November 02, 2001

MEMORANDUM TO: Stuart A. Richards, Director
Project Directorate IV and Decommissioning
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

FROM: Thomas H. Essig, Chief ***/RA/***
Environmental and Performance Assessment Branch
Division of Waste Management
Office of Nuclear Material Safety
and Safeguards

SUBJECT: REVIEW OF DOSE MODELING FOR 10 CFR 20.2002 APPLICATION TO DISPOSE OF DEBRIS AT SANITARY LANDFILL

This memorandum is responding to your April 14, 2001, technical assistance request from John A. Zwolinski regarding Consumers Energy's 10 CFR 20.2002 application to dispose of debris at sanitary landfill. Attached is the technical evaluation report which used the general dose modeling guidance of NUREG-1727.

Consumers Energy calculated dose estimates for three different scenarios. These three scenarios include a truck driver, bulldozer operator, and an inadvertent intruder moving on the site after closure. The analyses used conservative bounding analyses. None of the scenarios (including an alternate scenario that staff reviewed), resulted in doses exceeding 10 μSv/yr (1 mrem/yr). Based on these analyses, Consumers Energy has shown that the proposed 10 CFR 20.2002 disposal will result in very little risk to workers and the public.

One recommendation concerns future verification sampling of the debris material for the concentration ratios used in the dose assessment. The licensee used a set of 14 core samples to define the concentration ratios used in the assessment. It is recommended that the licensee perform verification sampling during gamma surveys to provide more confidence in the concentration ratios used. Because of the overall low risk significance of the calculated doses, especially considering a conservative analysis was used, the sampling rate should be low, as minor variations in the ratios will not be risk significant.

Attachment: Technical Evaluation Report

cc: David Wrona, NRR

CONTACT: Christepher McKenney, NMSS/DWM
415-6663, CAM1

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TECHNICAL EVALUATION REPORT

DOCKET NO. 55-155 LICENSE NO. DPR-6

LICENSEE: Consumers Energy.

FACILITY: Big Rock Point Nuclear Plant.

PROJECT MANAGER: David Wrona, NRR

TECHNICAL REVIEWER: Christepher McKenney

SUBJECT: REVIEW OF DOSE MODELING FOR 10 CFR 20.2002 APPLICATION TO DISPOSE OF DEBRIS AT SANITARY LANDFILL

SUMMARY AND CONCLUSIONS

Consumers Energy calculated dose estimates for three different scenarios. These three scenarios include a truck driver, bulldozer operator, and an inadvertent intruder moving on the site after closure. The analyses used conservative bounding analyses. None of the scenarios (including an alternate scenario that staff reviewed), resulted in doses exceeding 10 μSv/yr (1 mrem/yr). Based on these analyses, Consumers Energy has shown that the proposed 10 CFR 20.2002 disposal will result in very little risk to workers and the public.

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BACKGROUND

On May 18, 2001, Consumers Energy submitted a request to dispose of low-activity demolition debris in a sanitary landfill licensed by the State of Michigan. The decommissioning of the Big Rock Point facility will result in an estimated 38,400 metric tons (84.5 million pounds) of predominately concrete debris. Approximately half of this material will have the potential to contain limited amounts of residual surface activity or neutron activation products. The total volume of both non-impacted and impacted debris [approximately 15,900 m^3 (563,000 ft^3)] is approximately 2 percent of the annual volume of waste disposal at the landfill most likely to receive the waste. For purposes of the analysis, it is assumed that the entire volume of waste is sent to the landfill in a single year.

Attachment

TECHNICAL EVALUATION

A 10 CFR 20.2002 request for disposal in a landfill is similar to other dose analyses used in decommissioning reviews. Therefore, the staff used the general guidance (with the exception of decommissioning-specific information, such as, the Subpart E dose limit) in the NMSS Decommissioning Standard Review Plan's Chapter 5.2 to guide the review. The section states that NRC will review the following information provided by the licensee:

- "Source term information including nuclides of interest, configuration of the source, areal variability of the source, etc;
- Description of the exposure scenario including a description of the critical group;
- Description of the conceptual model of the site including the source term, physical features important to modeling the transport pathways, and the critical group;
- Identification, description and justification of the mathematical model used (e.g., hand calculations, DandD Screen v1.0, RESRAD v6.0, etc.);
- Description of the parameters used in the analysis;
- A discussion about the effect of uncertainty on the results; and
- Input and output files or printouts, if a computer program was used."

