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**DRAFT REGULATORY GUIDE**

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**DRAFT REGULATORY GUIDE DG-1085**

**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 Nuclear Regulatory Commission (NRC) license. A regulation became effective on July 29, 1996, that amended the NRC's regulations on the decommissioning procedures that lead to termination of an operating license for nuclear power reactors. 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." The revised regulations contain requirements related to submitting decommissioning cost estimates. The purpose of this regulatory guide is to provide licensees with guidance on a method that is acceptable to the NRC staff on the preparation of the major cost estimates specified in the regulations:

- Preliminary decommissioning cost estimate (hereinafter referred to as the preliminary cost estimate) at or about five years prior to the projected end of operations. (10 CFR 50.75(f)(2))
- Expected cost estimate contained in the Post-Shutdown Decommissioning Activities Report (PSDAR). (10 CFR 50.82(a)(4)(i))

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This regulatory guide is being issued in draft form to involve the public in the early stages of the development of a regulatory position in this area. It has not received complete staff review or approval and does not represent an official NRC staff position.

Public comments are being solicited on this draft guide (including any implementation schedule) and its associated regulatory analysis or value/impact statement. Comments should be accompanied by appropriate supporting data. Written comments may be submitted to the Rules and Directives Branch, Office of Administration, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001. Comments may be submitted electronically through the NRC's interactive web site at <[WWW.NRC.GOV](http://WWW.NRC.GOV)> through Rulemaking. Copies of comments received may be examined at the NRC Public Document Room, 11555 Rockville Pike, Rockville, MD. Comments will be most helpful if received by **January 30, 2002**.

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- Site-specific decommissioning cost estimates submitted within two years following permanent cessation of operations. (10 CFR 50.82(a)(8)(iii))

In addition, a licensee may submit a certification amount of funds for decommissioning based on a site-specific cost estimate that is equal to or greater than that calculated in the formula in 10 CFR 50.75(c)(1) or (2) when a higher funding level is desired.

- Updated site-specific estimate of remaining decommissioning costs contained in the License Termination Plan (LTP). (10 CFR 50.82(a)(9)(ii)(F))

This regulatory guide establishes a standard format for the reporting of these cost estimates that is acceptable to the NRC staff. The NRC staff suggests that licensees use this standard format to facilitate their preparation and the NRC's review of the cost estimates.

This regulatory guide supersedes the cost estimate reporting guidance provided in Regulatory Guide 1.159, "Assuring the Availability of Funds for Decommissioning Nuclear Reactors."

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 power reactor licensees that were engaged in decommissioning at the time the regulation became effective to 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 minimum decommissioning fund required by the NRC reflects only the efforts necessary to achieve termination of the Part 50 license. Other activities related to facility deactivation and site closure, including operation of the spent fuel storage pool, construction, operation, and decommissioning of an independent spent fuel storage installation (ISFSI), demolition of decontaminated structures, and site restoration activities after residual radioactivity has been removed, are not included within the NRC definition of decommissioning. Accordingly, such "non-decommissioning costs" are not addressed in this regulatory guide.

Regulations applicable to the funding of spent fuel storage are in 10 CFR 50.54(bb). Regulations applicable to an ISFSI facility are 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 residual radioactivity are outside the scope of NRC regulation.

Regulatory guides are issued to describe and make available to the public such information as methods acceptable to the NRC staff for implementing specific parts of the NRC's regulations, techniques used by the staff in evaluating specific problems or

postulated accidents, and data needed by the NRC staff in its review of applications for permits and licenses. Regulatory guides are not substitutes for regulations, and compliance with them is not required. Regulatory guides are issued in draft form for public comment to involve the public in the early stages of developing regulatory positions. Draft regulatory guides have not received complete staff review, do not represent an official NRC position, and are subject to change after comments from the public have been received.

The information collections contained in this draft regulatory guide are covered by the requirements of 10 CFR Part 50, which were approved by the Office of Management and Budget (OMB); approval number 3150-0011. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

## B. DISCUSSION

There are three basic methods for decommissioning: DECON, SAFSTOR, and ENTOMB. NUREG-0586, "Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities" (Ref. 1), evaluated the environmental impact of these three methods. The supplemental information to the 1988 decommissioning rule (53 FR 24019) also discussed these three methods. A short summary of the three methods of decommissioning follows.

**DECON:** The equipment, structures, and portions of the facility and site that contain radioactive contaminants are removed or decontaminated to a level that permits termination of the license shortly after cessation of operations. The Generic Environmental Impact Statement (GEIS) found DECON to be an acceptable decommissioning method.

