

February 14, 2000

FOR: The Commissioners  
FROM: William D. Travers /RA/  
Executive Director for Operations  
SUBJECT: USE OF RUBBLIZED CONCRETE DISMANTLEMENT TO ADDRESS 10 CFR PART 20, SUBPART E, RADIOLOGICAL CRITERIA FOR LICENSE TERMINATION

- PURPOSE:
- DISCUSSION:
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## PURPOSE:

To inform the Commission that the staff has received an application from Maine Yankee and will likely receive additional license termination plans (LTP) that include the in-situ disposal by burial of building rubble at reactor sites undergoing decommissioning. This procedure, referred to as "rubblization," appears compatible with the radiological performance criteria for license termination. However, it was not specifically considered in the "Statement of Consideration" to the final rule, and is somewhat controversial.

## DISCUSSION:

As proposed for the decommissioning of reactor sites, "rubblization" involves: (a) removing all equipment from buildings; (b) some decontamination of the building surfaces; (c) demolishing the above-grade part of the structure into concrete rubble; (d) leaving the below-grade structure in place; (e) placing the rubble into the below-grade structure; and (f) covering, regrading, and landscaping the site surface. Demolition of the above-grade concrete structures of the turbine building, reactor building, spent fuel building, and auxiliary building (potentially contaminated structures) could result in material ranging from gravel-size to large concrete blocks, or a mixture of both.

The concept of leaving rubblized material onsite or placing it in a building foundation as backfill is not new, and similar approaches have been taken at previously released reactor sites before the promulgation of the license termination rule. For example, at the Shoreham Nuclear Power Station, whose license was terminated and the facility released for unrestricted use in May 1995, the licensee left several large concrete blocks weighing between 4 and 7 tons sitting on the reactor floor. At the Fort St. Vrain Nuclear Generating Station, whose license was terminated and the site released for unrestricted use in June 1997, the licensee demolished the fuel building after completing the final survey and the survey report was approved by the NRC, and left the rubble onsite until after the license was terminated and the site released for unrestricted use.

Once a facility's license is terminated, structures can be demolished and buried, provided relevant Federal, State, and local requirements are met. The major difference in the current proposal is the level of contamination that can remain on building surfaces. Reduction in the level of surface decontamination required to be removed could save a licensee several million dollars. Reportedly, calculations performed by licensees show that the Part 20 unrestricted dose limit of 25 millirems and as low as reasonably achievable (ALARA) can be met with contamination levels considerably higher for a demolished buried building than one left standing and reused. The staff's reuse scenario model for buildings includes doses from both direct exposure as well as internal exposure from resuspension of surface activity and ingestion from transferred contamination. For a given total quantity of a radioisotope this may be the highest possible dose scenario. Any other configuration may give a lower dose. The cost reduction (see [Attachment 1](#)) results because of the significant reduction in the amount of concrete required to be removed compared to meeting the screening or site-specific surface-contamination values; the reduction in disposal cost because of the reduced volume of contaminated material resulting from the use of higher surface-contamination values allowed by rubblization; and elimination or reduction of the costs associated with the purchase and transport of fill dirt to backfill a building.



There are a number of technical and policy issues involved. Unrestricted release means that once the license is terminated anything could be done with the site or facility including excavation and reuse of any buried material. While the staff will need to review the Maine Yankee LTP, the staff has not reviewed any conceptual models representing rubblization, and guidance is not available for the dose-assessment modeling or the scenarios that would need to be addressed to demonstrate compliance with the license termination rule. A substantial effort may be required to review and approve proposed scenarios and the supporting dose-assessment. A licensee that plans to use rubblization may use a modified pathway approach to determine maximum surface-contamination values, or may propose a modified modeling approach to the building-occupancy scenario, since the buildings will not be occupied and will be demolished. Possible exposure scenarios could include: (a) a concrete-leaching scenario that impacts groundwater, (b) resident-farmer scenario; (c) excavation scenarios; and (d) intruder scenarios. The surface-contamination values that result from these scenarios are expected to be substantially higher than the surface-contamination screening values or site-specific values for building-surface contamination, derived from the building-occupancy scenario, using the DandD code issued in the November 18, 1998, Federal Register (65 FR 64132).



