

From: [Higgins, Kevin](#)
To: [Elliott, Robin](#)
Cc: [Byerly, Wesley](#)
Subject: [External_Sender] RE: RE: RE: Request for additional information
Date: Tuesday, October 5, 2021 2:10:24 PM
Attachments: [UH DFP Response 20211004.pdf](#)
[UH DFP 20211004.pdf](#)

License No.: 06-13022-02
Docket No: 030-01295
Control No: 624907

Hi Robin,

Attached are answers to the questions we received on June 17th, 2021. Also attached is the amended DFP. We hope you find these acceptable.

Please let me know if you have any questions on either document.

Thanks,

Kevin Higgins, PE
Director, Environment of Care & Radiation Safety
Radiation Safety Officer
UConn Health
263 Farmington Avenue
Farmington, CT. 06030-1020
(860) 679-4925 – P
(860) 576-3259 – C

From: Elliott, Robin <Robin.Elliott@nrc.gov>
Sent: Tuesday, June 29, 2021 10:15 AM
To: Higgins, Kevin <kevin.higgins@uchc.edu>; Byerly, Wesley <byerly@uchc.edu>
Subject: RE: RE: RE: Request for additional information

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Hi Kevin,

I think that is reasonable. Please let me know if you have additional questions as you progress through the revisions.

Regards,
Robin

From: Higgins, Kevin <kevin.higgins@uchc.edu>
Sent: Tuesday, June 29, 2021 7:16 AM

To: Elliott, Robin <Robin.Elliott@nrc.gov>; Byerly, Wesley <byerly@uchc.edu>

Subject: [External_Sender] RE: RE: Request for additional information

Good morning Robin.

I reviewed the NUREG and these comments and I think we have a decent amount of work to do here. With your permission, I would like to request an additional 90 days to redo the DFP to address NRC's questions and concerns. Let me know if that is OK.

Thanks,

Kevin Higgins, PE
Director, Environment of Care & Radiation Safety
Radiation Safety Officer
UConn Health
263 Farmington Avenue
Farmington, CT. 06030-1020
(860) 679-4925 – P
(860) 576-3259 – C

From: Elliott, Robin <Robin.Elliott@nrc.gov>

Sent: Thursday, June 17, 2021 7:41 AM

To: Higgins, Kevin <kevin.higgins@uchc.edu>; Byerly, Wesley <byerly@uchc.edu>

Subject: RE: RE: Request for additional information

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Kevin,

I understand this may take some time for you to respond to everything. If you need additional time to develop your response, please just give me a timeframe for me to track the progress of the action.

Many thanks,
Robin

From: Higgins, Kevin <kevin.higgins@uchc.edu>

Sent: Thursday, June 17, 2021 7:38 AM

To: Elliott, Robin <Robin.Elliott@nrc.gov>; Byerly, Wesley <byerly@uchc.edu>

Subject: [External_Sender] RE: Request for additional information

Thanks Robin. We will look into this.

Kevin

From: Elliott, Robin <Robin.Elliott@nrc.gov>
Sent: Thursday, June 17, 2021 7:20 AM
To: Byerly, Wesley <byerly@uchc.edu>
Cc: Higgins, Kevin <kevin.higgins@uchc.edu>
Subject: Request for additional information

*** Attention: This is an external email. Use caution responding, opening attachments or clicking on links. ***

License No.: 06-13022-02
Docket No: 030-01295
Control No: 624907

Licensee Name: UConn Health

This refers to your request to update your Decommissioning Funding Plan (DFP) dated March 4, 2021. In order to continue our review of your request, the following additional information is needed:

Based on the possession limits of your license and 10 CFR Part 30.35, you are required to submit a DFP. NUREG 1757 Vol. 3 Rev. 1 Consolidated Decommissioning Guidance Financial Assurance, Recordkeeping, and Timeliness provides licensees guidance on what to submit regarding DFPs. Based on the Checklist 1 Master Checklist for Decommissioning Financial Assurance (Page A-4) you need to provide the DFP (checklist 3) and Statement of Intent (checklist 11-A). Based on these checklists, please provide the following:

Section A.3.3 "Submitting the Required Documentation," of NUREG 1757 Vol. 3 Rev 1 provides information to licensees regarding the documents to submit for a DFP. As stated in the NUREG, the DFP must include a site-specific cost estimate, a means to adjust the estimate based on inflation, a Certificate of Financial Assurance, and an originally signed duplicate of the Financial Assurance instrument.

1. Please provide an updated Certificate of Financial Assurance if anything on the current one dated December 1, 2017, has changed or if the revisions to the DFP made as a result of this request dictate a higher amount. (If the only change is to the amount, please wait to submit until we have agreed on the final DFP amount)
2. Please provide the following information relative to the Statement of Intent (SI) dated December 1, 2017:
 - a. The document references the following locations: 263 Farmington Ave, 11 Shuttle Road, and 400 Farmington Ave; however, your DFP only addresses the Farmington Ave addresses. The SI needs to include the addresses of all locations where licensed materials requiring Financial Assurance (FA) are used/stored. As a broad scope licensee, that means all addresses listed on the license should be included, unless there is a tie-down commitment or some other license condition that limits certain locations only to material for which FA is not required. Please indicate why all addresses are not covered by the DFP.
 - b. Confirm that the authority established in the document referenced: "Description of Authority of Government Entity to Make Statement of Intent License Number; 06-

13022-02," is still valid, or provide an updated reference.

- c. If the revisions needed as a result of this request dictate a higher amount of FA, please generate a new SI for the new amount. (If the only change is to the amount, please wait to submit until we have agreed on the final DFP amount.)
3. With regard to the DFP, the license authorizes four locations: 230, 263, and 400 Farmington Avenue and 11 Shuttle Road and your DFP only addresses two locations. See item 2a above.
 - a. Please confirm that if only short-lived isotopes and sealed sources are used at 230 Farmington Avenue, that you will continue to restrict use in this way and maintain leak test records of sealed sources to confirm that none have leaked.
 - b. Please indicate why 11 Shuttle Road is not included in the DFP.
 - c. While comparing the 2017 DFP to the 2021 DFP there a number of significant reductions in cost for items such as disposal costs to decontaminate areas known to be contaminated or identified during characterization, disposal of collected radioactive materials, disposal of contaminated equipment; however, the only change appears to be the reduction in active labs from seven to none.
 - i. If you performed the decommissioning of those seven labs, provide the results of the final status surveys that demonstrate that these labs no longer are required to be considered in the DFP. Confirm that, if these laboratories are approved for use with licensed materials in the future, they will be included again in the cost estimate for the next update of the DFP.
 - ii. The cost estimate that was submitted does not have the level of detail as identified below, therefore it is difficult to determine if the current plan adequately addresses the current needs. While the tables provided in the Appendix are not required to be used, the detail laid out in these tables appears to be missing in your plan.
 1. Appendix A Section A.3.1.1 discusses the information to be submitted to adequately evaluate the facilities involved in eventual decommissioning. For example, although your plan references 234 labs that will be evaluated, your plan does not include the dimensions of the labs, or the number of fume hoods, glove boxes, lab benches, sewer lines and ductwork associated with these labs. Because you are a broad scope license, you may make some assumptions regarding the typical dimensions of most labs and account for any labs that are significantly different. Please review the NUREG again and update your plan to provide the stated detail.
 2. Appendix A Section A.3.1.2 discusses the information to be submitted for Estimated Decommissioning costs. Again, the information that you have provided does not provide the detail needed to adequately evaluate the decommissioning costs. For example, although section IV of your plan covers performing scoping surveys and determining impacted areas and classifications, clearing impacted labs in preparation for characterization surveys, performing final status surveys, etc., it does not include the Table in A.3.6 planning and preparation information such as: all the personnel involved in completing the tasks and the associated overhead costs. Please review the NUREG again and update your plan to provide the stated detail.
 - d. As a general comment, you have referenced using RESRAD-BUILD DCGLs in several sections of the plan. Note that the use of site-specific DCGLs, (DCGLs other than the NRC screening values or those generated using the DandD code) requires prior approval by the NRC, by submitting an amendment request for the site-specific values. Such an amendment should include the input parameters and the basis for selecting those parameters; a sensitivity analysis of the input parameters; and output data from

the code you are using to develop the site-specific DCGLs.

