

**Decontamination and Decommissioning at Small Nuclear Facilities:
Facilitating the Submission of *Decommissioning Funding Plans* – 9420**

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ABSTRACT

This paper describes the efforts of the Washington State Department of Health to ensure that small nuclear facilities have the tools each needs to submit *Decommissioning Funding Plans*. These Plans are required by both the U.S. Nuclear Regulatory Commission (NRC) and in some states—in the case of Washington state, the Washington State Department of Health is the regulator of radioactive materials.¹ Unfortunately, the guidance documents provided by the U.S. NRC pertain to large nuclear facilities, such as nuclear fuel fabrication plants, not the small nuclear laboratory nor small nuclear laundry that may also be required to submit such Plans. These small facilities are required to submit *Decommissioning Funding Plans* by dint of their nuclear materials inventory, but have only a small staff, such as a Radiation Safety Officer and few authorized users. The Washington State Department of Health and Attenuation Environmental Company have been working on certain tools, such as templates and spreadsheets, that are intended to assist these small nuclear facilities prepare compliant *Decommissioning Funding Plans* with a minimum of experience and effort.

INTRODUCTION

Decommissioning Funding Plans and Cost Estimates have been required of large nuclear facilities, and small nuclear facilities that possess a defined quantity or type of nuclear material, since the 1980s. Although such facilities are required to submit *Decommissioning Funding Plans*, and a concomitant Decommissioning Cost Estimate, small licensed nuclear facilities which use just enough radioactive material to warrant submission of a *Decommissioning Funding Plan* have not receive any clear, consistent, and complete guidance in producing these plans. This paper reviews the regulatory requirements for *Decommissioning Funding Plans*, discusses the key concepts of *Decommissioning Funding Plans*, presents the tools the state of Washington's Department of Health is devising to assist small nuclear facilities in their preparation of *Decommissioning Funding Plans*, and offers some conclusions regarding the use of these tools.

Regulatory Requirements

There has been a need for decommissioning funding since the first nuclear facility was constructed. Unfortunately, the use of *Decommissioning Funding Plans* and Decommissioning Cost Estimates have

¹ In the state of Washington, the Washington State Department of Health, Office of Radiation Protection, is the responsible party for radioactive materials usage and licensing. Washington is an Agreement State.

not been required by either federal or state regulators until relatively recently. By requiring *Decommissioning Funding Plans* and Decommissioning Cost Estimates, the federal and state governments can ensure that an appropriate level of funding is set aside and held for the eventual decommissioning, decontamination, dismantling, and/or disposal of nuclear facilities. This funding protects the local taxpayers from being burdened by decommissioning costs in the case of a failure of a licensed business (*i.e.*, bankruptcy, default, abandonment, *et cetera*).

The regulation of *Decommissioning Funding Plans* and Decommissioning Cost Estimates has a history of increasing progress and clarity: Over the last two decades, the U.S. Nuclear Regulatory Commission (U.S. NRC) has promulgated several rules having to do with *Decommissioning Funding Plans* and Decommissioning Cost Estimates. Corresponding guidance documents published by the U.S. NRC have also evolved in their completeness and value. The regulatory requirements for *Decommissioning Funding Plans* and Decommissioning Cost Estimates are promulgated at 10 C.F.R. Part 30.35. The current guidance document which is to be used by a facility to prepare its *Decommissioning Funding Plans* and Decommissioning Cost Estimates is NUREG-1757, *Consolidated NMSS Decommissioning Guidance* [1]. Indeed, this document is undergoing revision as this paper is written. However, although the documents pertaining to *Decommissioning Funding Plans* and Decommissioning Cost Estimates have matured, this evolution has not well served smaller nuclear facilities.

