

Yale Environmental Health & Safety

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May 30, 2018

Br. D.

Mr. Steven Courtemanche
U.S. NRC Region I
2100 Renaissance Blvd., Suite 100
King of Prussia, PA 19406-2713

REC#G1053148#M1033

Subject: 3 Year Update to Decommissioning Funding Plan
Yale University Broadscope License # 06-00183-03 *103000582*

Dear Mr. Courtemanche,

Per 10CFR30.35, the Decommissioning Funding Plan (DFP) for Yale University license #06-00183-03 (Broadscope license) has been reviewed and updated. Please accept this letter and the attached tables as our three-year update to this DFP.

Please note that our review included consideration of spills, waste inventory, waste disposal costs, facility modifications, current labor costs and changes in possession limits. This review determined that the basic assumptions listed in the original 2015 DFP are still accurate and thus remain unchanged. Some changes were determined to be warranted for the NUREG – 1757 Appendix A tables which in turn affect our decommissioning cost estimate. These updated tables are thus provided as part of this submittal.

The significant updates made to the cost estimation tables include:

1. The number of active radioactive material use spaces at Yale University has diminished over the last three years by about 10%.
2. Consultation with an outside decommissioning contractor indicated that labor costs have increased by about 2% a year. Labor cost estimates in the DFP were thus increased by 8%.
3. Radioactive waste costs have been stable and have not increased at Yale University since the submission of the original 2015 DFP. However, consultation was made with Yale's radioactive waste disposal vendor and in anticipation of costs likely increasing with Yale's next radioactive waste disposal contract renewal, waste shipping and disposal costs associated with the DFP were increased by 4%.
4. Per diem rates for lodging and food were updated to reflect 2018 figures.

Decommissioning costs are estimated in the tables numbered A.3.5-A.3.18 provided along with this letter. Table numbers follow those established in NUREG 1757 Volume 3 and Yale's originally submitted 2015 plan. An additional 25% contingency fund is added as a safety factor in table A.3.18 as per NRC guidance, resulting in a new decommissioning cost estimate of \$1,055,725.64. This cost estimate is very similar to the original DFP submitted 3 years ago differing by less than 2%.

A chart summarizing the estimated decommissioning costs is provided here:

608988
NUCLEAR MATERIALS-CO2

Total Decommissioning Costs - Summary

| Yale University Restricted Areas | 2015 Estimated Cost (\$) | 2018 Estimated Cost (\$) |
|--|---------------------------------|---------------------------------|
| Planning and Preparation | 271,095.76 | 267,329.22 |
| Decontamination & Dismantling of Radioactive Facility Components (glove boxes, hoods, bench tops, air filtration systems, etc) | 26,418.80 | 25,742.48 |
| Final Radiation Survey | 20,031.69 | 19,106.52 |
| Waste Disposal | 382,373.78 | 364,630.79 |
| Equipment and Supply | 33,750.00 | 35,420.50 |
| Laboratory | 75,340.00 | 79,107.00 |
| Miscellaneous | 52,326.00 | 53,244.00 |
| Sub-total | 861,336.03 | 844,580.51 |
| 25% Contingency | 215,334.00 | 211,145.13 |
| Total | 1,076,670.03 | 1,055,725.64 |

Once the NRC approves of this latest decommissioning cost estimate, Yale's financial assurance documents will be updated accordingly. Yale University's financial assurance documents are updated every September.

I can be reached at 203.737.2140 or via email at tammy.stemen@yale.edu with any questions or comments.

Sincerely,



Tammy Stemen, CHP
Radiation Safety Officer

Table A.3.5 Number and Dimensions of Facility Components

Use this table to summarize relevant features of the facility. Copy and complete the table as necessary for each room, laboratory, or area. Rooms, laboratories, or areas with similar levels of contamination may be consolidated in one table.

| Room/Location | Room | | | |
|---|----------------------|--|--|---|
| Component | Number of Components | Dimensions of Each Component (ft ²) ^a | Total Dimensions (ft ²) for scanning purposes ^b | Total Dimensions (ft ³) for waste management purposes |
| Glove Boxes | | | | |
| Fume Hoods* | | | | |
| Lab Benches** | | | | |
| Sinks*** | | | | |
| Drains and Piping*** | | | | |
| Floors**** | | | | |
| Walls† | | | | |
| Ceilings†† | | | | |
| Ventilation/Ductwork ‡ | | | | |
| Hot Cells | | | | |
| Incubators ¹ | | | | |
| Refrigerators ¹ | | | | |
| Freezers ¹ | | | | |
| Storage Units/Cabinets ¹ | | | | |
| Radwaste Areas | | | | |
| Biosafety Cabinets ^{1,*} | | | | |
| Desks ¹ | | | | |
| Other Equipment ¹ (specify) | | | | |
| Totals | | | | |
| Contaminated Area/Volume, Estimate² | | | | |

| Assumptions |
|--|
| * - Fume hoods are assumed to be 2.5 ft x 6 ft by 8 ft for disposal cost estimate. |
| ** - All lab benches combined into single unit and are 2.5 feet wide and 0.25 feet thick unless otherwise noted. Bench area assumed equal to 25% of the total lab area. All drawers in lab benches are surveyed. This will triple the surface area to be surveyed due to an assumption that there are, on average, two drawers for the full length of all bench space. Benches are assumed to be 36" in height for the purposes of estimating volume for waste disposal costs. |
| *** - All sinks are 4 ft ² unless otherwise noted and are assumed to be 36" in height for the purposes of estimating volume for waste disposal costs. |
| **** - "Dimensions of Components" information is total lab dimensions assuming lab is empty. "Total Dimensions" information is the floor "Dimensions of Component" minus area taken by fume hoods, benches, and sinks. Other equipment and desks are assumed to be removable, allowing floor underneath to be surveyed. |
| † - Walls are considered one unit, surveyed to a height of 6 feet, unless otherwise noted, and includes doors. Assumes all wall surfaces are surveyed, including walls behind permanent fixtures such as benches and hoods. |
| †† - Ceilings are not surveyed unless otherwise noted. |
| ‡ - Ventilation/Ductwork is assumed to be 8 feet in length from hood to ceiling at 4 ft ² surface area per linear foot. |
| ¹ - Equipment dimensions are units of ft ³ . This equipment will be completely surveyed (interior and exterior). Cubic foot dimension also used to estimate waste disposal costs. |
| ^a - This column not used for equipment. |
| ^b - Outer dimensions of equipment were doubled for the purposes of estimating area to be surveyed for scanning purposes. |

Table A.3.5 Number and Dimensions of Facility Components

Use this table to summarize relevant features of the facility. Copy and complete the table as necessary for each room, laboratory, or area. Rooms, laboratories, or areas with similar levels of contamination may be consolidated in one table.