- e. It is not clear what the is the scope of the plan. Based on what was presented it appears that there is no active use, there are 2 PIs authorized to use RAM, 4 known labs that contain long lived residual contamination, 6 labs that are presently authorized for RAM use, and 234 labs that would be subject to characterization surveys. Further, the plan estimates that 11 labs may be discovered as having some contamination less than 2200 dpm/cm² and none greater than that based on your experience in decommissioning the Veterans Administration Building.
 - i. Does the 234 number include all laboratories that could possibly have been involved with radioactive material use or storage? If not, what is the criteria used for selecting these laboratories?
 - ii. What is the total number of laboratories that exist at UConn or the total number of laboratories in the departments that have any history of radioactive material use?
 - iii. Indicate why the Veteran's Administration Building is a reasonable comparator for determining percentages of impacted laboratories.
 - iv. Does the estimate of the number of impacted laboratories include consideration of associated drain lines, hoods and ventilation ducts, or other building infrastructure.
- f. In Section II, "Decommissioning Objectives, Activities, and Tasks," and Section IV, "Perform Final Status Surveys (FSS) in Deconned Areas," it states that FSSs will be conducted in areas that required decontamination. Does this mean that FSSs will not be conducted in other laboratories? This would only be possible if the characterization surveys are designed correctly to meet FSS requirements. Please indicate if your intention is to design your characterization surveys to meet the FSS criteria or revise the estimate to include FSSs of all areas.
- g. In Section V, a table is included using the D and D Building Occupancy Scenario. Using these values rather than the approved screening values for P33, Fe59, Co57, As76 and Sr90 will involve NRC regional approval. Additionally, there is no need to include I125, Tc99m, and Hg203 as their half-life is less than 120 days.
- h. With regard to your Co-60 irradiators, an increase correlated to the CPI back to 2001 is not a good estimate of actual disposal costs. Either obtain an updated quote from your vendor or revise your estimate to more accurate data. A search on the disposal costs of Co-60 sources revealed a 2008 National Academy of Sciences report that quotes the cost of disposal alone for 300 Ci of Co-60 as \$130,000.
- i. Appendix A Section A.3.1 states that the site-specific estimate **must be based** on an independent third party performing the work. You have stated, "Our plan is to have the necessary staff from the Office of Radiation Safety with all required radiation detection equipment remain onsite until all surveys, decontamination and waste disposal are accomplished." Please clarify if you have included the labor costs for all activities associated with the plan at the third-party rates. In addition, please update your plan to include the May 2020 salary rate of \$40.29 from the Department of Labor's Bureau of Labor Statistics for Nuclear Technicians. The HPS society conducted a salary survey for 2020 for Medical RSOs. Please use the updated figures from that survey of \$145,636/year for Medical RSOs.
- j. It is noted that the release of the Red Cross Blood Center and Uncas on Thames Hospital in 1998, did not include a submission of any FSSs. It was stated that Uncas on Thames licensed material use was limited to isotopes with half-life less than 120 days or sealed sources, which were leak tested every six months and never revealed any contamination. The Red Cross Blood Center, however, did include use of C-14. It was stated that the final decommissioning survey was conducted on June 14, 1991, but that

survey was not submitted to the NRC for review. This survey may need to be reviewed at the time of license termination.

Your reply must be an originally signed and dated letter. The letter may be scanned and submitted as a pdf document attached to an email (preferred method during the pandemic); or it may be transmitted by facsimile to (610) 337-5269; or it may be sent by regular mail. Please reply within 30 calendar days from the date of this e-mail, in order for us to continue our prompt review of your submission.

Regards,

Robin L. Elliott

(Pronouns: she/her/hers)

Health Physicist

Medical & Licensing Assistance Branch

Division of Radiological Safety and Security

U.S. NRC, Region I

2100 Renaissance Boulevard, Suite 100

King of Prussia, PA 19406-2713

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Robin.Elliott@nrc.gov

Responses to NRC questions on 3/4/21 Decommissioning Funding Plan

1. An updated Certificate of Financial Assurance (CFA) is not needed since the amount indicated in the revised DFP is less than the amount indicated on the current CFA.
2. a. The only unsealed radionuclide ever licensed for use at 11 Shuttle Road was I-125. All I-125 was removed from this location prior to 1/21/2010 and a closeout survey was performed. No radioactive contamination was detected. Any potential unidentified contamination has since decayed. Two Ni-63 sealed sources were removed from this site prior to July 1996. Leak test records indicate no leakage from these sealed sources. There are currently no radioactive materials that are in use/storage at this site. Although there are no current plans to use radioactive materials again at this site, we will add this site to the DFP, as necessary, if radioactive material use resumes at this site.
b. The authority established in the document referenced "Description of Authority of Government Entity to Make Statement of Intent License Number; 06-13022-02" is still valid.
c. An updated Statement of Intent (SI) is not needed since the amount indicated in the revised DFP is less than the amount indicated on the current SI.
3. a. The only radionuclide that was in use at 230 Farmington Ave. was F-18. This short lived radionuclide was administered to patients in a portable PET facility through a separately licensed vendor, Insight. These patients used a bathroom at this address that was controlled and surveyed by Radiation Safety staff at UConn Health. We plan to remove this address from our license since it is no longer used.
b. Please see response to 2.b.
c.i. We have reviewed the 2017 and 2021 DFPs. The estimated number of active labs was 28 labs in 2017 and 6 labs in 2021. We could not find a "reduction in active labs from seven to none" in our submitted DFPs. The main cost change with the reduction of 22 active labs is associated with waste disposal costs. It was assumed at the time of decommissioning that there will be fewer labs requiring pick up and disposal of radioactive waste. If these or other labs are approved in the future we will adjust the number of active labs and associated estimated waste disposal costs.
c.ii. 1. We have reevaluated the assumed number of laboratories that will require a characterization survey. We have determined up to 162,700 ft² of lab floor space has or could be involved with the use of unsealed sources of radioactive material. Since lab space size can vary significantly, we have assumed the average lab size is about 25' x 25' or 625 ft². The calculated estimated total number of lab spaces or laboratories that will require a characterization survey is therefore 260 labs (162,700 ft²/625 ft²). We have revised the DFP with the 260 lab value. We expect, however, that the number of impacted labs will be substantially less than this number.

c.ii. 2. We have reviewed the A.3.6. Planning and Preparation guideline and believe our DFP provides the necessary information and associated costs if our facility were to be decommissioned. The A.3.6. table appears to be all encompassing to include the more complex, worst case scenario decommissioning projects. Most of our research activities have involved short lived radionuclides, used in small stock vial quantities in small controlled areas that should only need a more simple decommissioning approach. We have included all anticipated costs that would be expected based on our past decommissioning experience history of typical research use of radioactive material in a university setting. Our extensive regular surveys that have been performed during licensed operation, in addition to our past decommissioning experience history, has shown very few unexpected areas, including impacted areas, that required decontamination. Nonetheless, the DFP cost estimate we have submitted is very conservative. We have estimated a large number of additional labs and items that may require decontamination during decommissioning. In reality, no additional areas are expected to require decontamination.

d. We will use NRC screening values or submit an amendment, as needed, for site specific DCGL values.

e.i. It was conservatively estimated that 260 (revised from 234) research labs could potentially use radioactive materials. When a historical site assessment is done, the impacted labs will be determined and will most likely be much less than 260.

e.ii. The total number of laboratories is 260 (revised from 234).

e.iii. Similar research activities, lab size, lab set ups and radionuclides were used at both the VA building and the main UConn Health campus.

e.iv. The DFP addresses consideration of drain lines, hoods and other building infrastructure in impacted labs.

f. We will design our characterization surveys to meet FSS criteria.

g. We will use NRC screening values for P-33, Fe-59, Co-57,, As-76 and Sr-90 or obtain NRC approval for site specific values for these radionuclides.

h. UConn Health does not have Co-60 irradiators. We have obtained an updated quote for removal of our Cs-137 irradiators. This cost is indicated in the revised DFP.

i. The labor costs for all activities associated with the DFP are at third-party rates. We have revised the DFP with the updated May 2020 salary rate of \$40.29/hour from the Department of Labor's Statistics for Nuclear Technicians and the HPS 2020 salary rate of \$145,636/year for Medical RSOs.

