[7590-01-P]

NUCLEAR REGULATORY COMMISSION

10 CFR Parts 20 and 50

RIN 3150-AG

Entombment Options for Power Reactors

AGENCY: Nuclear Regulatory Commission.

ACTION: Advance notice of proposed rulemaking.

SUMMARY: The Nuclear Regulatory Commission (NRC) is considering an amendment to its regulations that would clarify the use of entombment for power reactors. The NRC has determined that entombment of power reactors is a technically viable decommissioning alternative and can be accomplished safely. Current regulations governing decommissioning and license termination require that decommissioning be completed within 60 years of permanent cessation of operations. Completion of decommissioning beyond 60 years will be approved by the NRC only when necessary to protect public health and safety. The regulations also establish dose criteria for license termination that includes a provision that permits license termination under restricted and unrestricted release conditions. This advance notice of proposed rulemaking invites early input from affected parties and the public on the issues surrounding the feasibility of entombment.

DATES: The comment period expires **[insert 75 days after publication]**. Comments received after this date will be considered if it is practical to do so, but the Commission is able to assure consideration only for comments received on or before this date.

ADDRESSES: Mail comments to: The Secretary, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, Attention: Rulemakings and Adjudications Staff. Deliver comments to: 11555 Rockville Pike, Rockville, Maryland, between 7:30 a.m. and 4:15 p.m. on Federal workdays. You may also provide comments via the NRC's interactive rulemaking website (http://ruleforum.llnl.gov). This site provides the availability to upload comments as files (any format), if your web browser supports that function. For information about the interactive rulemaking site, contact Ms. Carol Gallagher (301) 415-5905; e-mail CAG@nrc.gov.

The NRC maintains an Agency wide Documents Access and Management System (ADAMS), which provides text and image files of NRC's public documents. These documents may be accessed through the NRC's Public Electronic Reading Room on the Internet at http://www.nrc.gov/NRC/ADAMS/index.html. If you do not have access to ADAMS or if there are problems in accessing the documents located in ADAMS, contact the NRC Public Document Room (PDR) Reference staff at 1-800-397-4209, 301-415-4737 or by email to pdr@nrc.gov.

FOR FURTHER INFORMATION CONTACT: Stephanie P. Bush-Goddard, Ph. D., telephone (301) 415-6257, e-mail spb@nrc.gov, Office of Nuclear Material Safety and Safeguards, U. S. Nuclear Regulatory Commission, Washington, DC 20555-0001.

SUPPLEMENTARY INFORMATION:

Background

A. Current Rulemakings Related to Decommissioning and License Termination

Current requirements pertaining to decommissioning are contained in 10 CFR Part 50. Specific requirements on decommissioning alternatives were published June 27, 1988 (53 FR 24018). These provisions state that the Commission will terminate a license if it determines that the decommissioning has been performed in accordance with an approved decommissioning plan and that terminal radiation surveys and associated documentation demonstrate that the facility and site are suitable for release for unrestricted release. The Supplementary Information (SI) to the 1988 rule defined three broad decommissioning alternatives: DECON, SAFSTOR, and ENTOMB. The term ENTOMB was defined as the alternative, in which radioactive contaminants are encased in a structurally long-lived material, such as concrete; the entombed structure is appropriately maintained; and surveillance is continued until the radioactivity decays to a level permitting termination of the license with unrestricted release.

Currently, 10 CFR 50.82(a)(3) requires that decommissioning be completed within 60 years of permanent cessation of operations, and completion of decommissioning beyond 60 years be approved by the NRC only when necessary to protect public health and safety. The factors that will be considered by the Commission in evaluating an alternative that provides for the completion of decommissioning beyond 60 years of permanent cessation of operation include unavailability of waste disposal capacity and other site-specific factors affecting the

licensee's capability to carry out decommissioning, including the presence of other nuclear facilities at the site. In addition, the 1988 rule was structured so that use of any decommissioning option would result in termination of the license for unrestricted use. These requirements tended to favor the use of DECON and SAFSTOR. However, as noted in the SI for the June 27, 1988, final rule, the ENTOMB alternative was not specifically precluded because it was recognized that it might be an allowable alternative in protecting public health and safety.