Room/Location

235 Small Labs

| Component | Number of Components | Dimensions of Each Component (ft ²) ^a | Total Dimensions (ft ²) for scanning purposes ^b | Total Dimensions (ft ³) for waste management purposes |
|---|----------------------|--|--|---|
| Glove Boxes | 0 | | | |
| Fume Hoods* | 353 | 166.00 | 58598.00 | 42360.00 |
| Lab Benches** | 235 | 108.00 | 25380.00 | 6345.00 |
| Sinks*** | 470 | 4.00 | 1880.00 | 5640.00 |
| Drains and Piping*** | | | | |
| Floors**** | 235 | 70.00 | 16450.00 | 493.50 |
| Walls† | 235 | 288.00 | 20160.00 | 604.80 |
| Ceilings†† | | | | |
| Ventilation/Ductwork ‡ | 353 | 32.00 | 11296.00 | |
| Hot Cells | | | | |
| Incubators ¹ | 353 | 32.00 | 11296.00 | 4236.00 |
| Refrigerators ¹ | 353 | 65.00 | 22945.00 | 10590.00 |
| Freezers ¹ | 294 | 65.00 | 19110.00 | 8820.00 |
| Storage Units/Cabinets ¹ | 0 | | | |
| Radwaste Areas | 0 | | | |
| Biosafety Cabinets ^{1,*} | 118 | 72.00 | 8496.00 | 4248.00 |
| Desks ¹ | 940 | 16.00 | 15040.00 | 37600.00 |
| Other Equipment ¹ (specify) | | | | |
| Totals | | | 210651.00 | 120937.30 |
| Contaminated Area/Volume, Estimate² | | | 21065.10 | 604.69 |

| Assumptions |
|---|
| * - Fume hoods are assumed to be 2.5 ft x 6 ft by 8 ft for disposal cost estimate. Interior of fume hoods are surveyed. |
| ** - Lab benches combined into single unit and are 2.5 feet wide and 0.25 feet thick unless otherwise noted. Bench area assumed equal to 25% of the total lab area. All drawers in lab benches are surveyed. This will triple the surface area to be surveyed due to an assumption that there are, on average, two drawers for the full length of all bench space. Benches are assumed to be 36" in height for the purposes of estimating volume for waste disposal costs. |
| *** - All sinks are 4 ft ² unless otherwise noted and are assumed to be 36" in height for the purposes of estimating volume for waste disposal costs. |
| **** - "Dimensions of Components" information is total lab dimensions assuming lab is empty. Small labs are 12' x 12'. "Total Dimensions" information is the floor "Dimensions of Component" minus area taken by fume hoods, benches, and sinks. Other equipment and desks are assumed to be removable, allowing floor underneath to be surveyed. |
| † - Walls are considered one unit, surveyed to a height of 6 feet, unless otherwise noted, and includes doors. Assumes all wall surfaces are surveyed, including walls behind permanent fixtures such as benches and hoods. |
| †† - Ceilings are not surveyed unless otherwise noted. |
| ‡ - Ventilation/Ductwork is assumed to be 8 feet in length from hood to ceiling at 4 ft ² surface area per linear foot. |
| ¹ - Equipment dimensions are units of ft ³ . This equipment will be completely surveyed (interior and exterior). Cubic foot dimension also used to estimate waste disposal costs. Desks assumed to be 4' x 2' x 2.5'. Each small lab assumed to have 1.5 fume hoods, 5 lab benches, 2 sinks, 1.5 refrigerator (65 ft ² ; 30 ft ³ per) 4 desks (20 ft ² , 2.5 ft ³ per), 1.5 incubators (32 ft ² ; 12 ft ³ per), 1.25 freezers (65 ft ² ; 30 ft ³ per), and 0.5 biosafety cabinets (72 ft ² ; 36 ft ³). |
| ^a - This column not used for equipment. |
| ^b - Outer dimensions of equipment were doubled for the purposes of estimating area to be surveyed for scanning purposes. |

Table A.3.5 Number and Dimensions of Facility Components

Use this table to summarize relevant features of the facility. Copy and complete the table as necessary for each room, laboratory, or area. Rooms, laboratories, or areas with similar levels of contamination may be consolidated in one table.

Room/Location

97 Large Labs

| Component | Number of Components | Dimensions of Each Component (ft ²) ^a | Total Dimensions (ft ²) for scanning purposes ^b | Total Dimensions (ft ³) for waste management purposes |
|---|----------------------|--|--|---|
| Glove Boxes | 0 | | | |
| Fume Hoods* | 316 | 166.00 | 52456.00 | 37920.00 |
| Lab Benches** | 97 | 1050.00 | 101850.00 | 25462.50 |
| Sinks*** | 243 | 4.00 | 972.00 | 2916.00 |
| Drains and Piping*** | | | | |
| Floors**** | 97 | 975.00 | 94575.00 | 2837.25 |
| Walls† | 97 | 936.00 | 90792.00 | 2723.76 |
| Ceilings†† | | | | |
| Ventilation/Ductwork ‡ | 316 | 32.00 | 10112.00 | |
| Hot Cells* | 8 | 166.00 | 1328.00 | 960.00 |
| Incubators ¹ | 194 | 32.00 | 6208.00 | 2328.00 |
| Refrigerators ¹ | 217 | 65.00 | 14105.00 | 6510.00 |
| Freezers ¹ | 194 | 65.00 | 12610.00 | 5820.00 |
| Storage Units/Cabinets ¹ | 0 | | | |
| Radwaste Areas | 0 | | | |
| Biosafety Cabinets ^{1,‡} | 25 | 72.00 | 1800.00 | 900.00 |
| Desks ¹ | 630 | 16.00 | 10080.00 | 25200.00 |
| Other Equipment ¹ (specify) | | | | 0.00 |
| Totals | | | 396888.00 | 113577.51 |
| Contaminated Area/Volume, Estimate² | | | 39688.80 | 567.89 |

