Items,” rev. 0, 9/7/2011

3.7 WPI Decommissioning Radiation Protection Plan and Procedures, October 2011

3.8 WPI RHSC procedures: http://www.wpi.edu/offices/safety/rhscregs.html

3.9 WPI Health Physics procedure web page: http://www.wpi.edu/offices/safety/procedures.html

4 DEFINITIONS AND ABBREVIATIONS

ALARA: As Low As Reasonably Achievable

ARSO: Assistant Radiation Safety Officer

CFR: Code of Federal Regulations

DAP: Decommissioning Administrative Procedure

DP: Decommissioning Plan

DPH: Department of Public Health

DWP: Decommissioning Work Procedure

FSS: Final Status Survey

GFCI: Ground Fault Circuit Interrupter

HP: Health Physicist or Health Physics

HPT: Health Physics Technician

LT: License Termination

MARSSIM: Multi-Agency Radiation Survey and Site Investigation Manual

NA: Not Applicable

NRC: United States Nuclear Regulatory Commission

PPE: Personal Protective Equipment

RCA: Radiologically Controlled Area

RHSC: Radiation Health and Safety Committee

RSO: Radiation Safety Officer

RPP: Radiation Protection Procedure (Decommissioning)

RWP: Radiation Work Permit

Senior Decommissioning Personnel: Project personnel designated by the Decommissioning Plan (section 2.4.3) as having the qualifications and authority to make management decisions regarding conduct of the FSS work.

SME: Subject Matter Expert

SRD: Self Reading Dosimeter

SRO: Senior Reactor Operator

SU: Survey Unit

TLD: Thermo Luminescent Dosimeter

TLG: TLG Services, WPI's Decommissioning and Radiological Services contractor

Unrestricted Area: any location that is not controlled for the purpose of limiting radiation exposure

WPI: Worcester Polytechnic Institute.

5 GENERAL

5.1 EQUIPMENT

The following equipment, materials and supplies will be needed to perform this procedure. SMEs overseeing the implementation of this procedure may determine that substitutions can be made in the quantity or specific make or model of the items listed, as long as they meet the requirements of the NRC- approved FSS Plan (Ref. 3.1).

5.1.1 PPE

- Hard hats
- Latex laboratory gloves
- Work gloves
- Tyvek Lab coats
- Safety shoes
- Safety glasses
- Face shields
- Ear plugs or muffs

5.1.2 Nuisance Dust Control Materials and Equipment

- Maslin wipes
- Absorbent disposable towels
- Herculite and plastic sheeting and duct tape
- Plastic trash bags (various sizes)
- Plastic cups, bottles or catch basin (to fashion collectors for cutting chips resulting from drilling - determine size in the field)
- Wet-dry vacuum cleaner

5.1.3 Radiation Measuring Equipment and Sampling Supplies

- Radiation detection and measurement equipment:

Detector*		**Meter***
Type	**Make / Model**	**Make / Model**
Beta Scintillation (100 cm^2)	Bicron: DP-6A	Bicron: Labtech
Geiger-Mueller (15.5 cm^2)	Ludlum: 44-9	Ludlum: 12 or 177
Geiger-Mueller	Ludlum: 44-40	Ludlum: 2200
NaI (2” x 2”)	Ludlum: 44-10	Ludlum: 12
NaI (0.5” x 1”)	Ludlum: 44-62	Ludlum: 2000
NaI (2” x 2”)	Alpha Spectra: 818/2	Ludlum 732-1 PC-Based Gamma Ray Spectroscopy System

**Alternate instruments of equivalent capability may be substituted as necessary with Senior Decommissioning Personnel / SME approval.*

- Swipes, swabs
- Sample bags and jars
- Plastic sheeting / sleeves

5.1.4 Physical Barriers and Warning Devices

- Barricades / stanchions
- Caution tape

5.1.5 Tools and Equipment

- Portable Gantry Crane, w/ trollies, chain hoist, slings, chains (i.e., existing rigging equipment used during D&D phase)
- Rolling scaffold, adjustable height (with an approximate 12-foot working height)
- Step ladder, 8’ to 12’
- Concrete coring rig, with 2” to 3” core bits
- Misc. hand tools (existing TLG / WPI D&D tool crib)
- Hand trowel (for soil sampling)
- GFCI or GFCI outlet
- Electric drill, ½” min. chuck, with 2” to 3” hole saw bit (suitable for Aluminum)

- Carpenters level (~ 4')
- Laser projection level with stand
- Rulers and tape measures (with metric markings)
- Chalk snap line
- Fish tape
- String and or small diameter nylon rope (for pulling items through pipes and conduits)
- Flexible push rods (such as chimney brush rods)

5.1.6 Miscellaneous

- Pens, pencils and notebooks
- Various sized indelible markers (e.g., "Sharpies")
- Digital camera
- Duct tape
- Brightly colored stick-on labels

5.2 SAFETY CONSIDERATIONS

5.2.1 Radiation Hazards

This procedure will entail removal and handling (sampling and counting) of aluminum and concrete materials that may have been slightly neutron irradiated (activated) due to their close proximity reactor core region. Based upon limited preliminary sampling and laboratory analysis of structural materials believed to be at worst-case locations, it is believed that these material will have radionuclide concentrations below those required for license termination, producing minimal radiological hazards. However, as the facility has not yet been verified as meeting the LT criteria, principles of ALARA shall be followed to mitigate inadvertent ingestion, inhalation or spread of radioactive contamination. As such, any destructive sampling methods (e.g., drilling, coring, sawing or jackhammering) shall only be permitted when controls are in place to capture and collect dispersible debris, and suppress generation of airborne dusts.

5.2.2 Electrical Hazards

This procedure will entail use of electrically powered tools, at times within an electrically conductive structure / wet environment.

DANGER:
Only electric power sources equipped ground fault circuit interrupters shall be utilized for this procedure, when working in an electrically conductive structure or wet environment!

5.2.3 Falling / Shifting Objects

This procedure may entail use of sampling equipment (such as concrete coring rigs) that if unsupported during use could fall and strike personnel.

WARNING:
As appropriate, large, heavy sampling equipment (such as the concrete coring rig) shall be supported (rigged, cribbed or anchored in place) prior to use to prevent falling during use.

5.2.4 Overhead Load Hazards

This procedure may entail lifting items with an overhead gantry crane to emplace, secure in place or remove them from the reactor pool.

DANGER:
Do not allow any part of your body to be positioned under a suspended load! Personnel shall be cleared from the reactor pool when items are being hoisted!

5.2.5 Fall Hazards

This procedure will require personnel to enter the reactor pool and work on the reactor bridge or near the edge of the reactor pool. The reactor pool is drained and 15 feet deep.

DANGER:
Do not work on the reactor bridge without the railings or deck plates in place!

DANGER:
Do not stand upon the reactor pool edge unless appropriate personnel fall protection is utilized!

DANGER:
Do not enter the reactor pool from the top using a ladder! Routine personnel access into the pool shall only be through the basement level thermal column opening.