In 1997, the Commission amended its regulations to establish dose criteria for license terminations. These provisions appear in 10 CFR Part 20, Subpart E, and include a provision that permits license termination under restricted release conditions. Under a restricted release, the dose to the average member of the critical group must not exceed 0.25 mSv/yr (25 mrem/yr) total effective dose equivalent (TEDE) and be as low as reasonably achievable (ALARA) with the restrictions in place, and, if the restrictions were no longer in effect, the dose due to residual radioactivity could not exceed 1 mSv/yr (100 mrem/yr) (or 5 mSv/yr (500 mrem/yr), if additional conditions are met) TEDE and is ALARA. These caps were chosen to provide a safety net in the highly unlikely event that the restrictions failed.

B. Discussion of the Concept of Entombment

Entombment is an alternative method for decommissioning a power reactor that ultimately results in termination of its license. Before the start of entombment, the reactor permanently ceases operations. The spent fuel is permanently removed from the reactor core and either shipped offsite or stored in an independent spent fuel storage installation. After preliminary decommissioning activities are completed, radioactive contaminants to be left on-

site are placed, or left, in the reactor containment building or other structure. This collection of radioactive materials, their volume and radionuclide characterization, is referred to as the source term.

After the radioactive materials are placed in the containment, the material is entombed by designing and constructing engineered barriers that can reliably isolate the radioactive contaminants from the environment. This can be accomplished by suitable hardening to prevent inadvertent intruder exposures (e.g., use of concrete capping, or fill materials) and mitigation of transport of radionuclides to the environment (e.g., use of soil, added sorption materials, site considerations).

The length of time that the entombed structure must remain effective in isolating its contents depends on specific radionuclides present in the entombed structure and the time necessary for those radionuclides to be reduced, through radioactive decay, to a level that is acceptable for license termination.

For radionuclides Cobalt-60 and Cesium-137 (with half-lives of approximately 5.3 and 30 years, respectively), which are the principal dose contributors for reactors, the time estimated to reach the 0.25 mSv/yr (25 mrem/yr) unrestricted use criterion is about 160 and 300 years, respectively. If the long-lived activation products present in reactor internals were included in an entombed structure, the time of isolation for the long-lived activation products will depend not only on their half-lives but other site specific factors such as engineered barriers and site characteristics.

Specific Proposal

The NRC believes that decommissioning a power reactor using the entombment approach appears to be a safe and viable option for many situations, and that it could offer benefits and greater flexibility to accommodate particular site-specific decommissioning situations. In some cases, reactors may be able to achieve decommissioning through an entombment approach to license termination in accordance with the criteria of the license termination rule in 10 CFR Part 20, Subpart E, and within the 60-year timeframe provided in 10 CFR 50.82(a)(3). However, in other cases, the 60-year provision in § 50.82(a)(3) for completion of decommissioning may need to be revised to reflect the period of time required for reduction in dose to meet the restricted release criteria in 10 CFR Part 20, Subpart E, such that use of an entombment approach may require changes to the regulatory requirements and guidance before this option can be treated as a generic alternative.

Specific Considerations

Before it prepares a proposed rule on the subject, the NRC is seeking advice and recommendations on this matter from all interested persons. Specific areas on which the Commission is requesting comment are discussed in the following sections. Comments accompanied by supporting reasons are particularly requested on the questions contained in each section.

A. REGULATORY FRAMEWORK AND APPROACHES - RULEMAKING OPTIONS

Option 1

Do not conduct rulemaking. Currently, 10 CFR 50.82(a)(3) requires that decommissioning be completed within 60 years of permanent cessation of operations. Completion of decommissioning beyond 60 years may be approved by the NRC only when necessary to protect public health and safety. To extend decommissioning based on economic or other non-public health and safety reasons would require an exemption under 10 CFR 50.12.

The advantage of this option is that current regulations already permit case-specific Commission approval for completing license termination beyond 60 years (10 CFR 50.82) based on health and safety considerations. In addition, the current regulations (10 CFR Part 20, Subpart E) for license termination with restricted release provide dose criteria for decommissioning and, in some cases, could apply to entombment within the existing time frame of 10 CFR 50.82.