| Assumptions |
|--|
| * - Fume hoods and hot cells are assumed to be 2.5 ft x 6 ft by 8 ft for disposal cost estimate. Interiors are surveyed, doubling exterior area for purposes of estimating labor for scanning purposes. |
| ** - All lab benches combined into single unit and are 2.75 feet wide and 0.25 feet thick unless otherwise noted. Bench area assumed equal to 25% of the total lab area. All drawers in lab benches are surveyed. This will triple the surface area to be surveyed due to an assumption that there are, on average, two drawers for the full length of all bench space. Benches are assumed to be 36" in height for the purposes of estimating volume for waste disposal costs. |
| *** - All sinks are 4 ft ² unless otherwise noted and are assumed to be 36" in height for the purposes of estimating volume for waste disposal costs. |
| **** - "Dimensions of Components" information is total lab dimensions assuming lab is empty. Large labs are 28' x 50'. "Total Dimensions" information is the floor "Dimensions of Component" minus area taken by fume hoods, benches, and sinks. Other equipment and desks are assumed to be removable, allowing floor underneath to be surveyed. |
| † - Walls are considered one unit, surveyed to a height of 6 feet, unless otherwise noted, and includes doors. Assumes all wall surfaces are surveyed, including walls behind permanent fixtures such as benches and hoods. |
| †† - Ceilings are not surveyed unless otherwise noted. |
| ‡ - Ventilation/Ductwork is assumed to be 8 feet in length from hood to ceiling at 4 ft ² surface area per linear foot. |
| ¹ - Equipment dimensions are units of ft ³ . This equipment will be completely surveyed (interior and exterior). Cubic foot dimension also used to estimate waste disposal costs. Desks assumed to be 4' x 2' x 2.5'. Each large lab assumed to have 3.25 fume hoods, 6.5 lab benches, 2.5 sinks, 2.25 refrigerators (65 ft ² ; 30 ft ³), 6.5 desks (20 ft ² , 2.5 ft ³ per), 2 incubators (32 ft ² ; 12 ft ³), 2 freezers (65 ft ² ; 30 ft ³), and 0.25 biosafety cabinets (72 ft ² ; 36 ft ³). |
| ^a - This column not used for equipment. |
| ^b - Outer dimensions of equipment were doubled for the purposes of estimating area to be surveyed for scanning purposes. |

Table A.3.5 Number and Dimensions of Facility Components

Use this table to summarize relevant features of the facility. Copy and complete the table as necessary for each room, laboratory, or area. Rooms, laboratories, or areas with similar levels of contamination may be consolidated in one table.

Room/Location

44 Equipment Rooms

| Component | Number of Components | Dimensions of Each Component (ft ²) ^a | Total Dimensions (ft ²) for scanning purposes ^b | Total Dimensions (ft ³) for waste management purposes |
|---|----------------------|--|--|---|
| Glove Boxes | 0 | | | |
| Fume Hoods | 0 | | | |
| Lab Benches | 0 | | | |
| Sinks*** | 1 | 4.00 | 4.00 | 12.00 |
| Drains and Piping*** | | | | |
| Floors**** | 44 | 60.00 | 2640.00 | 79.20 |
| Walls† | 44 | 192.00 | 8448.00 | 253.44 |
| Ceilings†† | | | | |
| Ventilation/Ductwork ‡ | 0 | | | |
| Hot Cells | 0 | | | |
| Incubators ¹ | 66 | 32.00 | 2112.00 | 792.00 |
| Refrigerators ¹ | 44 | 65.00 | 2860.00 | 1320.00 |
| Freezers ¹ | 66 | 65.00 | 4290.00 | 1980.00 |
| Storage Units/Cabinets ¹ | 0 | | | |
| Radwaste Areas | 0 | | | |
| Biosafety Cabinets ^{1,*} | 0 | | | |
| Desks ¹ | 0 | | | |
| Other Equipment ¹ (specify) | | | | |
| Totals | | | 20354.00 | 4436.64 |
| Contaminated Area/Volume, Estimate² | | | 2035.40 | 22.18 |

| Assumptions |
|--|
| * - Fume hoods are assumed to be 2.5 ft x 6 ft by 8 ft for disposal cost estimate. Interior of fume hoods are surveyed. |
| ** - Lab benches combined into single unit and are 2.5 feet wide and 0.25 feet thick unless otherwise noted. Bench area assumed equal to 25% of the total lab area. All drawers in lab benches are surveyed. This will triple the surface area to be surveyed due to an assumption that there are, on average, two drawers for the full length of all bench space. Benches are assumed to be 36" in height for the purposes of estimating volume for waste disposal costs. |
| *** - All sinks are 4 ft ² unless otherwise noted and are assumed to be 36" in height for the purposes of estimating volume for waste disposal costs. |
| **** - "Dimensions of Components" information is total lab dimensions assuming lab is empty. Equipment rooms are 8' x 8'. "Total Dimensions" information is the floor "Dimensions of Component" minus area taken by fume hoods, benches, and sinks. Other equipment and desks are assumed to be removable, allowing floor underneath to be surveyed. |
| † - Walls are considered one unit, surveyed to a height of 6 feet, unless otherwise noted, and includes doors. Assumes all wall surfaces are surveyed, including walls behind permanent fixtures such as benches and hoods. |
| †† - Ceilings are not surveyed unless otherwise noted. |
| ‡ - Ventilation/Ductwork is assumed to be 8 feet in length from hood to ceiling at 4 ft ² surface area per linear foot. |
| ¹ - Equipment dimensions are units of ft ³ . This equipment will be completely surveyed (interior and exterior). Cubic foot dimension also used to estimate waste disposal costs. Desks assumed to be 4' x 2' x 2.5'. Each small lab assumed to have 1.5 fume hoods, 5 lab benches, 2 sinks, 1.5 refrigerator (65 ft ² ; 30 ft ³ per), 4 desks (20 ft ² , 2.5 ft ³ per), 1.5 incubators (32 ft ² ; 12 ft ³ per), 1.25 freezers (65 ft ² ; 30 ft ³ per), and 0.5 biosafety cabinets (72 ft ² ; 36 ft ³). |
| ^a - This column not used for equipment. |
| ^b - Outer dimensions of equipment were doubled for the purposes of estimating area to be surveyed for scanning purposes. |

Table A.3.5 Number and Dimensions of Facility Components

Use this table to summarize relevant features of the facility. Copy and complete the table as necessary for each room, laboratory, or area. Rooms, laboratories, or areas with similar levels of contamination may be consolidated in one table.

