Unified Decommissioning Funding Plan For The Pennsylvania State University Radiation Facilities At University Park, Hershey Medical Center, And Related Campuses

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Prepared by

Jeffrey Leavey Radiation Safety Officer, University Park

Steve King Radiation Safety Officer, Hershey Medical Center

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Introduction and Executive Summary

This decommissioning funding plan (DFP) was prepared using NUREG-1757 Volume 3 Rev 1 (2012) as a guidance document. The section designations correspond to the numbering system used in Appendix A.3 of the NUREG.

The Pennsylvania State University comprises 23 major campuses spread across the state as shown in Figure 1 (note that the Penn College of Technology is not under Penn State's Environmental Health and Safety oversight and thus is not counted in the list of supported campuses shown on the map). However, the use of radioactive materials is limited to the following 6 locations by either a PA state license or by an NRC license:

- 1. University Park Campus (UP) the main campus (PA and NRC licenses)
- 2. Penn State Breazeale Nuclear Reactor (PSBNR) at UP (NRC license)
- 3. Altoona Campus (UP PA license)
- 4. Harrisburg Campus (UP PA license)
- 5. Penn State Electro-Optical Center, Freeport (UP PA license)
- 6. Penn State Hershey Medical Center (PSHMC) (PA license).

Of these six locations, only three regularly utilize radioactive material: University Park, the Hershey Medical Center, and the Breazeale reactor. The Harrisburg campus, while an authorized place of use under the UP PA state license, has only one laboratory that has only ever utilized P-32 once in the month of November 2013. The Altoona campus has only one laboratory using nanocurie amounts of Al-26 and they have been inactive for the past few years.

There are five licenses that are held by Penn State University:

License Number	Issuing Agency	Brief Description and Campus Location	DFP Appendix
PA-0100	PA DEP	Broad scope byproduct materials, UP & others	A
PA-0127	PA DEP	Broad scope byproduct materials, PSHMC campus	В
PA-0127A	PA DEP	Self-shielded irradiator license, PSHMC campus	C
SNM-95	NRC	Special Nuclear Materials, UP campus	D
R-2	NRC	Research and Test Reactor license, UP campus	E

Because of the disparate geographical and radioactive material usage differences between the licenses, each has been separated into a self-contained appendix to this document. The Pennsylvania Department of Environmental Protection Bureau of Radiation Protection (PA DEP) will want to review Appendix A, B, and C. The Nuclear Regulatory Commission will want to review Appendix D and E.

The method for estimating decommissioning costs was changed in December 2012 when an update to 10 CFR 30.35.(e).(1).(i).(A) now requires costs estimates to be based on the cost of an independent contractor to perform all decommissioning activities. The cost estimates in this DFP reflect this change.

Records of information important to the decommissioning of Penn State's licenses are retained at the University Park Environmental Health and Safety offices and at the Health Physics offices at the Hershey Medical Center.



The decommissioning cost estimates for each license, individually and combined, are as follows:

Penn State University Unified Decommissioning Cost Estimate				
License	Туре	DFP Appendix	Estimated Cost (\$)	
PA-0100	Broad Scope	A	\$3,605,705	
PA-0127	Broad Scope	В	\$3,537,176	
PA-0127A	Irradiator	С	\$455,623	
SNM-95	Special Nuclear Materials	D	\$356,776	
R-2	Reactor	E	\$16,031,304	
	Penn State University TOTAL \$23,986,584			

Basic Assumptions Common to All DFPs

Several assumptions must be made to estimate the cost of decommissioning the facilities under each license. The assumptions common to all licenses are listed below while assumption specific to a license are contained in that license's appendix.

1. Compliance with 10 CFR 20.1402.

The operations plans and the cost estimates are based upon meeting the release limit of 10 CFR 20.1402. This release limit requires that "residual radioactivity that is distinguishable from background radiation results in a TEDE to an average member of the critical group that does not

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exceed 25 mrem per year."

2. One license is terminated at a time.

It is very unlikely that multiple, or all, licenses would be terminated at the same time. Because of shifts in the focus of research utilizing radioactive material over time, it is much more probable that only one license would be terminated at any one time. Normally Penn State staff would be available for decommissioning work in these instances; however, this DFP assumes an independent contractor will perform all work.

