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of Nuclear Power Reactors' Decommissioning Funds  
Could Be Further Strengthened (GAO-12-258)  
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GAO will release the following previously restricted product to the public today. Until then, use the secure link below to access the product.

GAO-12-258

**Nuclear Regulation: NRC's Oversight of Nuclear Power Reactors' Decommissioning Funds Could Be Further Strengthened**

<http://www.gao.gov/prerelease/Xj86>

This report contains recommendations to your agency. As you know, 31 U.S.C. 720 requires the head of a federal agency to submit a written statement of the actions taken on our recommendations to the Senate Committee on Homeland Security and Governmental Affairs and to the House Committee on Oversight and Government Reform not later than 60 calendar days from the date of the report and to the House and Senate Committees on Appropriations with the agency's first request for appropriations made more than 60 calendar days after that date. Since the congressional requester has asked that the distribution of the report be restricted, as provided by GAO's Congressional Protocols, the 60-day period begins on the date the report is released and e-mailed to you. Because agency personnel serve as the primary source of information on the status of recommendations, GAO requests that you also provide GAO with a copy of your agency's statement of action to serve as preliminary information on the status of open recommendations. Please send your statement of action to JONES, KAREN A ([joneska1@gao.gov](mailto:joneska1@gao.gov)) or to me at ([ruscof@gao.gov](mailto:ruscof@gao.gov)).

We appreciate the assistance and cooperation of your staff during our review.

**Franklin W. Rusco**

**Director, Government Accountability Office: Natural Resources and Environment**

After public release later today, the following link should be used to obtain the product.

<http://www.gao.gov/products/GAO-12-258>

GAO

Report to the Honorable Edward J.  
Markey, House of Representatives

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April 2012

# NUCLEAR REGULATION

## NRC's Oversight of Nuclear Power Reactors' Decommissioning Funds Could Be Further Strengthened



G A O

Accountability \* Integrity \* Reliability

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Highlights of GAO-12-258, a report to the Honorable Edward J. Markey, House of Representatives

April 2012

## NUCLEAR REGULATION

### NRC's Oversight of Nuclear Power Reactors' Decommissioning Funds Could Be Further Strengthened

#### Why GAO Did This Study

About 20 percent of U.S. electricity is generated by 104 nuclear reactors. NRC, which regulates reactors, requires their owners (licensees) to reduce radioactive contamination after reactors permanently shut down. This process, called decommissioning, costs hundreds of millions of dollars per reactor. NRC requires licensees to provide reasonable assurance that they will have adequate funds to decommission, in part, by accumulating funds that are greater than or equal to NRC's decommissioning funding formula. GAO and NRC's OIG have identified concerns about NRC's oversight of decommissioning funds. GAO was asked by Representative Markey in his former capacity as Chairman of the House Subcommittee on Energy and Environment to (1) describe how NRC ensures that licensees provide reasonable assurance of adequate decommissioning funds and (2) identify any improvements or weaknesses in NRC's oversight of this area. GAO analyzed NRC's formula and reviews of licensee information and interviewed NRC officials, licensees, and others.

#### What GAO Recommends

GAO recommends, among other things, that NRC define what it means by the "bulk" of the funds needed for decommissioning and consider reviewing a sample of licensees' investments to determine if they comply with standards. NRC agreed to consider reviewing a sample of investments, but disagreed that defining bulk is needed because of the comprehensiveness of NRC's regulatory system. GAO continues to believe that this definition is needed.

View GAO-12-258. For more information, contact Frank Rusco, 202-512-3841, [ruscof@gao.gov](mailto:ruscof@gao.gov).

#### What GAO Found

The Nuclear Regulatory Commission (NRC) periodically reviews licensees' decommissioning funds and related licensee data to determine if licensees have provided reasonable assurance that they will accumulate adequate funds for decommissioning. For example, licensees must submit estimates to NRC of decommissioning costs throughout the life of the reactor and submit fund status reports at least every 2 years while the reactor is operating. Licensees typically accumulate such funds over time through trust fund investments. The minimum amount of funds considered adequate is established by NRC's decommissioning funding formula, which is based on information collected more than 30 years ago.

NRC has taken actions to strengthen its oversight of licensees' decommissioning funds by (1) creating guidance and other documents related to criteria for reviewing licensees' 2-year reports and by using its enforcement process when deficiencies are identified, (2) conducting reviews at licensee offices to verify that fund balances licensees reported in their 2-year reports match their year-end bank statements in response to a 2006 NRC Office of the Inspector General (OIG) recommendation, (3) reevaluating the decommissioning funding formula to determine if it should be updated, and (4) improving decommissioning planning. However, several weaknesses may limit NRC's ability to ensure that licensees have provided reasonable assurance. Specifically:

- NRC's formula may not reliably estimate adequate decommissioning costs. According to NRC, the formula was intended to estimate the "bulk" of the decommissioning funds needed, but the term "bulk" is undefined, making it unclear how NRC can determine if the formula is performing as intended. In addition, GAO compared NRC's formula estimates for 12 reactors with these reactors' more detailed site-specific cost estimates calculated for the same period. GAO found that for 5 of the 12 reactors, the NRC formula captured 57 to 76 percent of the costs reflected in each reactor's site-specific estimate; the other 7 captured 84 to 103 percent.
- The results of more than one-third of the fund balance reviews that NRC staff performed from April 2008 to October 2010 to verify that the amounts in the 2-year reports match year-end bank statements were not always clearly or consistently documented. As an example of inconsistent results, some reviewers provided general information, such as "no problem," while others provided more detail about both the balance in the year-end bank statement and the 2-year report. As of October 2011, NRC did not have written procedures describing the steps that staff should take for conducting these reviews, which likely contributed to NRC staff not always documenting the results of the reviews clearly or consistently.
- NRC has not reviewed licensees' compliance with the investment standards the agency has set for decommissioning trust funds. These standards specify, among other things, that fund investments may not be made in any reactor licensee or in a mutual fund in which 50 percent or more of the fund is invested in the nuclear power industry. As a result, NRC cannot confirm that licensees are avoiding conditions described in the standards that may impair fund growth. Without awareness of the nature of licensees' investments, NRC cannot determine whether it needs to take action to enforce the standards.

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## Abbreviations

DECON	immediate decontamination and dismantlement
DFS	decommissioning funding status
FERC	Federal Energy Regulatory Commission
NRC	Nuclear Regulatory Commission
OIG	Office of the Inspector General
SAFSTOR	safe storage

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United States Government Accountability Office  
Washington, DC 20548

April 5, 2012

The Honorable Edward J. Markey  
House of Representatives

Dear Mr. Markey:

About 20 percent of the nation's electricity is generated by 104 nuclear reactors located at 65 power plants across the country. The Nuclear Regulatory Commission (NRC), which licenses and regulates reactors, requires that radioactive contamination be reduced to a level that allows NRC to terminate the reactor license and release the property for other use after a reactor shuts down permanently. This cleanup process—known as decommissioning—costs hundreds of millions of dollars per reactor, and NRC is responsible for ensuring that reactor owners (licensees) provide reasonable assurance that they will have adequate funds to decommission their reactors.<sup>1</sup> According to NRC guidance, such assurance is meant to avoid funding shortfalls that could delay decommissioning and pose risks to public health and safety and the environment. NRC's primary mission is to protect the public health, safety, and the environment from the effects of radiation from nuclear power plants and other facilities.

NRC requires licensees to provide this assurance throughout the life of a reactor: from licensing, through its period of operations—which is usually 40 years or longer<sup>2</sup>—and through decommissioning, which NRC requires licensees to complete within 60 years after a reactor permanently shuts down unless additional time is necessary to protect public health and safety.<sup>3</sup> Licensees provide such assurance, in part, by accumulating an amount of funds that is greater than or equal to an amount determined by a decommissioning funding formula developed by NRC. NRC considers the formula estimates to be the minimum amount needed by licensees to

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<sup>1</sup>In addition to the 104 operating reactors, 10 reactors have been fully decommissioned and 13 reactors are currently being decommissioned.

<sup>2</sup>NRC issues licenses for reactors to operate for up to 40 years and allows these licenses to be renewed for additional 20-year periods, depending on the outcome of safety and environmental reviews, among other things.

<sup>3</sup>10 C.F.R. § 50.82.

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decommission their reactors. Licensees are required to demonstrate that there is reasonable assurance that they will have adequate funds to decommission their reactors by the time they plan to shut down the reactors permanently. Licensees demonstrate that they are accumulating adequate funds by submitting decommissioning funding status (DFS) reports. The DFS reports, which licensees must submit to NRC at least every 2 years, include, among other things, the estimated amount of funds needed for decommissioning and the decommissioning funds accumulated to date as of the end of the previous calendar year.