5.2.6 Manual Lifting Hazards

This procedure will entail use and moving of potentially heavy tools and equipment (e.g., ladders, scaffolding, sampling equipment).

WARNING:
Do not attempt to manually lift or carry more than 40 pounds per person! Use mechanical lifting and carrying devices.

5.2.7 Emergency Egress

Personnel access (normal and emergency) to the work area inside the reactor pool shall be through the Thermal Column opening. Care shall be taken not to block the thermal column opening.

WARNING:
Do not allow equipment or materials to block the thermal column opening while personnel are in the reactor pool!

5.2.8 Sharp Metallic Edge Hazards

Dismantling activities may have caused certain structures or remaining equipment to have sharp or ragged edges that could cause injuries if contacted by personnel.

WARNING:
When working near sharp or ragged metal edges, cover them with a protective material such as duct tape, or render them dull by filing or de-burring!

5.2.9 Trip / Slip Hazards

This procedure may generate debris and will entail use of equipment and tools, which could cause the work area to become cluttered with items that could pose trip / slip hazards.

WARNING:
Do not allow the work area to become cluttered, maintain good housekeeping in the work area!

5.3 RESPONSIBILITIES

RSO / ARSO: Shall have ultimate authority over radiological protection matters.

Senior Decommissioning Personnel: Will oversee and direct implementation of this procedure.

Decommissioning Health Physics Personnel: Will implement this procedure.

5.4 PREREQUISITES

5.4.1 Personnel performing radiological measurement / sampling and data analysis duties shall have documented education, training and/or experience providing similar services.

5.4.2 All personnel implementing this procedure shall read this procedure and become familiar with the steps and requirements of this procedure before implementation.

5.5 RECORDS

The Field Data Forms, Attachments C, D and E, and the spread sheets, Attachments F, G, H and I shall be used to document the data generated by this procedure.

5.6 PRECAUTIONS AND LIMITATIONS

Provided in section 5.2 of this procedure.

5.7 REVISIONS

None, this procedure is for a one-time evolution, and will expire upon completion of reactor facility equipment dispositon.

5.8 OTHER

NA

5.9 ATTACHMENTS

Attachment A: FSS Survey Work Scope Activities

Attachment B: FSS Survey Triangular Grid Spacing Parameters

Attachment C: FSS Surface Contamination Field Data Sheet

Attachment D: FSS Embedded Pipe, Conduit and Duct Field Data Sheet

Attachment E: FSS Volumetric Contamination Field Data Sheet

Attachment F: Measurement Point Locating Spread Sheet (Embedded Excel File)

Attachment G: Surface Contamination Evaluation Spread Sheet (Embedded Excel File)

Attachment H: Volumetric Sample Gamma Screening Normalization Spread Sheet (Embedded Excel File)

Attachment I: Volumetric Concentration Evaluation Spread Sheet (Embedded Excel File)

6 PROCEDURE

6.1 Perform Part A- "Prepare Facility for FSS and Check for Extraneous Radioactive Materials" as follows:

Note: Part A of this procedure prepares the facility for performance of the FSS measurements and sampling (Part B); Part A activities may be performed in whole or in a piece-meal fashion on a Survey Unit-by-Survey Unit basis, at the discretion of the personnel performing the FSS work.

REMOVAL AND CLEARANCE OF ENCUMBRANCES

6.1.1 Assess the remaining furniture, supplies, tools and equipment (non-reactor) within the Reactor Facility to determine which are likely to block access to structures, systems and components that are subject to the FSS.

6.1.2 Perform clearance surveys on those items deemed likely to block access and remove them from the facility, in accordance with GWP- 1 "Clearance of Extraneous Items."

CHECK FOR EXTRANEOUS RADIOACTIVE MATERIALS WITHIN THE FACILITY

6.1.3 All items in the facility, not specifically addressed by Part B of this procedure (e.g., furniture, supplies, tools, documents and equipment) shall be checked to assure that radioactive material, if any, is found and appropriately dispositioned, and not inadvertently left in an uncontrolled state after license termination.

6.1.4 Items used to store other items, such as file cabinets, boxes and drums shall be opened, and internal surfaces and contents also checked for radioactivity.

6.1.5 Check for radioactivity by scanning items for beta - gamma emitting surface contamination in a manner similar to that described in steps 6.2.4 and 6.2.5. If an elevated count rate is found, perform smear sampling and gamma exposure rate measurements to evaluate potential radiological hazards; tag the item as radioactive material, and place it in a secure storage area. If necessary, wrap the item with plastic sheeting to control any potential dispersion of loose contamination.

6.1.6 Items found to be radioactive shall be deemed as radioactive waste and disposed of as accordingly, retained by WPI subject to the requirements of their

Massachusetts DPH radioactive materials license, or transferred to another radioactive material licensee.

PLACEMENT OF REFERENCE LOCATION GRIDS ON THE FACILITY'S STRUCTURAL SURFACES

6.1.7 For each Survey Unit listed in Attachment A (except the for Reference Areas, pipes and equipment, and optionally for SU's less than $20m^{2)}$, establish reference grid location markers as follows:

6.1.7.1 Observe the SU and select a grid Origin based upon a readily identifiable physical feature within the SU, such as a wall-wall-floor corner or other immovable feature. Note that location on the SU map.

6.1.7.2 Establish X and Y axis on the SU surfaces using chalk snap-lines, laser projection levels, or similar devices, and mark them using indelible markers.

6.1.7.3 Starting at the origin, establish, mark and label one meter increments on the X-Y axis using Cartesian coordinates.

6.1.7.4 Locate and mark the accessible / available one meter-by-one meter intersection points on the SU surfaces..

6.1.7.5 Make a scale map of the SU's structural and/or equipment features. Show any unique features such as doorways, pipe penetrations, etc.

6.1.7.6 Add the X-Y grid coordinate system to the map so that it coincides with the grid coordinates of the actual SU.

6.1.7.7 Label the Map using the SU's number and title indicated on Attachment A (e.g., 2.2 North and West Lower Walls, West of Biological Shield Centerline).

LOCATE DIRECT AND REMOVABLE SURFACE CONTAMINATION MEASUREMENT POINTS

6.1.8 Identify the SU's requiring direct and removable surface contamination measurement location points indicated on Attachment A: "FSS Survey Work Scope Activities."

6.1.9 Measurement points may be determined manually using the following steps, or may be determined in a similar manner using a pre-prepared excel spread sheet (Attachment F).

6.1.10 For each applicable SU, determine a random starting point as follows:

a) Determine the lengths (in meters) of the SU's X and Y axis.
b) Generate two random numbers between 0 and 99999 using:

http--stattrek.com-statistics-random-number-generator.aspx.url

c) Multiply those numbers by 0.00001
d) Multiply the lengths of the X and Y axis by the results of step (c) above, using the first number for the X-axis and the second number for the Y-axis. The resulting two numbers are the X and Y coordinates for the Random Starting Point for the SU.