**SAFSTOR:** The facility is placed in a safe, stable condition and maintained in that state until it is subsequently decontaminated and dismantled to levels that permit license termination. During SAFSTOR, a facility is left intact, but the fuel has been removed from the reactor vessel and radioactive liquids have been drained from systems and components and then processed. Radioactive decay occurs during the SAFSTOR phase, thus reducing the levels of radioactivity in and on the material, and, potentially, the quantity of material that must be disposed of during radiological decontamination and dismantlement (D&D). The GEIS found SAFSTOR to be an acceptable decommissioning method.

**ENTOMB:** ENTOMB involves encasing radioactive structures, systems, and components in a structurally long-lived substance, such as concrete. The entombed structure is appropriately maintained, and continued surveillance is carried out until the radioactivity decays to a level that permits termination of the license. The NRC staff has concluded that entombment can be a viable decommissioning method for many situations. However, because most power reactors will have radionuclides in concentrations exceeding the limits for unrestricted use even after 100 years and because current regulations require that

decommissioning be completed within 60 years of cessation of operation, the NRC is considering a rulemaking to alter the 60-year time for completing decommissioning and to clarify the use of engineered barriers for reactor entombments. Pending completion of such a rulemaking, entombment requests will be handled on a case-by-case basis.

The NRC recognizes that some combination of these methods would also be acceptable. For example, the licensee could conduct a partial radiological decontamination of the plant followed by entombment or a storage period, followed by the completion of the radiological D&D. Or the licensee could use a process of deferred dismantlement. Deferred dismantlement would typically consist of four distinct phases: (1) pre-shutdown planning/engineering and regulatory reviews, (2) plant deactivation and preparation for storage, (3) a period of plant safe storage with concurrent operations in the spent fuel pool until the pool inventory is zero, and (4) radiological D&D of the radioactive portions of the plant, leading to license termination.

SAFSTOR typically consists of five distinct phases, with the initial three phases identical to those of deferred dismantlement. The fourth phase of SAFSTOR is extended safe storage (< 60 years), without any fuel in the spent fuel storage pool, and the fifth phase is radiological D&D of the radioactive portions of the plant.

## **DECOMMISSIONING COST ESTIMATES**

In addition to maintaining reasonable financial assurance for decommissioning, there are requirements related to developing, submitting, and NRC review of decommissioning cost estimates:

- 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." Note that 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.
- 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. The PSDAR is to be submitted prior to or within two years following permanent cessation of operations. Regulatory Guide 1.185, "Standard Format and Content for Post-Shutdown Decommissioning Activities Report" (Ref. 2), identifies the type of information to be contained in the PSDAR. The cost estimate may be (1) the amount of decommissioning funds estimated to be required pursuant to 10 CFR 50.75(b) and (c) as currently reported on a calendar-year basis at least once every two years to the NRC according to 10 CFR 50.75(f)(1), (2) a site-specific cost estimate, (3) an estimate based on actual costs at similar facilities that have undergone similar decommissioning activities, or (4) a generic cost estimate.
- 10 CFR 50.82(a)(8)(iii) requires a licensee to provide a site-specific decommissioning cost estimate within two years following permanent cessation of

operations. (This requirement may be satisfied by including a site-specific estimate as part of the PSDAR.)

In addition, 10 CFR 50.75(c) specifies that the initial certification amount of funds for decommissioning be based on the amounts specified in 10 CFR 50.75(c)(1), which represents the minimum funding level that applicant and licensees must meet. At its discretion, however, a power reactor licensee may submit a certification based either on the formulas provided in 10 CFR.75(c)(1) and (2) or, when a higher funding level is desired, on a site-specific cost estimate that is equal to or greater than that calculated in the formula in 10 CFR 50.75(c)(1) or (2).

- 10 CFR 50.82(a)(9)(ii)(F) requires that a licensee provide “[a]n updated site-specific estimate of remaining decommissioning costs...” as part of a License Termination Plan (LTP). 10 CFR 50.82(a)(9)(i) requires that a licensee must submit its LTP at least two years before termination of the license date.

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 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 unless and until a site-specific decommissioning cost estimate is submitted to the NRC. In addition, use of any of the decommissioning funds is limited by 10 CFR 50.82(a)(8)(i) to legitimate radiological decommissioning expenses that neither reduce the value of the trust fund below that necessary to place and maintain the reactor in a safe storage condition, nor inhibit the ability of the licensee to complete funding of the trust to ultimately release the site and terminate the license. For example, use of the decommissioning trust fund for expenses related to storage of the spent fuel is prohibited unless the fund has been specifically structured into separate subaccounts to cover both NRC-required decommissioning costs and other costs. In such a case, the licensee should provide the NRC with a clear accounting of the allocation of funds between NRC-required and other decommissioning activities.

