



REGULATORY GUIDE

OFFICE OF NUCLEAR REGULATORY RESEARCH

REGULATORY GUIDE 1.202

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STANDARD FORMAT AND CONTENT OF DECOMMISSIONING COST ESTIMATES FOR NUCLEAR POWER REACTORS

A. INTRODUCTION

Decommissioning means permanently removing a nuclear facility from service and reducing radioactive material on the licensed site to levels that would permit termination of the license issued by the U.S. Nuclear Regulatory Commission (NRC). The NRC amended its regulations on decommissioning procedures that lead to termination of an operating license for nuclear power reactors, as specified in Title 10, Section 50.82, of the *Code of Federal Regulations* (10 CFR 50.82). The amended regulations became effective on July 29, 1996. This rulemaking included changes to 10 CFR Part 2, "Rules of Practice for Domestic Licensing Proceedings and Issuance of Orders"; Part 50, "Domestic Licensing of Production and Utilization Facilities"; and Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions." Among other relevant topics, these regulations contain requirements related to submission of decommissioning cost estimates. The purpose of this regulatory guide is to provide licensees with guidance on a method that the NRC staff finds acceptable for use in preparing the following required cost estimates as specified in the regulations:

- The preliminary decommissioning cost estimate (hereinafter referred to as the preliminary cost estimate) is to be submitted at or about 5 years prior to the projected end of operations [10 CFR 50.75(f)(2)].
- The expected cost estimate contained in the Post-Shutdown Decommissioning Activities Report (PSDAR) is required to be submitted (with the PSDAR) prior to or within 2 years of permanent cessation of operations [10 CFR 50.82(a)(4)(i)].

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This guide was issued after consideration of comments received from the public. The NRC staff encourages and welcomes comments and suggestions in connection with improvements to published regulatory guides, as well as items for inclusion in regulatory guides that are currently being developed. The NRC staff will revise existing guides, as appropriate, to accommodate comments and to reflect new information or experience. Written comments may be submitted to the Rules and Directives Branch, Office of Administration, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001.

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- The site-specific decommissioning cost estimate is to be submitted within 2 years following permanent cessation of operations [10 CFR 50.82(a)(8)(iii)].
- The updated site-specific cost estimate for remaining decommissioning activities is to be included in the License Termination Plan (LTP), which must be submitted at least 2 years before termination of the license [10 CFR 50.82(a)(9)(ii)(F)].

The NRC staff suggests that licensees use the standard format described in this regulatory guide to facilitate preparation and NRC review of the required cost estimates.

This regulatory guide applies only to power reactor licensees. The regulations for non-power reactor licensees are given in 10 CFR 50.82(b).

The 1996 amendment to the NRC's regulations on decommissioning procedures requires that power reactor licensees who were engaged in decommissioning at the time the regulation became effective must convert to, and comply with, the amended regulation. All power reactor licensees are required to comply with the decommissioning procedures specified in these regulations, and no "grandfathering" considerations are applicable.

The NRC's decommissioning regulations address the minimum decommissioning funding requirements necessary to achieve termination of the license issued under 10 CFR Part 50. The NRC's definition of decommissioning does not include other activities related to facility deactivation and site closure, including operation of the spent fuel storage pool, construction and/or operation of an independent spent fuel storage installation (ISFSI), demolition of decontaminated structures, and/or site restoration activities after residual radioactivity has been removed. Accordingly, this regulatory guide does not address such "non-NRC decommissioning costs"; nonetheless, this regulatory guide does address the cost to decontaminate an ISFSI licensed under the General License.

Rules applicable to managing and providing funding for the management of irradiated fuel following shutdown are contained in 10 CFR 50.54(bb). Regulations applicable to an ISFSI facility are contained in 10 CFR Part 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste." Site restoration activities that do not involve the removal of residual radioactivity necessary to terminate the NRC license are outside the scope of NRC regulation.

This regulatory guide contains information collections that are covered by the requirements of 10 CFR Part 50, which the Office of Management and Budget (OMB) approved under OMB control number 3150-0011. The NRC may neither conduct nor sponsor, and a person is not required to respond to, an information collection request or requirement unless the requesting document displays a currently valid OMB control number.

B. DISCUSSION

DECOMMISSIONING OPTIONS

The three basic methods for decommissioning are DECON, SAFSTOR, and ENTOMB. NUREG-0586, "Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities," and NUREG-0586, Supplement 1 (Ref. 1), evaluated the environmental impact of these three methods, which are summarized as follows:

- (1) **DECON:** The equipment, structures, and portions of the facility and site that contain radioactive contaminants are promptly removed or decontaminated to a level that permits termination of the license after cessation of operations. (Decontamination is initiated within a couple of years after shutdown and continues until completed, usually within 7 to 10 years.)
- (2) **SAFSTOR:** The facility is placed in a safe, stable condition and maintained in that state (safe storage). The facility is decontaminated and dismantled at the end of the storage period to levels that permit license termination. Therefore, the SAFSTOR determination includes consideration of those activities necessary for final decontamination and dismantlement of the facility. During SAFSTOR, a facility is left intact or may be partially dismantled, but the fuel is removed from the reactor vessel and radioactive liquids are drained from systems and components. Radioactive decay occurs during the SAFSTOR period, thereby reducing the quantity of contamination and radioactivity that must be disposed of during decontamination and dismantlement (D&D). The SAFSTOR determination also includes D&D of the facility at the end of the storage period.
- (3) **ENTOMB:** Radioactive structures, systems, and components are encased in a structurally long-lived substance, such as concrete. The entombed structure is appropriately maintained, and monitored (through continued surveillance) until the radioactivity decays to a level that permits termination of the license. Because most power reactors will have radionuclides in concentrations exceeding the limits for unrestricted use even after 100 years, and because current regulations require decommissioning to be completed within 60 years of cessation of operation, the NRC will handle entombment requests on a case-by-case basis.