The disadvantage of this option is that in some cases, current 10 CFR Part 20 Subpart E requirements for license termination with restricted release may not be sufficiently flexible to achieve license termination within the 60-year period specified, given the limitations for extending the time period. Therefore, this option results in regulating by exemption. Also if the current rules were used for considering the permissibility of entombment for case-specific situations for other than public health and safety reasons, it may require additional resources to process the site-specific exemptions for extension of time. Another disadvantage is that this option does not address the disposition of Greater Than Class C (GTCC) material, which otherwise might need to be disposed of in an offsite disposal facility. Finally, under 10 CFR Part 20, the entombment contains residual radioactivity and is considered to be suitable for

license termination. However, under other statutes, the residual radioactivity might be considered low level waste (LLW). Classification of the entombed material as LLW would raise issues concerning State and LLW compact legal authority over the entombment. Therefore, States and compacts have authority for disposal of LLW, and may prescribe means for its disposal other than entombment. In addition, some States have prescribed their own criteria for LLW disposal that may not be compatible with those in an entombment rule.

Option 2

Another option would be to conduct rulemaking to consider the need to add flexibility to 10 CFR 50.82 to amend the 60-year time frame for completion of decommissioning and to clarify the use of engineered barriers for reactor entombments.

Option 2 would modify the 60-year time period for completion of decommissioning activities. Under this option, the "Statement of Considerations" could clarify when credit could be taken for engineered barriers, independent of institutional controls, as a method for meeting the established dose criteria found in 10 CFR Part 20, Subpart E.[1] Engineered barrier system objectives, qualifying criteria, and implementation acceptability by the NRC could be specified in the rule to ensure a high level of confidence that the entombment would continue to isolate the radioactive material until it decays to a level that would be acceptable for restricted release. This option could specifically authorize the use of entombment for power reactors as a decommissioning alternative for license termination.

The advantage of this option is that amending 10 CFR 50.82 would provide more flexibility for terminating a license without the need for exemptions or Commission approval of

[1]Under 20 CFR Part 20, Subpart E, engineered barriers may be considered institutional controls depending upon the need for and the degree of human involvement to maintain their effectiveness. Option 2, unlike Option 1, would clarify this issue.

alternative schedules. It also permits flexibility of requirements for a broad variety of possible situations. This would result in resource savings. The use of engineered barriers would be clarified in the regulations. Furthermore, terminating the license is more efficient and effective compared to retaining a disposal license as proposed by Option 3 below.

The disadvantages of this option are that there may not be a defined time period for license termination and this approach may delay completion of decommissioning and license termination. However, there may be other factors that would motivate timely completion of decommissioning activities, such as continued requirements for payment of fees, insurance, and other resource impacts on licensees. Another disadvantage, as in Option 1 , is that it does not address the disposition of GTCC material, which otherwise might need to be disposed of in an offsite disposal facility. Finally, under 10 CFR Part 20, the entombment contains residual radioactivity and is considered to be suitable for license termination. However, under other statutes, the residual radioactivity might be considered LLW. Classification of the entombed material as LLW would raise issues concerning State and LLW compact legal authority over the entombment. Therefore, States and compacts have authority for disposal of LLW and may prescribe means for its disposal other than entombment. In addition, some States have prescribed their own criteria for LLW disposal that may not be compatible with those in an entombment rule.

Option 3

A third option would be to conduct a rulemaking to establish performance objectives and licensing requirements for an entombed facility. This option can be characterized as a disposal rather than decommissioning leading to license termination. It would provide for a rulemaking to establish performance objectives and technical requirements under a new or

existing part of the regulations for an entombed facility. Relevant requirements established in other existing parts of the NRC regulations (e.g., Part 20, Subpart E, and 10 CFR Part 61) could be incorporated into this rulemaking. These requirements could include, but would not be limited to, overall system performance objectives, institutional controls, including Federal or State ownership/oversite, and analyses of the long-term stability of the site. These requirements could also include pathway analysis to demonstrate protection of the average member of the critical group from releases of radioactivity using dose limits, which could include provisions for adequate barriers to prevent inadvertent intrusion. In addition, provisions for engineering features such as barrier controls could be established on a site-specific, license-specific basis. The license could also cover the activities of entombing the radioactive material, operations, and surveillance of controls. Similar to a license under Part 61, the entombed disposal facility would be maintained under an NRC license until the post-closure requirements were met. Also, since the facility would no longer be a licensed power reactor, but rather a new license, this option could apply to other types of facilites.