6.1.11 Locate and mark the Random Starting Point on the SU's map.

6.1.12 Draw a horizontal line across the SU map.

6.1.13 Refer to Attachment B- "FSS Survey Triangular Grid Spacing Parameters" and note the indicated "Horizontal Spacing" length (in meters) for the SU, and repeatedly extending that length from the Random Starting Point, locate and mark points (that fall on the SU's surface) along the horizontal line established in step 6.1.7.

6.1.14 Refer to Attachment B and note the indicated "Vertical Spacing" length (in meters) for the SU, and draw additional horizontal lines on the SU map that distance above and below the initial horizontal line established in step 6.1.7.

6.1.15 Locate measurement points on the lines (that fall on the SU's surfaces), horizontally half way between the measurement points established on the initial horizontal line (i.e., these measurement points should have the same horizontal spacing distance indicated on Attachment B, but off-set evenly halfway between the measurement points located above and below).

6.1.16 Repeat the process by drawing additional horizontal lines and measurement points so that the SU's surface is covered with the maximum points.

6.1.17 Label each of these measurement point locations with a sequential ID number. If done correctly, there should be at least 17 measurement points on the SU map.

6.1.18 Mark the actual SU surfaces with at the locations corresponding to the indicated measurement point locations, using a bright orange-colored sticky label. Label each with the sequential ID number indicated on the SU map.

6.1.19 Photograph the actual SU surface to document the reference grid and measurement point locations.

6.2 Perform Part B- "Perform FSS Field Work" as follows:

(Refer to Attachment A: "FSS Survey Work Scope Activities" to determine the FSS activities to be performed for each Survey Unit or Reference Area; perform the following measurement / sampling activities as appropriate:

STRUCTURAL SURFACE CONTAMINATION SCANS

Note: The contamination scans described in this section are intended for readily accessible surfaces such as floors, walls, ceilings, large items of equipment and interior surfaces of large diameter pipes and duct work.

6.2.1 Unless otherwise indicated on Attachment A, structural surface scans are to be performed for gross beta activity. For the gross beta scans, use the Bicron Labtech meter and DP-6A 100 cm^2 detector unless precluded from doing so due to size or geometric constraints of the SU. If necessary, use the Ludlum 12 or 177 rate meter and smaller 44-10 15.5 cm^2 GM detector where SU size or geometric constrains exist.

6.2.2 Determine from Attachment A the required scan coverage (i.e., Class 1 Areas 100%, Class 2 Areas 25% or Class 3 Areas 10% for structural surfaces, or as otherwise indicated). Class 1 and 2 areas are to be scanned on a systematic basis (i.e., scanned coverage is systematic and evenly distributed over the SU's surfaces); and Class 3 SU surfaces are to be scanned on a judgmental basis with a bias towards covering surfaces more likely to have contamination based on process knowledge.

6.2.3 Consult Reference 3.5, appendix A Figure A.3 and use the recommended scanning patterns as appropriate. Scan the SUs on a "Grid Box-by-Grid Box" basis (a grid box being defined as rectangular areas corner bounded by the SU's reference grid marks.)

6.2.4 Hold the detectors no more than 2 cm from the surface of interest, while passing the detector over the surface at a rate not to exceed 8 cm/sec for the 100 cm^2 detector and 4 cm2/sec for the 15.5 cm^2 detector. To aid in tracking what has been

scanned, use a bright pink sticky label to mark the grid boxes that have been scanned: label these with the scan date and initials of the surveyor.

6.2.5 While passing the detector over the surface of interest, have the audio count rate indicator turned on and listen for indications of increased count rate, while also noting the count rate indications on the display meter. Where there are indications of increased count rate (i.e., the count rate stands out as being greater than from the surrounding areas), stop and scan the area to find and bound the location having the maximum count rate. Mark the SU's surface to indicate the boundary of the area of elevated count rate.

6.2.6 If areas of elevated count rate are found, document these findings on Attachment C: "FSS Surface Contamination Field Data". Note the location of the center of the elevated area, the estimated size of the affected area and the maximum count rate found. Iindicate the location on the SU map, and take a photograph of the area in question. (Note: any identified areas of elevated count rate may be subject to further evaluation during the direct / removable surface contamination measurement or volumetric sampling process, as directed by Senior Decommissioning Personnel).

PIPE, CONDUIT AND DUCT CONTAMINATION SURVEYS

Note: The pipe, conduit and duct surveys described in this section are intended for long, small-diameter pipes and conduits embedded in concrete (or other structural media), that cannot be evaluated by conventional methods.

Contamination Survey of Pipe, Conduit and Duct Ends:

6.2.7 Perform surface contamination scans (as directed by steps 6.2.1 through 6.2.5) on any accessible portion of the open pipe ends. (Note: this may not be possible for small-diameter pipe stubs, but may be possible for certain larger features such as drain basins.)

6.2.8 Perform direct and removable surface contamination measurements / sampling (using guidance from the "Direct and Removable Surface Contamination Measurement" section of this procedure – starting at step 6.2.24) on any accessible portion of the open pipe ends.

Note: this may not be possible for small-diameter pipe stubs, but may be possible for certain larger features such as drain basins.)

6.2.9 Record results on Attachment D: FSS "Embedded Pipe, Conduit and Duct Field Data Sheet".

Interior Pipe, Conduit and Duct Swab Samples:

6.2.10 Where pipes, conduits or ducts (lines) have two open ends, install a "pull line" from end-to-end using fish tape or by vacuum pull. (The pull-line should be a string or rope that has sufficient strength to not break while pulling an object through the line.)

6.2.11 Attach suitable swab material to the pull line. (Use a cloth-like material large enough to span the cross-section of the line, but not so bulky as to get stuck in the line, and strong enough not to break apart while being pulled through the line).

6.2.12 Attach a retrieval pull line to the back end of the swab (such that the swab can be moved back and forth through the line, and a pull line will still be available in the line for additional use after the swab has been completely pulled through the line.)

6.2.13 Pull the swab completely through the line and retrieve it at the other end of the line. If a line is dead-ended, or a pull line cannot be installed due to blockage or constriction, swab the line to the extent possible using a flexible push rod. If the line is not dead-ended, but blocked or constricted, independently swab the other end(s) of the line to obtain additional samples. Maintain a pull line in the line for future use.

6.2.14 Screen the resulting swabs for gross beta contamination using the either the Bicron Labtech survey meter and record the findings on Attachment D: "FSS Embedded Pipe, Conduit and Duct Field Data Sheet."

6.2.15 Place the swab in a sample bag, and label it with the SU ID number, swabbed line interval, name of sampler and date. Retain the sample for further evaluations, if necessary.

6.2.16 If readily detectable radioactive contamination was detected in step 6.2.13, perform a gamma isotopic screening by counting the sample using the Ludlum 732-1 PC-Based Gamma Ray Spectroscopy System. Save the resulting spectrum and record the results for the photo peaks as indicated on Attachment D: "FSS Embedded Pipe, Conduit and Duct Field Data Sheet."