Although the selection of the decommissioning option is up to the licensee, the NRC requires the licensee to reevaluate its selection if the option (1) cannot be completed as described, (2) cannot be completed within 60 years of the permanent cessation of plant operations, (3) includes activities that would endanger the health and safety of the public by being outside of the NRC's health and safety regulations, or (4) will result in a significant impact to the environment.

DECOMMISSIONING COST ESTIMATES

The following regulatory requirements relate to submitting a decommissioning cost estimate:

- 10 CFR 50.75(f)(2) requires that a licensee "...shall at or about 5 years prior to the projected end of operations submit [to the NRC] a preliminary decommissioning cost estimate which includes an up-to-date assessment of the major factors that could affect the cost to decommission."
10 CFR 50.75(f)(4) requires a licensee to include plans to adjust funding levels to demonstrate a reasonable level of financial assurance, if necessary, in the preliminary cost estimate.

In addition, 10 CFR 50.75(c) specifies that the initial certification amount of funds for decommissioning must be based on the amounts specified in 10 CFR 50.75(c), which represents the minimum funding level that applicants and licensees must meet. However to meet the requirements of 10 CFR 50.75(c), a power reactor licensee may submit a certification based on a site-specific cost estimate, which may be more (but not less) than the amount specified in 10 CFR 50.75(b)(1) when a higher funding level than 10 CFR 50.75(c) is desired. The basis for any increases should be provided. Although this site-specific cost estimate is not the same site-specific cost estimate required by 10 CFR 50.82(a)(8)(iii), it should address many areas identified in Section 3 of this document; however, the level of detail will be less and the level of uncertainty may vary.

- 10 CFR 50.82(a)(4)(i) requires a licensee to provide "...an estimate of expected costs..." for the activities being proposed in the PSDAR. As previously stated, the PSDAR is to be submitted prior to or within 2 years following permanent cessation of operations. Regulatory Guide 1.185, "Standard Format and Content for Post-Shutdown Decommissioning Activities Report" (Ref. 2), identifies the types of information to be included in the PSDAR. The cost estimate may be a site-specific cost estimate or the amount of decommissioning funds estimated to be required pursuant to 10 CFR 50.75(b) and (c), as currently reported to the NRC on a calendar-year basis at least once every 2 years in accordance with 10 CFR 50.75(f)(1).
- 10 CFR 50.82(a)(8)(iii) requires a licensee to provide a site-specific decommissioning cost estimate within 2 years following permanent cessation of operations. (This requirement may be satisfied by including a site-specific cost estimate as part of the PSDAR.)

In addition, 10 CFR 50.75(c) specifies that the initial certification amount of funds for decommissioning must be based on the amounts specified in 10 CFR 50.75(c)(1), which represents the minimum funding level that applicants and licensees must meet. The site-specific cost estimate submitted within 2 years following permanent cessation of operations may be significantly larger than the funding level based on the formula. If the site-specific cost estimate results in a funding level that differs from the amount specified in 10 CFR 50.75(c), the licensee must provide the basis for the change.

- 10 CFR 50.82(a)(9)(ii)(F) requires a licensee to provide "an updated site-specific estimate of remaining decommissioning costs..." as part of a license termination plan (LTP).
10 CFR 50.82(a)(9)(i) requires a licensee to submit its LTP at least 2 years before termination of the license.

As provided in 10 CFR 50.82(a)(8)(ii), a licensee may withdraw funds from the decommissioning trust fund up to a cumulative total of 3 percent of the generic amount calculated under 10 CFR 50.75(c) for decommissioning planning purposes at any time without prior notification to the NRC. After submittal of the certifications of permanent shutdown and fuel removal required under 10 CFR 50.82(a)(1) and commencing 90 days after the NRC has received the PSDAR, the licensee may use up to an additional 20 percent of the decommissioning funds prescribed in 10 CFR 50.75(c) for decommissioning purposes. The licensee is prohibited from using the remaining 77 percent of the generic decommissioning funds until a site-specific decommissioning cost estimate is submitted to the NRC. In addition, 10 CFR 50.82(a)(8)(i) limits use of the decommissioning funds to legitimate radiological decommissioning expenses that neither reduces the value of the trust fund below that necessary to place and maintain the reactor in a safe storage condition, nor impacts the licensee's ability to complete funding of the trust to ultimately release the site and terminate the license.

C. REGULATORY POSITION

The major types of cost estimates affecting the licensee are (1) the preliminary cost estimate, (2) the estimate of expected costs presented in the PSDAR, (3) the site-specific decommissioning cost estimate, and (4) the updated site-specific estimate of remaining decommissioning costs.