- 3. Decommissioning estimates are based on current inventory and use locations. While each license may allow a larger selection of isotopes and activities than presently in use, this DFP is based on current inventories and use locations. As required by NRC regulations, the DFP will be updated every three years to reflect the future status of inventories and locations.
- 4. Prior decommissioned use locations are not included. Related to assumption 3, laboratories and use locations which are no longer authorized for radioactive material work are surveyed and inspected by Radiation Safety staff. Location owners are required to have all radioactive material removed and to clean their facilities and equipment to background levels. Once verified by Radiation Safety staff to be releasable, the space is deposted and allowed to be unrestricted space. These locations are not included in this DFP.
- 5. Penn State University will continue a "clean operations" policy. In accordance with 10 CFR 20.1406(c), Penn state will continue its long-standing policy of maintaining use locations in "un-restricted release" condition. This means that whenever a room, area, or major piece of equipment becomes contaminated, it is cleaned or disposed of, as appropriate, soon after discovery. Penn State can support this assumption by review of many years of survey data that show our laboratories do not have significant contamination issues. This "clean operations" policy is also in effect at the Hershey Medical Center. This policy will reduce the actual costs of decommissioning.
- 6. No remodeling costs are included.

Decommissioning costs do not include removal or disposal of non-radioactive structures or materials beyond that necessary to terminate the radioactive material license. Costs are not included for replacing hoods or bench-tops that were removed due to contamination. No follow-up costs for remodeling and renovation are included in these estimates.

7. No credit for salvage.

No credit is taken for salvage of equipment or materials that would likely be sold or transferred to another licensee, nor is credit taken for sale of non-radioactive use items.

8. No license amendments required.

No license amendments are expected for decommissioning. All activities are within the normal scope of tasks currently performed on a regular basis in accordance with established written procedures. If these tasks are performed by Penn State employees or by an outside group, the tasks are expected to be commensurate with normal activities.

9. Vendors will ship Type B materials.

Large activity sources that require Type B shipping containers will be shipped by outside vendors in accordance with the disposal methods currently used. No costs are included for writing and documenting a quality assurance plan. The outside vendor(s), specifically licensed to perform this work, will perform the packaging and shipping of the material.

10. Decommissioning of buildings.

Buildings in which "... no principal activities under the license have been conducted for a period of 24 months ..." are decommissioned in accordance with 10 CFR 30.36.(d).(3). Generally, it is infrequent that a building that had radioactive materials labs is decommissioned because labs do not terminate their use often. When a building is decommissioned its hoods, ducts, and sinks are checked for contamination, all labels and tags are removed, and a report is filed confirming compliance with 10 CFR 20.1402. This building report relies heavily upon the agglomeration of individual room decommissioning reports and is available for inspection.

11. A licensed radioactive waste site is available.

This DFP must be based upon the assumption that the shipment of radioactive waste is possible. Penn State currently has the ability to store waste for about six years prior to shipping, but decommissioning can only be accomplished if a low-level radioactive waste disposal facility is available.

12. DOE will accept the return of their materials.

Certain sources and materials must be returned to the Department of Energy for disposal. If the DOE refuses to receive this material then long-term storage costs may be significant; these costs are not included.

13. Waste on hand equals one year's waste generation.

This DFP assumes that one year's worth of normal operations waste is already on hand and waiting disposal at the start of decommissioning. Added to this amount will be the decommissioning waste so that the total amount of rad waste will be slightly larger than just from decommissioning only.

Reasons for the Differences in Cost Estimates With This DFP

The difference in cost estimates between this DFP and prior DFPs are due to these factors:

- 1. The current DFP is now required to be based on a third party contractor performing all work. Prior DFPs assumed that Penn State HP staff would be available to perform surveys, waste handling, and record keeping activities.
- 2. Prior UP and PSHMC DFPs assumed that only a small fraction of labs and/or facilities would need decontamination based on Penn State's policy of "*no contamination*". The current UP and PSHMC DFPs assumes that all labs and facilities will require decontamination efforts and

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generate the associated wastes.

- 3. New and conservative costs for irradiator disposal at UP were taken from 2013 estimates of irradiator disposal at PSHMC.
- 4. In prior DFPs labor rates were based on Penn State staff salaries covering labor costs. With the change to a third party contactor, higher labor rates based on current market conditions were used in the current DFP.
- 5. Following the outline of NUREG-1757 Volume 3 Rev 1 (2012) Appendix A.3 caused additional costs to be included that were not included in prior DFPs.
- 6. For the Breazeale Reactor Facility, although the facility-specific cost estimate (see DFP Appendix E) is in agreement with other reactors, the Georgia Institute of Technology decommissioning cost continues to be the worst case scenario and thus Penn State will continue to use that cost for this DFP.