Internal Pipe, Conduit and Duct Gamma Logging:

6.2.17 Assemble the small-diameter NaI detector and counter and securely attach the pull line coming out of the pipe, conduit or duct to the detector. Similarly attach a retrieval line and sleeve / wrap the detector with plastic. (Alternatively, if the pipe, conduit or duct is dead-ended, branched or otherwise obstructed, flexible

push rods may be attached to the detector and used to advance and retrieve the detector.)

6.2.18 Prior to inserting the detector into the pipe, conduit or duct, make a one-minute background count and a one-minute check source count (~ 0.5 µCi Cs-137 button source). Record results on Attachment D: "FSS Embedded Pipe, Conduit and Duct Field Data Sheet."

6.2.19 Insert the detector 3 cm into the pipe, conduit or duct so that the active portion of the detector is just inside the pipe, conduit or duct and make a one-minute count. Record the result on Attachment D: "FSS Embedded Pipe, Conduit and Duct Field Data Sheet," as "3 cm" Distance from Start.

6.2.20 Hold the retrieval line or signal cable taught and measure 10 cm from the line opening and mark that distance on the retrieval line, cable or push rod.

6.2.21 Use the pull line (or push rod) to insert the detector into the pipe, conduit or duct until the 10 cm mark on the retrieval line, cable or push rod reaches the beginning of the pipe, conduit or duct.

6.2.22 Make a one minute count and record the result on Attachment D: "FSS Embedded Pipe, Conduit or Duct Field Data Sheet" as "13 cm" Distance from Start.

6.2.23 Repeat steps 6.2.20 through 6.2.22 until the pipe, conduit or duct has been counted. (Note: If the detector cannot be further advanced due to the pipe, conduit or duct constrictions or branching, repeat the logging process starting from other end(s) of the pipe, conduit or duct.)

DIRECT AND REMOVABLE SURFACE CONTAMINATION MEASUREMENTS

6.2.24 For each Survey Unit listed in Attachment A, where a number of direct and removable surface contamination measurements have been designated, make a one-minute timed direct beta contamination measurement at each of the measurement points that were marked during step 6.1.13. Make the measurement using the Bicron Labtech survey meter, with the detector on contact with the surface of interest centered over the paper dot that makes the location of interest. (Note: If for some reason a measurement needs to be made at a location not pre-designated with a paper dot, place a paper dot at that location when the measurement is made.)

6.2.25 For each measurement, record the location coordinates, the gross counts and the count time in the data section of the SU's field data sheet (Attachment C).

6.2.26 At each designated measurement location, take a smear sample over a 100 cm^2 area and place the smear in a sample envelop that has been labeled with the SU ID number and location coordinates / description.

6.2.27 When counting the smear samples for each SU, first make three, one-minute background counts. Record the gross beta counts and the count time on the field data sheet (Attachment C). Then count the each of SU's smear samples for one minute and record the gross beta counts and the count time on the field data sheet (Attachment C) for the appropriate location.

6.2.28 Record all other appropriate information listed on the data sheet.

6.2.29 Repeat the process for the Reference Areas listed on Attachment A, where a number of direct surface contamination background measurements have been designated**.** Note: The same survey meter must be used for reference area (RA) background measurements, as was (or will be) used for making SU measurements.

6.2.30 Reference Areas measurements are to be made on selected surfaces that are located outside of the reactor room, but within the Stoddard Laboratory – Washburn Shops Building (see section 6.8 of Reference 3.1 for additional guidance). RA measurement locations are not determined using a reference location grid or triangular grid as is performed for the SUs. Instead, try to evenly spread the RA measurements over the selected surface.

6.2.31 Record the RA measurement data on a separate field data sheet (Attachment C) for each RA, along with other appropriate information listed on the data sheet.

VOLUMETRIC RADIOACTIVITY SAMPLING AND ANALYSIS

6.2.32 Survey Units requiring volumetric sampling (SU's 1.1 – 1.4 and 1.6) are listed in Attachment A; where the sample type (concrete, aluminum and soil), quantity and sampling location criteria are specified. (Note: swab samples specified in Attachment A are not included in this section of the procedure.)

6.2.33 For each applicable SU requiring volumetric sampling, selection of the sampling locations shall be biased towards areas likely to have the highest concentrations of reactor-originated radionuclides. Sampling locations shall be selected based first upon highest scanning results, and second on theoretical maximum neutron flux locations if no discernible differences exist for the scanning results.

6.2.33.1 If not already done so, scan the SU's surface area for gross gamma radioactivity using the 2"x2" NaI detector and rate meter, held close to the surface, and note any locations having higher counts. Also, review results of any direct beta contamination scanning that may have been performed for the SU as a part of the FSS surface contamination evaluations. From both sets of data, determine if there are any patterns indicative of areas with highest apparent radioactivity. If there are, select the concrete, Aluminum and soil sampling locations to coincide with the highest scan results. (Note: If the SU has multiple surfaces, such as the four pool walls or the four Thermal Column surfaces, and multiple samples are specified in Attachment A, at least one sample location should be assigned to each of the surfaces.)

6.2.33.2 If no apparent indications of higher radioactivity are observed in the scanning results, select the concrete and Aluminum sampling locations based upon the SU surfaces having been exposed to the highest theoretical Neutron flux. Such locations shall be from each of the SU's surfaces that intersect closest to a projection from the center of the reactor core. However, the Soil SU's samples should not be based upon Neutron flux, but should be evenly distributed over the exposed soil area, with sample locations approximately centered within quadrants of the SU.

6.2.34 At concrete and Aluminum sampling locations, install means to collect and prevent migration of cutting debris. This may include installation of collection bags or basins to catch falling debris / fluids and use of wet / dry vacuum cleaners.

6.2.35 Collect samples as follows:

6.2.35.1 Soil - at each sampling location uses a clean garden trowel to remove approximately 1000 g of soil (about one pint) evenly over the desired depth interval. Place the soil into a clean basin and homogenize the sample by mixing it with the trowel. Place the homogenized sample into a sealable plastic bag labeled with the SU ID number, sample number (corresponding to the sequential sample number on the field data sheet), location description/grid coordinates and depth interval.

6.2.35.2 Aluminum (liner) - at each sampling location, use a clean 2-to-3 inch diameter hole saw and electric drill to obtain a sample disk. Place the sample into a sealable plastic bag labeled with the SU ID number, sample number (corresponding to the sequential sample number on the field data sheet, and location description / grid coordinates).

Note: Some liner material may be situated directly upon underlying concrete. If that is the case, it may interfere with the hole saws bit's pilot. To alleviate this, there are two options: first cut away and remove a portion of the liner using a circular saw and then hole saw it, or pre-drill a pilot hole and adjust the depth of the pilot bit to allow clearance for starting the hole saw kerf and then completing the sawing without a pilot bit.

Note: Portions of the reactor pool liner at the point of theoretical highest Neutron flux were previously removed at the end of the D&D process in anticipation of future sampling. That material is still in the reactor pool and may be used for obtaining samples, if its location coincides with a location of interest.