UConn Health Decommissioning Funding Plan

October 4, 2021

Revised by

James Fomenko, CHP, ARSO
Office of Radiation Safety

I. General Information

The UConn Health campus (UH) is a broad scope human use licensee located at 263 Farmington Avenue and at 400 Farmington Avenue in Farmington, Connecticut. UH maintains NRC License #06-13022-02 that at this writing has an expiration date of May 31, 2024. Byproduct material is used in biomedical research and medical applications. UH is a State of Connecticut Hospital, Medical/Dental school and research institution. Presently there are 2 Principal Investigators authorized to use radioactive materials although this number may change somewhat each quarter. Of these, there are no active Principal Investigators at the present time. There are three high level 137-Cs irradiators on campus. Two of these units are used for research purposes and one is used for blood irradiation. Medical use includes sealed sources for HDR therapy and radiopharmaceuticals for diagnostic and therapeutic applications.

Our plan is to have the necessary staff from the Office of Radiation Safety with all required radiation detection equipment remain onsite until all surveys, decontamination and waste disposal are accomplished. This is a reasonable assumption as Office of Radiation Safety staff also provide other safety services to UH such as hazardous materials surveys and chemical waste pickup and disposal. It would be unlikely for all activities to cease at UH if the license were to be terminated. Outside contractors would only be used for tasks for which the scope of work is beyond the capabilities of the Radiation Safety staff (ie: jack hammering contaminated concrete, removing contaminated ductwork, etc.). All radiation surveys, minor decontamination of surfaces and packaging for waste disposal would probably be done by UH staff. Alternatively, as required, we have included estimated personnel costs if decommissioning activities are performed by an independent third party contractor.

A salary rate of \$40.29/hour was used for the services of a Nuclear Technician. This information was obtained from the Department of Labor's Bureau of Labor Statistics, May 2020.

A salary rate of \$69.75/hour was used for the services of an RSO. This information was obtained from the Health Physics Society's 2020 CHP salary survey for Medical RSOs (\$145,636/year). (Assumed 261 paid days/year at 8 hours/day)

Current vendor costs for disposal of licensed material are also provided.

II. Decommissioning Objectives, Activities and Tasks

The objective of this decommissioning plan is to remove all radioactive materials from UH such that all areas are acceptable for unrestricted release based on the criteria and methodology present in NUREG-1575 Rev. 1, "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), August 2000". The RESRAD-BUILD 3.0 and/or the D&D Version 2.1.0 computer codes will be utilized to demonstrate residual contamination levels are such that no individual member of the general public will receive a total effective dose equivalent in excess of 25 mrem per year (10 CFR 20.1402). In actual fact, areas will be decontaminated to ensure no member of the general public will receive more than 19 mrem per year total effective dose equivalent as per Connecticut Department of Energy and Environmental Protection requirements. All contaminated areas will be decontaminated as is practical, even if contamination levels would result in TEDEs of 19 mrem/year or less. The main objective is to remove all radioactive contamination, as is practical, to levels undistinguishable from background as measured

using appropriately sensitive instrumentation. Where sufficient information is not available for the cost incurred by certain activities, the information provided in NUREG/CR-6477 “Revised Analyses of Decommissioning Reference Non-Fuel-Cycle Facilities”, December, 2002, was utilized. Costs have been adjusted to December 2020, where necessary, using the U.S. Department of Labor Bureau of Labor Statistic’s Consumer Price Index % change from all urban consumers (CPI-U).

The Office of Radiation Safety staff will perform all contamination surveys, minor decontamination efforts and packaging and disposal of all radioactive waste generated. The UH Radiation Safety Officer will supervise these efforts and determine when outside contractors are needed for “special” projects. The Office of Radiation Safety staff is well trained and experienced in all aspects of the proposed decommissioning efforts. If the decision is made to cease work with radioactive materials at UH, the following sequence of events will be activated:

- Cease Ordering Radioactive Materials
- Request Funding From State of Connecticut
- Notify NRC of Intent to Terminate License
- Collect All Radioactive Materials, Package and Dispose
- Perform Historical Site Assessment and Determine DCGL’s for Radionuclides Used
- Perform Scoping Survey and Determine Impacted Areas and Classifications
- Calibrate Instrumentation for Nuclides of Interest
- Perform Equipment and Lab Supplies Surveys of All Impacted Areas
- Clear All Labs in Preparation for Characterization Surveys
- Perform Characterization Survey of Facility
- Decon As Necessary
- Perform Final Status Surveys in Deconned Areas
- Remove All Radioactive Waste from Storage Area and
- Perform Characterization Survey, Decon as Required
- Prepare, Submit Summary to NRC, Terminate License

A brief summary for each of the above decommissioning steps follows:

Cease Orders

Once the decision is made to terminate the NRC license, a date would be set beyond which no orders for radioactive materials would be accepted. At this time a radioactive materials inventory would be done to ensure plans could be made to collect and dispose of all unsealed material as waste. Inquiries would begin to retain an authorized vendor to remove the gamma cell units for disposal or resale.

Request Funding

When the decision is made to terminate the NRC license, a request for additional funds in the amount of that determined by this plan would be submitted to the Executive Vice President for Health Affairs (CEO). The Executive Vice President would then take the request to the University of Connecticut Board of Directors for approval.

Notify Nuclear Regulatory Commission and Connecticut Department of Energy and Environmental Protection

The Nuclear Regulatory Commission and the State of Connecticut Department of Energy and Environmental Protection would be notified that the UH license will be terminated. Any inquiries from the State or NRC would be addressed at this time. Both agencies would be notified that UH intends to implement this Decommissioning Funding Plan and that funding has been requested from the University of Connecticut Board of Directors.

Collect All Radioactive Materials, Package and Dispose

Once an inventory by location is obtained, contracted Nuclear Technicians or Office of Radiation Safety staff would begin collecting all radioactive materials and arrange for timely pickup and disposal. It is anticipated that during this time an outside vendor would remove the gamma cell units from the site.

Perform Historical Site Assessment and Determine DCGLs for Radionuclides Used

The contracted RSO, or Office of Radiation Safety would initiate an historical site assessment soon after the decision is made to terminate the license. This would involve a complete review of all survey records. Upon completion of the historical site assessment, current versions of RESRAD-BUILD and/or DandD would be used to determine derived concentration guideline levels (DCGLs) for each radionuclide ever used on the campus. The DCGL values would be based on the State of Connecticut Department of Energy and Environmental Protection release criteria of ≤ 19 mrem/year total effective dose equivalent. In areas where multiple radionuclides were used the sum of ratios of measured/DCGL values < 1 criteria would be used.