### **C. REGULATORY POSITION**

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

The licensee is reminded that decommissioning is defined in 10 CFR 50.2 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 considered decommissioning costs by the NRC. Rather, they are considered operating expenses not required by the NRC and are not included in the amount of money required by 10 CFR 50.75 to be placed in the plant's decommissioning fund.

The costs of constructing, loading, operating, maintaining, and decommissioning an on-site spent fuel storage facility or ISFSI are excluded from decommissioning costs in 10 CFR 50.75. A licensee is required by 10 CFR 50.54(bb) to separately notify the NRC of its program to manage and provide funding for the management of irradiated fuel.

The NRC will perform a comparison of the estimated costs with the minimum decommissioning trust fund requirement derived per the algorithm discussed in Regulatory Position 2.1. The estimate of expected costs will be considered deficient if the decommissioning cost estimate is less than the decommissioning trust requirement and adequate justification is not provided. If the decommissioning trust is not fully funded, licensees should include a discussion of the plans for adjusting the level of funds to demonstrate that funds will be available for use when needed.

## **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 five years before the projected end of operations. The intent of this 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 already will 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.) The preliminary cost estimate identifies shortfalls in decommissioning funding.

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 five 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 becomes applicable at the time the licensee docket its certification of permanent shutdown, and the preliminary cost estimate should be submitted at the same time. If a prematurely shutdown licensee chooses to submit its PSDAR along with its certification of permanent shut down, it could choose to submit its preliminary cost estimate as the estimate of costs required for the PSDAR. This action would satisfy the requirements of 10 CFR 50.75(f)(2) and 10 CFR 50.82(a)(4)(i) with a single submittal.

The preliminary cost estimate should include:

- A discussion of the decommissioning option anticipated to be implemented (DECON, SAFSTOR, or some combination thereof), with major factors that could

impact the cost of the decommissioning method, 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. The 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 need not be detailed, but 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 should be identified (e.g., that in soil, groundwater, or surface water).
- A preliminary schedule that shows the major decommissioning phases and the time period over which each of the phases extends. Typical major decommissioning phases were described in the Discussion section of this guide.
- A summary of the total estimated decommissioning costs by decommissioning activity. The summary should include the anticipated cost of low level waste (LLW) disposal. A suggested format for providing this information is presented in Table 1.
- A comparison of the estimated cost with the minimum decommissioning fund requirement derived per the algorithm discussed in Regulatory Position 2.1.
- 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.

## **2. ESTIMATE OF EXPECTED COSTS IN THE PSDAR**

Prior to or within two 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 type of information to be contained in the PSDAR. The cost estimate may be:

- (1) the amount of decommissioning funds estimated to be required by 10 CFR 50.75(b) and (c) as currently reported on a calendar-year basis at least once every two years to the NRC according to 10 CFR 50.75(f)(1),
- (2) a site-specific cost estimate,
- (3) an estimate based on actual costs at similar facilities that have undergone similar decommissioning activities, or
- (4) a generic cost estimate.

Other related but nondecommissioning 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 decommissioning is 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 assure 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 two 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.

This regulatory guide pertains only to preparation of the cost estimate portion of the PSDAR. Guidance on preparation of all sections of the PSDAR will be found in Regulatory Guide 1.185 (Ref. 2).

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

Licensees of operating nuclear power reactors 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). Specifically, this table says 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:

For a pressurized water reactor (PWR):  $MFA = (75 + 0.0088P)$

For a boiling water reactor (BWR):  $MFA = (104 + 0.009P)$

For either a PWR or BWR, if the thermal power of the reactor is less than 1200 MWt, the value of  $P$  to be used in these equations is 1200, whereas if the thermal power is greater than 3400 MWt, a value of 3400 is used for  $P$ . That is,  $P$  is never less than 1200 nor greater than 3400.

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). This ESC is

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

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, 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). NUREG-1307 is updated 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. A discussion of the origin of the *0.65L*, *0.13E*, and *0.22B* terms is given in Reference 2. Thus,

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

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.