Note: Hole sawing Aluminum may require use of cutting oil. If used, make sure any cutting oil residue has been wiped from the sample.

6.2.35.3 Concrete - at each sampling location, install the coring rig with a clean 2-to-3 inch diameter core bit according to manufacturer's instruction. Install appropriate means for collecting the cutting slurry. Core to the desired depth (approximately 30 cm), and then snap-off the concrete core by applying lateral pressure with a small pry bar. Place the sample into a sealable plastic bag labeled with the SU ID number, sample number (corresponding to the sequential sample number on the field data sheet, depth interval, and location description / grid coordinates.

Note: A portion of selected soil samples may be split with the NRC after it has been homogenized. Splitting of concrete or Aluminum samples will require that duplicate samples be collected from adjacent sampling locations.

6.2.36 Enter appropriate sample (and associated) information onto a FSS Volumetric Contamination Field Data Sheet (Attachment E) for the SU.

6.2.37 Screen each sample using the Bicron Labtech survey meter and note the location highest beta count rate (if any) and record that result onto a FSS Volumetric Contamination Field Data Sheet (Attachment E) for the SU.

6.2.38 Perform a gamma isotopic screening by counting the sample using the Ludlum732-1 PC-Based Gamma Ray Spectroscopy System. Count each sample for a minimum of 1800 seconds. Save the resulting spectra and record the results for the photo peaks as indicated on Attachment E. Prepare the samples / detection system as follows:

Aluminum disks: Count each disk with the pool / thermal column side of the sample against the detector. (Note: all the samples from within a SU should be of the same geometry to allow direct comparison of the results.)

Soil: Remove any rocks and homogenize each sample and place the sample media into tarred plastic counting containers (approximately 5 cm high by 5 cm diameter) with an aliquot of the sample. Weigh each filled counting container. All the containers should have the same approximate weight (less than a 5% variation from the lightest to the heaviest) - if not, adjust the containers' contents, as appropriate. Count the containers such that they are all in contact with the detector, in a near identical geometry, to allow direct comparison of the results.

Concrete cores: Set up the detector with a collimated shield, such that the concrete cores can be counted along their sides, with 5 cm wide "field of view." Starting at the pool end of the core, count each core in a series of separate 5 cm increments. Count the cores' increments such that they are all in contact with the detector, in a near identical geometry, to allow direct comparison of the results.

6.3 Part C- "Perform Data Reduction and Evaluation"

6.3.1 Enter the reference area and SU data from the Attachment C: "FSS Surface Contamination Field Data Sheets" onto the Attachment G: "Surface Contamination Evaluation Spread Sheets" Use of these spread sheets are self-explanatory. The required comparisons and statistical evaluations against the license termination criteria will be automatically performed. If the spread sheet indicates that additional survey points are required for a particular SU, perform the additional measurements as previously directed and add that data to the appropriate spread sheets.

6.3.2 Enter the data from the Attachment E: "FSS Volumetric Contamination Field data Sheets" onto an Attachment G: "Volumetric Sample Gamma Screening Normalization Spread Sheet" in the "Gamma Screening Results" section, for each applicable SU. For each applicable SU, select the sample that has the highest apparent concentration of reactor originated radioactivity, based on the gamma isotopic screening results data, and have that sample analyzed by Gamma Spectral Analysis by GEL Laboratories (or similarly qualified vendor). Enter that sample's screening data and laboratory results onto the Attachment H spread sheet in the "Normalization" section. The spread sheet will now calculate radionuclide concentrations for each sample within that SU. Enter the Surrogate radionuclide concentration (specific to each type of material sampled) onto an Attachment I: "Volumetric Concentration Evaluation Spread Sheet." (Note: choose the appropriate spread sheet template for the material sampled, as each sampled material will have a different surrogate radionuclide.) The Attachment I: "Volumetric Concentration Evaluation Spread Sheet" will then calculate all the constituent radionuclide concentrations based upon pre-determined radionuclide ratios for that material, and will then compare the results to the license termination criteria.

6.3.3 Review the data from the Attachment D: "FSS Embedded Pipe, Conduit and Duct Field Data Sheets," and determine if the data is indicative of the presence of internal contamination. (Note: this determination will be made by the FSS SME and is likely to be somewhat subjective and non-quantitative in nature. The determination is to be based upon whether or not removable contamination is found, the radiological measurement results for any exposed surfaces, the gamma logging count rates compared to background reference area results and check source response, and whether or not unexpected patterns are observed from the gamma logging data.)

7 QUALITY REQUIREMENTS

7.1 All calculation and data entry operations shall be checked for errors by an individual that did not perform the initial work. Work sheets shall be signed and dated by the individual performing the independent checks.

7.2 FSS samples shall be kept in locked cabinets when not personally maintained by FSS personnel. Chain of custody forms shall be used if samples are transferred to a third party for analysis.

7.3 Five percent of the FSS surface contamination measurements shall be replicated by an individual that did not perform the initial measurements. These replicate measurements shall be performed on a random, spot-check basis, distributed

across the FSS work scope, as assigned by Senior Decommissioning Personnel. Initial and replicate results shall be compared, and must match within expected statistical variations. Should results not match, the discrepancy shall be investigated, and if necessary survey results deemed invalid and new measurements made.

7.4 Survey Instruments shall be calibrated and function checked per RPP- 13 "Calibration and Quality Control of Portable Radiological Survey Instruments." Radiological function checks shall be performed before and after use each shift. Instruments failing initial function tests shall not be used to generate FSS data. Data generated by an instrument failing post-use function checks shall not be considered valid, back to the last passing function checks.

Attachment A: FSS SURVEY WORKSCOPE ACTIVITIES

Building Area	Survey Units (SU)	SU Class	Approx. SU Size	Surface Contamination Scans (% Coverage)	Direct and Removable Surface Contam. Measurements (Number, ea.)	Volumetric Radioactivity Sampling (Number of locations /depth profile)
1.0 Bio. Shield / Reactor Pool	1.1 Reactor Pool Aluminum Liner (floor and walls)	1	47 m^2	100%	17	4 Al disc samples @ highest scan locations or highest potential N flux locations, one sample location from each of the four walls.
	1.2 Thermal Column Aluminum Liner	1	2 m^2	100%	na	4 Al disc samples @ highest scan locations or highest potential N flux locations, one sample location from each of the four surfaces.
	1.3 Interior Concrete Floor	1	5 m^2	100%	na	1 concrete core sample location / 0-15 cm and 15-30 cm increments (concrete floor is only ~30 cm thick), @ highest scan locations or highest potential N flux locations.
	1.4 Interior Concrete Walls	1	43 m^2	100%	na	4 core sample locations, one from each of the four pool walls / 0-15 cm depth (with additional 15 cm increments if activation radionuclides detected, until decreasing trend established), @ highest scan or highest potential N flux locations,.