Room/Location

30 Cold Rooms

| Component | Number of Components | Dimensions of Each Component (ft ²) ^a | Total Dimensions (ft ²) for scanning purposes ^b | Total Dimensions (ft ³) for waste management purposes |
|---|----------------------|--|--|---|
| Glove Boxes | 0 | | | |
| Fume Hoods* | 0 | | | |
| Lab Benches** | 30 | 19.20 | 576.00 | 144.00 |
| Sinks*** | 30 | 4.00 | 120.00 | 360.00 |
| Drains and Piping*** | | | | |
| Floors**** | 30 | 53.60 | 1608.00 | 48.24 |
| Walls† | 30 | 192.00 | 5760.00 | 172.80 |
| Ceilings†† | | | | |
| Ventilation/Ductwork ‡ | 0 | | | |
| Hot Cells | 0 | | | |
| Incubators ¹ | 0 | | | |
| Refrigerators ¹ | 0 | | | |
| Freezers ¹ | 0 | | | |
| Storage Units/Cabinets ¹ | 0 | | | |
| Radwaste Areas | 0 | | | |
| Biosafety Cabinets ^{1,*} | 0 | | | |
| Desks ¹ | 0 | | | |
| Other Equipment ¹ (specify) | | | | |
| Totals | | | 8064.00 | 725.04 |
| Contaminated Area/Volume, Estimate² | | | 806.40 | 3.63 |

| Assumptions |
|---|
| * - Fume hoods are assumed to be 2.5 ft x 6 ft by 8 ft for disposal cost estimate. Interior of fume hoods are surveyed. |
| ** - Two lab benches per room combined into single unit and are 2.5 feet wide and 0.25 feet thick unless otherwise noted. Bench area assumed equal to 10% of the total cold room area. All drawers in lab benches are surveyed. This will triple the surface area to be surveyed due to an assumption that there are, on average, two drawers for the full length of all bench space. Benches are assumed to be 36" in height for the purposes of estimating volume for waste disposal costs. |
| *** - All sinks are 4 ft ² unless otherwise noted and are assumed to be 36" in height for the purposes of estimating volume for waste disposal costs. |
| **** - "Dimensions of Components" information is total lab dimensions assuming lab is empty. Cold rooms are 8' x 8'. "Total Dimensions" information is the floor "Dimensions of Component" minus area taken by fume hoods, benches, and sinks. Other equipment and desks are assumed to be removable, allowing floor underneath to be surveyed. |
| † - Walls are considered one unit, surveyed to a height of 6 feet, unless otherwise noted, and includes doors. Assumes all wall surfaces are surveyed, including walls behind permanent fixtures such as benches and hoods. |
| †† - Ceilings are not surveyed unless otherwise noted. |
| ‡ - Ventilation/Ductwork is assumed to be 8 feet in length from hood to ceiling at 4 ft ² surface area per linear foot. |
| ¹ - Equipment dimensions are units of ft ³ . This equipment will be completely surveyed (interior and exterior). Cubic foot dimension also used to estimate waste disposal costs. Desks assumed to be 4' x 2' x 2.5'. Each small lab assumed to have 1.5 fume hoods, 5 lab benches, 2 sinks, 1.5 refrigerator (65 ft ² ; 30 ft ³ per) 4 desks (20 ft ² , 2.5 ft ³ per), 1.5 incubators (32 ft ² ; 12 ft ³ per), 1.25 freezers (65 ft ² ; 30 ft ³ per), and 0.5 biosafety cabinets (72 ft ² ; 36 ft ³). |
| ^a - This column not used for equipment. |
| ^b - Outer dimensions of equipment were doubled for the purposes of estimating area to be surveyed for scanning purposes. |

Table A.3.5 Number and Dimensions of Facility Components

Use this table to summarize relevant features of the facility. Copy and complete the table as necessary for each room, laboratory, or area. Rooms, laboratories, or areas with similar levels of contamination may be consolidated in one table.

Room/Location

Rad Waste Storage

| Component | Number of Components | Dimensions of Each Component (ft ²) ^a | Total Dimensions (ft ²) for scanning purposes ^b | Total Dimensions (ft ³) for waste management purposes |
|---|----------------------|--|--|---|
| Glove Boxes | 0 | | | |
| Fume Hoods* | 0 | | | |
| Lab Benches** | 0 | | | |
| Sinks*** | 0 | | | |
| Drains and Piping*** | | | | |
| Floors**** | 1 | 3200.00 | 3200.00 | 96.00 |
| Walls† | 1 | 1584.00 | 1584.00 | 47.52 |
| Ceilings†† | | | | |
| Ventilation/Ductwork ‡ | 0 | | | |
| Hot Cells | 0 | | | |
| Incubators ¹ | 0 | | | |
| Refrigerators ¹ | 1 | 100.00 | 100.00 | 50.00 |
| Freezers ¹ | 7 | 65.00 | 455.00 | 210.00 |
| Storage Units/Cabinets ¹ | 0 | | | |
| Radwaste Areas | 0 | | | |
| Biosafety Cabinets ^{1,*} | 0 | | | |
| Desks ¹ | 0 | | | |
| Other Equipment ¹ : storage racks | 4 | 821.00 | 3284.00 | 492.00 |
| Totals | | | 8623.00 | 895.52 |
| Contaminated Area/Volume, Estimate² | | | 862.30 | 4.48 |

Assumptions

* - Fume hoods are assumed to be 2.5 ft x 6 ft by 8 ft for disposal cost estimate. Interior of fume hoods are surveyed.

** - Lab benches combined into single unit and are 2.5 feet wide and 0.25 feet thick unless otherwise noted. Bench area assumed equal to 25% of the total lab area. All drawers in lab benches are surveyed. This will triple the surface area to be surveyed due to an assumption that there are, on average, two drawers for the full length of all bench space. Benches are assumed to be 36" in height for the purposes of estimating volume for waste disposal costs.

*** - All sinks are 4 ft² unless otherwise noted and are assumed to be 36" in height for the purposes of estimating volume for waste disposal costs.