<u>APPENDIX D – University Park SNM-95 NRC License</u>

Section A.3.4 Facility Description

License Numbers and Types

The Pennsylvania State University maintains license number SNM-95 issued by the Nuclear Regulatory Commission a Special Nuclear Materials (SNM) license.

Types and Quantities of Materials Authorized

The following are the licensed materials and quantities permitted under SNM-95:

	Table 1 – SNM-95 License Summary				
Line Item	Isotope	Form	Allowed Quantity		

Description of How Licensed Materials Are Used



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be five (5).

Routine surveys are performed by Radiation Protection staff once per calendar quarter to assure that safe working conditions are maintained. Normal operating procedures require that radioisotope laboratories minimize contamination. Typically, surveys show no removable contamination above background (approximately < 50 dpm/100cm²) on surfaces and equipment using liquid scintillation counting (LSC) and Geiger meters. Penn State maintains a "*no contamination*" policy and any finding above background is promptly addressed and decontaminated.

Because of this continuous characterization of the radiation environment, normal decommissioning typically requires only the removal of radioactive materials, or solutions, and radioactive waste consisting of paper, plastic, and glass lab ware followed by appropriate surveys of the facility and equipment. Decommissioning surveys are a routine part of the radiation safety program when authorized users either relocate or terminate.

Description of Facilities

The Pennsylvania State University is a large educational institution serving more than 45,000 students and more than 2500 faculty. Research under this license takes place in three (3) buildings exclusively at the University Park (UP) campus. Some buildings share both educational and research missions; others are designed as research laboratory buildings. Within a building, the use of radioactive material can be in many or just a few locations as approved by the University Isotopes Committee. As the type and emphasis of research changes over time, the occupancy of a building may also change and interior spaces are often remodeled.

Table 2 – Buildings and Rooms					
Campus	Building	Use	Number of <u>Unsealed</u> Rooms		
		TOTAL Rooms	5		

Within any given approved laboratory space, researchers are encouraged to limit work with radioactivity to as small an area as possible, e.g. one bench top. Individual instruments and equipment that are used to store or process radioactive samples are labeled with a Caution Radioactive Material label.

In summary, standard operating procedure is to protect the bench surfaces from contamination with absorbent material. Generally, no liquids are disposed of via laboratory sinks but are collected for disposal by Radiation Protection staff. Only accidental or incidental (e.g. glassware washing, etc.) discharge via a laboratory sink is permitted unless sink disposal is approved by the University Isotopes Committee (UIC).

a Reference Laboratory (RL) will be defined. This generic laboratory consists of a single room used for performing research with radioactive materials as well as non-radiological research. Actual room sizes vary between approximately 100 ft² to 1500 ft² and the RL will be assumed to be 600 ft² (20 ft wide by 30 ft deep by 10 ft high). Section A.3.5 contains more detail as to the contents of a RL.

Radioactive Waste On-Hand Before Decommissioning

All wastes with less than or equal to 120 day half-life are held for decay for at least 10 half-lives, then surveyed and released as non-radioactive waste. Liquid wastes with half-lives greater than 120 days are disposed via sanitary sewer by Radiation Protection staff to ensure that legal release limits are not exceeded. All other long lived wastes are shipped to an appropriate waste disposal facility.

There are no SNM wastes on-hand prior to decommissioning. Since some wastes will be generated during decommissioning, the wastes costs are based on the prior three years of waste shipment data:

Table 3 – Waste History						
Year	Number of Containers	Isotopes	Total Activity (mCi)	Volume	Weight	Total Shipment Cost
2011	5 Cardboard Boxes	H-3, C-14, U(Nat), Fe-	72.6 mCi	78 ft^3 (15.6 ft^3 per	581 lb	