Attachment A: FSS SURVEY WORKSCOPE ACTIVITIES (cont.)

Building Area	Survey Units (SU)	SU Class	Approx. SU Size	Surface Contamination Scans (% Coverage)	Direct and Removable Surface Contam. Measurements (Number, ea.)	Volumetric Radioactivity Sampling (Number of locations /depth profile)
1.0 Biological Shield / Reactor Pool (cont.)	1.5 Beam Port Tube (~ 6" dia. Metal tube embedded in the concrete biological shield)	1	1.2 m long	100% of accessible interior surfaces	4 to 17	na
	1.6 Soil Under Removed Concrete Floor Area	1	~1 m^2	100%	na	4 soil sample locations / initial 0-15 cm increment (with additional 15 cm increments if reactor radionuclides detected and until decreasing trend established), @ highest scan locations or evenly distributed if scanning does not reveal any differences.
	1.7 Top of Biological Shield (Operating floor and stub walls (sides and top) surrounding the reactor pool, lower South room wall above Bio-shield and Reactor bridge spanning the pool)	1	39 m^2	100%	17	na
	1.8 Embedded Piping (in biological shield)					
	1.8.1 Drain line from pool scupper drains (1"ID)	1	~10 m long	Gamma scan interior with small dia. NaI, as accessible	During gamma scan process, perform timed – 1 min. count every 30 cm	Pull swab and count for gross beta, if positive results obtained, perform gamma spec. analysis count
	1.8.2 Return line from pool water treatment system (1"ID)	1	~3.7 m long	Gamma scan interior with small dia. NaI, as accessible	During gamma scan process, perform timed – 1 min. count every 30 cm	Pull swab and count for gross beta, if positive results obtained, perform gamma spec. analysis count

Attachment A: FSS SURVEY WORKSCOPE ACTIVITIES (cont.)

Building Area	Survey Units (SU)	SU Class	Approx. SU Size	Surface Contamination Scans (% Coverage)	Direct and Removable Surface Contam. Measurements (Number, ea.)	Volumetric Radioactivity Sampling (Number of locations /depth profile)
1.0 Biological Shield / Reactor Pool (cont.)	1.8.3 Vent line from beam port tube (1"ID)	1	~1.8 m long	Gamma scan interior with small dia. NaI, as accessible	During gamma scan process, perform timed – 1 min. count every 30 cm	Pull swab and count for gross beta, if positive results obtained, perform gamma spec. analysis count
	1.8.4 Drain line from Beam port Shutter Housing (1"ID)	1	~1.5 m long	Gamma scan interior with small dia. NaI, as accessible	During gamma scan process, perform timed – 1 min. count every 30 cm	Pull swab and count for gross beta, if positive results obtained, perform gamma spec. analysis count
	1.8.5 Feed line from pool to pool water treatment system (2"ID)	1	~3 m long	Gamma scan interior with small dia. NaI, as accessible	During gamma scan process, perform timed – 1 min. count every 30 cm	Pull swab and count for gross beta, if positive results obtained, perform gamma spec. analysis count
	1.8.6 Vent line from thermal column (1"ID)	1	~1.2 m long	Gamma scan interior with small dia. NaI, as accessible	During gamma scan process, perform timed – 1 min. count every 30 cm	Pull swab and count for gross beta, if positive results obtained, perform gamma spec. analysis count
	1.8.7 Vent line from thermal column (1"ID)	1	~1.2 m long	Gamma scan interior with small dia. NaI, as accessible	During gamma scan process, perform timed – 1 min. count every 30 cm	Pull swab and count for gross beta, if positive results obtained, perform gamma spec. analysis count
	1.8.8 Vent line from thermal column (1"ID)	1	~1.2 m long	Gamma scan interior with small dia. NaI, as accessible	During gamma scan process, perform timed – 1 min. count every 30 cm	Pull swab and count for gross beta, if positive results obtained, perform gamma spec. analysis count

Attachment A: FSS SURVEY WORKSCOPE ACTIVITIES (cont.)

Building Area	Survey Units (SU)	SU Class	Approx. SU Size	Surface Contamination Scans (% Coverage)	Direct and Removable Surface Contam. Measurements (Number, ea.)	Volumetric Radioactivity Sampling (Number of locations /depth profile)
1.0 Biological Shield / Reactor Pool (cont.)	1.8.9 Vent line from thermal column (1"ID)	1	~1.2 m long	Gamma scan interior with small dia. NaI, as accessible	During gamma scan process, perform timed – 1 min. count every 30 cm	Pull swab and count for gross beta, if positive results obtained, perform gamma spec. analysis count
	1.8.10 Vent line from thermal column (2"ID)	1	~1.8 m long	Gamma scan interior with small dia. NaI, as accessible	During gamma scan process, perform timed – 1 min. count every 30 cm	Pull swab and count for gross beta, if positive results obtained, perform gamma spec. analysis count
	1.9 Exterior Walls of Biological Shield					
	1.9.1 North Wall	2	22 m^2	25%	17	na
	1.9.2 West Wall	1	18 m^2	100%	17	na
	1.9.3 Thermal Column Shield Door	1	5 m^2	100%	>= 4	na
	1.9.4 East Wall	1	19 m^2	100%	17	na
2.0 Ground Floor Reactor Facility	2.1 South Lower Wall and Floor, West of Biological Shield Centerline	1	65 m^2	100%	17	na
	2.2 North and West Lower Walls, West of Biological Shield Centerline	2	16 m^2	25%	17	na
	2.3 South Lower Wall and Floor ,East of Biological Shield Centerline	1	104 m^2	100%	17	na
	2.4 North and East Lower Walls, East of Biological Shield Centerline	2	21 m^2	25%	17	na

Attachment A: FSS SURVEY WORKSCOPE ACTIVITIES (cont.)

Building Area	Survey Units (SU)	SU Class	Approx. SU Size	Surface Contamination Scans (% Coverage)	Direct and Removable Surface Contam. Measurements (Number, ea.)	Volumetric Radioactivity Sampling (Number of locations /depth profile)
2.0 Ground Floor Reactor Facility (cont.)	2.5 Upper Walls, Ceiling, and Exterior of Suspended Equipment Surfaces, West of the Biological Shield centerline (excluding the areas separately covered by SU 1.9.1 and SU 2.6).	2	100 m^2	25%	17	na
2.0 Ground Floor Reactor Facility (cont.)	2.6 Upper Walls, Ceiling, and Exterior of Suspended Equipment Surfaces, East of the Biological Shield centerline (excluding areas separately covered by SU 1.93).	2	166 m^2	25%	17	na
	2.7 WPI RAM Storage Room, Lower Walls and Floor	1	29 m^2	100%	17	na
	2.8 WPI RAM Storage Room, Upper Walls, Ceiling, and exterior of suspended equipment surfaces	1	44 m^2	100%	17	na
3.0 First Floor Reactor Facility	3.1 Lower Walls and Floor of Reactor office	3	36 m^2	10%	17	na
	3.2 Upper walls and ceiling of Reactor Office	3	66 m^2	10%	17	na
	3.3 Lower Walls and Floor, West of Biological Shield Centerline (excludes lower portion of South wall above Bio-shield	2	67 m^2	25%	17	na
	3.4 Upper walls and ceiling, West of Biological shield centerline	2	135 m^2	25%	17	na

Attachment A: FSS SURVEY WORKSCOPE ACTIVITIES (cont.)