The licensee is reminded that 10 CFR 50.2 defines decommissioning as the safe removal of a facility or site from service and the reduction of residual radioactivity to levels that permit release of the site and termination of the license. For example, removing uncontaminated material, such as soil or a wall, to gain access to contamination to be removed would be a legitimate decommissioning cost. However, the costs of demolition of decontaminated structures, site restoration activities, or other activities not involved with removing the facility from service or reducing residual radioactivity are not included within the NRC's definition of decommissioning costs, and are not included in the amount of funds that 10 CFR 50.75 requires to be placed in the plant's decommissioning fund. If a licensee sets aside funds in the trust that are supporting non-NRC decommissioning activities, the sub-accounts under the trust must be clearly designated.

1. PRELIMINARY COST ESTIMATE PRIOR TO THE END OF OPERATIONS

The preliminary cost estimate, required by 10 CFR 50.75(f)(2), must be submitted at or about 5 years before the projected end of operations. The intent of the preliminary estimate is to provide the NRC with an up-to-date estimate of decommissioning costs and identify major factors that would impact the cost of the decommissioning. The licensee will already have submitted a cost estimate for establishing a fund for decommissioning as required by 10 CFR 50.75(b). This estimate will have been revised periodically during operation and may be used in preparing the preliminary cost estimate. For the preliminary cost estimate, the NRC will compare the estimated costs with the minimum decommissioning trust fund amount derived from the formula and, if the preliminary cost estimate is greater than the amount in the decommissioning trust fund, the licensee should include a discussion of the mechanism for adjusting the level of funds to demonstrate that funds will be available for use at the time of permanent shutdown.

The preliminary cost estimate may be a new or previously developed site-specific cost estimate, provided that the estimate contains the information specified in 10 CFR 50.75(f)(2) and represents the cost to decommission the facility. The preliminary cost estimate information may be in summary form, as long as the supporting basis has previously been submitted and is referenced.

The projected end of operations need not be the same as the expiration date of the operating license if a licensee chooses to permanently cease operations at an earlier date. In some cases, a licensee may shut down prematurely and submit its certification of permanent cessation of operations, as required by 10 CFR 50.82(a)(1), more than 5 years prior to the expiration date of the operating license. In this event, the requirement of 10 CFR 50.75(f)(2) to submit a preliminary cost estimate is not applicable. If a prematurely shutdown licensee chooses to submit its PSDAR along with its certification of permanent shutdown, it could choose to submit its preliminary cost estimate as the estimate of expected costs required for the PSDAR. This action would satisfy the requirements of 10 CFR 50.82(a)(4)(i).

The information in the preliminary cost estimate should be similar to that submitted for the site-specific cost estimate; however, the level of detail will be less and the level of uncertainty may vary. For example, the NRC recognizes that many items (such as waste disposal cost) are difficult to estimate and may vary during the 5 years prior to shutdown. The preliminary cost estimate should include the following:

- a detailed discussion of the decommissioning option anticipated to be implemented (DECON, SAFSTOR, or some combination thereof), with major factors that could impact the cost of decommissioning, including major technical actions and waste disposal site availability
- a discussion of the potential for known or suspected contamination at the site that may affect the cost of decommissioning [This discussion should include an evaluation of the records of information important to decommissioning required by 10 CFR 50.75(g). Although the requirements described in 10 CFR 50.75(g) for keeping records of spills or other unusual occurrences are outside the scope of this regulatory guide, the licensee should evaluate the anticipated extent of contamination on the facility and site, based on information available in the decommissioning files. This evaluation should include descriptions of known instances of releases of contaminated materials into the facility and the external environment, along with the possible impact on decommissioning. Known environmental contamination (e.g., contamination in soil, groundwater, or surface water) should be identified.]
- a preliminary schedule that shows the major decommissioning phases and the time period over which each of the phases extends
- a summary of the total estimated decommissioning costs by decommissioning activity [This summary should include the anticipated cost of low-level waste (LLW) disposal. Table 1 of this document presents a suggested format for providing this information.]
- a comparison of the estimated cost with the minimum decommissioning fund requirement
- a discussion of the plans for adjusting the level of funds in the trust to demonstrate that funds will be available for use when needed should be included if the decommissioning trust is not fully funded

Table 1. Suggested Format for Tabulating Expected Costs

Decommissioning Activity	Estimated Decommissioning Cost (Millions of Estimate-Year Dollars)				
	Period 1 (X.X Years)	Period 2 (X.X Years)	Period 3 (X.X Years)	Period 4 (X.X Years)	Duration (X.X Years)
	Planning & Preparation	Plant Deactivation	Safe Storage Operations	Dismantle- ment	Total Cost
Radioactive Component Removal					
Decontamination and Dismantlement					
Management and Support					
LLW Costs including packaging, shipping and burial/vendor costs					
Total Cost					

2. ESTIMATE OF EXPECTED COSTS IN THE PSDAR

Prior to or within 2 years following permanent cessation of operations, the licensee is required [by 10 CFR 50.82(a)(4)(i)] to submit a PSDAR to the NRC. In addition to other prescribed content, this report must include an estimate of costs. Regulatory Guide 1.185 (Ref. 2) identifies the types of information to be contained in the PSDAR. The cost estimate may be satisfied by either of the following methods and supporting information:

- (1) the amount of decommissioning funds estimated to be required by 10 CFR 50.75(b) and (c), as currently reported to the NRC on a calendar-year basis at least once every 2 years in accordance with 10 CFR 50.75(f)(1)
- (2) a site-specific cost estimate

Other related but non-NRC decommissioning costs (e.g., spent fuel storage, site restoration) may be included in the estimate of costs if desired; however, the cost of radiological decommissioning as defined by 10 CFR 50.2 should be listed separately. As a separate item, the cost of placing and maintaining the facility in safe storage should be identified, along with a plan to ensure that sufficient funds will be available for this purpose, if necessary, until such time as the radioactively contaminated material is placed in an authorized waste disposal site. It should be noted that, as with the PSDAR, 10 CFR 50.82(a)(8)(iii) requires a licensee to provide a site-specific decommissioning cost estimate within 2 years following permanent cessation of operations. If the estimate of costs provided with the PSDAR is a site-specific cost estimate, this requirement can be satisfied with the PSDAR submittal.