If a heterogeneous mix of contaminated and non-contaminated concrete blocks results, this raises additional modeling questions, and whether the unavoidable mixing/diluting of contaminated material is acceptable. However, this mixing is important since it reduces the likelihood that the material will be reconfigured to deliver a dose as high as the building reuse scenario.

Another issue involves the GEIS. The "Generic Environmental Impact Statement (GEIS) in Support of Rulemaking on Radiological Criteria for License Termination of NRC-Licensed Nuclear Facilities," NUREG-1496, did not specifically address rubbleization. However, the GEIS, Section 4.2.1, "Human Health Impacts Resulting from Decommissioning" states:

Also not specifically addressed in the GEIS are the impacts from future inadvertent recycling of contaminated building rubble and soil following decommissioning of a site. One could postulate that both building rubble and soil containing residual radioactivity could be inadvertently recycled into new construction material, or used as fill, thus causing radiation exposures. Although the analyses in the GEIS does not specifically take this recycling into account, the building occupancy and onsite resident scenarios and assumptions used in the GEIS to estimate public doses from decommissioning lands and structures are considered sufficiently conservative to encompass recycling of such material. The exposure mechanisms are similar, and the resulting individual doses could only be less than those evaluated because contamination of the recycled material will be reduced through dilution with other raw materials. Thus, future inadvertent recycling of soils or structures following decommissioning of the reference sites would not affect the conclusions made in this GEIS regarding public health.

Using the rubbleized material from the above-grade building rubble as fill, and placing it in the below-grade structure results in a heterogeneous mix of contaminated and non-contaminated concrete blocks. The mixing results in diluting the contaminated material as noted in GEIS. The GEIS did not address the environmental impacts of leaving a substantial amount of contaminated concrete on site nor the potential impacts from wide spread use of rubbleization which may occur if rubbleization becomes the preferred approach based on economic considerations. The staff notes that NRC is preparing to update the GEIS that supported the rulemaking for [10 CFR 50.82](#), "Termination of License," and the update will address rubbleization. Once completed, the update should be useful for the NRC National Environmental Policy Act (NEPA) review of a license termination based on rubbleization. Each site must be evaluated on its own merits to determine its environmental impacts, and the evaluation is dependent on the decommissioning approach used by the licensee. It is premature to conclude whether an Environmental Assessment rather than an Environmental Impact Statement will be sufficient to fulfil the Commission's obligations under the NEPA.

During the License Termination Plan Workshop held at NRC Headquarters on August 18, 1999, a session was dedicated to rubbleization. The purpose for holding a separate session addressing this concept was to make sure that all stakeholders, both the nuclear industry and other stakeholders, had an opportunity to present views on rubbleization. During the session, several licensees indicated they were considering rubbleization. The conceptual models that licensees are developing to demonstrate compliance with the license termination rule vary significantly, as do the size of the rubbleized components. The Nuclear Energy Institute (NEI) committed to providing an issues paper addressing rubbleization. The NEI paper ([Attachment 2](#) ) supports rubbleization. In addition, another stakeholder, representing the New England Coalition on Nuclear Pollution (NECNP) and the Sierra Club, participated in the discussion on rubbleization, and provided an issues paper on rubbleization ([Attachment 3](#) )

The State of Maine also has submitted two-issues papers on rubbleization ([Attachments 4 and 5](#) ) . All of these papers contained substantive comments for staff consideration with the NECNP and the State of Maine being critical of rubbleization. The U.S. Environmental Protection Agency (EPA [EXIT](#)) also raised concerns about rubbleization, one of which is dilution, which was previously discussed, and also stated that such an approach may need an RCRA permit. The EPA provided an issues paper addressing rubbleization ([Attachment 6](#) ) . In addition, some of the low-level waste compacts have raised questions regarding rubbleization, and the impact that rubbleization may have regarding compact agreements. [Attachment 7](#) to this paper discusses the major concerns identified in the issues papers raised by the stakeholders. When the staff conducts a review of a licensee's submittal using rubbleization, the stakeholders concerns, identified in their issues papers will be considered in the staff's review. Additional correspondence on this issue has been recently received from Maine Yankee and the State of Maine and sent to the Commission for its information.

