

11. RADIOACTIVE EFFLUENT DOSE CONSEQUENCES FROM NORMAL OPERATIONS

The U.S. Nuclear Regulatory Commission (NRC) staff reviewed the information on radiological effluents and solid radioactive waste provided in Section 3.2 of the site safety analysis report (SSAR) submitted by Systems Energy Resources, Inc. (SERI or the applicant), as part of the early site permit (ESP) application for the Grand Gulf Nuclear Station (GGNS) site, as well as Sections 3.5 and 5.4 of the associated environmental report (ER), to determine whether site characteristics are such that the radiation dose to members of the public would be within regulatory requirements.

11.1 Technical Information in the Application

The applicant provided information on the radioactive gaseous and liquid effluents and solid radioactive waste material that would be generated as a normal byproduct of nuclear power operations. These radioactive materials will be collected, processed, stored, and discharged in a controlled manner to the local environment or transported off site for long-term storage or disposal. The proposed facility will have the ability to handle these radiological effluents and solid waste materials in a manner that minimizes radioactive releases to the environment and maintains exposure to the public and plant personnel during normal plant operation and maintenance at levels that are as low as reasonably achievable (ALARA).

11.2 Regulatory Evaluation

The NRC regulations require that applicants for an ESP address the characteristics of the proposed site that could affect the radiation dose to a member of the public from radiological effluents. The applicant provided a comprehensive listing of NRC regulations applicable to its ESP SSAR and ER in SSAR Section 3.2 and ER Sections 3.5 and 5.4, respectively. These sections contain information that adequately addresses anticipated radiological effluents according to Title 10, Section 52.17(a)(1)(iv), of the *Code of Federal Regulations* (10 CFR 52.17(a)(1)(iv)). Specifically, 10 CFR 52.17(a)(1)(iv) states that an ESP application should describe the anticipated maximum levels of radiological effluents that each facility will produce. Furthermore, 10 CFR 100.21(c)(1) requires that radiological effluent release limits associated with normal operation from the type of facility proposed for the site be met for any individual located off site. The staff reviewed this portion of the application for conformance with the applicable regulations.

11.3 Technical Evaluation

During normal operation, small quantities of radiological materials are expected to be released to the environment through gaseous and liquid effluents from the plant.

11.3.1 Gaseous Effluents

The gaseous waste management system will control, collect, process, store, and dispose of radioactive gases during plant operation, including startup, normal operation, shutdown, refueling, and anticipated operational occurrences. Routine radioactive gaseous effluents are

released to the environment through the waste gas processing systems, which will minimize these releases to the environment. Radioactive gases that may be present in the plant buildings as a result of leakage from systems will also be monitored and released through the building ventilation systems. The applicant will control and monitor the release of these effluents from the facility so that they comply with the regulatory limits in 10 CFR Part 20, "Standards for Protection Against Radiation." It will maintain these effluents at ALARA levels in accordance with Appendix I, "Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion 'As Low as is Reasonably Achievable' for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents," to 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities."

In SSAR Table 1.3-2, SERI estimated the bounding quantity of radioactive gaseous effluents that may be released from the gaseous waste management and the building ventilation systems. The applicant determined the gaseous radioactive effluent concentrations based on a composite of the highest activity content of the individual isotopes it anticipated would be released from the alternative reactor designs under consideration.

The applicant also provided bounding gaseous effluent release data to support its compliance with the gaseous effluent release concentration limits in Table 2 of Appendix B, "Annual Limits on Intakes (ALIs) and Derived Air Concentrations (DACs) of Radionuclides for Occupational Exposure; Effluent Concentrations; Concentrations for Release to Sewerage," to 10 CFR Part 20.

The applicant calculated the estimated dose to a hypothetical maximally exposed member of the public from the gaseous effluents using radiological exposure models based on Regulatory Guide (RG) 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors," and the GASPAR II program (NUREG/CR-4653, "GASPAR II—Technical Reference and User Guide," issued March 1987). The applicant evaluated several exposure pathways, including direct radiation from immersion in the gaseous effluent cloud and from particulates deposited on the ground, inhalation of gases and particulates, ingestion of milk contaminated through the grass-cow-milk pathway, and ingestion of foods contaminated by gases and particulates. The calculated gaseous pathway total body dose to a maximally exposed individual at the nearest site boundary is 0.0084 milliSievert per year (mSv/yr) (0.844 millirem per year (mrem/yr)).

