

**DECOMMISSIONING COST ESTIMATE FOR  
A PEBBLE BED MODULAR REACTOR (PBMR) FACILITY**

**I. ISSUE:**

10 CFR § 50.75(c) specifies a minimum amount for the decommissioning fund for boiling water reactors (BWRs) and pressurized water reactors (PWRs). However, this section does not specify a minimum amount for the required decommissioning fund for a gas cooled reactor.

**II. EXELON'S PROPOSAL:**

The first PBMR license application will include a cost estimate for decommissioning a PBMR module.

**III. ANALYSIS:**

10 CFR § 50.75(c) specifies a minimum amount for the decommissioning fund for BWRs and PWRs but not for a gas cooled reactor. Because the design of the PBMR is significantly different than the design of a BWR or PWR, neither of the cost estimates currently in Section 50.75(c) is appropriate for a PBMR module.

Therefore, the license application for the PBMR will include a decommissioning cost estimate. Because construction of the PBMR modules at a site will most likely be staggered, and because the PBMR modules might be decommissioned at different times, the cost estimate will apply to decommissioning of a single PBMR module.

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**CONSIDERATION OF THE ENVIRONMENTAL IMPACTS OF THE FUEL CYCLE  
AND TRANSPORTATION AS APPLICABLE  
TO A PEBBLE BED MODULAR REACTOR (PBMR) FACILITY**

**I. ISSUE:**

10 CFR §§ 51.51 and 51.52 (Tables S-3 and S-4) specify the environmental impacts attributable to the fuel cycle and transportation for light water reactors (LWRs) but not for other types of reactors. As a result, this issue is unresolved for the PBMR.

Additionally, 10 CFR § 51.23 resolves issues related to the environmental impacts of storage of spent fuel following cessation of reactor operation until a mined geologic repository is available to dispose of the spent fuel (the "waste confidence" rule). This paper addresses whether such resolution applies to spent fuel generated by a PBMR.<sup>1</sup>

**II. EXELON'S PROPOSAL:**

- 1) In the first PBMR application, Exelon will identify the environmental impacts attributable to the fuel cycle and transportation for a PBMR facility.
- 2) Based upon the resolution of these issues for the first PBMR application, NRC should initiate rulemaking to create tables for the PBMR that are similar to Tables S-3 and S-4.
- 3) Long term onsite storage of spent fuel beyond the licensed lifetime of the PBMR is not a concern under the NRC's Waste Confidence Rule in 10 CFR § 51.23.

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<sup>1</sup> It is expected that the PBMR will use 8% enriched Uranium-235 fuel, which is classified as low enriched uranium (LEU) fuel under 10 CFR § 50.2. The only regulation that imposes more restrictive requirements on 8% enriched fuel than on the 4% enriched fuel typically used in

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LWRs is 10 CFR § 50.68(b), which requires a criticality monitoring system for use, handling, and storage of fuel assemblies with an enrichment greater than 5%.

### **III. ANALYSIS:**

#### **A. Tables S-3 and S-4**

Since Tables S-3 and S-4 in 10 CFR §§ 51.51 and 51.52 are limited to LWRs, issues related to the environmental impacts attributable to the fuel cycle and transportation have not been resolved by rulemaking for other types of reactors.

As a result, as part of the first PBMR application, Exelon will provide information on the environmental impacts of the fuel cycle and transportation attributable to a PBMR facility.

Once this issue has been resolved for the first PBMR application, NRC should initiate rulemaking to eliminate the need for duplicative reviews of this same information for subsequent PBMR applications. Since these impacts are generic for all PBMR facilities (and any comparable facilities), the results of the evaluation of these impacts for the first PBMR application should serve as the basis for the rulemaking. This rulemaking could entail the addition of tables to Part 51 similar to the existing Tables S-3 and S-4, or this issue could be resolved as part of the design certification rulemaking for the PBMR.

#### **B. Waste Confidence Rule**

In the early 1980s, the NRC conducted a generic rulemaking to assess the degree of assurance that radioactive wastes could be disposed of safely, to determine whether disposal or offsite storage would be available, and to determine whether the waste could be stored safely at reactor sites beyond the expiration of existing facility licenses until offsite disposal or storage is available.

The rulemaking came to be known as the "Waste Confidence" proceeding. On August 31, 1984, the NRC published five findings, accompanied by a final rule (codified

at 10 CFR § 51.23) that incorporated the findings as the basis for excluding case-by-case consideration of environmental effects of extended onsite storage of spent fuel in reactor and spent fuel storage facility licensing proceedings. See 49 Fed. Reg. 34658, 34688. The NRC's Waste Confidence Rule, as revised,<sup>2</sup> states that:

The Commission has made a generic determination that, if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts for at least 30 years beyond the licensed life for operation (which may include the term of a revised or renewed license) of that reactor at its spent fuel storage basin or at either onsite or offsite independent spent fuel storage installations. Further, the Commission believes there is reasonable assurance that at least one mined geologic repository will be available within the first quarter of the twenty-first century, and sufficient repository capacity will be available within 30 years beyond the licensed life for operation of any reactor to dispose of the commercial high-level waste and spent fuel originating in such reactor and generated up to that time.

