NEI 07-11 Generic FSAR Template Guidance for Cost-Benefit Analysis for Radwaste Systems for Light-Water-Cooled Nuclear Power Reactors

1. Introduction

   This topical report provides a generic approach for use in support of design certification and combined license applications to demonstrate compliance with the regulatory requirement to perform a cost-benefit analysis for radwaste systems to provide reasonable assurance that licensees have incorporated into radwaste systems all items of reasonably demonstrated technology to maintain doses to members of the public as low as is reasonably achievable (ALARA).

   The approach included in this report consists of a bounding analysis to demonstrate that the estimated collective radiation doses to members of the public within a 50-mile radius of proposed nuclear power plants are sufficiently low so as to be able to conclude that there are no "items of reasonably demonstrated technology" that can be added to radwaste systems to achieve any substantive additional reduction in public dose (i.e., using the regulatory criteria of $1,000 per person-rem for total body or thyroid dose).

2. Regulatory Requirement

   The regulatory requirement for performing a cost-benefit analysis for radwaste systems at light-water-cooled nuclear power reactors is contained in 10 CFR 50, Appendix I, Section II.D, as follows:

   > "In addition to the provisions of paragraphs A, B, and C above, the applicant shall include in the radwaste system all items of reasonably demonstrated technology that, when added to the system sequentially and in order of diminishing cost-benefit return, can for a favorable cost-benefit ratio effect reductions in dose to the population reasonably expected to be within 50 miles of the reactor. As an interim measure and until establishment and adoption of better values (or other appropriate criteria), the values $1000 per total body man-rem and $1000 per man-thyroid-rem (or such lesser values as may be demonstrated to be suitable in a particular case) shall be used in this cost-benefit analysis. The requirements of this paragraph D need not be complied with by persons who have filed applications for construction permits which were docketed on or after January 2, 1971, and prior to June 4, 1976, if the radwaste systems and equipment described in the preliminary or final safety analysis report and amendments thereto satisfy the Guides on Design Objectives for Light-Water-Cooled Nuclear Power Reactors proposed in the Concluding

Statement of Position of the Regulatory Staff in Docket-RM-50-2 dated February 20, 1974, pp. 25-30, reproduced in the Annex to this Appendix I."

3. Regulatory Guidance

Regulatory guidance on acceptable methods and acceptance criteria for performing a cost-benefit analysis of radwaste systems to demonstrate compliance with 10 CFR 50, Appendix I, Section II.D, is included in USNRC Regulatory Guide (RG) 1.206, "Combined License Applications for Nuclear Power Plants," NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," and RG 1.110, "Cost-Benefit Analysis for Radwaste Systems for Light-Water-Cooled Nuclear Power Reactors," as follows:

Regulatory Guide 1.206, Section C.I.11, "Radioactive Waste Management, contains the following guidance

(C.I.11.2.1 Design Bases for Liquid Radwaste Treatment Systems) Within this evaluation, the applicant should provide a site-specific cost-benefit analysis for reducing population doses due to liquid effluents, pursuant to Appendix I to 10 CFR Part 50 and in accordance with the guidance in RGs 1.110, "Cost-Benefit Analysis for Radwaste Systems for Light-Water-Cooled Nuclear Power Plants," and 1.113, "Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I," and NUREG/CR-4013, "LADTAP II—Technical Reference and User Guide." If this guidance is not followed, describe the specific alternative methods used. More specifically, show that the proposed systems contain all items of reasonably demonstrated technology that, when added to the system in order of diminishing cost-benefit return, can, for a favorable cost-benefit ratio, effect reductions in dose to the population reasonably expected to be within 50 miles of the reactor. State all assumptions and describe the calculational methods used, including all supporting references.