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	(DAW)	55, Cs-137, Co-60, Na- 22, Zn-65, Ca-45		box)		
	5 Fiber Drums (30 gal)	Fe-55 (LSC Vials)	0.02 mCi	20.5 ft ³ (4.1 ft ³ per drum)	293 lb	
	1 Drum (55 gal) drum	H-3,C- 14,Cs- 137,Co-60, Ni-63, Cr- 51, Co-58, Mn-54, Zn- 65, activated metals	1.8 mCi	7.4 ft ³	206 lb	\$6,403
	<u> </u>					
2012	8 Cardboard Boxes (DAW)	H-3, C-14, Co-60,Cs- 137, Fe-55, U(Nat), Zn- 65, Eu-152, Eu-154, Eu- 155, Ra-226, U-238, Sr- 90	9.4	125 ft ³ (15.6 ft ³ per box)	980 lb	
	1 Drum (55 gal) drum	Co-60, Cs- 137, Eu-152, Eu-154, activated metals	1.7 mCi	7.4 ft ³	143 lb	
	3 Fiber Drums (30 gal)	Fe-55 (LSC Vials)	0.02 mCi	12.3 ft ³ (4.1 ft ³ per drum)	197 lb	\$6,900
		C 14 U 2		·		
2013	12 Cardboard Boxes (DAW)	C-14, H-3, Fe-55, U(Nat), Zn- 65, Co-60, Cs-137	12.2 mCi	187 ft ³ (15.6 ft ³ per box)	1,140 lb	
	3 Fiber Drums (30 gal)	Fe-55 (LSC Vials)	0.2 mCi	$\begin{array}{c} 12.3 \text{ ft}^{3} \\ (4.1 \text{ ft}^{3} \text{ per} \\ drum) \end{array}$	148 lb	
	3 Fiber	<u>H</u> -3	0.2 mCi	3.6 ft ³	58 lb	\$8,500

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Drums	(Animal	(1.2 ft ³ per	
(10 gal)	carcasses)	drum)	

The cost per waste type for the past three years is:

Table 4 – Waste Cost History			
Year	Waste Type	Cost per Cubic Foot	Cost per Pound
2011 Ecology Services, Inc.	Dry Active Waste (DAW)	\$40.22	\$5.40
	Activated Metals	\$181.33	\$6.60
	LSC Vials	\$92.93	\$6.50
2012 Ecology Services, Inc.	Dry Active Waste (DAW)	\$35.12	\$4.48
	Activated Metals	\$133.47	\$7.00
	LSC Vials	\$116.10	\$7.25
2013 Ecology Services, Inc.	Dry Active Waste (DAW)	\$34.22	\$5.61
	LSC Vials	\$81.46	\$6.77
	Animal Carcasses	\$306.11	\$19.00

For easier analysis, the unit costs table above has been rearranged as follows:

Table 5 – Cost per Cubic Foot				
Year	DAW	Metals	LSC	Animals
2011	\$40.22	\$181.33	\$92.93	
2012	\$35.12	\$133.47	\$116.10	
2013	\$34.22		\$81.46	\$306.11

Table 6 – Cost per Pound				
Year	DAW	Metals	LSC	Animals
2011	\$5.40	\$6.60	\$6.50	
2012	\$4.48	\$7.00	\$7.00	
2013	\$5.61		\$6.77	\$19.00

The cost of disposal will be the greatest per pound unit cost of the past three years plus 5%. Therefore, the waste on-hand for this DFP is:

Table 7 – Waste Costs per Pound for DFP				
DAW Metals LSC				
Cost per Pound	\$5.89	\$7.35	\$7.35	

Volume of Contaminated Subsurface Materials

There are no known areas with subsurface contamination associated with this DFP.

Section A.3.5 Number and Dimensions of Facility Components

Type of Space: Reference SNM radioactive material laboratory at Penn State University Park. Average Size: 600 ft² (20 ft wide by 30 ft long by 10 ft high) Level of Contamination: $< 100 \text{ dpm}/100 \text{ cm}^2$

Table 8 – Reference Lab Components				
Component	Number of Components	Dimensions of Component		
Fume Hood	1	5 W x 2 D x 5 H feet		
Lab Rad Benches	3	10 x 3 x 0.25 feet		
Sinks / Drains	1	2 W x 1.5 D x 1 H feet		
Shelving	12	10 x 1.5 feet		
Floors (net exposed ft^2)	1	450 ft^2		
Walls	1	1000 ft ²		
Ceiling Tiles	1	600 ft ²		
Bulk Equipment:				
Waste Containers	3	1.5 x 1.5 x 2.5 feet		
Benchtop Shielding (Plastic)	2	1.5 x 2 x 2.5 feet		
Hand Items (Misc labware)	10			

Section A.3.6 Planning and Preparation (Work Days)

Current Conditions

A third party contractor will be utilized for the decommissioning effort. It is assumed that normal operations continue up until the date the contractor comes on site. The contractor will need to first familiarize themselves with the facility and define the scope of work.