The advantage of this option is that it would allow for on-site disposal of GTCC waste, since such waste may only be disposed of at an NRC-licensed facility. This option would address a dose analysis period that may be necessary for GTCC waste. It might also provide an approach more acceptable to the public because entombing a large quantity of long-lived isotopes is viewed as more akin to disposal or burial of waste rather than leaving behind residual material in decommissioning. It could also address other license terminations with large source terms requiring extended periods of institutional controls. Furthermore, because no NRC-licensed power reactors have ever been entombed and given the potential source term for a power reactor, setting performance objectives and continuation of an NRC license would permit greater confidence that dose criteria would be met.

A disadvantage of this option is that it does not terminate the license and may raise questions as to why the radiological dose criteria for license termination alone are not adequate for protecting public health and safety. It could also require major expenditures of NRC and licensee resources to write a new part to the regulations and to re-license or convert the facility license. It could also require major expenditures to maintain the NRC license over the period of time during which the license would need to be retained. It may have complex policy implications because NRC's responsibility is to license GTCC disposal facilities; however, DOE has overall responsibilities for disposal strategies of GTCC material. Finally, classification of the entombed material as LLW might raise issues concerning State and LLW compact legal authority over the entombment.

Based on this discussion:

A.1. Does the existing 10 CFR 50.82(a)(3) provide an adequate basis to allow periods of entombment beyond 60 years. If not, in what way should the regulations be changed?

A.2. Is 10 CFR Part 20, Subpart E, adequate to achieve license termination using an entombment approach? If not, how and why should this rule be modified?

A.3. Should entombed facilities be required to maintain some type of NRC license after the facility meets the dose criteria of Part 20, Subpart E? If so, what conditions need to prevail before the license may be terminated? What alternatives might exist for adequately managing the radioactive materials left in the entombed structure?

A.4. A new part is being considered in the regulations to establish performance objectives and requirements for licensing an entombed disposal facility. Should this option replace Subpart E for purposes of entombment or should a licensee have a choice between using Subpart E approach or the entombed facility license approach? Should the dose based criteria for the entombed facility license be based on Subpart E dose limits? If not, what should be the basis for those limits.

A.5. Should the entombed facility option be available only to power reactors? If not, under what circumstances should it be applied to other than power reactors?

A.6. Are there other options that the Commission should consider in developing an approach to entombment that will provide for its viability while maintaining the public health and safety?

B. TECHNICAL FEASIBILITY ISSUES

Part 20, Subpart E (10 CFR 20.1403), allows release of a site under restricted conditions if:

(a) Institutional controls are in place to limit the dose from residual radioactivity to less than 0.25 mSv/yr (25 mrem/yr) TEDE and is as low as reasonable achievable (ALARA), and

(b) the radioactivity present has been reduced so that, if the institutional controls were no longer in effect, the dose would be less than 1 mSv/yr (100 mrem/yr) TEDE and is ALARA (5 mSv/yr (500 mrem/yr) is allowed if “durable institutional controls” are used).

Thus, the NRC is considering that approval of a license termination plan for an entombment be based on a site-specific technical evaluation of the entombment's ability to fulfill the requirements of 10 CFR Part 20, Subpart E.

An analysis prepared for the NRC indicates that the most likely way that the entombment engineered barrier might lose its effectiveness may be leakage through the barrier. The ability to ensure that any release would not exceed authorized levels is a function of the design, installation, quality, durability, robustness, etc., of the entombed structure, the environment at hand, and the time needed for the protective function to be performed. Each case must be evaluated on its own merits.