## **2.2 Cost Estimate Based on Actual Costs at Similar Facilities**

This type of cost estimate would be appropriate if the licensee had access to the actual costs of decommissioning a facility that used the same decommissioning method (DECON/SAFSTOR) and was of similar size (thermal power rating) and type (PWR/BWR) to the licensee’s facility. For example, some utilities have built essentially identical reactor plants in the same geographical area. If one of these plants has already been decommissioned, the cost data for that plant could serve as the basis for the cost estimate for the other plant. However, site-specific factors such as changes in waste disposal costs and disposal facility availability, changes in radiological decontamination and dismantlement (D&D) techniques, and differences in operational history will cause the estimated cost to differ from the actual decommissioning cost of the reference facility. The estimate of expected radiological decommissioning costs based on actual decommissioning costs of a different but similar type of plant will generally be substantially less detailed than the site-specific cost estimate and can consist of just a few items:

- Thermal power rating, whether the plant is a PWR or BWR, name of the plant, license number (or former number if license is terminated), and reference documentation for the actual decommissioning costs of the plant.
- A list of cost factors and an assessment of how the factors impact the actual cost estimate.
- The major element of the cost estimate is the comparison of the actual decommissioning cost for a similar facility with the estimated decommissioning cost, in current year (estimate year) dollars. Adjustment factors between actual and estimated costs, as discussed in Regulatory Position 2.1, should be explained.
- For the DECON option, the total decommissioning costs should be separated into the following or a similar set of decommissioning cost categories:
  - Major radioactive component removal -- reactor vessel and internals, steam generators, pressurizers, large-bore reactor coolant system piping, and other large components that are radioactive to a comparable degree
  - Radiological D&D - removal of remaining radioactive plant systems, including radiological decontamination

- Management and support (undistributed costs) -- labor costs of support staff and decommissioning operations contractor (DOC) staff, energy costs, regulatory costs, small tools, insurance, etc.
  - LLW packaging - placing LLW in packages
  - LLW shipping - shipping LLW to waste vendors/burial site
  - LLW burial/waste vendor - LLW burial charges, including LLW processing fees by waste vendors
  - Contingency - allowance for unexpected costs.
- For the SAFSTOR option, the decommissioning costs for the above cost categories should also be separated into the following or a similar set of decommissioning phases (time periods):
    - Pre-decommissioning engineering and planning/plant deactivation - all activities from pre-decommissioning engineering and planning through defueling, plant layup, and placement of the reactor into a 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 uncontaminated structures and site restoration activities are included in the cost estimate, they should be shown separately.)

A suggested format for providing this information is presented in Table 2.

### **2.3 Generic Cost Estimate**

As discussed in Regulatory Guide 1.185 (Ref. 2), the PSDAR estimate of expected decommissioning costs can be based on a generic cost estimate. Generic information would be particularly acceptable if a licensee has chosen extended safe storage of the facility followed by radiological D&D, since cost estimates of final dismantlement would occur far in the future and would therefore be highly uncertain. The generic cost estimate may be based on best estimates prepared by the NRC for reference nuclear power plants (i.e., NUREG/CR-0130, "Technology, Safety and Costs of Decommissioning a Reference Pressurized Water Reactor Power Station"; NUREG/CR-0672 (including Addenda 1 through 4), "Technology, Safety and Costs of Decommissioning a Reference Boiling Water Reactor Power Station"; NUREG/CR-5884, "Revised Analyses of Decommissioning for the Reference Pressurized Water Reactor Power Station"; and NUREG/CR-6174, "Revised Analyses of Decommissioning for the Reference Boiling Water Reactor Power Station" (Refs. 6—9)), or on other publicly available sources or other decommissioning cost estimates previously submitted to the NRC. However, factors such as inflation, regulatory changes, differences in thermal power rating, changes in waste disposal costs and disposal facility availability, and differences in the extent and kind of contamination at the site may cause the estimated cost to differ from the generic decommissioning cost used as the basis for the estimate of expected decommissioning costs. The estimate of

expected decommissioning costs based on a generic cost estimate will generally be substantially less detailed than the site-specific cost estimate.

The generic cost estimate should consist of the following:

- A discussion of the decommissioning option chosen (DECON, SAFSTOR, or some combination thereof), with identification of major factors that could impact the cost of decommissioning.
- A discussion of the methodology used to derive the cost estimates.
- A summary of total decommissioning costs by phase. The costs of items not considered part of decommissioning (such as demolition and spent nuclear fuel storage/management) should be listed separately.