Small Nuclear Facilities

The rules of the U.S. NRC stipulate that certain nuclear facilities must submit *Decommissioning Funding Plans* and Decommissioning Cost Estimates as well as provide financial surety instruments. A facility whose radioactive materials license meets any of the following criteria must prepare a *Decommissioning Funding Plan* and Decommissioning Cost Estimate:

- A license that authorizes the possession and use of any radioactive materials with a half-life greater than one hundred-twenty (120) days and in unsealed quantities exceeding 10^3 times the respective limits set forth in Appendix B to Part 30, “Quantities of Licensed Material Requiring Labeling,” or in sealed quantities exceeding 10^{10} times the respective quantities set forth in Appendix B to Part 30, “Quantities of Licensed Material Requiring Labeling.”
- A license that permits possession and use of source material in readily dispersible form and in quantities greater than 10 millicuries.
- A license that authorizes receipt of radioactive waste for the purpose of volume reduction, repackaging, and/or interim storage.
- A license that permits receipt of contaminated articles, such scrap material, equipment, or clothing, to be decontaminated at the licensee's facility.

Of course, the difference between a nuclear power plant and a small nuclear laundry is vast. But because some of these criteria are exceeded by smaller nuclear facilities, each such facility must submit a *Decommissioning Funding Plan* and Decommissioning Cost Estimate. These specific-licensed facilities are often fairly small operations, with minimal staff, which employ the merest amounts of radioactivity in unsealed materials and/or only a few of the specified radionuclides under their licenses. Or, in the case of a broad-licensed facility, such as a university, a facility may be licensed for large quantities of radioactive materials, but in fact uses only very minute quantities, albeit in myriad of locations. It is the licensed quantity, not the actual or on-site quantity, of radioactive materials that can trigger a *Decommissioning Funding Plan* and Decommissioning Cost Estimate.

The smaller nuclear facilities discussed in this paper include, but are not limited to:

- Nuclear laundries
- Small research and development laboratories
- Radioactive material analytical laboratories
- Small waste management facilities
- Small manufacturers of certain goods containing radioactivity
- Universities and larger research and development laboratories with broad-scope radioactive materials licenses

and so forth.

NUREG-1757 was apparently composed with large nuclear organizations in mind, such as nuclear power plants, nuclear fuel fabricators, major isotope manufacturers, and waste disposal facilities, where the risk of great environmental harm or compromised worker safety is large. The use of NUREG-1757 to guide such small facilities' development of *Decommissioning Funding Plans* and Decommissioning Cost Estimates is quite cumbersome. How to write a compliant *Decommissioning Funding Plan* for these small facilities has had to be discerned "between the lines," as it were, from copious U.S. NRC guidance documents. As such, NUREG-1757, with three thick volumes and already multiple revisions, is a difficult document for small nuclear facilities to use.

In order to receive effective and realistic *Decommissioning Funding Plans* and Cost Estimates from Washington State Department of Health radioactive material licensees, it became quite clear that additional local guidance would be necessary. This paper describes the tools Attenuation Environmental Company and the Washington State Department of Health have developed to provide this guidance.

DECOMMISSIONING FUNDING PLANS

A *Decommissioning Funding Plan* and Cost Estimate is a single, stand-alone document that describes a licensed facility, briefly discusses its history and its radioactive materials usage, considers the probable decontamination, dismantling, and disposal activities that may comprise "decommissioning," and, then, estimates the total cost of these activities. There are certain elements that must be presented in a *Decommissioning Funding Plan* as well as in a Decommissioning Cost Estimate, which must be included as part of the *Plan*. Indeed, the activities discussed in a *Decommissioning Funding Plan* are the basis upon which related decommissioning costs are predicated.

Decommissioning Considerations

There are certain standardized activities that will need to take place upon the eventual decommissioning of any nuclear facility, whether large or small. Each of these activities needs some thought as to how each will be accomplished at the time of facility decommissioning. For *Decommissioning Funding Plans* and Cost Estimates these activities must be itemized and roughly developed, specifically for a given facility. The actual implementation of these activities will be more formal and better described in a *Decommissioning Plan* that will be developed upon facility closure. Nonetheless, the decommissioning of even a small nuclear facility requires some thought and advance contemplation.