Building Area	Survey Units (SU)	SU Class	Approx. SU Size	Surface Contamination Scans (% Coverage)	Direct and Removable Surface Contam. Measurements (Number, ea.)	Volumetric Radioactivity Sampling (Number of locations /depth profile)
	3.5 Lower Walls and Floor, East of Biological Shield Centerline (excludes lower portion of South wall above Bio-shield	1	105 m^2	100%	17	na
	3.6 Upper walls and ceiling, East of Biological shield centerline	2	188 m^2	25%	17	na
3.0 First Floor Reactor Facility (cont.)	3.7 Reactor Tool closet lower walls and floors	1	27 m^2	100%	17	none
	3.8 Reactor Tool Closet, upper walls and ceiling	1	18 m^2	100%	17	none
4.0 Other Areas /Items	4.1 Exhaust ventilation duct interior surfaces (exterior to the reactor room)	1	Not Applicable	100% of accessible surfaces	17	none
	4.2 Floor drain and sanitary sewer line	1	Not Applicable	100% of accessible interior surfaces	Gamma log interior with small dia. NaI, every 30 cm, as accessible	Pull swab and check for gross beta, if positive results obtained, perform gamma spec. analysis count
	4.3 HVAC units – 3 units (room re-circ. Only)	1	Not Applicable	100% of accessible interior and exterior surfaces	17	none

Attachment A: FSS SURVEY WORKSCOPE ACTIVITIES (cont.)

Building Area	Survey Units (SU)	SU Class	Approx. SU Size	Surface Contamination Scans (% Coverage)	Direct and Removable Surface Contam. Measurements (Number, ea.)	Volumetric Radioactivity Sampling (Number of locations /depth profile)
5.0 Back-ground Reference Areas	5.1 Painted Sheet Rock	na	Not Applicable	none	17 (Direct meas. only)	none
	5.2 Painted Cement Block	na	Not Applicable	none	17 (Direct meas. only)	none
	5.3 Linoleum / Vinyl Tile Covered Concrete	na	Not Applicable	none	17 (Direct meas. only)	none
	5.4 Cast / Poured Concrete	na	Not Applicable	none	17 (Direct meas. only)	none
	5.5 Structural Wood	na	Not Applicable	none	17 (Direct meas. only)	none
	5.6 Structural Steel	na	Not Applicable	none	17 (Direct meas. only)	none
	5.7 Aluminum and / or steel pipe embedded in concrete (if available)	na	Not Applicable	none	Gamma log interior with small dia. NaI, every 30 cm, as accessible, up to 17 measurements	none

Attachment B: FSS SURVEY TRIANGULAR GRID SPACING PARAMETERS

Building Area	Survey Units (SU)	Approx. SU Size	Triangular Grid Spacing Parameters		
			Calculated "L" (meters)	Horizontal Spacing (meters)	Vertical Spacing (meters)
1.0 Bio. Shield / Reactor Pool	1.1 Reactor Pool Aluminum Liner (floor and walls)	47 m^2	1.78	1	0.9
	1.2 Thermal Column Aluminum Liner	2 m^2	na	na	na
	1.3 Interior Concrete Floor	5 m^2	na	na	na
	1.4 Interior Concrete Walls	43 m^2	1.71	1	0.9
	1.5 Beam Port Tube (~ 6" dia. Metal tube embedded in the concrete biological shield)	1.2 m long	na	na	na
	1.6 Soil Under Removed Concrete Floor Area	~1 m^2	na	na	na
	1.7 Top of Biological Shield (Operating floor and stub walls (sides and top) surrounding the reactor pool, lower South room wall above Bio-shield and Reactor bridge spanning the pool)	39 m^2	1.62	1	0.9
	1.8 Embedded Piping (in biological shield)				
	1.8.1 Drain line from pool scupper drains (1"ID)	~10 m long	na	na	na
	1.8.2 Return line from pool water treatment system (1"ID)	~3.7 m long	na	na	na
	1.8.3 Vent line from beam port tube (1"ID)	~1.8 m long	na	na	na
	1.8.4 Drain line from Beam port Shutter Housing (1"ID)	~1.5 m long	na	na	na
	1.8.5 Feed line from pool to pool water treatment system (2"ID)	~3 m long	na	na	na
	1.8.6 Vent line from thermal column (1"ID)	~1.2 m long	na	na	na
	1.8.7 Vent line from thermal column (1"ID)	~1.2 m long	na	na	na
	1.8.8 Vent line from thermal column (1"ID)	~1.2 m long	na	na	na

Attachment B: FSS SURVEY TRIANGULAR GRID SPACING PARAMETERS

Building Area	Survey Units (SU)	Approx. SU Size	Triangular Grid Spacing Parameters		
			Calculated "L" (meters)	Horizontal Spacing (meters)	Vertical Spacing (meters)
1.0 Biological Shield / Reactor Pool (cont.)	1.8.9 Vent line from thermal column (1"ID)	~1.2 m long	na	na	na
	1.8.10 Vent line from thermal column (2"ID)	~1.8 m long	na	na	na
	1.9 Exterior Walls of Biological Shield				
	1.9.1 North Wall	22 m^2	1.22	1	0.9
	1.9.2 West Wall	18 m^2	1.11	1	0.9
	1.9.3 Thermal Column Shield Door	5 m^2	na	na	na
	1.9.4 East Wall	19 m^2	1.15	1	0.9
2.0 Ground Floor Reactor Facility	2.1 South Lower Wall and Floor, West of Biological Shield Centerline	65 m^2	2.10	2	1.7
	2.2 North and West Lower Walls, West of Biological Shield Centerline	16 m^2	1.04	1	0.9
	2.3 South Lower Wall and Floor ,East of Biological Shield Centerline	104 m^2	2.66	2	1.7
	2.4 North and East Lower Walls, East of Biological Shield Centerline	21 m^2	1.20	1	0.9
	2.5 Upper Walls, Ceiling, and Exterior of Suspended Equipment Surfaces, West of the Biological Shield centerline (excluding the areas separately covered by SU 1.9.1 and SU 2.6).	100 m^2	2.60	2	1.7
	2.6 Upper Walls, Ceiling, and Exterior of Suspended Equipment Surfaces, East of the Biological Shield centerline (excluding areas separately covered by SU 1.93).	166 m^2	3.36	3	2.6
	2.7 WPI RAM Storage Room, Lower Walls and Floor	29 m^2	1.40	1	0.9
	2.8 WPI RAM Storage Room, Upper Walls, Ceiling, and exterior of suspended equipment surfaces	44 m^2	1.72	1	0.9

Attachment B: FSS SURVEY TRIANGULAR GRID SPACING PARAMETERS (cont.)