Source Term

The licensee has taken over 200 core borings to estimate the radionuclide content of the concrete debris they want to send to the landfill and its concentration profile at depth. They had 14 core samples analyzed for approximately 37 radionuclides; only Co-60, Cs-137, Fe-55, and H-3 were at levels greater than the lower limit of detection and above natural background concentrations. The licensee then used these concentrations in developing its source term.

The licensee divided the source term into two distinct groupings: shallow surface contamination and deep surface contamination. Shallow surface contamination is defined as no surface contamination but has detectable radionuclide concentration to a depth of 2.5 cm (1 in). Deep surface concentration is defined as highly contaminated surfaces prior to remediation with no detectable contamination after remedial action, but with some detectable radionuclide concentration to a depth of 15 cm (6 in). Evaluations by the licensee determined that approximately 122 m^3 (4,320 ft^3) of shallow and 144 m^3 (5,100 ft^3) of deep surface contamination will be present in the entire 7,950 m^3 (281,500 ft^3) of potentially impacted debris. As a conservative assumption, the licensee assumed the entire volume was contaminated at the same concentration, resulting in the total activities given in Table 1.

Table 1. Impacted Demolition Debris Total Activity (7,950 m^3)

Radionuclide	Concentration (pCi/g)	Total Activity (mCi)
Co-60	0.7	13.5
Cs-137	0.2	3.8
Fe-55	3.9	75.2
H-3	9.9	184
Total	14.4	277

Consumers Energy is requesting a bounding gamma emitter concentration limit of 0.185 Bq/g (5 pCi/g) and, therefore, the source term was scaled up based on the above concentration ratios and results in the following final assumed concentrations and total activities.

Table 2. Impacted Demolition Debris Total Activity Using 5 pCi/g Limit (7,950 m^3)

Radionuclide	Concentration (pCi/g)	Total Activity (mCi)
Co-60	3.89	74.8
Cs-137	1.11	21.3
Fe-55	21.7	75.2
H-3	53.2	417
Total	79.9	588

These assumptions lead to a conservative source term and is a valid approach for doing a bounding analysis. The homogeneity of the relative concentrations is only based on a set of 14 samples. Of concern is that the current approach requested by the licensee would not be able to verify if the concentrations of the Fe-55 and H-3 maintained the relative concentration ratios. The staff, therefore, suggests that random samples need to be taken during assay to verify the concentration ratios.

Critical Group, Scenarios and Pathway Identification and Selection

The disposal is to take place at a Michigan landfill. The licensee has analyzed three different scenarios: 1) a transport worker dose assessment, 2) a landfill worker dose assessment, and 3) a post-closure residential gardener intruder assessment. These three scenarios and the associated pathways are appropriate for the request. Dose analyses of children would not result in dramatically different results.

The transport worker scenario considers the dose to truck driver hauling the debris from the site to the landfill. For the purposes of this scenario, it is assumed that only three truck drivers are used for all of the shipments in one year. The only applicable pathway is direct radiation from the debris.

The landfill worker scenario analyzes the potential dose to a bulldozer operator who positions and spreads the demolition debris, and places the required 15 cm (6 in) soil cap. The Michigan landfill uses three operators currently, and the analysis assumes each operator has the same exposure time. The primary pathways for this scenario is inhalation and gamma.

The resident gardener scenario is appropriate for long-term analyses. The scenario involves a residence placed on top of a burial cell containing the waste. The resident has a vegetable garden and spends approximately 75 percent of his time on site. The licensee used all of the default pathways.

Calculations and Input Parameters

The licensee used Microshield vX for the truck driver scenario while RESRAD 6.0 was used for the other two scenarios.

The parameters and assumptions used for both the first and second scenarios are appropriate and result in bounding analyses. Based on the analyses, the first scenario resulted in a dose of 3.5 μSv/yr (0.35 mrem/yr) and the second, 2.8 μSv/yr (0.28 mrem/yr).

The licensee's analysis of the intruder scenario used the appropriate parameters but some of the assumptions relied on at least partial performance of the landfill design and requirements (e.g., the leachate collection system and the 120 cm (48 in) of engineered cap). The initial dose estimate by the licensee is 0.1 μSv/yr (0.01 mrem/yr). The staff reviewed an alternate scenario where the waste is carried to the surface as part of the building of the house. The staff took account of some dilution in other material in the burial site and discounted the liners and leachate collection systems. The staff's analyses resulted in a dose estimate of approximately
10 μSv/yr (1 mrem/yr).

Uncertainty Analysis

The analyses submitted by Consumers Energy are bounding in nature. No uncertainty analyses is required as the assumptions made have clearly bounded the dose assessment, especially through the overestimate of the source term.