**** - "Dimensions of Components" information is total lab dimensions assuming lab is empty. Facility is 100' x 32'. Also includes four storage racks measuring 67' x 12.25'. "Total Dimensions" information is the floor "Dimensions of Component" minus area taken by fume hoods, benches, and sinks. Other equipment and desks are assumed to be removable, allowing floor underneath to be surveyed.

† - Walls are considered one unit, surveyed to a height of 6 feet, unless otherwise noted, and includes doors. Assumes all wall surfaces are surveyed, including walls behind permanent fixtures such as benches and hoods.

†† - Ceilings are not surveyed unless otherwise noted.

‡ - Ventilation/Ductwork is assumed to be 8 feet in length from hood to ceiling at 4 ft² surface area per linear foot.

¹ - Equipment dimensions are units of ft³. This equipment will be completely surveyed (interior and exterior). Cubic foot dimension also used to estimate waste disposal costs. Desks assumed to be 4' x 2' x 2.5'. Room contains four storage racks (821 ft², 123 ft³ per), 1 refrigerator (100 ft²; 50 ft³), and 7 freezers (65 ft²; 30 ft³ per).

^a - This column not used for equipment.

^b - Outer dimensions of equipment were doubled for the purposes of estimating area to be surveyed for scanning purposes.

Table A.3.5 Number and Dimensions of Facility Components

Use this table to summarize relevant features of the facility. Copy and complete the table as necessary for each room, laboratory, or area. Rooms, laboratories, or areas with similar levels of contamination may be consolidated in one table.

Room/Location **Summary of all Laboratories**

| Component | Number of Components | Dimensions of Each Component (ft ²) ^a | Total Dimensions (ft ²) for scanning purposes ^b | Total Dimensions (ft ³) for waste management purposes |
|---|----------------------|--|--|---|
| Glove Boxes | 0 | 0 | 0 | 0 |
| Fume Hoods* | 669 | 332 | 111,054 | 80,280 |
| Lab Benches** | 362 | 1,177 | 127,806 | 31,952 |
| Sinks*** | 744 | 16 | 2,976 | 8,928 |
| Drains and Piping*** | 0 | 0 | 0 | 0 |
| Floors**** | 407 | 4,359 | 118,473 | 3,554 |
| Walls† | 407 | 3,192 | 126,744 | 3,802 |
| Ceilings†† | 0 | 0 | 0 | 0 |
| Ventilation/Ductwork ‡ | 669 | 64 | 21,408 | |
| Hot Cells | 8 | 166 | 1,328 | 960 |
| Incubators ¹ | 613 | 96 | 19,616 | 7,356 |
| Refrigerators ¹ | 615 | 295 | 40,010 | 18,470 |
| Freezers ¹ | 561 | 260 | 36,465 | 16,830 |
| Storage Units/Cabinets ¹ | 0 | 0 | 0 | 0 |
| Radwaste Areas | 0 | 0 | 0 | 0 |
| Biosafety Cabinets ^{1,‡} | 143 | 144 | 10,296 | 5,148 |
| Desks ¹ | 1,570 | 32 | 25,120 | 62,800 |
| Other Equipment ¹ (specify) | 4 | 821 | 3,284 | 492 |
| Totals | | | 644,580.00 | 240,572.01 |
| Contaminated Area/Volume, Estimate² | | | 64458.00 | 1202.86 |

| Assumptions |
|--|
| * - Fume hoods are assumed to be 3 ft x 6 ft by 8 ft in height and Biosafety cabinets are assumed to be 8 ft in height unless otherwise noted, for disposal cost estimate. Interior of fume hoods are surveyed, doubling exterior area for purposes of estimating labor for scanning purposes. |
| ** - All lab benches combined into single unit and are 2.5 feet wide unless otherwise noted. Bench area assumed equal to 25% of the total lab area. All drawers in lab benches are surveyed. This will triple the surface area to be surveyed due to an assumption that there are, on average, two drawers for the full length of all bench space. Benches are assumed to be 36" in height for the purposes of estimating volume for waste disposal costs. |
| *** - All sinks are 4 ft ^c unless otherwise noted and are assumed to be 36" in height for the purposes of estimating volume for waste disposal costs. Six disposal sinks assumed to contain 12 linear feet of contaminated pipe equating to 1 ft ³ of radioactive waste. |
| **** - "Dimensions of Components" information is total lab dimensions assuming lab is empty. "Total Dimensions" information is the floor "Dimensions of Component" minus area taken by fume hoods, benches, and sinks. Other equipment and desks are assumed to be removable, allowing floor underneath to be surveyed. |
| † - Walls are considered one unit, surveyed to a height of 6 feet, unless otherwise noted, and includes doors. Assumes all wall surfaces are surveyed, including walls behind permanent fixtures such as benches and hoods. |
| †† - Ceilings are not surveyed unless otherwise noted. |
| ‡ - Ventilation/Ductwork is assumed to be 8 feet in length from hood to ceiling at 4 ft ² surface area per linear foot. |
| ' - Equipment dimensions are units of ft ³ . This equipment will be completely surveyed (interior and exterior). Cubic foot dimension also used to estimate waste disposal costs. Desks assumed to be 4' x 2' x 2.5' unless otherwise noted in equipment worksheet. Each lab assumed to have one refrigerator (65 ft ² ; 30 ft ³) and two desks. Entire facility assumed to include 5 incubators (32 ft ² ; 12 ft ³), 5 freezers (65 ft ² ; 30 ft ³), and 5 storage cabinets (72 ft ² , 36 ft ³). |
| * - This column not used for equipment. |
| ^ - Outer dimensions of equipment were doubled for the purposes of estimating area to be surveyed for scanning purposes. |

A.3.6 Planning and Preparation (work days)

Estimate the number of work days, by specific labor category, that will be required to complete planning and preparation activities. Include all appropriate labor categories, including Supervisor, Foreman, Craftsman, Technician, Health Physicist, Laborer, Clerical, and others as needed.

| Activity | Supervisor | Health Physicist | Health Physics Technician (2) | Clerical |
|---|------------|------------------|-------------------------------|----------|
| Preparation of Documentation for Regulatory Agencies | 5 | 2 | 0 | 1 |
| Submittal of Decommissioning Plan to NRC when required by 10 CFR 30.36(g)(1) | 15 | 5 | 0 | 1 |
| Development of Work Plans | 20 | 0 | 0 | 1 |
| Procurement of Special Equipment | 0 | 3 | 2 | 2 |
| Staff Training | 5 | 3 | 10 | 0 |
| Characterization of Radiological Condition of the Fixed Components of the Facility* | 60 | 60 | 120 | 0 |
| Totals | 105 | 73 | 132 | 5 |