The Radiation Protection Office and Breazeale Nuclear Reactor Facility maintain all records pertinent to the use of radioactive materials under the licenses. These include receipts, inventory, locations of use or storage, waste inventory, personnel, and sealed sources. The records are kept electronically in a database and updated as the record is generated (i.e. inventory is updated as stocks are received; lab survey data is updated soon after the survey is completed, etc.) Laboratory surveys are performed on at least a quarterly basis and paper records kept for at least three years; therefore, a review of these documents will demonstrate the recent levels of contamination which may be expected. Locations of all licensable and generally licensed sealed sources are kept.

Historical Site Assessment

The following records are available in the Radiation Protection Office (RPO) with regard to historical use of radioactive materials:

A) Paper survey reports of laboratories where radioactive material has been used for the past three years. Survey reports are not to scale, but represent the pertinent fixtures and equipment used for radioactive materials work. Surveys may extend to non-use areas and equipment that may be in a particular location. Survey reports typically record the radionuclides recently used and may not reflect all historical uses in a particular location; however, historical purchase records are available.

B) Paper final survey reports of laboratories that have been decommissioned and released for unrestricted use after cessation of radioactive materials use. Survey reports are not to scale, but represent the pertinent fixtures and equipment used for radioactive materials work. Portable equipment released in a final survey report is not identified with specific information such as manufacturer, model or serial number. Once an item of equipment is determined to be free of radioactive contamination, the Caution Radioactive Materials label is removed and it is released to unrestricted use.

C) A listing of all locations by user, nuclides, building and room number where radioactive materials were ever authorized under license.

D) A listing of locations where radioactive materials are currently authorized.

E) A database of all licensable, generally licensed, and sealed sources currently in possession. Sealed sources are inventoried as least semi-annually by the RPO and all disposals of sealed sources are by the RPO. A concerted effort has been made to dispose of sources no longer needed; therefore there should not be any surprise discoveries of sealed sources.

F) Leak test records for all sealed sources.

G) A database of all radioactive waste currently being held in storage, whether for decay-in-storage, or ship-out.

H) Scale floor plans of buildings are maintained by Facilities Management but survey maps used by the RPO show major room components.

Other Activities

In addition to a records review, a visit to a representative sampling of locations will be made to confirm the starting radiological conditions. Based upon the current level of use, Penn State's "*no contamination*" policy, and a review of past surveys showing no contamination in labs, it can be concluded that radiological conditions are already within the release criteria.

The contractor will prepare the actual decommissioning plan for regulatory review. This will define the scope of work, the radiological conditions of the site, and provide a plan for action. Upon approval by

the regulator, a working plan will be developed to include a strategy for systematic decommissioning surveys along with manpower and equipment requirements.

The following table summarizes the work days associated with these activities. The estimates are from Ecology Services, Inc. and Chase Environmental, Inc. and are the worst case values for a particular activity. Other than the characterization activity, all others are independent of the number of laboratories. In addition, the final work days for this step are divided by the number of labs currently in use to obtain the work days per lab, which is the basis for all following tables.

Table 9 – Planning and Preparation Work Days									
Activity	Health Physicist	HP Technician	Clerical	Laborer	Job Supervisor				
Prepare documentation for regulatory agencies	2	1	5		5				
Submittal of decommissioning plan	2	5	3		2				
Development of work plans	2	5	3		1				
Procurement of equipment and supplies	1		1		4				
Staff training	1	2	· 1	2	1				
Characterization of radiological conditions	0.2	3	1		1				
Other (mobilization)	1	1	1	1	1				
Total Days	9.2	17	15	3	15				
Total Days per Lab	1.8	3.4	3	0.6	3				

Section A.3.7 Decontamination or Dismantling of Components (Work Days)

Based upon the continuous survey and decontamination efforts conducted during the normal radiation safety surveillance program, there are few components which might need to be addressed in this category.

Fume hoods -

surface areas and the connection to the exhaust duct. These areas will be wiped for contamination.

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Sinks – Although liquids are collected by the RPO, within a posted laboratory one sink per lab is assumed to possibly be contaminated from accidental spillage in the sink or for personal decontamination. To insure contamination has not lodged in the drain system, the sink traps will be disconnected to survey interior of drain piping.