For the DECON option, the total decommissioning costs should be separated into the following or a similar set of decommissioning cost categories:

- Major radioactive component removal -- reactor vessel and internals, steam generators, pressurizers, large-bore reactor coolant system piping, and other large components that are radioactive to a comparable degree
- Radiological D&D - removal of remaining radioactive plant systems, including radiological decontamination
- Management and support (undistributed costs) -- labor costs of support staff and DOC staff, energy costs, regulatory costs, small tools, insurance, etc.
- LLW packaging -- placing LLW in packages
- LLW shipping -- shipping LLW to waste vendors/burial site
- LLW burial/waste vendor -- LLW burial charges, including LLW processing fees by waste vendors
- Contingency -- allowance for unexpected costs.

For the SAFSTOR option, the decommissioning costs for the above cost categories should also be separated into the following, or a similar set of decommissioning phases (time periods):

- Pre-decommissioning engineering and planning/plant deactivation -- all activities from engineering and planning through defueling and layup to completing 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 purpose of reducing residual radioactivity (If demolition of uncontaminated structures and site restoration activities are included in the cost estimate, they should be shown separately.)

A suggested format for providing this information is presented in Table 2.

## **2.4 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 very detailed assessment that incorporates the cost impact of site-specific factors. The site-specific estimate is discussed in Regulatory Position 3.

## **3. SITE-SPECIFIC COST ESTIMATE**

A site-specific cost estimate is required by 10 CFR 50.82(a)(8)(iii) to be submitted within two years following permanent cessation of operations. This cost estimate may be included 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 higher funding level than that calculated in the formula in 10 CFR 50.75(c) is desired.

A licensee typically will be required by its rate regulators to provide extensive detail regarding decommissioning costs. However, the NRC does not require the same level of detail for cost data. Licensees should submit summaries of costs in a format that allows comparison to previous NRC studies of decommissioning costs. Radioactive waste disposal is a major cost factor in decommissioning; therefore, a licensee should submit relevant data on its radwaste projections. Suggested tabular formats are shown later in this section. The NRC uses information on the licensee's decommissioning schedule for scheduling inspection resources. Therefore, a licensee should submit its decommissioning work schedule.

The licensee should provide the following information to help NRC staff properly assess the estimate:

### **3.1 General Information**

- A discussion of the decommissioning option chosen (DECON, SAFSTOR, or some combination thereof)
- A discussion of the methodology used to derive the cost estimates
- A summary of total decommissioning costs by phase. The costs of items not considered part of decommissioning (such as site restoration and spent nuclear fuel storage/management) should be listed separately.

For the DECON option, the total decommissioning costs should be separated into the following or a similar set of decommissioning cost categories:

- Major radioactive component removal -- reactor vessel and internals, steam generators, pressurizers, large-bore reactor coolant system piping, and other large components that are radioactive to a comparable degree
- Radiological D&D -- removal of remaining radioactive plant systems, including radiological decontamination

- Management and support -- labor costs of support staff and decommissioning operations contractors (DOC) staff, energy costs, regulatory costs, small tools, insurance, etc.
- LLW packaging -- placing LLW in packages
- LLW shipping -- shipping LLW to waste vendors/burial site
- LLW burial/waste vendor -- LLW burial charges, including LLW processing fees by waste vendors
- Contingency -- allowance for unexpected costs

For the SAFSTOR option, the decommissioning costs for the above cost categories should also be separated into the following, or a similar set of decommissioning phases (time periods):

- Pre-decommissioning engineering and planning/plant deactivation -- all activities from engineering and planning through defueling and layup to completing 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 uncontaminated structures and site restoration activities are included in the cost estimate, they should be shown separately.)

A suggested format for providing this information is presented in Table 2.

- A comparison of the estimated cost with the minimum financial assurance (MFA) funding requirement discussed in Regulatory Position 2.1.
- A discussion of 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.

### **3.2. A Description of the Overall Decommissioning Project**

The description should include:

- A detailed work breakdown that describes all the activities to be performed, including planning and preparation.
- An inventory of contaminated components that require radiological decontamination or decommissioning. A suggested format for providing this information is shown in Table 3. The inventory should be a summary of components, not an itemized listing.
- Maps or diagrams showing areas of concrete and metal surfaces that require radiological decontamination. Instead of maps or diagrams, the licensee may find

it more convenient to provide a list of contaminated surfaces. A suggested format for this list is provided in Table 4. Maps or diagrams, if provided, should be large scale and provide a summary of contamination information. A listing, if provided, should be a summary. Detailed survey maps or itemized listings of contaminated areas are not required.