Developments since 2000 have called into question the strength of NRC's oversight of decommissioning funding assurance and the likelihood that licensees will have adequate funds for decommissioning. Specifically, the NRC Office of the Inspector General (OIG) reported in 2000 that the NRC decommissioning funding formula may be outdated and, in a follow-up report in 2006, found that as a result there is increased vulnerability to decommissioning funding shortfalls and potential adverse impacts on the reliability of NRC's assessment of licensee financial assurance and the amount of funds needed for decommissioning.<sup>4</sup> In December 2001, we reported, among other things, that NRC's evaluation of licensees' funding arrangements was not rigorous enough to ensure that decommissioning funds would be adequate and that a lack of information about the extent of radiological contamination at some power plants can increase the risk that licensees could incur unplanned cleanup expenses.<sup>5</sup> In October 2003, we reported that NRC had not established criteria for taking action if it determines that a licensee is not accumulating adequate funds.<sup>6</sup> In addition, in its 2006 follow-up report, the NRC OIG found that NRC relies on licensees' reports of decommissioning fund balances without verifying these balances. Furthermore, in NRC's 2009 review of licensee DFS reports, the agency found that licensees for 27 out of 104 operating reactors had a combined shortfall of more than \$2.4 billion in their

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<sup>4</sup>NRC, Office of the Inspector General, *Review of NRC's Decommissioning Fund Program* OIG/99A-16 (Rockville, MD: Feb. 1, 2000), and *Follow-up Audit of the Nuclear Regulatory Commission's Decommissioning Fund Program*, OIG-06-A-07 (Rockville, MD: Feb. 6, 2006).

<sup>5</sup>GAO, *Nuclear Regulation: NRC's Assurances of Decommissioning Funding During Utility Restructuring Could Be Improved*, GAO-02-48 (Washington, D.C.: Dec. 3, 2001).

<sup>6</sup>GAO, *Nuclear Regulation: NRC Needs More Effective Analysis to Ensure Accumulation of Funds to Decommission Nuclear Power Plants*, GAO-04-32 (Washington, D.C.: Oct. 30, 2003).

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decommissioning funds, in part, because of the financial market decline that began in 2007. In addition, NRC acknowledged in a 2011 decommissioning funding workshop that licensees may face greater costs during decommissioning than accounted for under the NRC decommissioning funding formula.

In this context, you asked us to follow up on our previous work on decommissioning funding assurance in your former capacity as Chairman of the House Subcommittee on Energy and Environment. Our objectives were to (1) describe how NRC ensures that licensees provide reasonable assurance of adequate decommissioning funds and (2) identify any improvements or weaknesses in NRC's oversight of this area.

To describe how NRC ensures that licensees provide reasonable assurance of adequate decommissioning funds, we reviewed decommissioning regulations and guidance and interviewed relevant NRC officials. To identify any improvements or weaknesses in NRC's oversight of decommissioning funding assurance, we analyzed NRC's decommissioning funding formula and the agency's reviews of licensee DFS reports. As part of our analysis of NRC's decommissioning funding formula, we compared NRC formula-generated cost estimates with licensee-generated site-specific cost estimates for 12 reactors for which we were able to obtain both estimates calculated in the same year. We also compared NRC's formula and the process the agency used to create the formula with GAO's cost-estimating guide, a compilation of cost-estimating best practices drawn from across industry and government.<sup>7</sup> In addition, we interviewed relevant officials to ensure our understanding of how the formula was developed and how it is used. As part of our analysis of NRC's reviews of licensee DFS reports, we examined data from licensees' 2011 DFS reports for operating reactors and currently decommissioning reactors, relevant NRC regulations and guidance, and reports by GAO and the NRC OIG on decommissioning funding assurance. We also visited nuclear power plants; interviewed NRC officials, licensees, and decommissioning fund stakeholders; and attended a decommissioning workshop to better understand issues related to the DFS reports and decommissioning in general. For our site

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<sup>7</sup>GAO, *GAO Cost Estimating and Assessment Guide: Best Practices for Developing and Managing Capital Program Costs*, GAO-09-3SP (Washington, D.C.: Mar. 2, 2009).

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visits, we selected a nonprobability sample of five nuclear power plants.<sup>8</sup> We selected these sites to include fully decommissioned, currently decommissioning, and operating reactors, among other things. We also interviewed NRC officials from the Office of Nuclear Reactor Regulation and the NRC OIG to better understand the agency's oversight of decommissioning funds. A more detailed description of our scope and methodology is in appendix I.

We conducted this performance audit from February 2011 to April 2012, in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

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## Background

Decommissioning begins when a licensee has filed documentation with NRC to permanently shut down a reactor and the fuel has been removed. NRC requires decommissioning to be completed within 60 years after a reactor permanently shuts down unless additional time is necessary to protect public health and safety.<sup>9</sup> Licensees choose from two decommissioning methods: immediate decontamination and dismantlement (DECON) or safe storage (SAFSTOR).<sup>10</sup> The DECON method calls for the licensee to remove the radioactively contaminated equipment, structures, and parts of the reactor for shipment to a low-level radioactive waste disposal site or for temporary storage. This process generally takes 5 or more years. Under the SAFSTOR method, the reactor is left for up to 60 years in a state that allows the radioactive components to decay while the reactor is maintained and monitored. Once radioactivity has decreased, the reactor is then dismantled in a way

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<sup>8</sup>Because this was a nonprobability sample, we could not generalize the information collected from these visits to all reactors but were able to use the information to better understand issues related to data in the DFS reports and decommissioning issues in general.

<sup>9</sup>10 C.F.R. § 50.82.

<sup>10</sup>A third method, known as ENTOMB, is recognized by NRC, but licensees have not requested this option. This method consists of encasing the radioactive material at the plant in long-lived material like concrete.

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similar to the DECON process. After all of the radioactive material has been removed, and NRC has terminated the reactor's license, the site can be used for other purposes. Licensees can begin decommissioning a reactor while another reactor at the site is operating. Currently, 36 nuclear power plants have more than one reactor at the site, and six of those plants have one reactor that is in the process of decommissioning.

In addition to decommissioning, licensees are also responsible for other postshutdown activities. These activities include the management of spent nuclear fuel—a type of high-level radioactive waste—until it can be transferred to the Department of Energy, which is responsible for providing permanent disposal.<sup>11</sup> Site restoration is another such activity, which includes the cleanup of nonradiological contaminants, such as acids and heavy metals, to restore the power plant site to a condition that is safe for public use. However, these activities do not fall within the scope of NRC's definition of decommissioning or under NRC's decommissioning oversight authority, and licensees must pay for these costs with funds that are separate from their decommissioning funds.

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<sup>11</sup>The Nuclear Waste Policy Act of 1982, as amended, directs the Department of Energy to study Yucca Mountain, in Nevada, as the site for the disposal of spent nuclear fuel. The Department of Energy submitted a license application for the repository in June 2008 but in March 2010 moved to withdraw it. Without access to a permanent repository for this waste, licensees may need to store the fuel on-site. The costs for construction and demolition of on-site spent fuel storage facilities are not included in decommissioning. For additional information about Yucca Mountain, see: GAO, *Commercial Nuclear Waste: Effects of a Termination of the Yucca Mountain Repository Program and Lessons Learned*, GAO-11-229 (Washington, D.C.: Apr. 8, 2011); DOE Nuclear Waste: *Better Information Needed on Waste Storage at DOE Sites as a Result of Yucca Mountain Shutdown*, GAO-11-230 (Washington, D.C.: Mar. 23, 2011); and *Yucca Mountain: Information on Alternative Uses of the Site and Related Challenges*, GAO-11-847 (Washington, D.C.: Sept. 16, 2011).

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## NRC Methods to Ensure That Licensees Provide Reasonable Assurance of Adequate Decommissioning Funds

NRC periodically reviews licensees' decommissioning funds and related licensee data to determine if licensees have provided reasonable assurance that they will accumulate adequate funds for decommissioning. According to NRC guidance, the amount of funds that is considered adequate is established by NRC's decommissioning formula, which represents the bulk of the funds needed to decommission a specific reactor and is not an estimate of the actual cost.<sup>12</sup> The formula estimates decommissioning costs by reactor type—pressurized water reactor or boiling water reactor—and the reactor's capacity to generate electricity. The formula is based on two studies, published in 1978 and 1980, that provided information on the technology available at the time, safety considerations, and the probable costs for decommissioning the two types of reactors. NRC codified its decommissioning funding formula in 1988.<sup>13</sup> According to this regulation, the three cost factors identified in the formula—labor, energy, and low-level radioactive waste disposal<sup>14</sup>—are adjusted annually to reflect the effects of inflation. To estimate costs in current year dollars, the labor and energy cost factors are adjusted from the prior year using data from the U.S. Department of Labor's Bureau of Labor Statistics, while the waste disposal cost factor is adjusted based on actual disposal cost data published by NRC.