Perform Scoping Survey and Determine Impacted Areas and Classifications

UConn Health has a well documented history of years of quarterly survey results. The policy has been to clean spills of radioactive material to background levels if practical. UH would utilize the data generated from the Historical Site Assessment to perform a scoping survey. Output from the survey database generated would provide information of many years relating to the contamination status of a specific lab. Areas of UH will be categorized as *Impacted or Not Impacted*, and those areas with

residual radioactivity will be classified as Class 1, Class 2 or Class 3 areas based on the MARSSIM methodology. The Office of Radiation Safety also maintains a list of areas in which residual radioactivity remains.

Calibrate Instrumentation for Nuclides of Interest

During the scoping survey instrumentation used routinely to quantify the radiological status of the facility will be calibrated. These instruments include existing liquid scintillation counters, sodium iodide detectors, GM probes and meters and ionization chambers. For liquid scintillation counting, standards would be purchased, where necessary, for calibration for efficiency versus beta/photon energy. Beta standards exist onsite for calibration of GM survey meters for surface contamination and an onsite calibration source could be used to calibrate photon detecting instruments.

Perform Equipment and Lab Supplies Surveys of All Impacted Areas

Prior to performing any surveys of the facility, all areas would need to be cleared of equipment and supplies. Nuclear Technicians or Office of Radiation Safety staff would systematically survey all areas where equipment and supplies were used for work with radioactive materials. Items found contaminated would be removed for disposal or decontaminated to NRC acceptable release levels.

Clear All Impacted Labs in Preparation for Characterization Surveys

Upon completion of the equipment surveys, UH Property Control staff would remove and store/transfer equipment and supplies that are releasable. Items found to be contaminated would be removed under the supervision of the RSO for decon or disposal as conditions dictate. As former radioactive materials use areas are cleared characterization surveys would begin.

Perform Characterization Survey of Facility

A complete survey of all impacted areas would be done using the general approach described in the most recent version of NUREG-1575 (MARSSIM). All impacted areas would be wipe tested and surveyed at near contact with a thin end window GM, a gas proportional floor monitor detector or other appropriate detectors. Each area would be sectioned into 1 meter squares for this survey, and would include all surfaces. In addition, ventilation systems and sanitary sewer lines would be surveyed. Survey results would be uniquely identified and results would be reported in dpm/100cm². Survey results would be compared to the DCGL values for each radionuclide and appropriate actions taken. Non-impacted areas would be surveyed but larger grid sizes would be utilized. These results would also be documented.

Decontaminate Areas Known to Contain Long Lived Residual Contamination

There are 4 labs within the UConn Health facility that have been documented as containing residual radioactivity. The contamination is located in isolated spots that are identified and contained. These areas would be decontaminated or removed for disposal concurrently with the characterization survey efforts.

Decon As Necessary

The goal of the decommissioning would be to remove contamination to non-detectable levels. It will be shown later that these minimum detectable levels are well below the DCGL values established for the State of Connecticut's 19 mrem/yr total effective dose equivalent residency requirement. All staff would be monitored, but based on the nature of radionuclide use at UH, the resulting doses would be trivial. Decon efforts would be documented as well as follow up surveys of these areas.

Perform Final Status Surveys in Deconned Areas

After areas found to be contaminated have been deconned, a final status survey would be conducted using the same techniques described above for the characterization surveys. Survey locations and results would be documented demonstrating such areas have been decontaminated to as low a level as practical and are below the appropriate DCGLs.

Remove All Radioactive Waste from Storage Area and Perform Characterization Survey, Decon As Necessary

Prepare and Submit Summary Document to NRC for License Termination

The Radiation Safety Officer would prepare a summary document detailing all activities, assumptions, calculations, calibrations, survey results and disposals to the NRC and the State of Connecticut's Department of Energy and Environmental Protection upon completion of the decommissioning activities. This would also include information obtained from the historical site assessment. All data and information collected would be retained indefinitely for NRC and/or State review.

III. General Approach Using Site Specific Information on Decommissioning

The Office of Radiation Safety staff has considerable experience in decommissioning activities. During the summer of 2001 the Veteran's Administration Research Building #5 was decommissioned and removed from the NRC license on July 23, 2003. This facility consisted of three floors with a total of 75 laboratories (approximately 22,000 ft²) used by 37 different investigators over the period from 1970 through license termination. The use of radioactive materials in these labs is very representative of the profile of use at UH. The decommissioning process followed the general plan outlined in Section II of this document and was found to be a very practical process. Historically, as is standard operating procedure at UH, any contamination found through the years at the VA was deconned to background levels. Quarterly surveys were done by the Radiation Safety Office and corrective actions implemented. This decommissioning plan utilizes applicable information learned from the decommissioning of Building 5.

In addition to the above experience, the radioactive waste storage facility was surveyed and decommissioned by Office of Radiation Safety staff

Radionuclides used and/or stored in the above locations included 125-I, 14-C, 36-Cl, 22-Na, 32-P, 35-S, 3-H, 45-Ca, 51-Cr, 63-Ni, 65-Zn, 86-Rb and 18-F. Surveys of VA lab equipment and supplies required the efforts of two radiation safety staff members for a period of approximately 1 working month (20 days). This included counting of all wipe tests. Very few items were found to be contaminated. A complete building characterization survey done during the months of May through August 2001 utilized

2 radiation safety staff members per day. The historical site assessment resulted in the conclusion that very few if any lab areas would be found with contamination levels above the derived DCGLs, and that if contamination were detected, activities would be far below the DCGLs. The characterization survey found 2 areas with isolated spots of residual contamination, and these areas were below the DCGL values. These areas were easily decontaminated to levels below MDC (ambient background). There were no areas that had been cataloged prior to the surveys as having residual contamination present. Therefore the characterization surveys detected these unknown spots of contamination. It was also found that decommissioning the radioactive waste storage facility involved similar effort to the VA work. Therefore, the following approximate rates will be used when applicable in planning for decommissioning:

Equipment Surveys	2 persons	20 days	75 labs
	3.75 labs/day, 0.53 person-days/lab		
Characterization Surveys	2 persons	123 days	75 labs + other
	2 persons	123 days	22,144 ft ²
	0.61 lab/day, 3.28 person-day/lab & other		
	Or 0.011 person-days/ ft ²		
Contaminated Areas	2 areas/75 labs	0.03 areas/lab	

It should be noted that the effort for the characterization surveys includes less exhaustive surveys of non-impacted areas such as hallways, offices, etc. Also, the number of contaminated areas per lab represents the expected average number of labs that will be found to have residual contamination and NOT the average number of contaminated areas found in an individual lab. UH has maintained information on lab surveys, number of wipes and contamination results. From January, 1991 through December, 2020, the following statistics were obtained:

Total UConn Health Labs Surveyed	14,006	
Total Wipe Tests < 100 dpm/100cm ²	141,744	99.5 %
Total Wipe Tests 100-220 dpm/100cm ²	378	0.3 %
Total Wipe Tests 220-2200 dpm/100cm ²	220	0.2 %
Total > 2200 dpm/100cm ²	56	0.04 %

This data was used to provide an independent estimate of the number of contaminated labs expected per lab surveyed. If one assumes that any wipe test above 100 dpm/cm² is an area with contamination and that each wipe test result is representative of one lab, then an estimate of the number of labs expected to contain some level of contamination is (378+220+56)/14,006, or 0.047 areas/lab surveyed. This is very near the number (0.03 areas/lab) found during the VA characterization survey. It should be noted that no survey result recorded was in excess of any applicable DCGL (see later text).