2.1 Cost Estimate Based on Financial Assurance Amounts [10 CFR 50.75(b) and (c)]

Licensees of operating pressurized-water reactors (PWRs) and boiling-water reactors (BWRs) must provide reasonable assurance that funds will be available to accomplish decommissioning within 60 years from the date of permanent cessation of operations, as required by 10 CFR 50.82(a)(3). Reasonable assurance may be demonstrated by compliance with the requirements of 10 CFR 50.75(b), (c), (e), and (f). These requirements ensure that a licensee has financial assurance in effect for an amount that may be more (but not less) than the amount stated in the table in 10 CFR 50.75(c)(1). A licensee is required [by 10 CFR 50.75(f)(1)] to report, on a calendar-year basis at least once every 2 years, the status of its decommissioning funding. Specifically, this table demonstrates that if P equals the thermal power of a reactor in megawatts (MWt), the minimum financial assurance (MFA) funding amount (in millions, January 1986 dollars) is calculated as follows:

- for a PWR: $MFA = (75 + 0.0088P)$
- for a BWR: $MFA = (104 + 0.009P)$

For either a PWR or a BWR, if the thermal power of the reactor is less than 1,200 MWt, the value of P to be used in these equations is 1,200, whereas if the thermal power is greater than 3,400 MWt, the value of P to be used is 3,400.

The financial assurance amounts calculated in the above equations are based on January 1986 dollars. To account for inflation from 1986 to the current year, these amounts must be adjusted annually by multiplying by an escalation factor (ESC) described in 10 CFR 50.75(c)(2), as follows:

$$ESC(\text{current year}) = (0.65L + 0.13E + 0.22B)$$

where L and E are the ESC from 1986 to the current year for labor and energy, respectively, and are to be taken from regional data of the U.S. Department of Labor, Bureau of Labor Statistics (Refs. 3 and 4), and B is an annual ESC from 1986 to the current year for waste burial and is to be taken from the most recent revision of NUREG-1307, "Report on Waste Disposal Charges: Changes in Decommissioning Waste Disposal Costs at Low-Level Waste Burial Facilities" (Ref. 5). The NRC updates NUREG-1307 from time to time to account for disposal charge changes. In January 1986 (the base year), using disposal costs from DOE's Hanford Reservation waste disposal site, L , E , and B all equaled unity; thus, the ESC itself equaled unity. (Reference 2 discusses the origin of the $0.65L$, $0.13E$, and $0.22B$ terms.) Thus,

$$MFA(\text{in millions, current year dollars}) = MFA \times ESC(\text{current year})$$

2.2 Site-Specific Cost Estimates in the PSDAR

The estimate of expected decommissioning costs required for the PSDAR can be the same as the site-specific cost estimate required by 10 CFR 50.82(a)(8)(iii). The site-specific cost estimate is a detailed assessment that incorporates the cost impact of site-specific factors. (Section 3 of this document discusses the site-specific estimate.)

3. SITE-SPECIFIC COST ESTIMATE

A licensee is required [by 10 CFR 50.82(a)(8)(iii)] to submit a site-specific cost estimate within 2 years following permanent cessation of operations. The licensee may include this cost estimate with the PSDAR [10 CFR 50.82(a)(4)(i)]. In addition, a site-specific estimate may be submitted, at the discretion of the licensee, when a funding level differs from that calculated in the formula in 10 CFR 50.75(c). The site-specific cost estimate must clearly identify and provide the basis for the funding level if it differs from the formula. The site-specific cost estimate information, as well as the update of the site-specific cost, may be in summary form, as long as the supporting basis has previously been submitted and is referenced. If the cost estimate was prepared for the rate regulator, it may contain additional costs that the NRC does not consider part of the radiological decommissioning costs; however, the cost estimate is acceptable provided the costs are separated and easily distinguishable. Sections 3.1–3.4 discuss the types of information that the licensee should provide to help the NRC staff properly assess the estimate.

3.1 General Information

- Discuss the chosen decommissioning option (DECON, SAFSTOR, or some combination thereof).
- Discuss the methodology used to derive the cost estimates.
- Summarize total decommissioning costs by period. (Table 2 of this document presents a suggested format for providing this information.) Provide a separate list of the costs of items not considered part of decommissioning (such as site restoration and spent nuclear fuel storage/management).
- Compare the estimated cost with the minimum financial assurance (MFA) funding requirement.
- Discuss the plans for adjusting the level of funds in the trust should be included to demonstrate that funds will be available for use when needed if the decommissioning trust is not fully funded.
- Summarize the costs of services, supplies, and special equipment. This category should include cost estimates for protective clothing and equipment services supplied by an outside vendor. Also included under this category would be costs of purchasing or leasing specialized decommissioning equipment.
- Summarize undistributed costs, such as property taxes, consultancy costs, nuclear liability insurance costs, energy costs, annual maintenance costs for SAFSTOR phases, site termination survey costs, and regulatory costs (inspections, miscellaneous fees, etc.).