- A summary description, based on the records of information important to decommissioning required by 10 CFR 50.75(g), of any events that occurred during the plant's operating lifetime that resulted in the release of contamination and the mitigating actions taken to clean up the release. Experience at decommissioning plants suggests that interviewing long-term employees about potentially contaminated areas may provide useful information. The description should also include information on the involved nuclides, quantities, forms, and concentrations.
- A summary of available characterization information (i.e., location, extent, radionuclides/chemicals involved, ranges from sampling, if available) on known or suspected environmental (e.g., soil, groundwater, and surface water) contamination.
- A summary description of structures or equipment in the restricted area where radioactive materials were used or stored and the locations of possible inaccessible contamination.

### **3.3 Detailed Schedule (Gantt Chart or Equivalent) of Decommissioning Activities**

The schedule should include all the elements of the work breakdown, phases of interim safe storage, labor requirements (person-hours), and key milestones. The schedule would be expected to contain such associated activities as:

- Planning and preparation
- Characterization survey of facility and site
- Disposal of ion-exchanger resins
- Removal, radiological decontamination, and packaging of spent fuel racks
- Concentration and shipment of boron waste (PWR)
- Radiological decontamination of systems using chemical cleaning methods
- Draining and processing of spent fuel pool water
- Removal of spent fuel pool cooling system
- Removal and packaging of reactor pressure vessel (RPV) internals
- Radiological decontamination and closure of RPV
- Removal of contaminated cranes
- Radiological decontamination, removal, and packaging of spent fuel pool liner
- Removal of RCS piping and equipment

- Removal of pressurizer (PWR)
- Removal of steam generators (PWR)
- Removal of control rod drive system
- Segmentation and packaging of reactor pressure vessel
- Removal of bioshield/sacrificial shield
- Removal of turbine/generators (BWR and possibly PWR if contamination present)
- Removal of turbine condensers (BWR and possibly PWR if contamination present)
- Removal of moisture separator reheaters (BWR)
- Removal of feedwater heaters (BWR)
- Removal of feedwater condensate system (BWR)
- Removal of feedwater pumps/turbine drives (BWR)
- Radiological decontamination and removal of floor drains
- Vacuuming, washing, or other radiological decontamination of surfaces
- Removal of contaminated concrete
- Removal of HVAC ducts and equipment
- Removal of other contaminated systems (list each system)
- Final survey

If the decommissioning project includes SAFSTOR phases (longer than about five years), the following activities and manpower requirements should also be included in the schedule:

- Removal of any low-level waste that is ready to be shipped
- Shipment and processing or storage of greater-than-Class-C waste
- De-energizing or deactivating specific systems
- Reconfiguration of ventilation systems and fire protection systems for use during the storage period
- Maintenance of any systems critical to final dismantlement during the storage period
- Mobilization of additional personnel at the end of the SAFSTOR period to begin the active phase of decommissioning work

### **3.4 Cost Estimate for the Removal or Radiological Decontamination of Major Radioactive Components**

For a PWR, these components should include but not be limited to:

- Reactor vessel and internals
- Bioshield
- Reactor coolant loops
- Reactor coolant pumps
- Pressurizer
- Steam generators
- Spent fuel racks
- Other large contaminated components

For a BWR, these components should include but not be limited to:

- Reactor vessel and internals
- Sacrificial shield
- Reactor coolant piping
- Main turbines/generators
- Turbine condensers
- Moisture separator reheaters
- Feedwater heaters
- Feedwater pumps
- Spent fuel racks
- Other large contaminated components

### **3.5 D&D Management**

The estimated support staff and DOC staffing costs for each decommissioning phase (including phases of SAFSTOR) should be provided.

### **3.6 Aggregate and Undistributed Cost Information**

The following cost information should be provided:

- 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.
- 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.)

Suggested formats for presenting the information discussed in Items 3.4 through 3.6 above are provided in Tables 5 and 6.

### **3.7 Burial Cost and Volumes**

The licensee should provide tabulations of expected waste volumes, packaging costs, shipping costs, and burial costs by decommissioning activity. A suggested format is given in Table 7. 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. Radwaste volume by class expected to be generated during decommissioning (assuming no volume reduction) should also be provided. A suggested format is given in Table 8.

### **3.8 Other Items**

The following additional information should be provided:

- 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 necessary to place and maintain the reactor in a safe storage condition if such action becomes necessary
- Labor requirements (person-years) and labor costs by time period. A suggested format is given in Table 9.