Type of Space: Reference SNM radioactive material laboratory at Penn State University Park. Average Size: 600 ft² (20 ft wide by 30 ft long by 10 ft high) Level of Contamination: $< 100 \text{ dpm}/100 \text{ cm}^2$

Table 10 -	- Decontaminatio	n or Dismantling	g of Compone	nts Work	Days per L	ab
Component	Decon Method	Health Physicist	HP Technician	Clerical	Laborer	Job Supervisor
Fume Hood	Wipe Down		1		1.	
Lab Rad Benches	Wipe Down		0.5		0.5	
Sinks / Drains	Wipe Down		0.5		0.5	
Shelving	Wipe Down		0.1		0.1	
Floors (net exposed ft ²)	Wipe Down		0.5		0.5	
Walls	Wipe down		1		1	
Ceiling Tiles	Test and Dispose		1		1	
Bulk Equipment:						
	Wipe Down		0.1		0.1	
Waste Containers	Wipe Down		0.1		0.1	
Benchtop Shielding (Plastic)	Wipe Down		0.1		0.1	
Hand Items (Misc labware)	Wipe Down		0.5		0.5	
Other			·.			
(Supervision,		1		1		1
analysis, record		I				1
keeping, etc.)						
Total Days		1	5.4	1	5.4	1

Section A.3.8 Restoration of Contaminated Areas (Work Days)

There are no known areas external to buildings where contamination has occurred for this DFP.

Section A.3.9 Final Radiation Survey (Work Days)

HP Technician activities during the final survey include removal of SNM materials and waste in laboratory, preparing survey documents, taking wipes and performing a meter survey, analyzing wipes, recording wipe and survey results, returning to lab to decontaminate, if needed, and removing radiation labels. HP activities include review of survey results, inspection of laboratory, and signing off on report. Clerical activities include preparation of documents for submission to regulatory authority.

Table 11 – Final Radiation Surveys Work Days per Lab									
Task	Health Physicist	HP Technician	Clerical	Laborer	Job Supervisor				
Final Characterization Surveys	0.1	1	0.1		0.1				
Final Report	0.5	0.5	0.1		0.1				
Total Days	0.6	1.5	0.2		0.2				

Section A.3.10 Site Stabilization Long Term Surveillance (Work Days)

There are no known areas requiring stabilization or long term surveillance for this DFP.

Section A.3.11 Total Work Days By Labor Category

Table 12 – Total Work Days By Labor Category per Lab									
Task	Health Physicist	HP Technician	Clerical	Laborer	Job Supervisor				
Planning and Prep	1.8	3.4	3	0.6	3				
Decontamination	1	5.4	1	5.4	1				
Restoration of Contam Areas	0	0	0	0	0				
Final Rad Survey	0.6	1.5	0.2	0	0.2				
Site Stabilization	0	0	0	0	0				
Total Days	3.4	10.3	4.2	6	4.2				

Section A.3.12 Worker Unit Cost Schedule

Salary and labor rate data for Pennsylvania May 2012 was obtained from: <u>http://www.bls.gov/oes/current/oes_pa.htm#19-0000</u> Life, Physical Social Sci – nuclear technician = \$78,250 Management – construction managers = \$109,540 Office admin support – info and records clerks = \$39,600 Construction laborers = \$35,470 Salary data for CHPs for 2012 was obtained from:

<u>http://www.hps.org/documents/2012_chp_salary_survey.pdf</u> Median CHP salary for the Northeast = \$116,250

Table 13 – Worker Unit Cost Schedule										
Labor Cost Component	Health Physicist	HP Technician	Clerical	Laborer	Job Supervisor					
Salary (\$/yr)	\$116,250	\$78,250	\$39,600	\$35,470	\$109,540					
Fringe Benefits (%)	22%	22%	22%	22%	22%					
Overhead & Profit Rate (%)	30%	30%	30%	30%	30%					
Total cost per Year (\$)	\$184,373	\$124,105	\$62,806	\$56,255	\$173,730					
Travel and Per-Diem per Day	\$175	\$175	\$175	\$175	\$175					
Total Cost per Work Day *	\$884	\$652	\$417	\$391	\$843					
* Based on 260 work days per ye	ear									

Section A.3.13 Total labor Costs by Major Decommissioning Task

Table 14 – Total Labor Costs per Lab									
Task	Health Physicist	HP Tech	Clerical	Laborer	Job Supervisor	Total			
Planning and Prep	\$1591	\$2217	\$1251	\$237	\$2529	\$7825			
Decontamination	\$884	\$3521	\$417	\$2111	\$843	\$7776			
Restoration of Contam Areas	0	0	0	0	0	0			
Final Rad Survey	\$530	\$978	\$83	0	\$169	\$1760			
Site Stabilization	0	0	0	0	0	0			
Total Cost	\$3,005	\$6,716	\$1,751	\$2,348	\$3,541	\$17,361			

To obtain the complete costs, the number of labs (5) is then multiplied by the per lab costs from above.