10 CFR § 51.23(a) (emphasis added). This provision does not distinguish between types of spent fuel.<sup>3</sup> Additionally, in making its findings in support of the Waste Confidence Rule, the Commission explicitly considered non-LWR fuel, including fuel from gas cooled reactors. See, e.g., 49 Fed. Reg. at 34663 and 34683. Accordingly, the Waste Confidence Rule is broad enough to cover fuel irradiated in a gas-cooled reactor like the PBMR.

Furthermore, as a practical matter, there should be a repository available long before the end of the licensed lifetime of the PBMR. The Waste Confidence Rule states

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<sup>2</sup> The NRC recently reaffirmed its decision in the Waste Confidence Rulemaking, finding that there have been “no major shifts in national policy, no major unexpected institutional developments, [and] no unexpected technical information . . . that would cast doubt on the Commission’s Waste Confidence findings . . .” 64 Fed. Reg. 68005, 68007 (Dec. 6, 1999).

<sup>3</sup> Part 51 does not define “spent fuel.” The closest definition is “spent nuclear fuel” in 10 CFR Part 2, Subpart K, governing hearing procedures for expansion of spent nuclear fuel storage capacities. See 10 CFR 2.1105. That definition states that spent nuclear fuel means “fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated by reprocessing.” *Id.* This definition also does not distinguish between the

that there is reasonable assurance that a repository will be available by the first quarter of the twenty-first century (i.e., by 2025). In contrast, Exelon does not expect that the first PBMR will begin operation in the United States until 2006. Given a 40-year licensed lifetime for the PBMR, the license for the first PBMR would not expire until 2046 at the earliest - - long after the repository is expected to be available.

Under the Nuclear Waste Policy Act (NWPA), 42 U.S.C. §§ 10101 *et seq.*, the Department of Energy (DOE) will be required to accept irradiated PBMR fuel. The NWPA makes the federal government responsible for permanent disposal of spent nuclear fuel. 42 U.S.C. § 10131(4). To carry out this responsibility, the NWPA authorizes the Secretary of the DOE to enter into contracts with any person who generates, among other things, "spent nuclear fuel." 42 U.S.C. § 10222(a)(1). For civilian nuclear power plants, these contracts provide payment of fees in exchange for DOE's "acceptance of title, subsequent transportation, and disposal of . . . spent fuel." *Id.*

Nothing in the NWPA excludes irradiated PBMR fuel. The federal government's obligation applies to "spent nuclear fuel," which is defined as "fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated by reprocessing." See 42 U.S.C. §§ 10102(23), 10222. Also, the contract mechanism which applies to civilian nuclear power reactors would include any "power plant required to be licensed as a utilization facility under section 103 or 104(b) of the Atomic Energy Act of 1954." See 42 U.S.C. § 10102(6). Since the irradiated PBMR fuel meets the definition of "spent nuclear fuel," and the PBMR itself

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type of fuel generated in the reactor. Accordingly, under NRC regulations, the type of fuel generated - whether LWR or PBMR fuel - should not affect the Waste Confidence Rule.

will be licensed pursuant to Section 103 of the Act, DOE would be required to enter into a contract with Exelon for the ultimate disposal of the irradiated PBMR fuel.

The DOE's regulations implementing the contract requirement explicitly support this position. DOE regulations in 10 CFR § 961.1 clarify that DOE "will make available nuclear waste services to the owners and generators of spent nuclear fuel," and that "DOE will take title to, transport, and dispose of spent nuclear fuel . . . delivered to DOE by those owners of generators who execute the contract" set forth in 10 CFR § 961.11.

This contract explicitly states that:

the DOE has the responsibility following commencement of operation of a repository to take title to the spent nuclear fuel [SNF] or high-level radioactive waste [HLW] involved as expeditiously as practicable upon the request of the generator or owner of such waste or spent nuclear fuel.

Furthermore, Article I.18 of the contract states that the contract "applies to the delivery by Purchaser to DOE of SNF and/or HLW of domestic origin from civilian nuclear power reactors." Finally, Appendix E.4 of the contract explicitly states that such fuel includes "non-LWR fuel" (which is classified as nonstandard fuel under the contract). Thus, the standard DOE contract explicitly encompasses non-LWR fuel such as PBMR fuel, and DOE is required to accept such fuel from licensees who execute DOE's standard contract.

In summary, the Nuclear Waste Policy Act requires DOE to take title to and dispose of spent PBMR fuel. Since NRC expects the DOE repository to be in operation by the time the license for the first PBMR facility expires, long term storage of spent fuel from a PBMR does not represent a concern under the NRC's Waste Confidence Rule.