(C.I.11.3.1 Design Bases for Gaseous Radwaste Treatment Systems)The applicant should provide an evaluation showing the capability of the proposed systems to control releases of radioactive materials to within the numerical design objectives of Appendix I to 10 CFR Part 50. Within this evaluation, provide a site-specific cost-benefit analysis for reducing population doses due to gaseous effluents, in compliance with Appendix I to 10 CFR Part 50, and in accordance with the guidance in RGs 1.110 and 1.111 and NUREG/CR-4653, "GASPAR II—Technical Reference and User Guide." If this guidance is not followed, describe the specific alternative methods used. More specifically, show that the proposed systems contain all items of reasonably demonstrated technology that, when

added to the system in order of diminishing cost-benefit return, can, for a favorable cost-benefit ratio, effect reductions in dose to the population reasonably expected to be within 50 miles of the reactor. State all assumptions and describe the calculational methods used, including all supporting references.

[References and text for SRP 11.2 and 11.3 and RG1.110 to also be included]

4. Approach to Demonstrating Compliance

RG 1.110 outlines a method for performing the required cost-benefit analysis of radwaste systems and provides cost parameters for estimating the costs for the various radwaste treatment equipment items in use, or proposed for use, at light-water-cooled nuclear power reactors. The costs presented consider the direct equipment cost and the costs of building space, supportive services, maintenance, interest, and operating as well as other costs generally considered in analyzing capital and operating costs in power plant estimating.

The Regulatory Position in the guide stipulates the following:

- "The cost-benefit analysis should consider the reduction in release of radioactive material from all effluent pathways. Liquid and gaseous radwaste system augments considered in the analysis should be selected in order of diminishing cost-benefit returns."

- "All costs are given in terms of 1975 dollars (as is the $1,000 per man-rem cost with which they are compared). Allowances for inflation after 1975 should not be factored into the cost estimates."

- "The method of calculation described in Appendix A and the parameters presented in Appendix B of this guide are acceptable to the NRC staff for performing the cost-benefit analysis."

Estimated collective doses for populations within a 50 mile radius of operating nuclear power plants are extremely low, ranging from 0.0015 to 7.2 person-rem for all but two of the sites analyzed by the USNRC in the "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (NUREG-1437). Preliminary data provided by near-term COL applicants indicates that the estimated collective doses for populations within a 50 mile of proposed plants are generally less than or equal to those for operating plants.

The extremely low estimated population doses expected to be contained in COL applications support a generic approach of performing a bounding analysis that evaluates the most favorable cost-benefit-ratio options for both liquid and gaseous radwaste treatment systems, using the regulatory criteria of $1,000 per person-rem

for total body and thyroid dose and the 1975 dollars cost information prescribed by RG 1.110. In order to be "bounding" the analysis utilizes the cost factors from RG 1.110 that lead to the least-cost options for liquid and gaseous radwaste treatment systems and assumes that each option reduces the effluent and estimated dose for that pathway by 100% (i.e., reduces the estimated dose to zero). In accordance with the methodology of RG 1.110, no further cost-benefit analysis is required because other options evaluated in a sequential comparison of "diminishing cost-benefit returns" will also not meet the $1,000 criteria.

5. Analysis

The methodology for determining the Total Annual Cost (TAC) for each augment is as follows:

TAC = Annual Fixed Cost (AFC) + Annual Operating Cost (AOC) + Annual Maintenance Cost (AMC), where:

AFC = Total Capital Cost (TCC) x Cost Recovery Factor (CRF), where:

TCC = Total Direct Cost (TDC) x Indirect Cost Factor (ICF), where:

TDC = Direct Cost of Eqpt/Mat'ls + Adjusted Labor Cost
ICF is taken from a table

AOC and AMC are taken from tables in RG 1.110

Using this methodology, the least-cost options are as follows:

[The following is for illustrative purposes only]

Main Condenser Vacuum Pump Charcoal/HEPA Filtration System TAC = A

PWR Air Ejector Charcoal/HEPA Filtration Unit TAC = B

1,000 cfm Charcoal/HEPA filtration system TAC = C

20 gpm liquid effluent cartridge filter TAC = D

6. Conclusion

For gaseous effluent pathways, an estimated collective dose for the population within the 50 mile radius of the plant of less than X person-rem is assumed to be ALARA, in accordance with the methodology prescribed in RG 1.110.

For liquid effluent pathways, an estimated collective dose for the population within the 50 mile radius of the plant of less than X person-rem is assumed to be ALARA, in accordance with the methodology prescribed in RG 1.110.