Table 15 – Total Labor Costs ALL Labs									
Task	Health Physicist	HP Tech	Clerical	Laborer	Job Supervisor	Total			
Planning and Prep	\$7955	\$11085	\$6255	\$1185	\$12645	\$39125			
Decontamination	\$4420	\$17605	\$2085	\$10555	\$4215	\$38880			
Restoration of Contam Areas	0	0	0	0	0	0			
Final Rad Survey	\$2650	\$4890	\$415	0	\$845	\$8800			
Site Stabilization	0	-0	0	0	0	0			
Total Cost	\$15,025	\$33,580	\$8,755	\$11,740	\$17,705	\$86,805			

Section A.3.14 Packing, Shipping, and Disposal of Wastes

Note: Labor costs for waste processing is included in this section and not in the above analysis.

Packaging Material Costs

Because of our "*no contamination*" policy, there would be a minimal amount of waste generated from decommissioning. There are no areas in which protective clothing, other than gloves, need to be worn. Penn State owns enough dry and liquid waste containers to handle all waste on-hand and residual liquid and dry collection beyond the normal waste generation volume. The only waste stream anticipated will be dry waste consisting of wipe down towels, gloves, and miscellaneous paper and/or solid items. Note that no labor costs are associated with packing materials needed. Using the Reference Laboratory, the following packing materials will be needed:

	Table 16 – Packing Material Costs per Lab								
Waste Type	Volume	Number of Containers	Type of Container	Container Unit Cost	Total Packaging Costs				
Dry	15.6 ft ³	1	Fiber Box	\$35	\$35				
Liquid	l gal	1	Plastic	\$0	\$0				
				Total	\$35				

For the total number of labs, 5, the per lab packing material costs are multiplied by 5.

. It is assumed that most of

the materials can be packed with multiple pieces in a drum.

Table 17 – Packing Material Costs ALL Labs									
Waste Type	Volume	Number of Containers	Type of Container	Container Unit Cost	Total Packaging Costs				
Dry	15.6 ft ³	5	Fiber Box	\$35	\$175				
Liquid	30 gal	1	Drum	\$0	\$0				
Drum	55 gal	20	Metal Drum	\$45	\$900				
				Total	\$1,075				

Shipping Costs

Once a laboratory has been decommissioned, there is labor cost associated with the collection of the waste containers from the lab, documenting the shipment, and packing the truck. These costs are addressed below. Note that since all lab wastes will be shipped at one time, the costs shown are for ALL labs.

To calculate the number of standard 40 foot semi-truck loads needed, the volume of a 40 foot trailer (<u>http://www.yrc.com/shippers/semi-trailer-dimensions.html</u>) is 3083 ft³. The total volume to be shipped is:

	Table 18 – Shipping Volume of Wastes ALL Labs							
Waste Type	Unit Volume	Number of Containers (Decomm + On-hand)	Total Volume (ft ³)					
Dry	15.6 ft ³ (Box)	5 + 0 = 5	780					
Liquids	$4 \text{ ft}^3 (30 \text{ gal})$	1 + 0 = 1	4					
Metals	$7.4 \text{ ft}^3 (55 \text{ gal})$	20	148					
		Total	932					

Therefore only one 40 foot truck, or less, will be needed to ship all wastes. The labor costs for handling containers and packing the truck are:

Table 19 – Shipping Labor Costs ALL Labs								
Task	Health Physicist	HP Tech	Clerical	Laborer	Job Supervisor	Total		
Collect Containers From Lab (Work Days per Lab)	0	0.1	0	0.1	0.1	0.3		
Load Truck (Work Days per Lab)	0	0	0	0.1	0.1	0.2		
Documentation (Work Days per Lab)	0.1	0.1	0.1	0	0	0.3		
Subtotal Work Days per Lab	0.1	0.2	0.1	0.2	0.2	0.8		
Total for 5 Labs (Work Days)	0.5	1	0.5	1	1	4		
Cost / Work Day	\$884	\$652	\$417	\$391	\$843			
Total Cost	\$442	\$652	\$209	\$391	\$843	\$2,537		

Shipping costs were provided by Ecology Services, Inc. Note that normally rad waste would ship to Energy Solutions in Oak Ridge, TN (705 miles to TN).