Table A.3.7 Decontamination or Dismantling of Radioactive Facility Components (Work Days)

Estimate the number of workdays, by specific labor category, that will be required to complete decontamination and/or dismantling activities for each facility component. Copy and complete this table as necessary for each room, laboratory, or area. Rooms, laboratories, or areas with similar levels of contamination may be consolidated into one table. Assumes 10% of surfaces require decontamination, 5% of decontaminated surfaces require dismantling and disposal as radioactive waste, supervisor and health physicist spends approximately 5 and 10%, respectively, of the time spent by HP Techs performing decontamination, demolition, and packaging of contaminated units.

| Name of room, laboratory, or area | | All labs | | | | | |
|-----------------------------------|-----------------|---|-----------|------------|------------------|-------------------------------|----------|
| Level of Contamination | | Low levels expected, decontamination performed on 10% of surfaces; 5% of deconned surfaces require dismantling for disposal as llrw | | | | | |
| Component | Number of units | Decon Method | Days/Unit | Supervisor | Health Physicist | Health Physics Technician (2) | Clerical |
| Glove Boxes | 0 | Dis+Pack//Wash clean | | 0.00 | 0.00 | 0.00 | 0.00 |
| Fume Hoods | 669 | Dis+Pack//Wash clean | 0.06 | 0.20 | 0.40 | 4.01 | 0.00 |
| Lab Benches | 362 | Dis+Pack//Wash clean | 0.06 | 0.11 | 0.22 | 2.17 | 0.00 |
| Sinks | 744 | Dis+Pack//Wash clean | 0.06 | 0.22 | 0.45 | 4.46 | 0.00 |
| Drains/Pipes | 0 | Dis+Pack//Wash clean | | 0.00 | 0.00 | 0.00 | 0.00 |
| Floors | 407 | Dis+Pack//Wash clean | 0.06 | 0.12 | 0.24 | 2.44 | 0.00 |
| Walls | 407 | Dis+Pack//Wash clean | 0.06 | 0.12 | 0.24 | 2.44 | 0.00 |
| Ceilings | 0 | Dis+Pack//Wash clean | | 0.00 | 0.00 | 0.00 | 0.00 |
| Ventilation/Ductwork | 669 | Dis+Pack//Wash clean | | 0.00 | 0.00 | 0.00 | 0.00 |
| Hot Cells | 8 | Dis+Pack//Wash clean | 0.24 | 0.01 | 0.02 | 0.19 | 0.00 |
| Incubators | 613 | Dis+Pack//Wash clean | 0.06 | 0.18 | 0.37 | 3.68 | 0.00 |
| Refrigerators | 615 | Dis+Pack//Wash clean | 0.06 | 0.18 | 0.37 | 3.69 | 0.00 |
| Freezers | 561 | Dis+Pack//Wash clean | 0.06 | 0.17 | 0.34 | 3.37 | 0.00 |
| Storage Units/Cabinets | 0 | Dis+Pack//Wash clean | | 0.00 | 0.00 | 0.00 | 0.00 |
| Radwaste Areas | 0 | Dis+Pack//Wash clean | | 0.00 | 0.00 | 0.00 | 0.00 |
| Biosafety Cabinets | 143 | Dis+Pack//Wash clean | 0.06 | 0.04 | 0.09 | 0.86 | 0.00 |
| Desks | 1,570 | Dis+Pack//Wash clean | 0.06 | 0.47 | 0.94 | 9.42 | 0.00 |
| Other Equipment (specify)* | 4 | Dis+Pack//Wash clean | 0.24 | 0.00 | 0.01 | 0.10 | 0.00 |
| | | | | | | | |
| TOTALS | | | | 1.84 | 3.68 | 36.83 | 0.00 |

A.3.8 Restoration of Contaminated Areas on Facility Grounds (work days)

Estimate the number of work days, by specific labor category, that will be required to restore contaminated areas on facility grounds.
No restoration of grounds expected as a result of decontamination of Yale University facilities.

| Activity | Supervisor | Health Physicist | Health Physics Technician | Clerical | Labor Category | Labor Category |
|---------------------------|------------|------------------|---------------------------|----------|----------------|----------------|
| Backfill and Restore Site | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| Totals | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

A.3.9 Final Radiation Survey (Work Days)

Estimate the number of work days, by specific labor category, that will be required to conduct a final radiation survey. Assumes 10% of facility and equipment requires re-survey after decontamination and/or demolition after initial radiological characterization.

| Activity | Supervisor | Health Physicist | Health Physics Technician (2) | Clerical |
|--|------------|------------------|-------------------------------|----------|
| Resurvey laboratory facilities and equipment after decontamination | 6.02 | 6.02 | 12.04 | 0.00 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Totals | 6.02 | 6.02 | 12.04 | 0.00 |

A.3.10 Site Stabilization and Long-term Surveillance (Work Days)

Estimate the number of work days, by specific labor category, that will be required to complete site stabilization and long-term surveillance.

No site stabilization or long-term surveillance of the facility is expected as a result of contamination.

| Activity | Supervisor | Health Physicist | Health Physics Technician | Clerical |
|----------|------------|------------------|---------------------------|----------|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Totals | 0.00 | 0.00 | 0.00 | 0.00 |

A.3.11 Total Work Days by Labor Category

Enter the total work days estimated for each specific labor category from the applicable table above (i.e., from the bottom rows of Tables A.3.6 through A.3.10)

| Activity | Supervisor | Health Physicist | Health Physics Technician | Clerical |
|--|------------|------------------|---------------------------|----------|
| Planning and Preparation (TOTALS from Table A.3.6) | 105 | 73 | 132 | 5 |
| Decontamination and/or Dismantling of Radioactive Facility Components (Sum of TOTALS from all copies of Table A.3.7) | 2 | 4 | 37 | 0 |
| Restoration of Contaminated Areas on Facility Grounds (TOTALS from Table A.3.8) | 0 | 0 | 0 | 0 |
| Final Radiation Survey (TOTALS from Table A.3.9) | 6 | 6 | 12 | 0 |
| Site Stabilization and Long- Term Surveillance (TOTALS from Table A.3.10) | 0 | 0 | 0 | 0 |
| Totals | 113 | 83 | 181 | 5 |