The development of a final *Decommissioning Plan* is one of the activities that must be planned for in a *Decommissioning Funding Plan* and its Cost Estimate. The *Decommissioning Plan* document will include individual plans for certain activities as well as standard operating procedures. The individual plans, reports, and assessments that will be contained in a final *Decommissioning Plan* include:

- Site Assessment
- Radiation Survey Work Plans and Survey Reports
- Sampling and Analysis Plans and Data Evaluations
- Decontamination and Dismantling Procedures
- Waste Management Plan
- Health and Safety Plan
- Quality Assurance Plan.

Although none of these plans need to be fully constructed for a *Decommissioning Funding Plan*, basic decommissioning strategies will need to be explored and then appraised in a *Decommissioning Funding Plan* and Decommissioning Cost Estimate. For a small nuclear facility, especially, the preparation of this type of document can be a lengthy and time consuming activity.

In addition to the general formulation of these documents, the costs of actually implementing each activity needs to be estimated in the *Decommissioning Funding Plan* and the Decommissioning Cost Estimate. Thus, the parameters and the costs of an initial survey, perhaps a characterization survey, and a final survey will need to be described in the *Decommissioning Funding Plan* and calculated in the Decommissioning Cost Estimate. This is done prior to, and in addition to, the actual preparation of a final *Decommissioning Plan*. This is true for all decommissioning costs that need to be estimated. Other examples are the costs of survey instrument rental/purchase, laboratory fees, decontamination and dismantling equipment rental/purchase, and waste management (*i.e.*, disposal) costs.

Decommissioning Costs

Most of the costs above have a labor (or fee) component and/or an equipment and supply expense component. Most of these costs are dependent upon the facility size, radioactive materials deployment, processes conducted in the facility, and any ancillary systems present at the facility. For example, the total cost of a sampling and analysis campaign at a facility includes not only the labor time required for staff to collect samples, but also the costs of personal protective gear and sample supplies as well as laboratory costs (most likely on a per-analysis fee).

Similarly, the cost of, for example, waste disposal will depend upon the size of the facility, the methods of decontamination and/or dismantling identified in a *Decommissioning Funding Plan*, and the expected results of decontamination efforts. Some decontamination methods will generate more waste per unit of floor space, for example, than others. And larger facilities usually generate greater quantities of waste.

DECOMMISSIONING FUNDING PLAN AND COST ESTIMATE TOOLS

Because of the lack of specific guidance for small nuclear facilities, the Washington State Department of Health has received poorly planned, and less than inadequate, *Decommissioning Funding Plans* and Decommissioning Cost Estimates. These *Plans* often did not include the required activities and costs discussed above. Not only did the organization and content vary substantially and significantly from one *Decommissioning Funding Plan* to another, but the agency's staff were unable to efficiently evaluate such *Decommissioning Funding Plans* and Decommissioning Cost Estimates in the absence of specific criteria.

To this end, Attenuation Environmental Company and the Washington State Department of Health have worked closely to develop a couple of hands-on tools that will permit small nuclear facilities to compose and submit compliant *Decommissioning Funding Plans* and Decommissioning Cost Estimates more readily. These tools are both composed in Microsoft products; the Decommissioning Funding Plan Template is in Word™, while the Decommissioning Cost Estimate Spreadsheet is in Excel™.

Decommissioning Funding Plan Template

The first of these tools is the standardized Decommissioning Funding Plan Template, or interactive outline, that can be used to facilitate the insertion facility-specific text. This Template is accessible in Microsoft Word™ so that it can be physically used to develop a facility-specific *Decommissioning Funding Plan* by simply filling in the indicated information and using the titles and subtitles provided in the Template. This allows licensees to understand exactly what information they need to include and ensures that the resulting *Decommissioning Funding Plans* received by the Washington State Department of Health are uniformly organized and contain adequate information—information the Department needs in order to evaluate the “appropriateness” and “level of detail” (as required by the U.S. NRC in NUREG-1757) of the respective *Decommissioning Funding Plans*.

The Decommissioning Funding Plan Template begins with a set of general instructions and then each section and subsection contain further instructions as the user of the Template proceeds through the development of a *Decommissioning Funding Plan*. The Decommissioning Funding Plan Template is organized in a logical sequence consistent with U.S. NRC guidance.