UH has also had experience (March, 1996) in decontaminating and removing a fume hood and associated ductwork contaminated with 14-C. This work involved an outside contractor, 10 working days for 4 technologists, 14-C contamination ranging from up to 8,000 dpm/100cm² and the removal of a hood, blower motor, and associated 140 linear feet of ductwork. It should be noted that this was decontaminated and yielded a total waste volume of 10 gallons. This was an area known to be contaminated based on historical knowledge.

UH has experience in removal and transfer of a gamma cell irradiator (May, 2001) and the disposal of mCi level sealed sources (February, 2004 and April, 2014). This historical information will be used to estimate the costs of these activities in this plan.

The Office of Research Safety performs semiannual hazard analysis surveys of *ALL* laboratories located at UH. As of the writing of this document, it is estimated that there are 196 Research Investigators whose laboratories are inspected twice yearly. The total laboratories (rooms) inspected is estimated to be about 260. There are currently 2 Investigators, with about 6 labs, who are authorized to use byproduct material in research. When a historical site assessment is done, the impacted labs will be determined and will most likely be much less than 260. However, for the purposes of this plan, it is assumed that 260 laboratories will require a characterization survey. There are a total of 4 labs that have been identified as containing residual fixed radioactive contamination that are a part of this 260 lab total and will need remediation (although levels are below DCGLs). Using the lab contamination frequency determined previously (0.047 contaminated labs/lab surveyed), we would conservatively expect to find approximately $((260-4) \times 0.047)$ 12 additional labs with contamination in addition to the 4 known areas.

IV. Decommissioning Schedule

Notify NRC of Intent to Terminate License

The Nuclear Regulatory Commission would be notified as soon as practical once the decision is made to terminate the UH license.

Cease Ordering Radioactive Materials

Once the decision is made to decommission, a date would be selected beyond which no orders would be accepted. All authorized investigators would be notified of this date and other actions that they will need to take in preparation for removal of all radioactive materials from their labs.

Request Funding From the State of Connecticut

Funding in the amount determined by this decommissioning funding plan would be requested as soon as practical after the decision to terminate the NRC license was made. Discussions with administration at UH indicated that such funding could be obtained within 2 to 4 weeks of submission.

Historical Site Assessment is estimated to consume no more than 60 days of effort. The cost for RSO services for this task is estimated to be $(\$69.75/\text{hour} \times 8 \text{ hours/day} \times 60 \text{ days})$ \$33,480. This is based on the historical site assessment performed by the UH Radiation Safety Officer in preparation of the decommissioning of the Veteran's Administration Building #5 during the summer of 2001 and decommissioning of the radioactive waste facility done during the spring of 2012.

Perform Scoping Survey and Determine Impacted Areas and Classifications

The historical site assessment would be used to determine potentially impacted areas. The complete file of quarterly surveys would be reviewed to determine what areas are potentially impacted areas. These areas would be targeted for the characterization surveys described later. As this survey will be done during the historical site assessment, the time needed is estimated to be 60 days.

Calibrate Instrumentation for Nuclides of Interest

Radiation detection instrumentation used for the characterization surveys would be calibrated prior to initiation of the process. Based on current calibration procedures, calibration of all appropriate instrumentation would be done onsite with existing radiation standards. It is estimated that instrumentation calibration would require approximately one week (40 hours) of effort. The cost for Nuclear Technician (Tech) services for this task is estimated to be \$1,612.

Collect All Radioactive Materials, Package and Dispose

Using current figures, it is estimated that there might be 2 active Investigators and 6 laboratories that have radioactive material in storage at the time the decision to decommission is made. The Office of Radiation Safety would cease ordering radioactive materials and initiate a campus wide effort to collect all unused stock vials and radioactive waste on hand for disposal. A notice would be sent to all Principal Investigators instructing them to package their waste materials with an expected date of pickup. Existing radioactive materials inventories for each lab would be used to ensure all materials are picked up. It is estimated that it would take a Tech 8 hours to pick up and process for disposal the radioactive material from these labs. A scheduled 3 weeks would be allotted for this activity. The cost for Nuclear Technician services for this task is estimated to be \$322.

Equipment and lab supply surveys would only be done in impacted areas. It has been estimated that 260 laboratories could be involved. It is not known at this time how many of these labs would be impacted areas. An impacted area would be a laboratory with a reasonable possibility of containing residual radioactivity in excess of natural background. Based on site specific information provided previously, and using the estimated effort of 0.53 person-days/lab for 260 labs, this process would take approximately 138 person-days. If 4 Nuclear Technicians performed this task, it would take approximately 31 days to accomplish. The cost for Nuclear Technician services for this task is estimated to be \$44,416.

Clear All Impacted Labs in Preparation for Characterization Surveys

It is not expected that all 260 lab areas would be impacted as determined by the historical site assessment. However, it is assumed that removal and/or moving of equipment could be done concurrently with the equipment and lab surveys and the characterization surveys. Therefore, it is estimated that the maximum time for this activity would be 1 lab per day per FTE, or 4 labs/day (12 weeks).

Characterization surveys would be performed following equipment removal from impacted areas. It is highly likely that some laboratories would not be using radioactive materials but could be classified as impacted based on the historical site assessment. These labs would have been decommissioned previously when radioactive materials were removed and thus have a low probability of residual contamination existing. In such cases equipment could be moved out of the way instead of being removed from the area. The decision on equipment removal would be on a case by case basis and made by the Radiation Safety Officer. It is estimated that radioactive materials might be actively used in 6

labs when decommissioning activities begin. Removing non-contaminated equipment and supplies from impacted labs would be a time consuming process. It is estimated that a minimum of 1 laboratory per day could be cleared for the characterization survey.

Data collected from the decommissioning of the Veteran's Administration Building #5 was utilized to estimate the time needed to perform the characterization surveys. Assuming all 260 labs will be surveyed, and using 3.28 person-days/ lab and other areas, the estimated maximum effort for these surveys would be 853 person-days. This would include less intensive surveys of non-impacted areas such as hallways and offices. Assuming 4 Nuclear Technicians would be available for this task, the time for this task is estimated to be 213 days. The cost for Nuclear Technician services for this task is estimated to be \$274,939.

Decon Labs as Necessary

The expected number of contaminated labs found in areas that were active immediately preceding the decommissioning effort will be estimated using UH survey data of active labs since 1991. Of the 6 assumed active labs, 1 lab would be expected to contain contamination below 2200 dpm/100 cm² and no labs would be expected to contain residual contamination in excess of 2200 dpm/100 cm². There are an estimated total of 260 labs that might be surveyed, of which 6 might be active. Of these remaining 254 labs, approximately 12 labs could be expected to contain contamination below 2200 dpm/100 cm² and no labs would be expected to contain residual contamination in excess of 2200 dpm/100 cm². This is based on the survey results of the Veteran's Administration Building and decommissioning of the radioactive waste storage area.

Based on historical knowledge of the facility, contamination would not be extensive and would be in discrete isolated spots. It is expected that this contamination would be found on asbestos containing benchtops that may require removal by a licensed Asbestos abatement contractor. Radioactive waste generation from decontaminating these areas would be minimal. It is assumed that a minimum of 1 lab per day could be decontaminated. Total time is estimated to be 12 days. The cost for Nuclear Technician services for this task is estimated to be \$3,868.

Areas Known to Contain Residual Contamination

At the time of this writing, there are 4 lab areas known to contain residual long lived radioactive contamination. It is expected that the contamination levels will be below derived DCGLs. Also, contamination is confined to discrete locations and not wide spread. Significant waste volumes are not expected from these efforts. It is assumed that 1 lab per day could be decontaminated. Total time is estimated to be 4 days. The cost for Nuclear Technician services for this task is estimated to be \$1,289.