As part of NRC's oversight of decommissioning funds, the agency requires licensees to provide decommissioning cost estimates and other information to NRC throughout the life cycle of a nuclear reactor:

- *Initial decommissioning estimate and financial method.* Beginning in July 1990, NRC has required licensees to report that they had (1) estimated the amount needed for decommissioning, typically using NRC's decommissioning funding formula, and (2) developed a plan for accumulating these funds by the projected time of permanent shutdown.<sup>15</sup> Since that date, license applicants have been required to

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<sup>12</sup>NRC, *Assuring the Availability of Funds for Decommissioning Nuclear Reactors*, Regulatory Guide 1.159, Revision 2 (Rockville, MD: October 2011).

<sup>13</sup>10 C.F.R. § 50.75.

<sup>14</sup>NRC's decommissioning funding formula accounts only for the waste generated specifically during decommissioning and not for waste generated during reactor operations.

<sup>15</sup>10 C.F.R. § 50.33(k).

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submit this information as part of their license application.<sup>16</sup> NRC regulations allow licensees to use one or more methods as part of their plan to accumulate funds, such as prepayment of the entire estimated decommissioning amount, a trust fund that is separate from other licensee assets and accrues earnings based on investments, parent company guarantees, or letters of credit. The most common financial method is a trust fund that is allowed to grow over the life of the reactor and during the decommissioning process. Once licensees contribute funds to a decommissioning trust fund, funds generally cannot be withdrawn for other purposes.

- *DFS reports.* NRC requires licensees to submit DFS reports at least every 2 years while a reactor is operating, and every year once a reactor is within 5 years of permanent shutdown through license termination.<sup>17</sup> Licensees may report the amount of funds estimated to be needed for decommissioning using the decommissioning funding formula or a licensee-generated site-specific cost estimate if it is greater than the formula amount. According to NRC guidance, NRC staff compare two things in reviewing these reports: (1) the licensee's accumulated funds plus amounts provided by any other methods in the licensee's plans to accumulate funds as described above and (2) the amount estimated to be needed for decommissioning, which is the greater of an NRC-generated formula estimate or the licensee-generated site specific cost estimate.<sup>18</sup> If the licensee's balance is greater than or equal to the estimated amount needed for decommissioning, an NRC reviewer makes a determination of reasonable assurance. If the balance is less than the estimated amount needed for decommissioning, the reviewer projects the licensee's accumulated funds through the decommissioning period to account for any anticipated growth. If the projected amount plus amounts provided by other methods is less than the estimated amount needed for decommissioning and a second reviewer verifies this finding, then NRC may request additional information from the

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<sup>16</sup>Nearly all of the 104 operating reactors were licensed before July 1990.

<sup>17</sup>NRC required licensees to submit their first DFS reports by March 1999. Licensees must also submit DFS reports every year for reactors that are involved in mergers or acquisitions or that have permanently shut down before the end of their licensed life.

<sup>18</sup>NRC, *Procedures for NRC's Independent Analysis of Decommissioning Funding Assurance for Operating Nuclear Power Reactors*, LIC-205, Revision 4 (Rockville, MD: December 27, 2010).

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licensee and repeat the process. According to agency guidance, licensees are expected to make adjustments to correct shortfalls in 2 or 5 years,<sup>19</sup> depending on the type of licensee, from when the DFS report in question is submitted.<sup>20</sup> An NRC official told us that the agency determines on a case-by-case basis if additional actions should be taken to assure the agency that the licensee will have adequate decommissioning funds when needed.

- *Preliminary decommissioning cost estimate.* About 5 years prior to a reactor's projected permanent shutdown, NRC requires licensees to submit a preliminary decommissioning cost estimate that is more detailed than NRC's decommissioning funding formula.<sup>21</sup> This cost estimate provides NRC with an up-to-date estimate of expected decommissioning costs and an assessment of the major factors that could affect such costs, as well as the licensee's plans for adjusting decommissioning funding levels if necessary. Major factors include, but are not limited to, the potential for contamination of the site and the decommissioning method the licensee plans to use. NRC guidance calls for staff to compare the preliminary cost estimate with the decommissioning cost estimate generated by the NRC formula.<sup>22</sup> The licensee's preliminary cost estimate is deemed acceptable if it is equal to or greater than the formula amount. If it is less than the formula amount, NRC informs the licensee that additional information is needed to assure the agency that the licensee will accumulate adequate funds for decommissioning.
- *Site-specific cost estimate.* NRC requires licensees to submit a site-specific cost estimate prior to or within 2 years following permanent shutdown;<sup>23</sup> licensees may also develop such estimates earlier at their discretion. The intent of this cost estimate is to provide NRC with a more detailed assessment that incorporates the cost impacts of site-

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<sup>19</sup>NRC, Regulatory Guide 1.159.

<sup>20</sup>Licensees that own non-rate-regulated reactors are expected to correct shortfalls in 2 years, and licensees that own rate-regulated reactors, called public utility licensees, are expected to do so in 5 years.

<sup>21</sup>10 C.F.R. § 50.75(f)(3).

<sup>22</sup>NRC, *Standard Review Plan for Decommissioning Cost Estimates for Nuclear Power Reactors*, NUREG-1713 (Rockville, MD: December 2004).

<sup>23</sup>10 C.F.R. § 50.82(a)(4)(i).



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specific factors. Site-specific factors include, but are not limited to, an estimate of the volume of radioactive waste and a summary of costs estimated for each major decommissioning activity. According to NRC guidance, the site-specific estimate may be significantly greater than the minimum amount based on the NRC formula.<sup>24</sup> If the site-specific estimate and formula amount differ, NRC requires licensees to provide information on the basis for the difference. If NRC determines that the information provided is insufficient, an agency official told us that the agency decides, on a case-by-case basis, how many information requests it will make and whether it will consider taking additional actions to assure the agency that the licensee will have adequate decommissioning funds when needed.

- *License termination plan with updated site-specific cost estimate.* Toward the end of decommissioning and at least 2 years before termination of the reactor's license, NRC requires licensees to submit a license termination plan.<sup>25</sup> In this plan, licensees must estimate the remaining costs of decommissioning. NRC guidance calls for agency staff to review this report to independently verify that a reactor can be decommissioned safely and the license terminated.<sup>26</sup> As part of this review, staff are to compare the estimated remaining costs of decommissioning with the licensee's funds available for decommissioning. If the available decommissioning funds are less than the estimated remaining costs, the plan must indicate the means the licensee will use for ensuring adequate funds to complete decommissioning.

Licensees who choose to invest their decommissioning trust funds are generally required to do so in accordance with standards set by NRC. NRC defers to the Federal Energy Regulatory Commission (FERC) for investment standards for reactors that are owned by public utilities, which constitute about half of the 104 operating reactors.<sup>27</sup> FERC requires the

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<sup>24</sup>NUREG-1713.

<sup>25</sup>10 C.F.R. § 50.82(a)(9)(i).

<sup>26</sup>NRC, *Standard Review Plan for Evaluating Nuclear Power License Termination Plans*, NUREG-1700 (Rockville, MD: April 2003).

<sup>27</sup>FERC regulates the interstate transmission of electricity. The agency does not regulate reactors, but does oversee public utility financial reporting in accordance with a uniform system of accounts. See 18 C.F.R. § 101.

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utilities it regulates to invest their decommissioning funds in accordance with several standards.<sup>28</sup> These standards state, among other things, that the fund must be independent of the public utility, its subsidiaries, affiliates, or associates; the public utility may not serve as its own investment fund manager; and the investment manager must exercise the standard of care that a prudent investor would use in the same circumstances. Public utilities are required to submit annual decommissioning fund statements to FERC that summarize the public utility decommissioning fund balances and investments, among other things.

For reactors that are not owned by public utilities, NRC regulations set investment standards specifying, for example, that the funds must be held by an independent trustee who adheres to a standard of care required by state or federal law or, in the absence of any such standard, to a prudent investor standard as defined by FERC; investments may not be made in any reactor licensee or in a mutual fund in which 50 percent or more of the fund is invested in the nuclear power industry; and no more than 10 percent of the funds can be indirectly invested in securities of any entity owning or operating a reactor.

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## **NRC Has Strengthened Its Oversight of Decommissioning Funds, but Several Weaknesses Remain**

In response, in part, to GAO's and the NRC OIG's recommendations, NRC has taken actions to strengthen its oversight of licensees' decommissioning funds, including creating guidance for reviewing DFS reports, reevaluating the decommissioning funding formula, and requiring licensees currently decommissioning their reactors to report to NRC the actual costs of decommissioning. However, remaining weaknesses in NRC's oversight may limit the agency's ability to ensure that licensees have provided reasonable assurance that they will have adequate funds to decommission their reactors.