## **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 a License Termination Plan (LTP). According to 10 CFR 50.82(a)(9)(i), the licensee must submit the LTP at least two 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 per 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 for ensuring adequate funds to complete the decommissioning. In some cases, a licensee may borrow funds to continue work while its decommissioning fund is collecting revenues that will be used to repay the loans. A licensee that uses these methods should identify the schedule for borrowing and repayment. 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, equally detailed, version of the site-specific estimate submitted to the NRC earlier (see Regulatory Position 3). The LTP cost estimate should contain refined estimates of the remaining decommissioning activities, waste transportation and disposal costs, survey costs and license termination survey costs. If the site is to be released for restricted use, the estimated costs for controls and a description of the financial assurance mechanisms used to ensure the availability of funds when they are needed should also be included.

## **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 on the original documents and reproduced copies. Also, ensure that symbols are defined and that scales are not reduced to the extent that visual aids are necessary to interpret pertinent items of information. These graphic presentations should be located in the section where they are 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).

### **PHYSICAL FORMAT**

#### **Paper Size**

Text pages: 8-1/2 x 11 inches.

Drawings and graphics: 8-1/2 x 11 inches. A larger size is acceptable provided the finished copy, when folded, does not exceed 8-1/2 x 11 inches.

#### **Paper Stock and Ink**

Use suitable quality in substance, paper color, and ink density for handling and reproduction by microfilming or image-copying equipment.

#### **Page Margins**

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

## **Printing**

Composition: Text pages should be single spaced.

Type Face and Style: Should be suitable for microfilming or image-copying equipment, including computer scanning.

Reproduction: May be mechanically or photographically reproduced. All pages of text should be printed on both sides and the image printed head-to-head.

## **Binding**

No requirements.

## **Page Numbering**

Pages should be numbered sequentially.

## **Table of Contents**

A table of contents should be included.

## **Procedures for Updating or Revising Pages**

Data and text should be updated or revised by replacing pages. The changed or revised portion on 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 pages 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 the pages to be removed should accompany the revised pages. When major changes or additions are made, a revised table of contents should be provided.

## **Exceptions to Physical Specifications**

Submittals may be made over the internet or electronically; see NRC's Regulatory Issue Summary 2001-05 (Ref. 12) for guidance.

## **D. IMPLEMENTATION**

The purpose of this section is to provide information to licensees and applicants regarding the NRC staff's plan for using this regulatory guide.

This draft guide has been released to encourage public participation in its development. Except in those cases in which the applicant or licensee proposes an acceptable alternative method for complying with specified portions of the NRC's regulations, the methods to be described in the final guide reflecting public comments will be used in the evaluation of submittals for licensing basis documents and revisions or updates to the decommissioning cost estimates that are submitted in accordance with applicable regulations.

## REFERENCES

1. U.S. Nuclear Regulatory Commission, "Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities," NUREG-0586, August 1988.<sup>1</sup>
2. U.S. Nuclear Regulatory Commission, "Standard Format and Content for Post-Shutdown Decommissioning Activities Report," Regulatory Guide 1.185, August 2000.<sup>2</sup>
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.<sup>1</sup>
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).<sup>1</sup>
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).<sup>1</sup>
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.<sup>1</sup>

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<sup>1</sup> 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 by writing NTIS at 5285 Port Royal Road, Springfield, VA 22161; (telephone (703)487-4650; <<http://www.ntis.gov/ordernow>>. Copies are available for inspection or copying for a fee from the NRC 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](mailto:PDR@NRC.GOV).

<sup>2</sup>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 Section, OCIO, USNRC, Washington, DC 20555-0001, or by fax to (301)415-2289, or by email to <[DISTRIBUTION@NRC.GOV](mailto: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 <<http://www.ntis.gov/ordernow>>. Copies of certain guides and many other NRC documents are available electronically on the internet at NRC's home page at <[WWW.NRC.GOV](http://WWW.NRC.GOV)> in the Reference Library. Documents are also available through the Electronic Reading Room (NRC's ADAMS document system, or PARS) at the same web site.

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.<sup>1</sup>
10. U.S. Nuclear Regulatory Commission, "Standard Format and Content of License Termination Plans for Nuclear Power Reactors," Regulatory Guide 1.179, January 1999.<sup>2</sup>
11. U.S. Nuclear Regulatory Commission, "Standard Review Plan for Evaluating Nuclear Power Reactor License Termination Plans," NUREG-1700, April 2000.<sup>1</sup>
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.<sup>3</sup>

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<sup>3</sup> Copies are available online at [WWW.NRC.GOV](http://WWW.NRC.GOV) in the Reference Library. Copies are also available for inspection or copying for a fee from the NRC Public Document Room at 11555 Rockville Pike (first floor), Rockville, MD; the PDR's mailing address is USNRC PDR, Washington, DC 20555; telephone (301)415-4737 or 1-(800)397-4209; fax (301)415-3548; e-mail <PDR@NRC.GOV>.