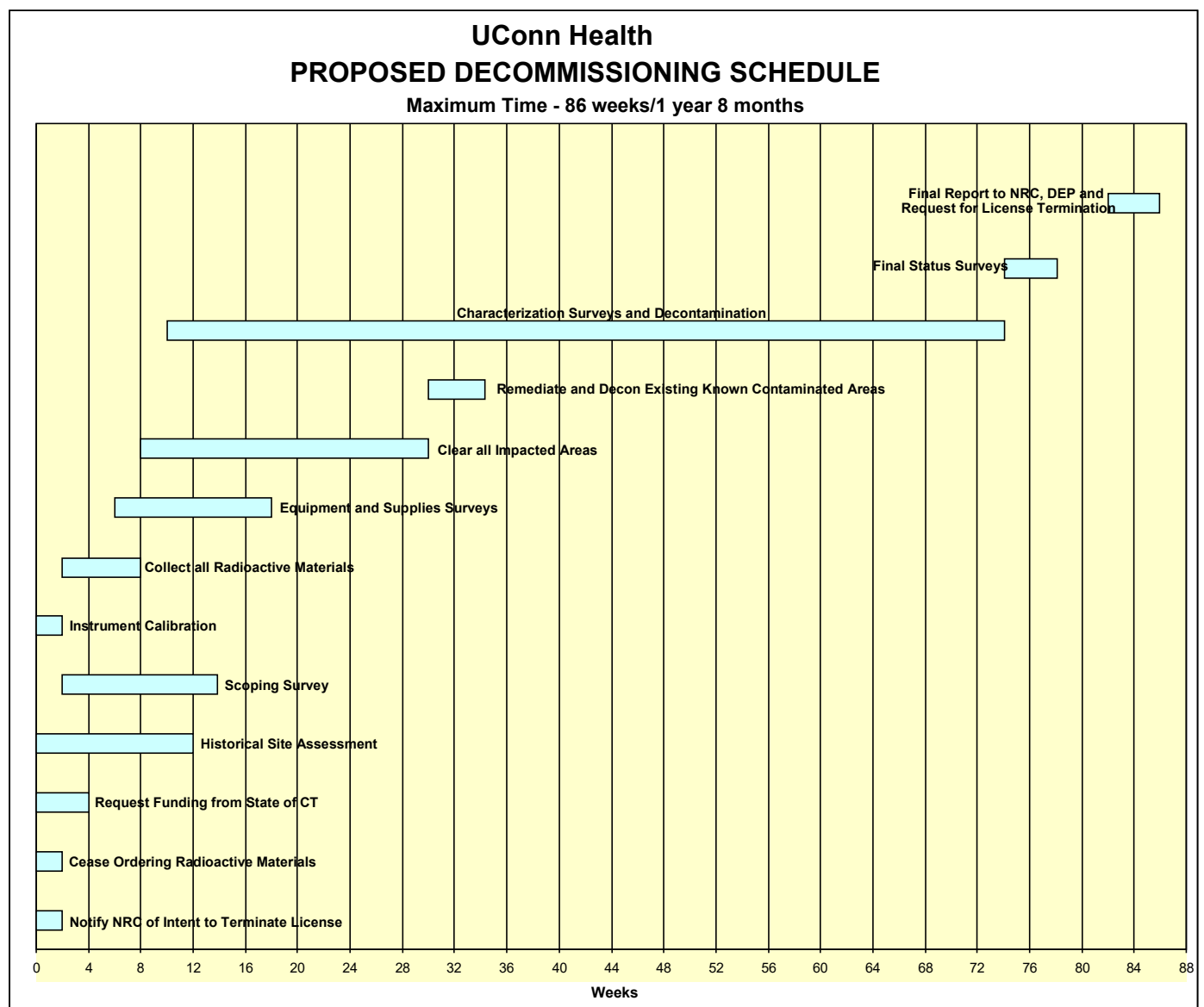
Perform Final Status Surveys in Deconned Areas

The final status surveys in areas found to be contaminated, and then decontaminated, is expected to take 3.28 person-days/lab, or for 12 labs a total of 39 person-days. Assuming 4 trained staff are available, time to do task is 10 days. The cost for Nuclear Technician services for this task is estimated to be \$12,570.

Prepare and Submit Summary Document to NRC for License Termination

Upon completion of all survey requirements, documenting that no area is above a DCGL and disposal of all waste a final document will be prepared and forwarded to the NRC and the State of Connecticut Department of Energy and Environmental Protection. The Radiation Safety Officer would perform this task that is estimated to require approximately 10 days of effort. The cost for RSO services for this task is estimated to be \$5,580.

Estimated Time Line for Decommissioning



The attached chart provides an estimated time line for the decommissioning activities. It is estimated that from beginning to end a total of 86 weeks would be needed, at most.

V. DCGLs and Instrumentation Sensitivities

Contamination surveys would be conducted by trained Office of Radiation Safety staff using instrumentation currently in use for maintenance of the byproduct materials license. Ludlum Model 3 survey meters and pancake GM probes and a gas proportional floor monitor would be used for scans of building surfaces. Certain areas that have used 51-Cr, 125-I and other photon emitting radionuclides would be scanned with a sodium iodide crystal and pulse rate meter in addition to a GM scan. The pancake probes have a nominal window thickness of 1.5 mg/cm^2 and an active area of 15.5 cm^2 . Sodium iodide probes have a window area of approximately 5 cm^2 . Survey meters are calibrated using an external ^{137}Cs beam to ensure linearity on all scales as well as correct response in mr/hr . Once meters pass the linearity test, a calibration is performed for beta response. A set of NTIS beta calibration standards of various energies are used for quantification of beta response at several distances in cpm/dpm . Wipe tests of building surfaces would be relied upon heavily for evidence of residual contamination. Wipe tests are analyzed in a liquid scintillation counter. It is assumed that 10% of the surface activity is removable. This removal efficiency was recommended in a November 18, 1998, Federal Register Notice "Supplemental Information on the Implementation of the Final Rule on Radiological Criteria for License Termination". Calculations of wipe test and scan MDCs were obtained using methodologies described in the "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)", August 2000, NUREG-1575, Revision 1. Default values were used.

The DandD computer code, version 2.1.0, was utilized to obtain estimates of derived concentration guideline levels (DCGL) for the radionuclides of interest. The output from this computer code is provided as an attachment. As was stated previously, the DCGL values are computed based on the Connecticut Department of Energy and Environmental Protection release criteria of 19 mrem/year total effective dose equivalent for a building occupant. Default values were used.

The following table summarizes the output from the DandD code. A contamination level of 1 $\text{dpm}/100\text{cm}^2$ was entered as input for each radionuclide. The resulting TEDE column is dose expected per year from the contamination level. The $\text{dpm}/100\text{cm}^2$ per mrem/year column was obtained by dividing the $\text{dpm}/100\text{cm}^2$ by the TEDE in mrem/year . Assuming an unrestricted release yearly total effective dose equivalent of 19 mrem/yr , the contamination levels to yield 19 mrem/yr were calculated. The DCGL columns were obtained directly from the previous column, except the DCGL for a wipe was corrected for a 10% wipe efficiency. The final two columns are the estimated instrument sensitivities for a meter scan and a wipe test. In all cases the survey techniques planned are sensitive enough to detect less than a DCGL for each radionuclide. It is not expected that any area would be found in excess of a DCGL.