B.1. To what degree should credit be given to engineered barriers for the purposes of dose reduction to meet the license termination criteria of 10 CFR Part 20, Subpart E?

C. ENTOMBMENT OF GREATER THAN CLASS C (GTCC) WASTE

At the time of permanent cessation of power reactor operations, the reactor vessel's internals contain some long-lived radioactive materials, that result from neutron activation of these materials near the reactor core. One of these radionuclides is Niobium (Nb-94), which has a half life of about 20,000 years. If reactor internals with GTCC concentrations of Nb-94 had to be disposed of offsite, a special facility for their disposal would be required, since they cannot be disposed of in LLW facilities. Also removal of the GTCC waste from the reactor internals is difficult work and results in exposure to occupational workers, but these exposures can be maintained within regulatory limits. In addition, the Low-Level Radioactive Waste Policy

Amendments Act of 1985 provides that GTCC waste resulting from NRC licensed activities may only be disposed of in a facility licensed by the NRC.

Alternatively, it may be possible that case-specific permission might be given to dispose of the reactor pressure vessel (RPV) in an LLW facility based on averaging; i.e., calculating the GTCC waste-volume concentration by using the volume of the RPV in the average. The residual radiation after volume averaging could be classified as LLW.

C.1. Should material that could be classified as GTCC waste be considered in the entombment approach? Are there circumstances under which residual radioactivity that could be classified as GTCC be allowed to be entombed on site? If so, under what conditions?

D. STATE ISSUES

D.1. Power reactor licensees are exclusively regulated by the NRC (under 10 CFR Part 50), even in Agreement States. The NRC consults with stakeholders, including Agreement and non-Agreement States, about regulatory actions under consideration that may impact stakeholders. What additional role, if any, should the affected States have in the license termination process based on entombment for power reactors? In addition should an Agreement State be permitted to issue a license for an entombed disposal facility?

D.2. Under 10 CFR Part 20, Subpart E, the entombment contains material having residual radioactivity and is suitable for license termination if the dose criteria are met. However, under other statutes, such as the LLW Policy Act, the material

might be considered to be low level waste. What issues exist for entombment in a State where existing State legislation prohibits LLW disposal?

D.3. Are there other issues not covered above, for an entombment that impact Low Level Waste Compacts?

D.4. If the entombment disposal facility option does not include GTCC waste and the disposal license is issued by an Agreement State, what compatibility[2] categories, as described in NRC's "Policy Statement on Adequacy and Compatibility of Agreement State Programs," published September 3, 1997 (62 FR 46517), and in NRC's Management Directive 5.9, "Adequacy and Compatibility of Agreement State Programs," should be assigned?

E. FURTHER INFORMATION

E.1. Please provide any other considerations or rule changes that the Commission should consider to facilitate license termination based on an entombment approach, while maintaining the requisite protection of the public health and safety?

The preliminary views expressed in this document may change in light of comments received. If the proposed rule is developed by the Commission, there will be another opportunity for additional public comment in connection with that proposed rule.

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[2]Compatibility refers to the extent to which Agreement State radiation control programs are consistent with NRC's program for the regulation of Atomic Energy Act radioactive materials to ensure that an adequate and coherent nationwide effort is collectively established for regulation of such materials.

List of Subjects

10 CFR Part 20

Byproduct material, Criminal penalties, Licensed material, Nuclear materials, Nuclear power plants and reactors, Occupational safety and health, Packaging and containers, Radiation protection, Reporting and recordkeeping requirements, Special nuclear material, Source material, Waste treatment and disposal.

10 CFR Part 50

Antitrust, Classified information, Criminal penalties, Fire protection, Intergovernmental relations, Nuclear power plants and reactors, Radiation protection, Reactor siting criteria, Reporting and recordkeeping requirements.

The authority citation for this document is: 42 U.S.C. 2201; 42 U.S.C. 5841.

Dated at Rockville, Maryland, this _____ day of _____ , 2001.

For the Nuclear Regulatory Commission.

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Annette L. Vietti-Cook,
Secretary of the Commission.