The user is first prompted to begin with the composition of an Introduction (Fig. 1). Next, the Template continues with detailed prompts that require the user to provide various descriptions of radioactive materials, facility processes, anticipated facility characterization techniques, and decontamination and decommissioning strategies. Completion of the Template requires some modicum of contemplation regarding the decontamination and decommissioning activities that will take place at facility closure.

INTRODUCTION

This first section should briefly include the following information.

Facility Identification

This section is to identify your business, facility, and radioactive materials license information. If you wish, some of the subsection may be combined into one paragraph— whichever is best for your facility and your Decommissioning Funding Plan (DFP).

Name of Business

Please specify the name of your business. You should also include a “Vicinity Map” figure, which is a neighborhood and/or town map with the facility’s location shown clearly. You can collect all of your figures (e.g., maps) at the end of the DFP’s text or insert each as it is called out in the text.

Nature of Business

Summarize the nature of your business (e.g., nuclear laundry, analytical laboratory, public university, or so forth).

Number of Radioactive Materials License

Specify the number of your Radioactive Materials License. You do not need to submit actual license with your DFP (but see the next subsection).

Before the Template ends, it provides the user an opportunity to explain the assumptions that underlie the Cost Estimate, including the assumptions *required* by the U.S. NRC in NUREG-1757. A short narrative of the Estimate itself, which has been prepared by using the Decommissioning Cost Estimate Spreadsheet

described below, is discussed. The Template ends with Abbreviations and Definitions to assist the user in identifying appropriate information.

Decommissioning Cost Estimate Spreadsheet

The second tool is an extensive Microsoft Excel™ spreadsheet that has been partitioned for ease of use. This Spreadsheet includes cells for all of the required facets of a Decommissioning Cost Estimate, a major component of any *Decommissioning Funding Plan*, so that the respective data and costs can be easily inserted by the user. Then, the total Cost Estimate is calculated.

Each worksheet of the Cost Estimate Spreadsheet is tabbed and labeled with the name of the expense or other variable being calculated. The tabs of the Spreadsheet are:

- Notes and General Comments
- Areas and Components
- Planning and Preparation Labor
- Radiation Survey Labor
- Sampling and Analysis Labor
- Decommissioning Labor
- Waste Management Labor
- Total Labor Costs
- Waste Management Costs
- Other Costs
- Cost Estimate Totals

First, the user fills in the cells where the name of the licensee is requested, the number of the license, and the date. These insertions are made on the first-tabbed worksheet and then they are automatically filled in on all of the remaining worksheets in the Spreadsheet.

The user then inputs information regarding the various areas where radioactive materials have been used at a given facility and components which have potentially come into contact with radioactive materials (Fig. 2).

DECOMMISSIONING FUNDING PLAN COST ESTIMATE						
AREAS AND COMPONENTS						
NOTE: See definition of "component" below.						
Component	Quantity of Respective Component	Size of Respective Area or Component			Respective Component	
		Length (in feet)	Width (in feet)	Depth/Height/Thickness (as appropriate) (in feet)	Total Surface Area (in sq. ft.)	Total Volume (in cubic ft.)
Radioactive Materials Storage Area #1						
Walls		x		x	= 0.00	0.00
Floors			x	x	= 0.00	0.00
Ceilings						0.00
HVAC / Duct Work						
Plumbing Fixtures (e.g., pipes)						
	Diameter:	x	3.14159	x Length:	=	0.00
Sinks						
Fume Hoods			x	x	=	
Lab Benches			x	x	=	
Glove Boxes			x	x	=	
Hot Cells			x	x	=	
Equipment			x	x	=	
Storage Tanks			See comments at right.			
Other--Please specify:			x	x	=	

NOTE: Don't forget to multiply your respective calculations (discussed in the following comments) for HVAC / Duct Work by the total number of such components.

Fig. 2. “Areas and Components” worksheet in Decommissioning Cost Estimate Spreadsheet.