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## **NRC Has Taken Actions to Strengthen Its Oversight**

NRC has taken steps to identify and resolve decommissioning funding shortfalls by creating guidance and other documentation related to criteria for reviewing DFS reports and by using its enforcement process when

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<sup>28</sup>18 C.F.R. §§ 35.32, 35.33.

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deficiencies are identified.<sup>29</sup> In 2003, we recommended that NRC establish criteria for taking action when it determines that a licensee is not accumulating sufficient funds. Since then, NRC has developed guidance for reviewing DFS reports that includes criteria for when staff should request additional information from licensees to address shortfalls.<sup>30</sup> NRC has updated this guidance several times based on lessons learned from its DFS report reviews. NRC also documented the approach staff are to use to request additional information from licensees when the agency identified decommissioning shortfalls in 2009 through its DFS reviews. In addition, NRC has used its enforcement process in three cases to address DFS reporting deficiencies since 2009. Agency officials said that such actions were effective in getting the licensees to resolve the issues identified, in part because NRC's enforcement process provides publicly available information in the event that an apparent violation is identified.

In addition, in response to an NRC OIG recommendation, NRC has conducted reviews at licensee offices to verify that the amounts licensees reported to NRC in DFS reports as fund balances match the amounts stated in licensees' year-end bank statements. The NRC OIG recommended in 2006 that the agency require verification of decommissioning fund balances in order to better ensure that licensees are providing reasonable assurance that they will have the necessary funds. NRC documents indicate that from April 2008 through October 2010, NRC officials performed 136 reviews at 35 locations. NRC officials told us that during these reviews they verified that the decommissioning fund balances reported in the bank statements matched the balances reported in the DFS reports, with one exception,<sup>31</sup> and that they did not find any cases where a licensee overreported its fund balance.

Furthermore, in response to an NRC OIG recommendation, NRC began reevaluating its decommissioning funding formula in 2009 to determine if it should be updated because of changes in decommissioning technology and the cost of management and disposal of low-level radioactive waste.

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<sup>29</sup>According to NRC officials, the enforcement process entails a review of the nature of the deficiency by NRC staff, requests for additional information to address the deficiency, and a final determination if an enforcement action is warranted.

<sup>30</sup>NRC, LIC-205, Revision 4.

<sup>31</sup>NRC officials told us that during one of these reviews, they found that one licensee underreported its decommissioning trust fund balance.

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The NRC OIG recommended in 2000 that the agency consider reassessing the reasonableness of the formula, in part because it was outdated, and reiterated this recommendation in 2006. NRC has not updated its decommissioning funding formula since it was codified in 1988. NRC officials told us that they plan to make a recommendation to agency management in late 2012 about whether an update is warranted based on its evaluation. In commenting on a draft of this report, NRC officials told us that, as part of evaluating the formula, they expect to estimate the lower and upper bounds of the cost of decommissioning based on licensee-generated cost estimates and historical decommissioning costs—thereby creating a range of expected decommissioning costs—and then see how an updated formula fits into this range.

Moreover, NRC amended its decommissioning funding regulations in June 2011 to improve decommissioning planning and reduce the likelihood that any currently operating power plant will become a legacy site—a facility with a licensee that cannot complete complex decommissioning work for technical or financial reasons.<sup>32</sup> The regulatory changes as a result of the amendments will, among other things, require licensees of the reactors currently undergoing decommissioning to report to NRC the actual costs being incurred during decommissioning, specifically, to report annual decommissioning expenditures.<sup>33</sup> NRC wants these data to assess the adequacy of decommissioning funding after permanent shutdown. These data could be used to determine if the agency's decommissioning formula estimates the bulk of the funds that licensees will likely need to decommission their reactors. The amendments become effective in December 2012, and licensee reporting of these data is required by March 31, 2013.

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<sup>32</sup>Decommissioning Planning, 76 Fed. Reg. 35512 (June 17, 2011).

<sup>33</sup>The amendments also clarified NRC's existing requirements that licensees operate in a manner that minimizes the introduction of radioactivity into the site and made some regulatory changes, including requiring licensees to monitor and record radiological contamination, including subsurface soil and groundwater, if there is a history of spills or leaks to the subsurface at the site. For additional information about subsurface leaks at nuclear power plants, see GAO, *Nuclear Regulatory Commission: Oversight of Underground Piping Systems Commensurate with Risk, but Proactive Measures Could Help Address Future Leaks*, GAO-11-563 (Washington, D.C.: June 3, 2011).

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## Several Weaknesses May Limit the Adequacy of NRC's Oversight of Decommissioning Funds

Even with the actions NRC took to strengthen its oversight, the agency's ability to ensure that licensees provide reasonable assurance that they will have adequate funds at the time of decommissioning may be limited by several remaining weaknesses in its oversight. Specifically, NRC has not (1) clearly defined what the agency means by the "bulk" of the funds licensees will likely need to decommission and the decommissioning funding formula may not reliably estimate adequate decommissioning costs, (2) always clearly or consistently documented its fund balance review results and may discontinue these reviews, and (3) reviewed licensees' compliance with investment standards.

## NRC Has Not Defined the "Bulk" of Costs Needed, and the Agency's Decommissioning Funding Formula May Not Reliably Estimate Adequate Costs

NRC has not defined what it means by the bulk of the funds licensees will likely need to decommission a reactor. When we compared decommissioning funding formula estimates provided by NRC for 12 reactors with licensees' site-specific cost estimates calculated for the same reactors, we found that the NRC formula captured from 57 to 103 percent of the costs reflected in each reactor's site-specific estimate, with 5 of the 12 capturing 76 percent or less (see table 1). Even though the formula estimates captured more than 50 percent of the licensee's site-specific cost estimates for each of the 12 reactors, the wide range of differences between formula and site-specific cost estimates raises a question about whether or not the formula can reasonably be said to have captured the bulk of decommissioning costs.

In addition, for 8 of the 12 reactors, the licensees calculated their site-specific cost estimates less than 7 years before the license was originally due to expire, and their estimates were as much as \$362 million more than the formula estimates at that time.<sup>34</sup> It is true that NRC expects that its formula estimate may be less than licensees' site-specific cost estimates. However, licensees whose formula estimate is significantly less than the site-specific estimate when calculated near the end of their reactors' operating lives would have fewer years to accumulate a significant amount of decommissioning funds. Overall, 9 of the 12 reactors have had their licenses renewed, which gives these licensees more time to accumulate the decommissioning funds they will likely need. However, without changes to the NRC formula, it is possible that the NRC

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<sup>34</sup>Similarly, the NRC OIG compared the agency's decommissioning funding formula estimates for 34 reactors with site-specific cost estimates and found that the site-specific estimates exceeded the formula estimates by as much as \$312 million.

formula estimates could be significantly less than the licensees' site-specific cost estimates several years from their new shutdown date.

**Table 1: Comparison of NRC and Site-Specific Formula Estimates for Decommissioning Costs at 12 Operating Nuclear Reactors**

Dollars in millions

Reactor	Year of original license expiration	License renewal status <sup>a</sup>	NRC decommissioning funding formula estimate for decommissioning costs	Year of NRC funding formula estimate	Site-specific cost estimate for decommissioning costs <sup>b</sup>	Year of site specific cost estimate	Percentage of site-specific cost estimate represented by NRC estimate
1	2015	Decision pending on license renewal with 2035 expiration	\$474.22	2010	\$836.45	2010	57
2	2017	Decision pending on license renewal with 2037 expiration	447.33	2010	525.48	2010	85
3	2026	—	616.28	2010	710.54	2010	87
4	2014	License renewed with 2034 expiration	345.50	2008	537.98	2008	64
5	2013	License renewed with 2033 expiration	345.50	2008	487.99	2008	71
6	2014	License renewed with 2034 expiration	384.74	2008	504.12	2008	76
7	2026	License renewed with 2046 expiration	554.16	2008	725.26	2008	76
8	2014	License renewed with 2034 expiration	503.37	2008	499.00	2008	101
9	2014	License renewed with 2034 expiration	520.90	2008	506.08	2008	103
10	2012	License renewed with 2032 expiration	478.16	2006	468.84	2006	102
11	2020	License renewed with 2040 expiration	354.70	2002	420.14	2002	84
12	2016	License renewed with 2036 expiration	\$354.70	2002	\$390.13	2002	91

Source: GAO analysis of NRC and licensee data.

<sup>a</sup>Licensees for 11 of the 12 reactors submitted applications to NRC to renew the reactor license and continue operating beyond the original license expiration date.