Table 2. Suggested Format for Tabulating Decommissioning Costs by Period

Decommissioning Option Chosen DECON or SAFSTOR	Decommissioning Period Duration (Years) / Decommissioning Cost (Millions of Estimate-Year Dollars)				
	Period 1 Planning & Preparation	Period 2 Plant Deacti- vation	Period 3 Safe Storage Operations	Period 4 Dismantle- ment	Total
Period Years					
Period Cost					

For the DECON option, the total decommissioning costs should be separated into the following activities:

- major radioactive component removal (reactor vessel and internals, steam generators, pressurizers, large-bore reactor coolant system piping, and other large components)
- radiological decontamination and dismantlement (D&D, which involves removing remaining radioactive plant systems, including radiological decontamination) (Tables 3 and 4 of this document present suggested formats for providing this information.)
- management and support [labor costs of support staff and decommissioning operations contractors (DOCs), energy costs, regulatory costs, small tools, insurance, etc.]
- low-level waste (LLW) costs (including packaging, shipping, and burial/waste vendor costs)
- groundwater and soil remediation, if any
- final radiological survey costs
- contingency (allowance for unexpected costs)

Table 3. Suggested Format for Listing Contaminated Equipment and Piping

Equipment Category^(a)	Length of Piping in Feet or Number of Items in Each Category
Piping diameter > 3 inches	
Piping diameter # 3 inches	
Valves > 3 inches	
Valves # 3 inches	
Tanks of all sizes	
Pumps > 100 pounds	
Pumps # 100 pounds	
Heat exchangers > 100 pounds	
Heat exchangers # 100 pounds	
Electrical components > 100 pounds	
Electrical components # 100 pounds	
Miscellaneous components > 100 pounds	
Miscellaneous components # 100 pounds	
Large piping hanger for pipes > 4 inches in diameter	
Small piping hanger for pipes # 4 inches in diameter	

^(a) The equipment categories shown here as examples. Any reasonable method of categorization is acceptable.

Table 4. Suggested Format for Listing Concrete and Metal Surfaces that Require Radiological Decontamination or Removal

Building or Location	Area of Concrete Decontaminated (ft²)	Volume of Concrete Removed (ft³)	Area of Metal Surfaces Decontaminated (ft²)	Volume of Metal Surfaces Removed (ft³)

For the SAFSTOR option, the decommissioning costs should also be separated into the following time periods, or a similar set of decommissioning time periods:

- pre-decommissioning engineering and planning/plant deactivation (all activities from engineering and planning through defueling and layup to complete the placement of the reactor into permanent shutdown condition)
- extended safe storage operations (safe storage monitoring of the facility until dismantlement begins); if storage or monitoring of spent fuel is included in the cost estimate, it should be shown separately
- final radiological D&D (radiological D&D of radioactive systems and structures required for license termination, including demolition for the purposes of reducing residual radioactivity); if demolition of decontaminated structures and site restoration activities are included in the cost estimate, they should be shown separately

Table 1 provides an example of a format for tabulating costs for either DECON or SAFSTOR. Tables 5 and 6 provide suggested formats for tabulating decommissioning cost for both PWR and BWR component cost.

Table 5. Suggested Format for Tabulating PWR Decommissioning Costs by Period

Decommissioning Activity	Decommissioning Cost (Thousands of Estimate-Year Dollars)				
	Period 1 (X.X Years) Planning & Preparation	Period 2 (X.X Years) Plant Deactivation	Period 3 (X.X Years) Safe Storage Operations	Period 4 (X.X Years) Dismantlement	Duration (X.X Years) Total Cost
Radioactive Component Removal					
Removal of RPV Internals					
Removal of Reactor Pressure Vessel					
Steam Generator--Direct Removal Costs					
Steam Generator--Cascading Costs					
RCS Piping					
Large Miscellaneous RCS Piping					
Small Miscellaneous RCS Piping					
RCS Insulation					
Pressurizer					
Pressurizer Relief Tank					
Primary Pumps					
Spent Fuel Racks					
Biological Shield					
Subtotal					
Decontamination and Dismantlement					
Decontamination of Site Buildings					
Removal of Contaminated Plant Systems					
Subtotal					
Management and Support					
Support Staff					
DOC Staff					
Consultant/Other Staff					
Termination Survey Costs					
Regulatory Costs					
Special Tools and Equipment					
Environmental Monitoring Costs					
Laundry Services					
Small Tools and Minor Equipment					
Nuclear Liability Insurance					
Property Taxes					
DOC Mobilization/Demobilization Costs					
Steam Generator--Undistributed Costs					
Chemical Decon					
Plant Power Usage					
Subtotal					
LLW Costs including packing,shipping and vendor/burial costs					
Total					