A.3.12 Worker Unit Cost Schedule

Estimate labor costs (including salary, fringe benefits, and corporate overhead). Include all appropriate labor categories, including Supervisor, Foreman, Craftsman, Technician, Health Physicist, Laborer, Clerical, and others as needed.

| Labor Cost Component | Supervisor | Health Physicist | Health Physics Technician | Clerical |
|------------------------------------|-------------|------------------|---------------------------|-----------|
| Salary (\$/hr) | \$ 69.00 | \$ 42.00 | \$ 30.00 | \$ 19.50 |
| Fringe (%) | 36% | 36% | 36% | 36% |
| Salary & Fringe (\$/hr) | \$ 24.98 | \$ 15.20 | \$ 10.86 | \$ 7.06 |
| Overhead Rate (%) | 51.3% | 51.3% | 51.3% | 51.3% |
| Overhead (\$/hr) | \$ 35.40 | \$ 21.55 | \$ 15.39 | \$ 10.00 |
| Salary+Fringe+Overhead (\$/hr) | \$ 129.38 | \$ 78.75 | \$ 56.25 | \$ 36.56 |
| G&A Rate (%) | 12.5% | 12.5% | 12.5% | 12.5% |
| G&A (\$/hr) | \$ 16.17 | \$ 9.84 | \$ 7.03 | \$ 4.57 |
| Salary+Fringe+Overhead+G&A (\$/hr) | \$ 145.55 | \$ 88.59 | \$ 63.28 | \$ 41.13 |
| Fee (10%) | \$ 14.55 | \$ 8.86 | \$ 6.33 | \$ 4.11 |
| Total Cost Per Hour | \$ 160.10 | \$ 97.45 | \$ 69.61 | \$ 45.25 |
| Total Cost Per Work Day | \$ 1,280.81 | \$ 779.63 | \$ 556.88 | \$ 361.97 |

A.3.13 Total Labor Costs by Major Decommissioning Task

Multiply the estimated work days or each specific labor category (from Table A.3.11) by the total cost per work day for the corresponding labor category (from Table A.3.12), and enter the results in the table below. Then, add across all labor categories to determine the total labor costs for each major decommissioning task.

| Activity | Supervisor | Health Physicist | Health Physics Technician | Clerical | Totals |
|--|---------------|------------------|---------------------------|-------------|---------------|
| Planning and Preparation (TOTALS from Table A.3.6) | \$ 134,733.04 | \$ 57,063.42 | \$ 73,722.92 | \$ 1,809.84 | \$ 267,329.22 |
| Decontamination and/or Dismantling of Radioactive Facility Components (Sum of TOTALS from all copies of Table A.3.7) | \$ 2,358.87 | \$ 2,871.67 | \$ 20,511.93 | \$ - | \$ 25,742.48 |
| Restoration of Contaminated Areas on Facility Grounds (TOTALS from Table A.3.8) | \$ - | \$ - | \$ - | \$ - | \$ - |
| Final Radiation Survey (TOTALS from Table A.3.9) | \$ 7,709.65 | \$ 4,692.83 | \$ 6,704.04 | \$ - | \$ 19,106.52 |
| Site Stabilization and Long-Term Surveillance (TOTALS from Table A.3.10) | \$ - | \$ - | \$ - | \$ - | \$ - |

A.3.14 Packaging, Shipping, and Disposal of Radioactive Wastes (Excluding Labor Costs)

(a) Packing Material Costs (Use and Delivery charges)

Estimate the types and volumes of waste to be generated, along with the number and types of containers required for packaging the waste. Multiply the number of containers required by the unit cost per container. Assumes 5% of contaminated equipment, floor and wall surfaces (see table A.3.5-Lab Summary) cannot be decontaminated and requires disposal of equipment and removal and disposal of floor and wall surfaces to a depth of 1 cm (0.03 ft). Assumes remaining 95% of equipment and floor/wall surfaces are successfully decontaminated.

| Waste Type | Volume (ft ³) | Number of Containers | Type of Container | Unit Cost of Container | Total Packaging Costs |
|---|---------------------------|----------------------|---|------------------------|-----------------------|
| Contaminated Equipment/Benches/Sinks/Floors/Walls | 1,202.86 | 11.0 | B-25 box container (130 ft ³) | \$ 2,300.00 | \$ 25,300.00 |
| | | | | | |
| | | | | | |
| TOTAL | 1202.86 | 11.0 | - | - | \$ 25,300.00 |

(b) Shipping Costs (See (a) above)

Estimate the number of truckloads of waste to be shipped. Multiply shipping costs per mile (including truckload costs, surcharges and overweight charges) by the total distance shipped.

| Waste Type | Number of truckloads | Unit Cost (\$/truck load)* | Surcharge (\$/mile) | Overweight Charges (\$/mile) | Distance Shipped | Total Shipping Costs |
|---|----------------------|----------------------------|---------------------|------------------------------|------------------|----------------------|
| Contaminated Equipment/Benches/Sinks/Floors/Walls | 3 | 3650.00 | | | TBD | \$ 10,950.00 |
| | | | | | | |
| | | | | | | |
| TOTAL | 3 | 3650.00 | - | - | - | \$ 10,950.00 |

(c) Waste Disposal Costs

Estimate the volume of waste to be disposed. Multiply the volume of waste disposed by the unit disposal cost (including any volume based surcharges). Add any surcharges that are based on the number of containers of waste.

| Waste Type | Disposal Volume (ft ³) | Unit Cost (\$/ft ³)* | Surcharge (\$/ft ³ or \$/container)* | Total Disposal Costs |
|---|------------------------------------|----------------------------------|---|----------------------|
| Contaminated Equipment/Benches/Sinks/Floors/Walls | 1,202.86 | \$ 252.00 | 21 | \$ 328,380.79 |
| | | | | |
| | | | | |
| | | | | |
| TOTAL | 0.00 | \$ 252.00 | 21 | \$ 328,380.79 |

A.3.15 Equipment/Supply Costs (Excluding Containers)

Estimate the quantity of equipment and supplies required for decommissioning and multiply that quantity by the appropriate unit costs.