<sup>b</sup>Site-specific cost estimates do not include costs not covered by NRC's decommissioning funding formula.

Furthermore, NRC's decommissioning funding formula may not provide a reliable estimate of adequate decommissioning costs for several reasons. We compared NRC's formula and the process the agency used to create

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NRC Fund Balance Review  
Results Were Not Always  
Clearly or Consistently  
Documented, and NRC May  
Discontinue These Reviews

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the formula with GAO's cost-estimating guide, which compiles cost-estimating best practices drawn from across industry and government and, in doing so, identified several issues that raise additional questions about the quality of the formula.<sup>35</sup> For example, NRC's decommissioning funding formula substantially met two characteristics of a high-quality formula, but only partially met the other two. Specifically, NRC's supporting documentation for the formula was not thorough enough for us to understand and replicate its derivation. According to our cost-estimating guide, without thorough documentation, NRC cannot reliably explain its rationale for the cost elements that support the formula and formula-generated cost estimates. In addition, NRC did not perform a risk analysis on the formula, which would convey a level of confidence in the likelihood of the formula's ability to estimate the most likely minimum cost of decommissioning. Without performing a risk analysis on the formula, NRC cannot be assured of the accuracy of the formula because management may not be able to determine a defensible level of contingency reserves that is necessary to cover increased costs such as underestimated labor and waste disposal costs. See appendix II for our detailed assessment of the formula in comparison with the four characteristics identified in our cost-estimating guide.

The results of more than one-third of the 136 fund balance reviews that NRC staff performed from April 2008 to October 2010 to verify the amounts in DFS reports were not always clearly or consistently documented. Specifically, the results of 49 reviews were not clear because the reviewer either did not check "yes" or "no" or checked both boxes on the one-page form NRC staff used to collect information when indicating whether the original licensee documents were verified to show that the amounts in year-end bank statements matched the amounts in DFS reports (see fig. 1). In other cases, the results were not consistently documented, with some reviewers providing general information on their forms, such as writing "no problem," while others provided more detailed information, such as providing both the balance in the year-end bank statement and in the DFS report.

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<sup>35</sup>According to GAO's cost-estimating guide, a high-quality cost-estimating formula is credible, well documented, comprehensive, and accurate.

**Figure 1: NRC Form Used to Collect Information during On-site Fund Balance Reviews**

INITIAL ON-SITE OBSERVATIONS OF THE INDEPENDENT REACTOR DECOMMISSIONING TRUST FUND OVERSIGHT ANALYSIS	
UNIT:	_____
LICENSEE:	_____
PERCENT OWNERSHIP:	_____
LOCATION OF REVIEW:	_____
LICENSEE CONTACT:	_____
ORIGINAL DOCUMENTS VERIFIED TO SHOW TRUST BALANCE IS EQUAL TO ACTUAL TRUST BALANCE CLAIMED IN LAST DECOMMISSIONING FUNDING STATUS REPORT:	
	<input type="checkbox"/> YES <input type="checkbox"/> NO
ATTACHMENTS PROVIDED:	<input type="checkbox"/> YES <input type="checkbox"/> NO
OVERSIGHT REVIEW AND AUDIT FINDINGS:	
_____	
_____	
_____	
ADDITIONAL COMMENTS:	
_____	
_____	
_____	
PERFORMED BY:	_____
DATE OF REVIEW:	_____

Source: NRC.



NRC Has Not Reviewed  
Licensees' Compliance with  
Investment Standards

As of October 2011, NRC did not have written procedures describing the steps that staff should take in analyzing licensee documentation and documenting review results on the one-page form, which likely contributed to NRC staff not always documenting the results of the reviews clearly or consistently. We have previously reported that written procedures help ensure consistency within an organization.<sup>36</sup> Under *Standards for Internal Control in the Federal Government*, federal agencies are to clearly document internal control—the policies, procedures, techniques, and mechanisms that enforce management's directives—and the documentation is to be readily available for examination.<sup>37</sup>

In addition, NRC officials told us that management was considering recommending that the agency discontinue the reviews. If NRC discontinues these reviews, the agency will no longer have a mechanism for verifying the accuracy of licensee fund balances in their DFS reports and will no longer address the 2006 NRC OIG recommendation to verify licensee balances to better ensure that licensees are providing reasonable assurance that they will have the necessary funds for decommissioning. NRC officials told us that the reasons they may discontinue the reviews are a lack of findings and budget constraints. However, according to our analysis of the results of the 136 reviews, it is unclear whether NRC's conclusion of a lack of findings is accurate. In addition, an NRC official told us that these reviews could be incorporated into the DFS review process, thereby eliminating the cost of travel to a licensee's office, potentially mitigating budget constraint concerns.

NRC has not reviewed licensees' compliance with the investment standards the agency has set for decommissioning funds. NRC does not require licensees to file statements showing how their decommissioning funds are invested, and NRC's DFS review process does not include an evaluation to ensure that licensees comply with these investment standards. As a result, NRC cannot confirm that licensees are avoiding conditions described in the standards, such as investing in other licensees. According to two stakeholders involved in decommissioning fund management and investment consulting, a small but growing

<sup>36</sup>GAO, *Bureau of Prisons: Written Policies on Lateral Transfers and Assessment of Temporary Assignments Needed*, GAO-09-141 (Washington, D.C.: Feb. 25, 2009).

<sup>37</sup>GAO, *Standards for Internal Control in the Federal Government*, GAO/AIMD-00-21.3.1 (Washington, D.C.: November 1999).

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number of licensees are considering investing in hedge funds as a way of improving returns on their investments and managing market volatility. As we have stated in the past, hedge funds pose a number of risks and challenges beyond those posed by traditional investments.<sup>38</sup> NRC officials told us that their staff resources are limited and that they lack the financial expertise to evaluate compliance with investment restrictions. For public utility licensees, NRC officials stated that they coordinate informally with FERC in cases where potential funding shortfalls or problems arise. FERC officials told us that they review licensee compliance with the standards only if a problem with a licensee's decommissioning trust fund is brought to the agency's attention, which would mean that most licensees' compliance with the standards would not be reviewed. Without awareness of the nature of licensees' investments, NRC cannot determine whether it needs to take action to enforce the standards.

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## Conclusions

NRC ensures that licensees have provided reasonable assurance that they will have adequate funds to decommission their reactors by periodically reviewing licensees' decommissioning funds and related licensee data. Consistent with its mission to protect the public and environment from the effects of radiation, NRC has taken steps to strengthen its oversight of licensees' decommissioning trust funds. NRC, for example, amended its decommissioning funding regulations to improve decommissioning planning and reduce the likelihood that any currently operating power plant will become a legacy site. In addition, NRC began reevaluating its decommissioning funding formula in 2009 to determine if it should be updated because of changes in decommissioning technology and the cost and management of low-level radioactive waste. NRC officials plan to make a recommendation to management in late 2012 about whether an update is warranted based on this evaluation.

However, weaknesses remain in NRC's oversight of decommissioning funds that could leave the public and environment vulnerable. For example, NRC has not defined what it means by the bulk of funds that the decommissioning funding formula is supposed to estimate, and we found a wide-range of differences between NRC's decommissioning funding

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<sup>38</sup>GAO, *Defined Benefit Pension Plans: Plans Face Challenges When Investing in Hedge Funds and Private Equity*, GAO-11-901SP (Washington, D.C.; Aug. 31, 2011).

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formula estimates and some licensees' site-specific cost estimates. This raises questions about the reliability of the formula as an estimate of the minimum amount needed for decommissioning. In addition, the agency did not have thorough documentation that would enable us to understand and replicate the derivation of its formula and did not perform a risk analysis on the formula, raising questions about the quality of the cost estimates used to create the decommissioning formula. Without a definition of what NRC means by the bulk of decommissioning costs and without high-quality estimates of these costs, it is unclear how NRC can determine if the formula is performing as intended or that licensees will have adequate decommissioning funds when necessary. In addition, NRC does not have written procedures describing the steps that staff should take in their reviews analyzing licensee documentation and verifying that the amounts licensees report to NRC in their DFS reports match the amounts reported on their year-end bank statements, a fact that likely contributed to the results of the reviews not always being clearly or consistently documented. However, NRC may discontinue these reviews, which the agency undertook in response to a 2006 NRC OIG recommendation. Without conducting these reviews, NRC will not have an accountability mechanism for ensuring that the amounts reported in DFS reports match the amounts shown in licensees' year-end bank statements. Finally, NRC has not reviewed licensees' compliance with the investment standards it has set for decommissioning funds. Therefore, the agency cannot confirm that licensees are avoiding conditions described in the standards that could put decommissioning funds at risk. Without awareness of the nature of licensees' investments, NRC cannot determine whether it needs to take action to enforce decommissioning investment standards.