DandD BUILDING OCCUPANCY SCENARIO

(DandD VERSION 2.1.0)

DERIVED DCGL'S BY RADIONUCLIDE FOR UNRESTRICTED RELEASE
FOR 19 MREM/YEAR TO BUILDING OCCUPANT
ASSUMES 10% OF SURFACE ACTIVITY RESUSPENDED

NUCLIDE	dpm / 100 cm ²	TEDE, mrem/yr	d/100 ² / mrem/yr	d/100cm2 19mrem/y	dpm/100CM ²		dpm/100 cm ²		
					DCGL METER	DCGL WIPE	METER SCAN MDC	WIPE TEST MDC	
3-H	1	2.20E-07	4.55E+06	8.64E+07	8.64E+07	8.64E+06	Nd	8.20E+01	
14-C	1	7.41E-06	1.35E+05	2.56E+06	2.56E+06	2.56E+05	2.61E+04	2.60E+01	
22-NA	1	2.62E-03	3.82E+02	7.25E+03	7.25E+03	7.25E+02	6.32E+03	8.20E+01	
32-P	1	2.89E-06	3.46E+05	6.57E+06	6.57E+06	6.57E+05	4.36E+03	2.20E+01	
35-S	1	2.21E-06	4.52E+05	8.60E+06	8.60E+06	8.60E+05	2.18E+04	2.50E+01	
36-CL	1	5.66E-05	1.77E+04	3.36E+05	3.36E+05	3.36E+04	4.60E+03	2.20E+01	
45-CA	1	9.89E-06	1.01E+05	1.92E+06	1.92E+06	1.92E+05	1.09E+04	2.60E+01	
51-CR	1	4.83E-06	2.07E+05	3.93E+06	3.93E+06	3.93E+05	1.80E+04	4.60E+02	
\$ 54-MN	1	7.94E-04	1.26E+03	2.39E+04	2.39E+04	2.39E+03	9.12E+03	4.60E+02	
63-NI	1	1.56E-05	6.41E+04	1.22E+06	1.22E+06	1.22E+05	Nd	8.20E+01	
65-ZN	1	5.24E-04	1.91E+03	3.63E+04	3.63E+04	3.63E+03	9.12E+03	2.70E+02	
& 90-Y	1	3.96E-05	2.53E+04	4.80E+05	4.80E+05	4.80E+04	4.36E+03	2.20E+01	
86-RB	1	1.16E-05	8.62E+04	1.64E+06	1.64E+06	1.64E+05	4.79E+03	2.20E+01	
99M-TC	1	1.68E-07	5.95E+06	1.13E+08	1.13E+08	1.13E+07	1.80E+03	na	
* 99-TC	1	6.96E-14	1.44E+13	2.73E+14	2.73E+14	2.73E+13	1.09E+04	2.60E+01	
^ 125-I	1	3.79E-05	2.64E+04	5.01E+05	5.01E+05	5.01E+04	2.60E+04	4.10E+01	
131-I	1	2.12E-05	4.72E+04	8.96E+05	8.96E+05	8.96E+04	5.01E+03	2.30E+01	
131M-XE	1	1.02E-08	9.80E+07	1.86E+09	1.86E+09	1.86E+08	Gas	gas	
o 203-HG	1	6.52E-05	1.53E+04	2.91E+05	2.91E+05	2.91E+04	2.18E+04	2.50E+01	
* 45-Ca MDC used & 32-P used		# 45-Ca used		\$ 51-Cr used, conservative ^ gamma scintillator		o 35-S used			

VI. Training and Monitoring of Decommissioning Workers

The Radiation Safety Officer will be responsible for ensuring that all individuals are properly trained for the intended work tasks. Nuclear Technicians and Radiation Safety staff are experienced and well trained in assessing radiological hazards, measuring the amount of radioactivity involved and performing safe decontamination procedures. All tasks will involve a Health Physics supervisor. Ancillary staff will be trained specifically for assigned tasks. An asbestos abatement contractor may be required for removal of sections of contaminated benchtops that contain asbestos. The perimeter of a contaminated area can be removed without disturbing the radioactivity present. Non Office of Radiation Safety staff will be trained in the basics of radioactivity, the specific hazards of the task and methods to

be used to minimize radiation exposure. The Radiation Safety Officer or designated alternate will provide this task specific training with documentation.

The cost estimates assume that the decommissioning work will be done by a third party contractor. Contractors would also be required for a portion of the decontamination work. The Radiation Safety Officer will ensure that these contractors are properly trained and experienced to do the required work. Once an outside contractor is selected, the Radiation Safety Officer will provide training relating to the specific requirements of the task.

UH has an extensive personnel monitoring and ALARA program in place. Historically, Office of Radiation Safety staff obtain minimal exposures in performance of daily tasks similar to those activities required during a decommissioning project. All personnel will be monitored for external photon and beta exposures and any work with high level sealed sources will be done using an additional extremity monitor. No work will be done by UH staff that would require respirators or engineering controls to prevent exposure to airborne radioactive materials. Contractors would be used for this purpose and verification of their methods and personnel protection measures will be done by the Radiation Safety Officer. It is not expected that any risk to the general public would result from decommissioning activities. The established ALARA program at UH would be adhered to during this work.

VII. Decommissioning Cost Estimates For Unsealed Sources

Adjustments for Inflation

Estimated costs resulting from this analysis will be adjusted using the Consumer's Price Index, where necessary, to December 2020. Various estimates were done using existing decommissioning data obtained at the time work was done. Consumer Price Index information was obtained from the U.S. Department of Labor Bureau of Labor Statistics' website.

The publication "Revised Analyses of Decommissioning References Non-Fuel Cycle Facilities", NUREG/CR-6477, published December, 2002, will be used for estimating costs for which no facility specific information is available. The information provided in NUREG/CR-6477 for an Institutional Isotope User Facility (NUREG) will be used.

Decontaminating Known Existing Areas

The following areas are known to contain residual amounts of radioactive contamination at levels below DCGL values. Costs are based on tasks that normally budgeted Office of Radiation Safety manpower and supplies would not cover.

Historical Contaminated Bench Tops and Sinks

The areas listed below are presently known to be contaminated in discrete spots with fixed long lived radionuclides below DCGLs that could be decontaminated by or under the supervision of the Office of Radiation Safety staff. Any locations described in the January, 2007, plan not identified in this current revision have been decommissioned and/or removed and disposed. Radioactive contamination resides on asbestos containing (where applicable) benchtops necessitating contractor removal. An estimate for disposal of contaminated sections of asbestos benchtop is \$10 per pound (based on a 1/19/21 quote from our radioactive waste disposal vendor). The cost per bench of removal of a section of contaminated

asbestos containing benchtop is estimated to be \$2,360 per section. This was obtained from an asbestos abatement group that has done such work at UH. An average weight of 148 lbs/countertop was estimated for each countertop below. The estimated weight of a countertop was based on the average weight of countertops that were shipped for disposal in 2014.

KNOWN EXISTING FIXED CONTAMINATED AREAS AND ESTIMATED DISPOSAL COSTS

1/19/2021

Lab	Item	Nuclides(s)	Waste, lbs	Cost
L-2042	Benchtop spot	14-C	148	\$ 1,480
L-2044	Benchtop spot	14-C	148	\$ 1,480
L-2084	Benchtop, 2 spots	36-Cl	148	\$ 1,480
L-3042	Benchtop	14-C	148	\$ 1,480
All Areas 4 Benchtops			592	\$ 5,920

The total estimated waste disposal cost is \$5,920, and with a 25% contingency, is \$7,420. The cost of removal of 4 contaminated asbestos benchtops is \$9,440. Adjusted using a consumer price index correction factor of 1.21 and a 25% contingency is calculated to be \$14,278. The total cost is then **\$21,698**.