## CONSIDERATIONS

The staff recognizes that guidance on the rubbleization approach has not been developed. The staff has identified, in [Attachment 8](#), several technical areas that will need to be considered, in the case-by-case evaluation of a rubbleization application.

## CONCLUSION

At this time, the staff believes that it is technically possible to approve a LTP that includes rubbleization. The staff's belief is premised on a licensee's demonstration that rubbleization meets the requirements of Part 20, Subpart E, considering the scenarios of intrusion, excavation, and reuse of buried material and recognizes that, in some cases, mixing/diluting of contaminated material may occur. This appears to be consistent with the performance-based approach set forth in the license termination rule. However, the staff recognizes that substantial technical review will be necessary before it will be able to approve a site-specific rubbleization application. In addition, resources will need to be allocated to support the revision of the GEIS, and to incorporate review methods and acceptance criteria into the Standard Review Plan (SRP) being developed by the staff. The staff will include these resources in the next budget cycle, and incorporate available guidance on rubbleization into the SRP as an update of the final SRP due to be issued in July 2000. Consultation with the Commission may be warranted

before the staff completes its assessment of a rubblization application.

## COORDINATION:

The Office of the General Counsel (OGC) has no legal objection to this paper.

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Attachments:

1. [Cost Comparison](#)
2. [NEI Issues Paper](#) 
3. [NECNP Issues Paper](#) 
4. & 5. [State of Maine Issues Papers](#) 
6. [US EPA Issues Paper](#) 
7. [Summary of Issues](#)
8. [Considerations](#)

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ATTACHMENT 1

## **Estimated Cost Comparison Using The Rubblized Approach Surface Contamination Values And The Building Occupancy Surface Contamination Values For Demonstrating Compliance With 10 CFR Part 20, Subpart E**

The estimate compares the cost of meeting surface contamination values for buildings based on the values published in Federal Register (61 FR 64133, November 18, 1998) to the cost of meeting surface contamination values calculated from the conceptual model for the rubblized approach identified by some licensees. The rubblized values calculated from the conceptual model were approximately 100,000 dpm/100 cm<sup>2</sup> for cobalt 60 and cesium 137. The surface contamination values for the building occupancy scenario were based on the surface contamination screening values published in the Federal Register on November 18, 1998. The surface areas used for this estimate were based on the final survey areas at the Trojan Nuclear Power Station for: 1) Containment Building; 2) Turbine Building; 3) Fuel Building; 4) Auxiliary Building; and 5) Control Building and the surface areas were calculated from the Trojan License Termination Plan (LTP). The Trojan LTP, Section 5, "Final Survey Plan," Table 5-4 lists the surface areas for each of these buildings.

For this evaluation, the estimate assumes that 20 percent of the surface areas of each of the buildings required remediation to meet surface contamination screening values compared to meeting the rubblized surface contamination values, and the surface contamination was within the first 0.5 inches of the building surface. Because the limits for the rubblization were considerably higher, the estimate assumes that the licensee would be required to only remediate one percent of the area for rubblization compared to the twenty percent of the area based on the screening values from the building occupancy scenario. The actual estimate of the surface areas requiring remediation would be based on characterization data, and examined on a building by building, area by area basis. In areas where surface contamination was in the first 0.1 inches, the areas may be decontaminated by grit blasting, and grit blasting is considerably less expensive. Disposal costs were based on \$600 per cubic foot for Barnwell disposal facility and \$100.00 per cubic foot for Envirocare. Scabbling (mechanically chipping the concrete surface) cost was based on a cost of \$30.00 per square foot, and there is a difference in cost to scabble floor areas compared to scabbling wall areas. An average cost was used. A cost of \$5.00 per cubic yard to purchase and backfill the structure with soil was assumed if a licensee committed to demolishing the buildings and grading the site. The costs listed below are the differential costs required to meet the building occupancy surface contamination screening values instead of the rubblized surface contamination values. The comparison also assumed that both surface limits resulted in similar levels of worker exposure.