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## Recommendations for Executive Action

To further strengthen NRC's oversight of decommissioning funding assurance, we recommend that the NRC Commissioners take the following five actions:

- Ensure reliability as part of the agency's process of reevaluating its decommissioning funding formula, by
  - defining what the agency means by the "bulk" of the funds that licensees will likely need to decommission their reactors and
  - using the cost-estimating characteristics as a guide for a high-quality cost-estimating formula in the event that NRC chooses to update the formula.

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- Better ensure that licensees are providing reasonable assurance that they will have the necessary funds and improve the consistency of information the agency collects by
    - documenting procedures describing the steps that staff should take in their reviews analyzing licensee documentation and verifying that the amounts licensees report to NRC in their DFS reports match the balances on their year-end bank statements and
    - continuing these reviews of fund balances in a way that is most efficient and effective for the agency.
  - Consider reviewing a sample of licensees' investments to determine if licensees are complying with decommissioning investment standards and determine whether action should be taken to enforce these standards.

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## Agency Comments and Our Evaluation

We provided a draft of this report to NRC for review and comment. NRC provided written comments, which are presented in appendix III, and technical comments, which we incorporated in the report as appropriate. NRC agreed with three of our recommendations, disagreed with one recommendation, and partially agreed with another recommendation. Specifically, NRC agreed with our recommendations that the agency (1) document procedures describing the steps that staff should take in their reviews analyzing licensee documentation and verifying that the amounts licensees report to NRC in their DFS reports match the balances on their year-end bank statements; (2) continue these reviews of fund balances in a way that is most efficient and effective for the agency; and (3) consider reviewing a sample of licensees' investments to determine if licensees are complying with decommissioning investment standards and determine whether action should be taken to enforce these standards.

However, NRC disagreed with our recommendation that, when the agency reevaluates its decommissioning funding formula, it define what it means by the "bulk" of the funds that licensees will likely need to decommission their reactors. In its comments, NRC stated that, in view of the comprehensiveness of the agency's regulatory system, a precise definition of the meaning of "bulk" is not necessary to ensure that licensees adequately plan for decommissioning costs. We did not recommend that NRC provide a precise definition but we continue to believe that a definition is necessary. As we noted in our draft report,

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without a definition of what the agency means by bulk it is unclear how NRC can determine if the formula is performing as intended or if licensees will have adequate decommissioning funds when necessary, especially given the wide range of differences we identified when we compared formula-based and site-specific cost estimates. NRC suggested that we revise our recommendation to state that NRC's reevaluation of the formula consider the relationship between the formula amount and the range of expected decommissioning costs. This approach could be appropriate, as long as NRC states what the relationship between the formula and the range should be. According to NRC officials, the agency has not yet developed this range of expected decommissioning costs. Officials explained that, as part of its process of reevaluating the formula, the agency expects to estimate the lower and upper bounds of the range of expected decommissioning costs based on licensee-generated cost estimates and historical decommissioning costs and will determine how an updated decommissioning funding formula fits into this range. We believe such an analysis could help the agency better define the bulk of funds licensees should accumulate to ensure adequate funds for decommissioning. In response to this comment, we modified the report to include information about the range of expected decommissioning costs NRC plans to develop, but did not revise the recommendation.

Finally, NRC partially agreed with our recommendation that the agency use the cost-estimating characteristics as a guide for a high-quality cost-estimating formula in the event that NRC chooses to update the formula as part of ensuring reliability during the process of evaluating its decommissioning funding formula. NRC agreed that the decommissioning funding formula should provide a credible and well-documented basis for establishing the minimum amount of funding needed to plan for the costs of decommissioning a reactor, but disagreed that the formula is the appropriate tool for achieving the characteristics of comprehensiveness and accuracy in estimating decommissioning costs. NRC commented that the formula was not intended to provide a cost estimate but rather provide a reference level for licensees as a planning tool early in a reactor's life. We disagree that the formula is not a cost estimate. As we noted in our draft report, NRC considers the formula to be the minimum amount needed by licensees to decommission their reactors; we believe that this meets the definition of a cost estimate. NRC further commented that the agency believes that it achieves the characteristics of comprehensiveness and accuracy by requiring a licensee to provide an updated, plant-specific cost estimate late in a plant's life. We recognize that the plant-specific cost estimate that NRC requires can draw on additional information to help

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achieve characteristics of a high-quality cost estimating formula. However, this requirement does not address the quality of the formula. The formula needs to be appropriately accurate and comprehensive for its intended purpose. As we noted in our draft report, licensees typically use the formula to meet NRC's requirement to report an initial decommissioning cost estimate in their license application, and NRC uses the formula to determine if there is reasonable assurance that licensees will have adequate decommissioning funds as part of the DFS report review process. We recognize that NRC is in the process of reevaluating its more than 30-year old formula to determine if the formula should be updated to reflect changes in decommissioning technology and costs. We believe that an updated formula that reflects these changes and has the characteristics of a high-quality cost-estimating formula could help to ensure that NRC's decommissioning funding formula is appropriately accurate and comprehensive.

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As agreed with your office, unless you publicly announce the contents of this report earlier, we plan no further distribution until 30 days from the report date. At that time, we will send copies to the Chairman of NRC, appropriate congressional committees, and other interested parties. The report also will be available at no charge on the GAO website at <http://www.gao.gov>.

If you or your staff members have any questions about this report, please contact me at (202) 512-3841 or [ruscof@gao.gov](mailto:ruscof@gao.gov). Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff that made major contributions to this report are listed in appendix IV.

Sincerely yours,



Frank Rusco  
Director  
Natural Resources and Environment

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# Appendix I: Scope and Methodology

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To describe how the Nuclear Regulatory Commission (NRC) ensures that reactor owners (licensees) provide reasonable assurance of adequate decommissioning funds, we reviewed relevant regulations, including *Reporting and Record Keeping for Decommissioning Planning*,<sup>1</sup> and guidance documents, such as *Procedures for NRC's Independent Analysis of Decommissioning Funding Assurance for Operating Nuclear Power Reactors*.<sup>2</sup> We also reviewed GAO and NRC Office of the Inspector General (OIG) reports on decommissioning funding assurance and interviewed NRC officials from the Office of Nuclear Reactor Regulation and OIG to better understand the agency's oversight of decommissioning funds.

To identify any improvements or weaknesses in NRC's oversight of decommissioning funding assurance, we analyzed NRC's decommissioning funding formula and the agency's reviews of licensee decommissioning funding status (DFS) reports. To analyze NRC's decommissioning funding formula, we compared NRC formula-generated cost estimates with licensee-generated site-specific cost estimates for 12 nuclear reactors for which we were able to obtain both types of estimates that were calculated in the same year. We also compared NRC's formula and the process the agency used to develop the formula with GAO-identified best practices for cost estimating,<sup>3</sup> and reviewed documents used to create the formula. To ensure our understanding of how the formula was developed and how it is used, we interviewed NRC officials and staff of the Pacific Northwest National Laboratory (the contractor NRC used to create the formula). To analyze NRC's reviews of licensee DFS reports, we analyzed data from reactor licensees' 2011 DFS reports for each of the operating reactors and for currently decommissioning reactors. These reports reflect estimated decommissioning costs and actual decommissioning fund balances as of December 31, 2010, among other things. We assessed the reliability of the data we used by interviewing NRC officials to identify steps the agency uses to verify the data, and several licensees to identify steps they take to ensure that the data they provide are reliable. In our assessment of the data, we

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<sup>1</sup>10 C.F.R. § 50.75.

<sup>2</sup>NRC, *Procedures for NRC's Independent Analysis of Decommissioning Funding Assurance for Operating Nuclear Power Reactors*, LIC-205, Revision 4 (Rockville, MD: Dec. 27, 2010).

<sup>3</sup>GAO, *GAO Cost Estimating and Assessment Guide: Best Practices for Developing and Managing Capital Program Costs*, GAO-09-3SP (Washington, D.C.: March 2009).

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determined these data were sufficiently reliable for our purpose of identifying the number of licensees who had not reported specific data in the 2011 DFS reports. We also reviewed the results of NRC's in-licensee-office comparisons of licensees' DFS reports and year-end bank statements from April 2008 through October 2010.