**Table 1. 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					

**Table 2. 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 Packaging					
LLW Shipping					
LLW Burial/Waste Vendor					
<b>Total Cost</b>					

**Table 3. Suggested Format for Listing Contaminated Equipment and Piping**

<b>Equipment Category<sup>(a)</sup></b>	<b>Length of Piping in Feet or Number of Items in each Category</b>
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	

<sup>(a)</sup> The equipment categories shown here are shown 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**

<b>Building or Location</b>	<b>Area of Concrete Decontaminated (ft<sup>2</sup>)</b>	<b>Volume of Concrete Removed (ft<sup>3</sup>)</b>	<b>Area of Metal Surfaces Decontaminated (ft<sup>2</sup>)</b>	<b>Volume of Metal Surfaces Removed (ft<sup>3</sup>)</b>

**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) Dismantle- ment	Duration (X.X Years) Total Cost
<b>Radioactive Component Removal</b>					
Removal of RPV Internals					
Removal of Reactor Pressure Vessel					
Steam Generator--Direct Removal					
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					
<b>Subtotal</b>					
<b>Decontamination and Dismantlement</b>					
Decontamination of Site Buildings					
Removal of Contaminated Plant					
<b>Subtotal</b>					
<b>Management and Support</b>					
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/Deboration Energy					
Plant Power Usage					
<b>Subtotal</b>					
<b>LLW Packaging</b>					
<b>LLW Shipping</b>					
<b>LLW Burial/Waste Vendor</b>					
<b>Total</b>					

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
<b>Radioactive Component Removal</b>					
RPV Internals					
Reactor Pressure Vessel and Sacrificial Shield					
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					
Spent Fuel Racks					
<b>Subtotal</b>					
<b>Decontamination and Dismantlement</b>					
Decontamination of Site Buildings					
Removal of Contaminated Plant					
<b>Subtotal</b>					
<b>Management and Support</b>					
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 Energy					
Plant Power Usage					
<b>Subtotal</b>					
<b>LLW Packaging</b>					
<b>LLW Shipping</b>					
<b>LLW Burial/Waste Vendor</b>					
<b>Total</b>					

**Table 7. Typical Waste Burial Cost and Volumes**

<b>Decommissioning Activity</b>	<b>Waste Volume (ft<sup>3</sup>)</b>	<b>Packaging Cost (Estimate-Year \$millions)</b>	<b>Shipping Cost (Estimate-Year \$millions)</b>	<b>Burial Cost (Estimate-Year \$millions)</b>
Removal of Nuclear Steam Supply System				
Removal of Contaminated Plant Systems				
Radiological Decontamination of Site Buildings				
Dry Active Waste				
<b>Total</b>				

**Table 8. Burial Volumes by Waste Class**

<b>Waste Class</b>	<b>Volume (ft<sup>3</sup>)</b>	<b>Percent</b>
Class A		
Class B&C		
Greater-Than-Class-C		
<b>Total</b>		

**Table 9. Labor Requirements and Labor Costs**

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

## **REGULATORY ANALYSIS**

A separate regulatory analysis was not prepared for this guide. The regulatory analysis prepared for the amendments to Parts 2, 50, and 51, "Decommissioning of Nuclear Power Reactors," which was issued on July 29, 1996 (61 FR 39278), provides the regulatory basis for this guide and examines the costs and benefits for the rule as implemented by the guide. A copy of this regulatory analysis, with NUDOCS Accession Number 9503160089, is available for inspection or copying for a fee in the NRC Public Document Room, located at 11555 Rockville Pike (first floor), Rockville, Maryland.

## **BACKFIT ANALYSIS**

This regulatory guide is being developed to describe a voluntary method that is acceptable to the NRC staff for submitting decommissioning cost estimates required by amendments to 10 CFR Parts 2, 50, and 51, "Decommissioning of Nuclear Power Reactors," issued on July 29, 1996 (61 FR 39278). The reasons for the collection of this information were considered during that rulemaking process. Compliance with this regulatory guide is not a requirement, and a licensee may choose this or another way to achieve compliance with these rules. 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 or a regulatory staff position interpreting the NRC's rules that is either new or different from a previous staff position; nor does it require the modification of or addition to systems, structures, components, or design of a facility, or the procedures or organization required to design, construct, or operate a facility.