Total Cost for Decommissioning Historically Known or Discovered Contaminated Areas

The total cost for decommissioning and disposal include removing known contaminated items and decontaminating and/or removing items found in characterization surveys. We would expect to discover approximately 12 lab areas that would require remediation during the characterization surveys. It is assumed contamination in these labs would be similar to those described in the previous table (contaminated countertops) and the waste disposal cost of 1 countertop per lab would be \$1,480 and countertop removal would be \$2,859 per lab. So for these 12 lab areas it is expected that the cost for removal and disposal would be \$52,068 and with a 25% contingency is \$65,085. From previous discussion, the cost for removing and disposal of known contaminated items would be \$21,698. Summing the above costs for removal of residual contamination (contaminated countertops) from identified laboratories containing long lived radioactive materials is estimated not to exceed **\$ 86,783**.

Collect All Radioactive Materials, Package and Dispose

An initial step in the decommissioning process, in addition to decommissioning known labs containing contamination, would be to collect all radioactive materials once ordering has ceased. It is estimated there may be 6 labs that could have radioactive materials in use and/or in storage. The table below provides an estimate of disposal costs for initial cleanout of labs using a 1/19/21 quote from our vendor.

<u>Waste Type</u>	<u>Quantity</u>	<u>Cost per Unit</u>	<u>Total Cost</u>
Dry Waste	12 boxes	\$630	\$7,560
Aqueous Liquids	2 drums	\$663	\$1,326
RCRA Haz. Waste	1 drum	\$4,000	\$4,000
Liq. Scint. Vials	4 drums	\$525	\$2,100
Transportation			\$1,100
		Total Cost	\$16,086

Adding a 25% contingency, the estimated cost for the disposal is **\$ 20,108.**

Contaminated Equipment In Impacted Areas

At this time it is estimated that 2 laboratories would be in active use at the time of decommissioning and up to 6 labs that may have material in storage. A conservative estimate of the cost for decontamination and/or disposal of lab equipment is made here. It is conservatively assumed that two refrigerator/freezers used for storage of radioactive materials would be found to be contaminated. As it is not cost effective to decontaminate a refrigerator, an estimated 2 refrigerators could be shipped for disposal as solid waste. The estimated volume is approximately 17.9 ft³ per unit and each unit is estimated to weigh about 225 pounds. The UH waste vendor indicated the current cost for disposal of each unit would be \$1,609 (\$7.15 per pound) for a total of \$3,218. Added to this cost would be other items such as glassware, micro centrifuges, etc., that would not be decontaminated. This equates to an estimate of one half of a 65 gallon box per lab, or 3, 65 gallon boxes of dry waste total. The current estimated cost per box for disposal (100 pounds/box) is \$630 each, for a total of \$1,890. A thirty gallon aqueous liquid is assumed to weigh 125 pounds (12 one gallon bottles per drum). The total estimate for lab cleanout is \$ 5,108. When adjusted for a 25% contingency, is **\$6,385.** This is a conservative estimate based in part on the Veteran's Administration Building #5 decommissioning experience.

Decommissioning Labs Found to Have sink/Drain Contamination

The 4 historically contaminated areas identified and described previously in this plan did not indicate any sink contamination. UH encourages users not to dispose of radioactive materials into the sanitary sewerage system. Records indicate that this is generally followed based on the volumes of liquid waste picked up during routine waste removal operations. In addition, data collected from the decommissioning activities performed at the Veteran's Administration Building #5 and decommissioning of the radioactive waste storage facility indicated no sink or hood contamination. It is therefore assumed that this would be a minimal cost. The estimated cost of decommissioning a sink and drain provided in NUREG/CR-6477 of \$900 per sink and drain, adjusted using a consumer price index correction factor of 1.77 is \$1,593 per unit. A minimal waste disposal cost of \$100 per unit is added.

Adding a 25% contingency, the final cost per unit is \$2,116. An arbitrary 4 sink/drain units have been included as a potential decommissioning cost resulting in an estimate of **\$ 8,465** for this task.

Decommissioning Hoods and Ductwork

UH has documented one hood system decontamination due to the presence of 14-C. This contamination was below the DCGL for 14-C. The system, including 140 feet of ductwork, was decontaminated by a contractor and generated less than 2 ft³ of dry waste. This was done during March, 1996, at a cost of \$25,382. For the purposes of this decommissioning plan, it was assumed that one system might be found during the characterization survey. The \$25,382 for one hood system adjusted to present dollars, using a consumer price index factor of 2.03, would be \$51,526 and corrected for a 25% contingency would be \$64,407. Waste disposal would cost approximately \$95 per hood system and after a contingency adjustment would be \$193 for a total of **\$64,600**.

Incidental Supplies and Equipment

The Office of Radiation Safety possesses all the equipment and facilities to accomplish the decommissioning, except for the instances noted above. It is assumed here that the budgeted incidental supply expense should not be more than the annual Office of Radiation Safety operating expenses budget. For FY 2020/2021 this budget for supplies was approximately \$1,578. This expense would probably not be an additional expense incurred due to a decommissioning but is included here as a contingency measure. Adding a 25% contingency results in a cost of **\$1,973**.

VIII. Decommissioning Costs for Removal of Sealed Sources

At the time of this writing UH possesses three 137-Cs gammacell irradiators, one 137-Cs gamma instrument calibration source and many low activity check sources. UH has recent experience with removal of a gammacell irradiator and disposal of various low and high activity sealed sources. This decommissioning plan utilizes this historic data and is corrected for contingency and consumer price index. Details regarding the activity of these sources are not provided here for security reasons.

Gammacell Irradiators

UH currently has 3 high activity 137-Cs gammacell irradiators that would be returned to the vendor should full decommissioning be required. UH received a quote for removal of these three irradiators from the vendor on 9/2/2021. The cost of removal of the three irradiators is **\$329,974**. Implicit in this analysis is that none of the irradiators could be transferred to another NRC or agreement state licensee.

137-Cs Instrument Calibrator and Other Low Activity Sources

The assumption is made that this unit would not be transferred to another licensee. This self shielded unit would be disassembled and placed in a dry waste container as specified by the UH radioactive waste vendor. This work can be done safely by Nuclear Technicians or Office of Radiation Safety staff. UH has recent experience with disposal of sources of similar activity. A representative package of sealed sources was disposed during April of 2014 for a cost of \$30,810. The estimated cost of disposal using a consumer price index correction factor of 1.21 and a 25% contingency results in a cost of **\$46,600**.

IX. Summary of Decommissioning Costs as of 10/4/2021

The following table provides a summary of estimated costs for each task and a summary of the total cost for decommissioning the UConn Health Campus.

<u>Task Description</u>	<u>Estimated Cost</u>
Disposal Cost to Decommission Areas Known To Be Contaminated or Identified During Characterization Surveys	\$86,783
Disposal of Collected Radioactive Materials	\$20,108
Disposal of Contaminated Equipment	\$6,385
Disposal of Sinks/Drains Found Contaminated During Characterization Surveys	\$8,465
Disposal of Hoods/Ductwork Found Contaminated During Characterization Surveys	\$64,600
Removal and Disposal of 3 Gammacells	\$329,974
Disposal of Calibration Sources	\$46,600
Incidental Equipment & Supplies	\$1,973
Historical Site Assessment by RSO	\$33,480
Calibrate Instrumentation by a Nuclear Tech	\$1,612
Collection of all Radioactive Materials by a Nuclear Tech	\$322
Equipment and Lab Supply Surveys By a Nuclear Tech	\$44,416
Characterization Surveys By a Nuclear Tech	\$274,939
Decontamination of Potentially Contaminated Labs by a Nuclear Tech	\$3,868

Decontamination of Known Contaminated Labs by a Nuclear Tech	\$1,289
Final Status Surveys of Decontaminated Labs by a Nuclear Tech	\$12,570
Preparation and Submittal of Summary Document to NRC for License Termination By an RSO	\$5,580

Summing the above costs the estimated total cost to fully decommission the UConn Health Campus is estimated to be **\$942,964.**

James Fomenko, CHP, ARSO
Office of Radiation Safety
10/4/2021