Note that the small, red triangles in some of the cells of the various worksheets, as shown above, indicate that there are additional definitions, comments, and/or assistance that will show in the box when the cursor is moved to such a cell.

Next, individual labor and non-labor costs, such as laboratory charges and waste management, are itemized, and the total labor costs are automatically summed and filled in on the “Total Labor Cost” worksheet (Fig. 3).

DECOMMISSIONING FUNDING PLAN COST ESTIMATE									
DECOMMISSIONING COSTS									
Total Labor Costs									
NOTE: Please fill in the cells below to justify the base hourly rates indicated in earlier worksheets.									
Labor Category									
	#1	#2	#3	#4	#5	#6	#7	#8	
Title of Labor Category:	0	0	0	0	0	0	0	0	0
Fee per Hour:	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Salary & Fringe (\$/Year)									
Percent Overhead Rate (times 0.xx)									
Total Cost Per Year	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Total Cost Per Work Week (i.e. Divide Per Year by 50.)	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Total Cost per Work Day (i.e. Divide per Work Week by 40.)	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00

Fig. 3. "Total Labor Costs" worksheet in Decommissioning Cost Estimate Spreadsheet.

Finally, the Grand Total of all costs is automatically calculated and displayed (Fig. 4).

DECOMMISSIONING FUNDING PLAN COST ESTIMATE									
TOTAL COST OF DECOMMISSIONING					Total Cost of Decommissioning				
Total Planning and Preparation Labor Costs					\$0.00				
Total Radiation Survey Labor Costs					\$0.00				
Total Sampling Labor Costs					\$0.00				
Total Decontamination, Dismantling, and Decommissioning Labor Costs					\$0.00				
Total Equipment and Supply Costs					\$0.00				
Total Analytical Laboratory Costs					\$0.00				
Total Waste Management Costs					\$0.00				
Other Costs					\$0.00				
Any Other Miscellaneous Costs <i>Please specify and add cost:</i>									
SUBTOTAL COST					\$0.00				
plus 25% Contingency Fee					\$0.00				
TOTAL DECOMMISSIONING COST ESTIMATE					\$0.00				

Fig. 4. "Total Cost of Decommissioning" worksheet in Decommissioning Cost Estimate Spreadsheet.

CONCLUSIONS

Both of these tools, that is to say the Decommissioning Funding Plan Template and the Cost Estimate Spreadsheet, are currently undergoing beta testing by some licensees of the Washington State Department of Health. These licensees include facilities that have many areas of radioactive materials usage and other facilities that have only one area of radioactive materials usage.

It is hoped that these tools will permit each small nuclear facility licensee to prepare more uniform and more compliant *Decommissioning Funding Plans* and Decommissioning Cost Estimates, more easily. It is expected that small nuclear facilities will use these tools to provide more suitable organization and more germane content in their *Plans*, in a less painful and less time-consuming way. Also, it is anticipated that a less lengthy review time for each *Decommissioning Funding Plan* will be possible. This in turn diminishes the interval of time that a facility does not have adequate decommissioning funding set aside and, thus, decreasing public risk and increasing public safety. Finally, the use of departmental staff time will be optimized when these tools become standardized—both the Decommissioning Funding Plan Template and the corresponding Cost Estimate Spreadsheet will provide an easier way for the regulator to perform an independent assessment of postulated facility decommissioning and the related costs, as desired.

The Washington State Department of Health will be posting these *Decommissioning Funding Plan* tools on its website—<http://www.doh.wa.gov/EHP/RP/>—in the near future. This deployment will permit unrestricted access to these tools for Washington state licensees. Attenuation Environmental Company will also be conducting workshops on this topic for Washington State Department of Health staff and others. The Template and Spreadsheet will be available for download, at no cost, to anyone with Internet access. We believe these tools are likely to aid other state and federal jurisdictions as well as their licensees.

REFERENCES

1. *Consolidated NMSS* [Nuclear Material Safety and Safeguards] *Decommissioning Guidance*, Volumes 1-3, NUREG-1757. Division of Waste Management, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission (2003).