We also analyzed relevant Federal Energy Regulatory Commission (FERC) regulations governing decommissioning trust funds, because FERC oversees public utility financial reporting and about half of the 104 operating reactors are owned by public utilities.<sup>4</sup>

To better understand issues related to decommissioning nuclear power reactors in general, we interviewed officials from other federal agencies (such as from FERC and the Department of Energy), a decommissioning cost estimator, nongovernmental organizations, nuclear power industry groups, licensees of nuclear power reactors, and decommissioning fund stakeholders—a fund trustee and two investment advisors—who have knowledge of nuclear reactor decommissioning or are involved with it. We identified the trustee through licensee interviews and one investment advisor through a March 2011 NRC public decommissioning workshop that we attended. We also attended the 23rd annual NRC Regulatory Information Conference held in March 2011. In addition, we visited five nuclear power plants—Haddam Neck (Connecticut Yankee) in Connecticut, Indian Point in New York, Peach Bottom Atomic Power Station and Three Mile Island Nuclear Station in Pennsylvania, and Enrico Fermi Atomic Power Plant in Michigan—interviewed licensee officials there, and toured the facilities. The five sites we visited were a nonprobability sample that we selected to include a mix of fully decommissioned, currently decommissioning, and operating reactors. Because we used a nonprobability sample, the information obtained from these site visits is not generalizable to other reactors. To select these sites, we considered sites that were a mixture of types of reactors, types of ownership, and types of decommissioning methods used, as well as reactors that are operating, currently decommissioning, or fully decommissioned. In addition to these criteria, we considered sites that were close to GAO headquarters in Washington, D.C., for cost-saving purposes. The exception was the Enrico Fermi Atomic Power Plant in Michigan. We visited this site because it has the closest currently

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<sup>4</sup>18 C.F.R. §§ 35.32, 35.33.



decommissioning reactor using the immediate decontamination and dismantlement (DECON) method. We also interviewed relevant state agency officials (e.g., the Pennsylvania Public Utility Commission and Michigan Department of Environmental Quality) in the states where we conducted our site visits to better understand their roles in the decommissioning process.

We conducted this performance audit from February 2011 to April 2012, in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

# Appendix II: GAO Assessment of NRC's Decommissioning Funding Formula

Table 2 shows our comparison of NRC's decommissioning funding formula compared with our cost-estimating guide's four characteristics of a high-quality cost-estimating formula.

**Table 2: Comparison of NRC's Decommissioning Funding Formula with Characteristics of a High-Quality Cost-Estimating Formula**

Characteristic	Explanation	Overall assessment <sup>a</sup>	Best practice	Individual assessment
Credible	An estimate is credible if any limitations of the analysis because of uncertainty or bias surrounding data or assumptions are discussed. Major assumptions may be varied, and other outcomes are recomputed to determine how sensitive they are to changes in the assumptions. A risk and uncertainty analysis is performed to determine the level of risk associated with the estimate. The estimate's cost elements are crosschecked, and an independent cost estimate conducted by a group outside the acquiring organization is developed to determine whether other estimating methods produce similar results.	Characteristic substantially met	The cost-estimating formula includes a sensitivity analysis that identifies a range of possible costs based on varying major assumptions, parameters, and data inputs.	Practice met: NRC performed sensitivity analyses on a number of key assumptions in the studies used to create the formula.
			A risk and uncertainty analysis was conducted that quantified the imperfectly understood risks and identified the effects of changing key cost driver assumptions and factors.	Practice minimally met: NRC did not conduct a risk and uncertainty analysis on the formula. Instead, NRC applied a 25 percent contingency factor to all the cost estimates used to derive the formula. NRC explained that the 25 percent contingency factor is based on Department of Energy cost-estimating guidance for large construction projects. However, according to that guidance, the 25 percent contingency is for small construction projects.

**Appendix II: GAO Assessment of NRC's  
Decommissioning Funding Formula**

Characteristic	Explanation	Overall assessment <sup>a</sup>	Best practice	Individual assessment
			Major cost elements were cross-checked to see whether results were similar.	Practice partially met: The studies supporting the formula were developed to provide information on the available technology, safety conditions, and probable costs of decommissioning a large nuclear power reactor. However, experience at that time was limited to the decommissioning of reactors smaller than those in use today, and extrapolations of costs from the smaller to larger reactors are considered to be generally unreasonable.
			An independent cost estimate was conducted by a group outside the acquiring organization to determine whether other estimating methods produce similar results.	Practice substantially met: NRC initiated two independent cost estimates to determine decommissioning costs for one nuclear power reactor. However, the formula continues to reflect the original decommissioning studies performed in the late 1970s and early 1980s.
Well documented	An estimate is well documented if it contains detailed information, including source data and significance; clearly detailed calculations and results; and explanations of why particular methods and references were chosen. In addition, data can be traced to their source documents.	Characteristic substantially met	The documentation should capture the source data used, the reliability of the data, and how the data were normalized.	Practice partially met: The majority estimates for costs came from published studies that provided detailed estimates outlining the contents and units of the data, but some of the estimates were derived from engineering judgment. Engineering judgment can be useful in the absence of data, but data were available for the costs in question. Disadvantages associated with engineering judgment include lack of objectivity.

**Appendix II: GAO Assessment of NRC's  
Decommissioning Funding Formula**

Characteristic	Explanation	Overall assessment <sup>a</sup>	Best practice	Individual assessment
			The documentation describes in detail the calculations performed and the estimating methodology used to derive each work breakdown structure element's cost. <sup>b</sup>	Practice partially met: The documentation outlines the calculations performed and the detailed cost estimates used to derive the formula. However, some elements were developed using engineering judgment, and there is no evidence of quantitative historical data to enable the engineering judgment estimates to be adjusted for optimism and bias.
			The documentation describes step by step how the cost-estimating formula was developed so that a cost analyst unfamiliar with the program could understand what was done and replicate it.	Practice partially met: NRC provided ample documentation of the basis of the formula. However, the documentation did not clearly describe the step-by-step derivation process of the formula. As a result, we could not determine the mathematical derivation of the formula, and we were unable to consistently replicate the calculation of labor and energy factors NRC developed.
			The documentation discusses the technical baseline description and the data in the baseline are consistent with the cost-estimating formula.	Practice met: Key documents and subsequent studies outline a technical baseline description consistent with the formula.
			The documentation provides evidence that the cost-estimating formula was reviewed and accepted by management.	Practice substantially met: NRC has reviewed and accepted the main studies used to support the derivation and updates of the formula by publishing them. However, one aspect of this best practice is that management discussed the risk analysis during the review of the formula, and NRC did not conduct a risk analysis.

**Appendix II: GAO Assessment of NRC's  
Decommissioning Funding Formula**

Characteristic	Explanation	Overall assessment <sup>a</sup>	Best practice	Individual assessment
Comprehensive	An estimate is comprehensive if it has enough detail to ensure that cost elements are neither omitted nor double-counted. All cost-influencing ground rules and assumptions are detailed in the estimate's documentation.	Characteristic partially met	The cost-estimating formula includes the efforts for radiological cleanup.	Practice partially met: The formula represents a detailed cost estimate of reference reactors assuming immediate dismantlement based on the best available information at that time, which included off-site disposal of the low-level waste generated during decommissioning. However, circumstances have changed with regard to the cost and management of this low-level waste, and the availability of disposal sites, and these costs are not accounted for in the formula.
			The cost-estimating formula completely defines the program, reflects the current schedule, and is technically reasonable.	Practice partially met: The formula is based on the best information available 30 years ago, and the formula has not been updated since 1988. However, as NRC has noted, decommissioning technology and practices in use today are significantly different than assumed in the original studies on which the formula is based. As a result, NRC is currently reevaluating the formula.
			The cost-estimating formula work breakdown structure is product-oriented, traceable to the statement of work/objective, and at an appropriate level of detail to ensure that cost elements are neither omitted nor double-counted.	Practice partially met: The formula is a linear formula for estimating decommissioning costs as a function of the power-generating capacity of the reactor. However, there is no standardized, product-oriented work breakdown structure associated with the formula. Establishing a product-oriented work breakdown structure allows a program to track cost and schedule by defined deliverables.

**Appendix II: GAO Assessment of NRC's  
Decommissioning Funding Formula**

Characteristic	Explanation	Overall assessment <sup>a</sup>	Best practice	Individual assessment
			The cost-estimating formula documents all cost-influencing ground rules and assumptions.	Practice partially met: The main reports and studies on which the formula is based document all cost-influencing ground rules and assumptions. However, risks associated with some key assumptions were not accounted for in the formula. In addition, the formula assumes that all reactors will use the immediate decontamination and dismantlement (DECON) method of decommissioning—which calls for the removal of radioactively contaminated equipment, structures, and parts of the reactor—which is no longer representative of what reactors use.
Accurate	An estimate is accurate if it is unbiased, the work is not overly conservative or overly optimistic, and is based on an assessment of most likely costs. Few, if any, mathematical mistakes are present and those that are minor.	Characteristic partially met	The cost-estimating formula results are unbiased, not overly conservative or optimistic, and are based on an assessment of most likely costs.	Practice minimally met: According to NRC, the formula represents a detailed estimate based on the best available information at the time the formula was created. However, NRC has not performed a risk analysis, and therefore cannot convey a level of confidence that the formula will achieve the most likely cost of decommissioning. In addition, NRC does not require licensee's to provide actual costs of decommissioning.