The result of this cost comparison indicates a significant reduction in disposal cost when decontaminating a facility to the rubblized surface limits compared to the Federal Register values. The cost comparison indicates a reduction from \$10 million to \$16 million. Changes in surface area, depths of contamination, and volume of waste are variables that have a significant impact on the cost estimate.

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ATTACHMENT 7

## Summary Of Major Stakeholders Issues Identified in the Positions

### **Concern 1:** Placing Waste in the Below-Grade Structure Constitutes a Low-Level Waste Disposal Facility Resulting in Proliferation of Low-Level Waste Sites

Several stakeholders have identified a concern about the use of rubblization because rubblization leaves contaminated material below grade. Stakeholders are concerned that rubblization will result in proliferation of low-level-waste sites, and contend that placing the rubblized material in the below-grade structure constitutes a low-level waste disposal facility. Some stakeholders further contend that rubblization has no striking difference from a design of a low-level waste facility and should be licensed under 10 CFR Part 61.

The staff recognizes that the use of rubblization approach results in leaving waste on site: however, Part 20, Subpart E, being a performance based rule, appears implicitly to allow an approach such as the rubblization concept-- leaving contaminated material on the site and placed in the below-grade structure-- provided the licensee demonstrates compliance with the 25 mrem per year and reducing residual radioactivity to as low as is reasonably achievable (ALARA). 10 CFR Part 61 applies to disposal of waste from other site/sources.

### **Concern 2:** Rubblization of Contaminated Material Requires a 10 CFR 20.2002 Approval

Several stakeholders have raised the contention that the application of rubblization for decommissioning requires a 10 CFR 20.2002 application. The relationship between 10 CFR Part 20, Subpart K and Subpart E is not explicitly stated in the Commission's regulations. The staff's position is that Subpart E, the license termination rule, allows the use of rubblization provided the licensee demonstrates compliance with the 25 mrem per year and ALARA.

Subpart K, specifically section 20.2002, provides the authority to dispose of material that is not authorized by the regulation. The staff's position is that Subpart K does not apply to decommissioning of the facility. Any approved on-site disposal under section 20.2002 would be reviewed at the time of decommissioning and be subject to the license termination rule.

### **Concern 3:** Departure from Previous Practice

Several stakeholders have raised the concern that leaving elevated contaminated material on the site is a significant departure from past licensing practice. The staff recognizes this is a departure from previous practice before the Commission amended its regulations on July 27, 1997 (62 FR 39058) to 10 CFR Part 20, Subpart E for license termination. The new dose-based license termination rule allows residual contamination to remain, or to be buried on a site, provided the applicant demonstrates compliance with the 25 mrem per year dose limit and ALARA. The staff recognizes rubblization is a new approach. However, Subpart E being a performance based rule, may allow approaches such as rubblization, although it may result in more elevated levels of residual contamination to remain on a site after the license is terminated than has been past practice.

### **Concern 4:** Demonstration of ALARA Principles

Several stakeholders have raised the concern about the demonstration of ALARA principles in the application of rubblization. As indicated earlier, the staff will review each rubblization application on a case-by-case basis, to make sure the licensee clearly demonstrates compliance with the 25 mrem per year and ALARA. Current guidance on meeting ALARA is available. The staff recognizes that the current guidance is only draft and thus subject to change. The staff also recognizes that the application of ALARA principles for decommissioning generally demonstrates that it is ineffective to remove additional contamination beyond the 25 mrem because of the high additional decontamination cost and minimal reduction in the dose. The licensee's application will be reviewed for demonstration of ALARA principles.