Table 6. Suggested Format for Tabulating BWR Decommissioning Costs by Period

Decommissioning Activity	Decommissioning Cost (Thousands of Estimate-Year Dollars)				
	Period 1 (X.X Years) Planning & Preparation	Period 2 (X.X Years) Plant Deactivation	Period 3 (X.X Years) Safe Storage Operations	Period 4 (X.X Years) Dismantle- ment	Duration (X.X Years) Total Cost
Radioactive Component Removal					
RPV Internals					
Reactor Pressure Vessel and Insulation					
Shielding					
Recirculation Pumps					
RCS Piping					
RCS Piping Insulation					
Main Turbine					
Main Turbine Condenser					
Moisture Separator Reheaters					
Feed Water Heaters					
Turbine Feed Pumps					
Structural Beams, Plates, & Cable Trays					
Spent Fuel Racks					
Subtotal					
Decontamination and Dismantlement					
Decontamination of Site Buildings					
Removal of Contaminated Plant Systems					
Subtotal					
Management and Support					
Support Staff					
DOC Staff					
Consultant/Other Staff					
Termination Survey Costs					
Regulatory Costs					
Special Tools and Equipment					
Environmental Monitoring Costs					
Laundry Services					
Small Tools and Minor Equipment					
Nuclear Liability Insurance					
DOC Mobilization/Demobilization Costs					
Chemical Decontamination					
Plant Power Usage					
Subtotal					
LLW Costs including packaging,shipping, and burial/vendor costs					
Total					

3.2 Cost Estimate for the Removal or Radiological Decontamination of Major Radioactive Components

For a PWR, major radiological components should include, but not be limited to, the following:

- reactor vessel and internals
- reactor coolant loops
- reactor coolant pumps
- bioshield
- pressurizer
- steam generators
- spent fuel racks
- other large contaminated components

For a BWR, major radiological components should include, but not be limited to, the following:

- reactor vessel and internals
- reactor coolant piping
- main turbines/generators
- turbine condensers
- moisture separator reheaters
- feedwater heaters
- feedwater pumps
- spent fuel racks
- other large contaminated components

3.3 Burial Cost and Volumes

The licensee should provide tabulations of expected waste volumes, packaging costs, shipping costs, and burial costs by decommissioning activity. Table 7 provides a suggested format. The licensee should also submit plans for radwaste disposition, including radwaste disposal sites to be used, if available. If a vendor will process the waste, the radwaste information after processing should be provided to show the results of the waste minimization. The licensee may also elect to provide descriptions of the methods and technologies used to achieve the improved waste characteristics. The licensee should also provide radwaste volumes by class expected to be generated during decommissioning. Table 8 provides a suggested format.

Table 7. Typical Waste Burial Cost and Volumes

Decommissioning Activity	Waste Volume (ft³)	Packaging Cost (Estimate-Year \$millions)	Shipping Cost (Estimate-Year \$millions)	Burial Cost (Estimate-Year \$millions)
Removal of Nuclear Steam Supply System				
Removal of Contaminated Plant Systems				
Radiological Decontamination of Site Buildings				
Dry Active Waste				
Total				

Table 8. Burial Volumes by Waste Class

Waste Class	Volume (ft ³)	Percent
Class A		
Class B&C		
Greater-Than-Class-C		
Total		

3.4 Other Items

The licensee should provide the following additional information:

- a brief discussion of contingency costs and the methods used to calculate them
- a brief discussion of how inflation is accounted for in the cost estimate
- a schedule for the accumulation and expenditure of decommissioning funds
- an estimate of the cost to support safe storage, if it becomes necessary
- labor requirements (person-years) and labor costs by time period; Table 9 provides a suggested format

Table 9. Labor Requirements and Labor Costs

	Labor Requirements (person-yrs) and Labor Costs (Estimate-Year \$millions)									
	Phase 1		Phase 2		Phase 3		Phase 4		Total	
	(Labor Req)	(Labor Cost)	(Labor Req)	(Labor Cost)	(Labor Req)	(Labor Cost)	(Labor Req)	(Labor Cost)	(Labor Req)	(Labor Cost)
Decommissioning Crews										
Management/Support Staff										
Total										

4. LICENSE TERMINATION COST ESTIMATE

According to 10 CFR 50.82(a)(9)(ii)(F), a licensee must submit an “updated site-specific estimate of remaining decommissioning costs” as part of an LTP. According to 10 CFR 50.82(a)(9)(i), the licensee must submit the LTP at least 2 years before termination of the license. The estimated remaining costs of decommissioning must be compared with the present funds set aside for decommissioning. The financial assurance instrument required by 10 CFR 50.75 must be funded at least to the amount of the cost estimate. If there is a deficit in present funding, the LTP must indicate the means to ensure that adequate funds will be available to complete the decommissioning. Licensees should be aware that 10 CFR 50.82(a)(8)(i)(B) requires that expenditures are not to reduce the value of the decommissioning trust below an amount necessary to place and maintain the reactor in a safe storage condition if unforeseen conditions arise. Information on the preparation of an LTP may be found in Regulatory Guide 1.179, “Standard Format and Content of License Termination Plans for Nuclear Power Reactors” (Ref. 10), and NUREG-1700, “Standard Review Plan for Evaluating Nuclear Power Reactor License Termination Plans” (Ref. 11).

The cost estimate portion of the LTP is an updated version of the site-specific estimate that the licensee previously submitted to the NRC. The LTP cost estimate should contain refined estimates of the remaining decommissioning activities, including the cost to remediate surface and groundwater, soil contamination, waste transportation and disposal costs, and license termination survey costs. If the site is to be released for restricted use, the LTP cost estimate should also include estimated costs for controls and a description of the financial assurance mechanisms used to ensure the availability of funds when they are needed. Cost estimates for restricted release or entombment will be handled on a case-by-case basis.