| Equipment/Supplies | Quantity | Unit | Unit Cost | Total Equipment/Supply Cost |
|--|----------|-----------|-------------|-----------------------------|
| Mobilization | 1 | each | \$ 2,100.00 | \$ 2,100.00 |
| Supplies* for laboratory/equipment surveys | 1 | each | \$ 4,200.00 | \$ 4,200.00 |
| Detectors** | 68 | day | \$ 262.50 | \$ 17,850.00 |
| P-10 gas for detectors | 5 | each tank | \$ 210.00 | \$ 1,050.00 |
| Van/truck rental, gas, tolls | 68 | day | \$ 131.00 | \$ 8,908.00 |
| Supplies for waste management activities† | 5 | day | \$ 262.50 | \$ 1,312.50 |
| | | | | |
| | | | | |
| TOTAL | - | - | - | \$ 35,420.50 |

* - Supplies includes the following: Tape measures, pens, labels, forms, sample media and envelopes, cleaning materials, waste bags, sample preparation and analysis materials, etc.

** Ludlum model 239-1F floor monitor with scaler/ratemeter 2224; Ludlum model 43-68 GP detectors with scaler/ratemeter 2224.

†- Equipment and supplies for waste management (tools, protective clothing, duct tape, poly sheeting, power equipment, pallet jack, cart, screw guns, etc.).

A.3.16 Laboratory Costs

If applicable, estimate costs for analyses to be performed by an independent third-party laboratory.

| Activity | Number of Units | Unit | Unit Cost | Total Cost |
|-----------------------|-----------------|---------|-----------|--------------|
| Swipe sample analysis | 15,000 | sample | \$ 5.25 | \$ 78,750.00 |
| Transport of Samples | 68 | package | \$ 5.25 | \$ 357.00 |
| Other (specify) | | | | \$ - |
| TOTAL | - | | - | \$ 79,107.00 |

A.3.17 Miscellaneous Costs

Estimate any other applicable costs.

| Cost Item | Number of Units | Unit Cost (per day) | Total Cost |
|-----------------------------|-----------------|---------------------|--------------|
| Per diem (lodging) | 272 | \$ 110.00 | \$ 29,920.00 |
| Per diem (meals) | 272 | \$ 64.00 | \$ 17,408.00 |
| Sub-total | - | - | \$ 47,328.00 |
| G&A for above items (12.5%) | | | \$ 5,916.00 |
| TOTAL | - | - | \$ 53,244.00 |

A.3.18 Total Decommissioning Costs

Enter the total costs reported in Tables A.3.13, A.3.13(a)-(c), A.3.15, A.3.16, and A.3.17 into the appropriate cells below, then add them to obtain a subtotal. Add to the subtotal a contingency allowance in the amount of 25 percent of the subtotal to obtain the total decommissioning cost estimate. Also, calculate for each task/component the percentage it represents of the subtotal.

| Task/Component | Cost | Percentage |
|--|------------------------|------------|
| Planning and Preparation (From Table A.3.13) | \$ 267,329.22 | 32% |
| Decontamination and/or Dismantling of Radioactive Facility Components (From Table A.3.13) | \$ 25,742.48 | 3% |
| Restoration of Contaminated Areas on Facility Grounds (From Table A.3.13) | \$ - | 0% |
| Final Radiation Survey (From Table A.3.13) | \$ 19,106.52 | 2% |
| Site Stabilization and Long-Term Surveillance (From Table A.3.13) | \$ - | 0% |
| Packing Material Costs (TOTAL from Table A.3.14(a)) | \$ 25,300.00 | 3% |
| Shipping Costs (TOTAL from Table A.3.14(b)) | \$ 10,950.00 | 1% |
| Waste Disposal Costs (TOTAL from Table A.3.14(c)) | \$ 328,380.79 | 39% |
| Equipment/Supply Costs (TOTAL from Table A.3.15) | \$ 35,420.50 | 4% |
| Laboratory Costs (TOTAL from Table A.3.16) | \$ 79,107.00 | 9% |
| Miscellaneous Costs (TOTAL from Table A.3.17) | \$ 53,244.00 | 6% |
| Subtotal | \$ 844,580.51 | 100% |
| 25% Contingency | \$ 211,145.13 | |
| TOTAL DECOMMISSIONING COST ESTIMATE | \$ 1,055,725.64 | |



ACKNOWLEDGEMENT - RECEIPT OF CORRESPONDENCE

| | |
|--|--|
| Name and Address of Applicant and/or Licensee | Date |
| Yale University ATTN: Ben Polak, Ph.D., Yale University Provost 135 College Street, 1st Floor, Suite 100 Radiation Safety Section -OEHS New Haven, CT 06510-2411 | June 6, 2018 |
| | License Number(s) |
| | 06-00183-03 |
| | Mail Control Number(s) |
| | 608988 |
| | Licensing and/or Technical Reviewer or Branch |
| | Commercial, Industrial, R&D, & Academic Branch |

This is to acknowledge receipt of your: Letter and/or Application Dated: 05/30/2018

The initial processing, which included an administrative review, has been performed. Financial Assurance

Amendment Termination New License Renewal

There were no administrative omissions identified during our initial review.

This is to acknowledge receipt of your application for renewal of the material(s) license identified above. Your application is deemed timely filed, and accordingly, the license will not expire until final action has been taken by this office.

Your application for a new NRC license did not include your taxpayer identification number. Please complete and submit NRC Form 531, Request for Taxpayer Identification Number, located at the following link: <http://www.nrc.gov/reading-rm/doc-collections/forms/nrc531.pdf>

Follow the instructions on the form for submission.

The following administrative omissions have been identified:

| |
|--|
| |
|--|

Your application has been assigned the above listed MAIL CONTROL NUMBER. When calling to inquire about this action, please refer to this control number. Your application has been forwarded to a technical reviewer. Please note that the technical review, which is normally completed within 180 days for a renewal application (90 days for all other requests), may identify additional omissions or require additional information. If you have any questions concerning the processing of your application, our contact information is listed below:

| |
|---|
| Region I U. S. Nuclear Regulatory Commission Division of Nuclear Materials Safety 2100 Renaissance Boulevard, Suite 100 King of Prussia, PA 19406-2713 (610) 337-5260, (610) 337-5313, (610) 337-5398, or (610) 337-5239 |
|---|