Table 20 – Shipping Costs ALL Labs									
Waste Type	Number of Truckloads	Unit Cost (\$/mile/load)	Surcharges (\$/mile)	Overweight Charges (\$/mile)	Distance Shipped (miles)	Labor Cost (\$)	Total Shipping Costs		
All	1	\$3.60	\$0.50	\$0	705		\$2573		
Labor						\$2537	\$2537		
Truck Rental	1						\$2500		
Total							\$7610		

Waste Disposal Costs

For the Reference Lab, one dry box and one gallon of liquid per lab is assumed to be generated. Historically, the cost per pound is more consistent year to year so this DFP will estimate disposal cost by weight rather than volume. On average, historically each box is assumed to weigh 100 pounds, each 30 gallon drum of liquids is assumed to weigh 175 pounds, and each 55 gallon drum of SNM materials is assumed to weigh 500 pounds.

Table 21 – Waste Disposal Costs ALL Labs				
Waste Type	Total Weight ALL Labs (lb)	Unit Cost (\$/lb)	Surcharges (\$/lb)	Total Disposal Cost
Dry	500	\$5.89	\$0	\$2945
Liquids	175	\$7.35	\$0	\$1286
Metals	10,000	\$7.35	\$0	\$73,500
			Total	\$77,731

Sealed Sources

For the discrete sources, some are owned by the Department of Energy and it is expected that the DOE will accept these sources back to avoid disposal costs. However, for this DFP disposal costs are included to be conservative.

Table 22 – Discrete Source Disposal				
Discrete Sources	Description	Number of Sources	Contracto r Hours	2012 External Vendor Total Charge
			16	\$10000
			40	\$7000
			40	\$21000
		Total Hours	96	
		Total Contractor Charges (\$200/hr)	\$19200	

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Total Other	
Vendor	\$38000
Charges	
Total	\$57,200

Section A.3.15 Equipment and Supply Costs

The only supplies anticipated will be gloves, smears, vials, scintillation fluid. An allowance of \$5000 will be included for these.

No other equipment costs are necessary as Penn State has a sufficient number of survey meters (GM, Nal, alpha, LSC, and neutron) to supply the decommissioning team.

Table 23 – Equipment and Supply Costs			
Equip / Supplies	Quantity	Unit Cost	Total
Survey Supplies			\$5000
		Total	\$5,000

Section A.3.16 Laboratory Costs

It is not anticipated that any analyses will need to be performed by independent third party laboratory.

Table 24 – Laboratory Costs			
Equip / Supplies	Quantity	Unit Cost	Total
Sample Analysis	0		\$0
Total \$0			

Section A.3.17 Miscellaneous Costs

Present methods of waste disposal are through a waste broker and no special licenses or site permits are necessary. Contractors provide proof of insurance before being awarded contracts. The work associated with decommissioning is not taxable by Pennsylvania.

The Nuclear regulatory Commission may bill for regulatory oversight efforts to include final status survey reports, confirmatory survey efforts, department lab, or contractor fees and oversight of license termination activities. An estimate of these costs is included in the following table.

Table 25 – Miscellaneous Costs			
Cost Item	Total		
License fees, insurance, taxes, other	\$0		
NRC oversight	\$50000		
Total	\$50,000		

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Section A.3.18 Total Decommissioning Costs

This estimate does not take credit for any salvage value that might be realized from the sale of potential assets.

Table 26 – Total Decommissioning Costs			
Task/Component	Cost	Percentage	
Planning and Preparation (Table 15)	\$39,125	14%	
Decontamination/Dismantling (Table 15)	\$38,880	14%	
Restoration (Table 15)	\$0	0%	
Final Rad Survey (Table 15)	\$8,800	3%	
Site Stabilization (Table 15)	\$0	0%	
Packing Material Costs (Table 17)	\$1,075	0.4%	
Shipping Costs (Labor and transport) (Table 20)	\$7,610	3%	
Waste Disposal Costs (Table 21)	\$77,731	27%	
Discrete Source Disposal (Table 22)	\$57,200	20%	
Equipment Costs (Table 23)	\$5,000	2%	
Laboratory Costs (Table 24)	\$0	0%	
Miscellaneous Costs (Table 25)	\$50,000	17%	
Subtotal	\$285,421	100%	
25% Contingency	\$71,355		
Total Decommissioning Cost Estimate	\$356,776		

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