5. FORMAT OF THE DECOMMISSIONING COST ESTIMATES

Graphic presentations such as charts, drawings, maps, diagrams, sketches, and tables should be employed when the information may be presented more adequately or conveniently by such means. Care should be taken to ensure that all information so presented is legible in the original documents and reproduced copies. Also, ensure that symbols are defined and scales are not reduced to the extent that visual aids are necessary to interpret items of information. These graphic presentations should be located in the section where the subject matter is primarily addressed. References should appear as footnotes on the page they were discussed or at the end of each chapter.

Decommissioning cost estimates may be submitted to the NRC in electronic or paper format, as described in Regulatory Issue Summary (RIS) 2001-05, “Guidance on Submitting Documents to the NRC by Electronic Information Exchange or on CD-ROM” (Ref.12).

5.1 Physical Format

5.1.1 Paper Size

- Text pages: 8½ × 11 inches.
- Drawings and graphics: 8½ × 11 inches. A larger size is acceptable provided the finished copy, when folded, does not exceed 8½ × 11 inches.

5.1.2 Paper Stock and Ink

Use suitable quality in substance, paper color, and ink density for handling and reproduction.

5.1.3 Page Margins

A margin of no less than 1 inch should be maintained on the top, bottom, and binding side of all pages submitted.

5.1.4 Printing

- Composition: Text pages should be single spaced.
- Type Face and Style: Should be suitable for image-copying equipment, including computer scanning.
- Reproduction: Copies may be mechanically or photographically reproduced.

5.1.5 Binding

No requirements.

5.1.6 Page Numbering

Pages should be numbered sequentially.

5.1.7 Procedures for Updating or Revising Pages

Data and text should be updated or revised by replacing pages. The changed or revised portion of each page should be highlighted by a “change indicator” mark consisting of a bold vertical line drawn in the margin opposite the binding margin. The line should be of the same length as the portion actually changed.

All pages submitted to update, revise, or add information to the report should show the date of change and a change or amendment number. A guide page listing the pages to be inserted and/or removed should accompany the revised pages. When major changes or additions are made, a revised table of contents should be provided.

5.1.8 Exceptions to Physical Specifications

Submittals may be made over the Internet or electronically; for guidance, see Regulatory Issue Summary 2001-05 (Ref. 12).

REFERENCES

1. U.S. Nuclear Regulatory Commission, "Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities," NUREG-0586, Supplement 1, October 2002.¹
2. U.S. Nuclear Regulatory Commission, "Standard Format and Content for Post-Shutdown Decommissioning Activities Report," Regulatory Guide 1.185, August 2000.²
3. U.S. Department of Labor, Bureau of Labor Statistics, *Monthly Labor Review*, currently Table 24, updated periodically.
4. U.S. Department of Labor, Bureau of Labor Statistics, *Producer Price Index*, currently Table 6, updated periodically.
5. U.S. Nuclear Regulatory Commission, "Report on Waste Disposal Charges: Changes in Decommissioning Waste Disposal Costs at Low-Level Waste Burial Facilities," NUREG-1307, Rev. 9, September 2000.¹
6. R.I. Smith, G J. Konzek, and W.E. Kennedy, Jr., "Technology, Safety and Costs of Decommissioning a Reference Pressurized-Water Reactor Power Station," NUREG/CR-0130 (Prepared for the U.S. NRC by Pacific Northwest Laboratory, Richland, Washington), June 1978 (Addendum 1, July 1979; Addendum 2, July 1983; Addendum 3, September 1984; Addendum 4, July 1988).¹
7. H.D. Oak et al., "Technology, Safety and Costs of Decommissioning a Reference Boiling-Water Reactor Power Station," NUREG/CR-0672 (Prepared for the U.S. NRC by Pacific Northwest Laboratory, Richland, Washington), June 1980 (Addendum 1, July 1983; Addendum 2, September 1984; Addendum 3, July 1988; Addendum 4, December 1990).¹
8. G.J. Konzek et al., "Revised Analyses of Decommissioning for the Reference Pressurized-Water Reactor Power Station," NUREG/CR-5884 (Prepared for the U.S. NRC by Pacific Northwest Laboratory, Richland, Washington), November 1995.¹
9. R.I. Smith et al., "Revised Analyses of Decommissioning for the Reference Boiling-Water Reactor Power Station," NUREG/CR-6174 (Prepared for the U.S. NRC by Pacific Northwest National Laboratory, Richland, Washington), July 1996.¹

¹ Copies are available at current rates from the U.S. Government Printing Office, P.O. Box 37082, Washington, DC 20402-9328 (telephone (202) 512-1800); or from the National Technical Information Service (NTIS) by writing NTIS at 5285 Port Royal Road, Springfield, VA 22161; <http://www.ntis.gov>; telephone (703) 487-4650. Copies are available for inspection or copying for a fee from the NRC's Public Document Room at 11555 Rockville Pike, Rockville, MD; the PDR's mailing address is USNRC PDR, Washington, DC 20555; telephone (301) 415-4737 or (800) 397-4209; fax (301) 415-3548; email is PDR@nrc.gov.