### **Concern 5:** Rubblization has the Potential to Conflict with Proposed Initiative on Control of Solid Materials

Some stakeholders raised the concern about rubblization potentially conflicting with the initiative on control of solid materials-proposed clearance rule. The solid material initiative addresses the release of solid material from a licensee while the license termination rule addresses unrestricted release of a facility provided the licensee demonstrates compliance with the 25 mrem per year and ALARA. The staff recognizes, although it's unlikely, that a piece of rubblized material removed from a site that has been released for unrestricted use may exceed the range of doses being considered in the NRC's current initiative on establishing dose criteria for the release of solid material. The relationship between the license termination rule and the proposed clearance rule will need to be addressed as part of the rulemaking on the clearance rule. In support of the license termination rule, the "Generic Environmental Impact Statement (GEIS) in Support of Rulemaking on Radiological Criteria for License Termination of NRC-Licensed Nuclear Facilities," although not specifically addressing rubblization, concluded that the exposure mechanisms for recycled material were similar, and the resulting individual doses could only be less than those evaluated in support of license termination because contamination of the recycled material will be reduced through dilution with other raw materials.

### **Concern 6:** Rubblization Requires a Generic and/or a Site Specific Environmental Impact Statement

Several stakeholders have raised the concern that the environmental impacts needed to be reconsidered before allowing a licensee to use the rubblization approach. Past generic impact statements do not specifically address rubblization and did not envision the potential for rubblization being used at a significant number of reactors sites or for that matter at any licensed

facility contaminated with radioactive material. Given the precedent-setting nature of a policy that allows this new form of decommissioning, the environmental impacts, including the consideration of non NRC-licensed contaminants, must be considered on either a generic or site specific basis before approving this approach. The staff recognizes that it must fulfill its NEPA responsibilities before approving the use of rubblization. The staff intends to update the GEIS for 10 CFR 50.82 which will address rubblization. An environmental review will be conducted for each site.

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## **Considerations That Need To Be Examined When Evaluating Licensees' Applications Using The Rubblization To Demonstrate Compliance with 10 CFR Part 20, Subpart E**

Because the staff did not specifically consider rubblization, the staff will need to consider the following areas in the case-by-case review on the acceptability of the approach:

- 1) Current dose assessment guidance does not address the proposed conceptual models for rubblization including the acceptability of mixing/diluting contaminated material, nor does the current guidance define the scenarios that should be addressed, and the staff will need to develop supporting guidance for both these areas. Until dose modeling guidance is developed, NRC staff will have to review each applicant's dose modeling proposal on a case-by-case basis, and this will increase the review time of the application. The acceptability of mixing/diluting contaminated material must be addressed;
- 2) Because the rubblized concrete is a heterogeneous mix, the staff will need to develop guidance on how to address hot spots when using this approach; however, the staff recognizes that the use of area factors as defined in NUREG-1575, "MARSSIM," is an acceptable technique to address hot-spot (elevated areas of contamination) analysis for surface contamination and soils;
- 3) The proposed rubblization approach may allow a higher level of residual contamination per unit area to remain at the site than the surface-screening contamination values, or surface site-specific values for the building occupancy scenario;
- 4) The revised radiological criterion resulting from the license termination rule requires the licensee to describe in detail the methods and assumptions used to demonstrate that the dose to the average member of the critical group does not exceed 25-mrem per year and that residual radioactivity be reduced to ALARA. The assumptions/scenario must reasonably represent the conditions that will exist at the site. Draft NUREG-1700, "Standard Review Plan for Evaluating Nuclear Power Reactor License Termination Plans" states "If a site-specific scenario is used, a description of the reasonable use of the structure after license termination for the projected lifetime of the structure should be provided." Rubblization represents the conditions that will exist at the time the license is terminated;
- 5) The below-ground structures that remain should be subjected to the surface contamination limits based on a possible reuse scenario;
- 6) The rubblized material should be analyzed under some reuse scenario;
- 7) A site specific EIS may be needed pending completion of the update to the GEIS supporting 10 CFR 50.82; and
- 8) Does rubblization demonstrates the application of ALARA principles consistent with existing ALARA guidance?"