**Appendix II: GAO Assessment of NRC's  
Decommissioning Funding Formula**

Characteristic	Explanation	Overall assessment <sup>a</sup>	Best practice	Individual assessment
			The cost-estimating formula has been adjusted properly for inflation.	Practice substantially met: NRC developed an additional formula for adjusting the decommissioning funding formula estimate to account for inflation. However, one component of the inflation formula is labor costs, and because NRC does not maintain nuclear labor cost data, the agency relies on data from the U.S. Bureau of Labor Statistics.
			The cost-estimating formula contains few, if any, minor mistakes.	Practice substantially met: The derivation of the formula is generally sound. However, some of the values in the formula were rounded off in a way that was not thoroughly explained.
			The cost-estimating formula is regularly updated to reflect significant changes in the decommissioning process, such as when schedules or other assumptions change, and actual costs so that it is always reflecting current status.	Practice minimally met: Two types of large nuclear reactors and different decommissioning methods were studied in the creation of the decommissioning funding formula. However, the formula has not been updated since it was put into regulations in 1988, and the agency does not require the collection of actual decommissioning costs from licensees, so the formula does not account for factors that may raise the final cost of decommissioning.
			Variances between planned and actual costs are documented, explained, and reviewed.	Practice not met: Variances between the formula estimates and actual costs have not been documented, reviewed, or explained.

**Appendix II: GAO Assessment of NRC's  
Decommissioning Funding Formula**

Characteristic	Explanation	Overall assessment <sup>a</sup>	Best practice	Individual assessment
			The cost-estimating formula is based on a historical record of cost estimating and actual experiences from other comparable programs.	Practice partially met: The formula represents a detailed estimate based on the best available information at the time it was created. However, the formula has not been updated since it was put into regulations in 1988, and the agency does not require the collection of actual decommissioning costs from licensees.

Source: GAO assessment of NRC's decommissioning funding formula based on GAO-identified cost-estimating best practices.

Notes: We analyzed the cost-estimating practices used by NRC for the decommissioning funding formula, as stated in 10 C.F.R. § 50.75.

<sup>a</sup>The ratings we used in this analysis are as follows: "Not met" means that NRC provided no evidence that satisfies any of the best practices; "Minimally met" means that NRC provided evidence that satisfies a small portion of the best practices; "partially met" means that NRC provided evidence that satisfies about half of the best practices; "substantially met" means that NRC provided evidence that satisfies a large portion of the best practices; and "met" means that NRC provided complete evidence that satisfies all of the best practices.

<sup>b</sup>A work breakdown structure provides a basic framework for defining in detail the work necessary to accomplish a program's objectives, and deconstructs a program's end product into successive levels with smaller specific elements until the work is subdivided to a level suitable for management control.



# Appendix III: Comments from the Nuclear Regulatory Commission



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D.C. 20555-0001  
March 26, 2012

Ms. Karen Jones, Assistant Director  
Natural Resources and Environment Team  
U.S. Government Accountability Office  
441 G Street, NW.  
Mail Stop: 2T23-A  
Washington, D.C. 20548

Dear Ms. Jones:

I would like to thank you for the opportunity to review and submit comments on the draft of your report GAO-12-258, "Nuclear Regulation: NRC's Oversight of Nuclear Power Plants' Decommissioning Funds Could Be Further Strengthened," which the U.S. Nuclear Regulatory Commission (NRC) received on February 23, 2012. The NRC appreciates the time and effort that you and your staff have taken to review this topic.

The U.S. Government Accountability Office (GAO) concludes that the NRC has strengthened its oversight of licensees' decommissioning funding. In addition, the GAO provided five recommendations to address potential weaknesses that may limit the NRC's ability to ensure that licensees will have adequate funds at the time of decommissioning. The NRC agrees with three of the recommendations, disagrees with one recommendation and recommends it be revised, and agrees in part and disagrees in part with one recommendation. Our comments on the recommendations are listed below.

- Recommendation: Document procedures describing the steps the staff should take in their reviews analyzing licensee documentation and verifying that the amounts licensees report to the NRC in their decommissioning funding status reports match the amounts on their year-end bank statements.

Response: The NRC agrees with this recommendation for its reviews of licensee decommissioning trust fund balance documentation. The NRC recognizes the need and is in the process of updating Office Instruction LIC-205, "Procedures for NRC's Independent Analysis of Decommissioning Funding Assurance for Operating Nuclear Power Reactors," to implement the recommendation.

- Recommendation: Continue the reviews of fund balances in a way that is most efficient and effective for the agency.

Response: The NRC agrees with this recommendation to continue the reviews of fund balances in a cost-effective manner.

- Recommendation: Consider reviewing a sample of the licensees' investments to determine if licensees are complying with decommissioning investment standards and determine whether action should be taken to enforce these standards.

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Response: The NRC agrees and will consider reviewing samples of the licensees' investments to determine if licensees are complying with the decommissioning investment standards and whether action should be taken to enforce these standards.

- Recommendation: The NRC's re-evaluation of its decommissioning funding formula should define the meaning of the "bulk" of the funds that licensees will likely need to decommission their reactors.

Response: The NRC disagrees with this GAO recommendation and suggests that GAO revise the recommendation to state that NRC's re-evaluation of the formula should consider the relationship between the formula amount and the range of expected decommissioning costs. In view of the comprehensiveness of the NRC's regulatory system, the NRC disagrees that a precise definition of the meaning of "bulk" is necessary to ensure that licensees adequately plan for decommissioning costs. The decommissioning funding formula is only one input to the NRC's regulatory system for funding assurance, which includes annual adjustments and accounting for site-specific costs. Licensees must perform several steps which, when considered as a whole, provide reasonable assurance that funds will be available when needed. In addition, the NRC monitors licensee performance and takes action to ensure that the licensee's funding assurance meets the requirements. Based on experience, the regulatory system has been adequate to ensure that power reactor licensees obtain funds when needed for decommissioning.

- Recommendation: The NRC's re-evaluation of its decommissioning funding formula should use the GAO's cost-estimating characteristics as a guide for a high-quality cost-estimating formula in the event that NRC chooses to update its formula.

Response: The NRC agrees in part and disagrees in part with this GAO recommendation. The GAO stated that its cost-estimating guideline identified four characteristics of a high-quality, cost-estimating formula: being credible, being well-documented, being comprehensive, and being accurate. The NRC agrees that the decommissioning funding formula should provide a credible and well-documented basis for establishing the minimum amount of funding needed to plan for the costs of decommissioning a reactor. The GAO determined that the formula meets those characteristics. However, the NRC disagrees that the formula is the appropriate tool for achieving the characteristics of comprehensiveness and accuracy in estimating decommissioning costs. The formula is not intended to provide a cost estimate. It provides a reference level for use by licensees as a planning tool early in plant life, based on studies of the costs to decommission a reference reactor. Licensees must perform annual adjustments of the reference level to account for inflation. The reference level approach recognizes that the benefits of providing a precise estimate early in plant life are outweighed by the uncertainties of the costs of a project that will not occur for several decades.

The NRC believes that it achieves the characteristics of comprehensiveness and accuracy by requiring the licensee to provide an updated, plant-specific cost estimate late in plant life.

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At that time, additional information will be available. Performing the cost estimate late in plant life reduces the uncertainty in costs to a level that is outweighed by the benefits of improved accuracy based on near-term knowledge of the cost factors. When considered as a whole, the NRC's regulatory system achieves all the characteristics recommended by GAO.

The NRC will continue to evaluate its processes and policies associated with decommissioning funding assurance for power reactor facilities. The enclosed NRC comments are intended to provide a more comprehensive perspective related to the conclusions and recommendations contained in the draft GAO report. Should you have any questions about these comments, please contact Jesse Arildsen, of my staff, at 301-415-1785.

Sincerely,



R. W. Borchardt  
Executive Director  
for Operations

Enclosure:  
As stated

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## Appendix IV: GAO Contact and Staff Acknowledgments

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### GAO Contact

Frank Rusco, (202) 512-3841 or [ruscof@gao.gov](mailto:ruscof@gao.gov)

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### Staff Acknowledgments

In addition to the individual named above, Karen Jones, Assistant Director; Karen Richey, Assistant Director; Josey Ballenger; Bernice Dawson; Jennifer Echard; Jonathan Kucskar; Robin Marion; Katya Melkote; Cynthia Norris; Michelle K. Treistman; and Vanessa V. Welker made significant contributions to this report. Mehrzad Nadji and Anne Rhodes-Kline also made important contributions to this report.

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