² Single copies of regulatory guides, both active and draft, and draft NUREG documents may be obtained free of charge by writing the Reproduction and Distribution Services, USNRC, Washington, DC 20555-0001, or by fax to (301) 415-2289, or by email to DISTRIBUTION@nrc.gov. Active guides may also be purchased from the National Technical Information Service on a standing order basis. Details on this service may be obtained by writing NTIS, 5285 Port Royal Road, Springfield, VA 22161; telephone (703) 487-4650; online at <http://www.ntis.gov>. Copies of active and draft guides are available for inspection or copying for a fee from the NRC's Public Document Room at 11555 Rockville Pike, Rockville, MD; the PDR's mailing address is USNRC PDR, Washington, DC 20555; telephone (301) 415-4737 or (800) 397-4209; fax (301) 415-3548; email PDR@nrc.gov.

10. U.S. Nuclear Regulatory Commission, "Standard Format and Content of License Termination Plans for Nuclear Power Reactors," Regulatory Guide 1.179, January 1999.³
11. U.S. Nuclear Regulatory Commission, "Standard Review Plan for Evaluating Nuclear Power Reactor License Termination Plans," NUREG-1700, April 2000.⁴
12. U.S. Nuclear Regulatory Commission, Regulatory Issue Summary 2001-05, "Guidance on Submitting Documents to the NRC by Electronic Information Exchange or on CD-ROM," January 25, 2001.⁵

³ Single copies of regulatory guides, both active and draft, and draft NUREG documents may be obtained free of charge by writing the Reproduction and Distribution Services, USNRC, Washington, DC 20555-0001, or by fax to (301) 415-2289, or by email to DISTRIBUTION@nrc.gov. Active guides may also be purchased from the National Technical Information Service on a standing order basis. Details on this service may be obtained by writing NTIS, 5285 Port Royal Road, Springfield, VA 22161; telephone (703) 487-4650; online at <http://www.ntis.gov>. Copies of active and draft guides are available for inspection or copying for a fee from the NRC's Public Document Room at 11555 Rockville Pike, Rockville, MD; the PDR's mailing address is USNRC PDR, Washington, DC 20555; telephone (301) 415-4737 or (800) 397-4209; fax (301) 415-3548; email PDR@nrc.gov.

⁴ Copies are available at current rates from the U.S. Government Printing Office, P.O. Box 37082, Washington, DC 20402-9328 (telephone (202) 512-1800); or from the National Technical Information Service (NTIS) by writing NTIS at 5285 Port Royal Road, Springfield, VA 22161; <http://www.ntis.gov>; telephone (703) 487-4650. Copies are available for inspection or copying for a fee from the NRC's Public Document Room at 11555 Rockville Pike, Rockville, MD; the PDR's mailing address is USNRC PDR, Washington, DC 20555; telephone (301) 415-4737 or (800) 397-4209; fax (301) 415-3548; email is PDR@nrc.gov.

⁵ The NRC's regulatory issue summaries are available electronically on the agency's public Web site at <http://www.nrc.gov/reading-rm/doc-collections/gen-comm/reg-issues>. Copies are also available for inspection or copying for a fee from the NRC's Public Document Room at 11555 Rockville Pike, Rockville, MD; the PDR's mailing address is USNRC PDR, Washington, DC 20555; telephone (301) 415-4737 or (800) 397-4209; fax (301) 415-3548; email PDR@nrc.gov.

D. IMPLEMENTATION

The purpose of this section is to provide information to applicants and licensees regarding the NRC staff's plans for using this guide. No backfitting is intended or approved in connection with the issuance of this guide.

Except when an applicant or licensee proposes or has previously established an acceptable alternative method for complying with specified portions of the NRC's regulations, the methods described in this guide will be used in evaluating (1) submittals for licensing-basis documents, and (2) revisions or updates to the decommissioning cost estimates that are submitted in accordance with applicable regulations.

REGULATORY ANALYSIS

The NRC staff did not prepare a separate regulatory analysis for this regulatory guide. The regulatory analysis prepared for the amendments to 10 CFR Parts 2, 50, and 51, "Decommissioning of Nuclear Power Reactors," which the NRC issued on July 29, 1996 (61 FR 39278), provides the regulatory basis for this guide and examines the costs and benefits associated with implementing the rule as described in this guide. A copy of this regulatory analysis is available for inspection and copying (for a fee) at the NRC's Public Document Room (PDR), which is located at 11555 Rockville Pike, Rockville, Maryland. The PDR's mailing address is USNRC PDR, Washington, DC 20555-0001. The PDR can also be reached by telephone at (301) 415-4737 or (800) 397-4205, by fax at (301) 415-3548, and by email to PDR@nrc.gov.

BACKFIT ANALYSIS

This regulatory guide describes a voluntary method that the NRC staff considers acceptable for submitting the decommissioning cost estimates required by amendments to 10 CFR Parts 2, 50, and 51, "Decommissioning of Nuclear Power Reactors," which the NRC issued on July 29, 1996 (61 FR 39278). During the rulemaking process associated with those amendments, the NRC staff carefully considered the reasons for collecting the required information. Compliance with this regulatory guide is not a requirement, and a licensee may choose this or another method to achieve compliance with these rules. Thus, this regulatory guide does not require a backfit analysis, as described in 10 CFR 50.109(c), because it does not impose a new or amended provision in the NRC's rules, does not present a regulatory staff position that interprets the NRC's rules in a manner that is either new or different from a previous staff position; and does not require the modification of or addition to the systems, structures, components, or design of a facility, or the procedures or organization required to design, construct, or operate a facility.