Building Area	Survey Units (SU)	Approx. SU Size	Triangular Grid Spacing Parameters		
			Calculated "L" (meters)	Horizontal Spacing (meters)	Vertical Spacing (meters)
3.0 First Floor Reactor Facility	3.1 Lower Walls and Floor of Reactor office	36 m^2	1.56	1	0.9
	3.2 Upper walls and ceiling of Reactor Office	66 m^2	2.12	2	1.7
	3.3 Lower Walls and Floor, West of Biological Shield Centerline (excludes lower portion of South wall above Bio-shield	67 m^2	2.13	2	1.7
	3.4 Upper walls and ceiling, West of Biological shield centerline	135 m^2	3.03	3	2.6
	3.5 Lower Walls and Floor, East of Biological Shield Centerline (excludes lower portion of South wall above Bio-shield	105 m^2	2.68	2	1.7
	3.6 Upper walls and ceiling, East of Biological shield centerline	188 m^2	3.58	3	2.6
	3.7 Reactor Tool closet lower walls and floors	27 m^2	1.36	1	0.9
	3.8 Reactor Tool Closet, upper walls and ceiling	18 m^2	1.10	1	0.9
4.0 Other Areas /Items	4.1 Exhaust ventilation duct interior surfaces (exterior to the reactor room)	Not Applicable	na	na	na
	4.2 Floor drain and sanitary sewer line	Not Applicable	na	na	na
	4.3 HVAC units – 3 units (room re-circ. Only)	Not Applicable	na	na	na
5.0 Back-ground Reference Areas	5.1 Painted Sheet Rock	Not Applicable	na	na	na
	5.2 Painted Cement Block	Not Applicable	na	na	na
	5.3 Linoleum / Vinyl Tile Covered Concrete	Not Applicable	na	na	na
	5.4 Cast / Poured Concrete	Not Applicable	na	na	na
	5.5 Structural Wood	Not Applicable	na	na	na
	5.6 Structural Steel	Not Applicable	na	na	na

Attachment C: FSS Surface Contamination Field Data Sheet

Survey Unit:	**No.:**	**Area (m²):**	**MARSSIM Class:**
	SU Description:		
Reference Area:	**Material Description:**	**Location:**	
Date of Survey:			
Surveyors:			
Survey Meter:	**Model:**	**S/N:**	
	% Beta Eff.:	**Radionuclide:**	
	Cal. Due Date:		
Smear Counter:	**Model:**	**S/N:**	
	% Beta Eff.:	**Radionuclide:**	
	Cal. Due Date:		

DATA

Sample Number	Location Coord. or Description	Direct Gross Beta Count	Count Time (Min.)	Smear Gross Beta Count	Count Time (Min.)
SMEAR BKG CT. 1	----------------	----------------	----------------		
SMEAR BKG CT. 2	----------------	----------------	----------------		
SMEAR BKG CT. 3	----------------	----------------	----------------		
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					

13					
14					
15					
16					
17					

ADDITIONAL DIRECT and REMOVABLE DATA

Sample Number	Location Code or Description	Direct Gross Beta Count	Count Time (Min.)	Smear Gross Beta Count	Count Time (Min.)

ELEVATED SCAN RESULT LOG

Reference Grid Coordinates		Affected Area, m^2	Maximum Results, CPM	Comments
X	Y			

Attachment D: FSS Pipe, Conduit and Duct Field Data Sheet

Survey Unit:	No.:	length:	MARSSIM Class:
	SU Description:		
	Location:		
Date(s) of Sampling / Survey:			
Surveyors:			

CONTAMINATION SURVEY OF LINE END(S)

Location / Description	Direct Beta CPM	Removable Beta CPM

INTERNAL GAMMA SCREENING

Start Location:
Ending Location:
Comments:

Distance from Start, cm	Gross Counts	Ct. Time (min.)	Distance from Start, cm	Gross Counts	Ct. Time (min.)
Initial BKG					
Check Source					
			Ending BKG		
			Check Source		
Instruments: Model / SN			Check Source:	ID:	µCi:

Survey Unit:	No.:	
	SU Description:	
	Sample Material:	
	Location:	
Date(s) of Sampling:		
Counting Equipment:	Model: Ludlum PR322477	HV:
	S/N: GS-01034	Gain:
Analysis by:		Date:

SWAB SAMPLE GROSS BETA SCREENING DATA

Swab Sample No.	Start Location	Ending Depth (cm) (if dead-ended)	Gross β Screen Data (CPM)
1			
2			
3			
4			
Gross β Screening Instrument(s): S/N(s):			Gross β BKG (CPM):

SWAB SAMPLE GAMMA ISOTOPIC SCREENING DATA

ROI:		1	2	3	4	5	Report ID
Radionuclide:		Eu-152	Cs-137	Eu-152	Co-60	Co-60	
Photo Peak Centroid Energy (keV):		344	662	965	1,173	1,332	
Swab Sample Number	Count Time (sec)	Net Count Rate (CPS)	Net Count Rate (CPS)	Net Count Rate (CPS)	Net Count Rate (CPS)	Net Count Rate (CPS)	
1							
2							
3							
4							

Attachment E: Volumetric Contamination Field Data Sheet

Survey Unit:	No.:	Area (m²):	MARSSIM Class:
	SU Description:		
	Sample Material:		
	Location:		
Date(s) of Sampling:			
Surveyors:			

SAMPLE COLLECTION DATA

Sample No.	Location Grid Coordinates or Description	Beginning Depth (cm)	Ending Depth (cm)	Sample Diameter (cm)	Sample Mass (grams)	Gross β Screen Data (CPM)
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
Gross β Screening Instrument(s): S/N(s):					Gross β BKG (CPM):	

Survey Unit:	**No.:**	
	SU Description:	
	Sample Material:	
	Location:	
Date(s) of Sampling:		
Counting Equipment:	**Model: Ludlum PR322477**	**HV:**
	S/N: GS-01034	**Gain:**
Analysis by:		**Date:**

SAMPLE GAMMA SCREENING DATA

ROI:		1	2	3	4	5	Report ID
Radionuclide:		Eu-152	Cs-137	Eu-152	Co-60	Co-60	
Photo Peak Centroid Energy (keV):		344	662	965	1,173	1,332	
Sample Number	Count Time (sec)	Net Count Rate (CPS)	Net Count Rate (CPS)	Net Count Rate (CPS)	Net Count Rate (CPS)	Net Count Rate (CPS)	
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

Attachment F: Measurement Point Locating Spread Sheet (Embedded Excel File)

REDACTED

Attachment G: Surface Contamination Evaluation Spread Sheet (Embedded Excel File)

REDACTED

Attachment H: Volumetric Sample Gamma Screening Normalization Spread Sheet (Embedded Excel File)

REDACTED

Attachment I: Volumetric Concentration Evaluation Spread Sheet (Embedded Excel File)

REDACTED