11.3.2 Liquid Effluents

The liquid waste management system will control, collect, process, store, and dispose of, as required, potentially radioactive liquids during plant operation, including startup, normal operation, shutdown, refueling, and anticipated operational occurrences. The applicant will typically operate the system in a manner that minimizes the release of radioactivity into the environment. Normal liquid effluents will discharge through the existing discharge mechanism of GGNS Unit 1.

Currently, the GGNS facility routinely discharges radioactive liquid wastes into the Mississippi River. The applicant expects its ESP facility to continue this practice. The applicant has given a bounding assessment to demonstrate its capability to comply with the regulatory requirements in 10 CFR Part 20 and Appendix I to 10 CFR Part 50.

In ER Table 3.0.8, SERI provided the bounding annual average quantity of radioactive liquid effluents that may be released from the ESP facility. This quantity represents the highest activity content of the individual isotopes from the alternative reactor designs under consideration. These data show that the bounding liquid effluent release concentrations will fall within the liquid effluent release concentration limits in Table 2 of Appendix B to 10 CFR Part 20.

The applicant calculated the estimated dose to a hypothetical maximally exposed member of the public from the liquid effluents using radiological exposure models based on RG 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," issued October 1977, and the LADTAP II program (NUREG/CR-4013, "LADTAP II—Technical Reference and User Guide," issued April 1986). The applicant evaluated several exposure pathways, including eating fish or invertebrates caught near the point of discharge, using the shoreline for activities (e.g., sunbathing or fishing), and swimming and boating on the Mississippi River near the point of discharge. The calculated liquid pathway total body dose to a maximally exposed individual at the nearest site boundary is 0.0217 mSv/yr (2.17 mrem/yr).

11.3.3 Solid Waste

The solid waste management system of the ESP facility will control, collect, handle, process, package, and temporarily store the wet and dry solid radioactive waste materials generated during normal plant operations before shipping them off site. The solid waste materials may consist of filters; demineralizer resins; waste evaporator bottoms; paper; rags; contaminated clothing, tools, and equipment; and laboratory solid wastes. The applicant will periodically ship solid radioactive waste material from the ESP site to the permanent waste disposal facility.

In ER Table 3.0-3, SERI estimated that it will generate an average of 18,646 cubic feet (ft³) of radioactive waste each year. The applicant estimated the maximum curie content of the waste at 5400 curies. The applicant will package and ship the waste in accordance with the applicable regulations in 10 CFR Part 71, "Packaging and Transportation of Radioactive Material," and 49 CFR Part 173, "Shippers—General Requirements for Shipments and Packagings."

Consistent with the requirements of Subpart B, "Evaluation Factors for Stationary Power Reactor Site Applications on or After January 10, 1997" of 10 CFR Part 100 and Subpart A, "Early Site Permits," of 10 CFR Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants," SERI did not provide details regarding the solid waste management system. The NRC will evaluate solid waste management at the construction permit or combined license (COL) stage.

11.3.4 Conclusions

The applicant provided adequate information to give reasonable assurance that it will control, monitor, and maintain radioactive gaseous and liquid effluents from the ESP facility within the regulatory limits specified in 10 CFR Part 20, 10 CFR Part 71, and 49 CFR Part 173, as well as maintain them at ALARA levels, in accordance with the effluent design objectives contained in Appendix I to 10 CFR Part 50. A COL applicant that references an ESP for the site should

verify that the calculated radiological doses to members of the public from radioactive gaseous and liquid effluents for any facility to be built on the site are bounded by the radiological doses included in the SSAR for the ESP application and reviewed by the NRC staff as described above. In addition, detailed information on the solid waste management system used to process the radioactive gaseous and liquid effluents will be required. This is **COL Action Item 11.1-1**.

Based upon these considerations, the staff concludes that radiological doses to members of the public from radioactive gaseous and liquid effluents resulting from the normal operation of one or more new nuclear power plants that might be constructed on the proposed ESP site do not present an undue risk to the health and safety of the public. Therefore, the staff concludes, with respect to radiological effluent release dose consequences from normal operations, that the proposed site is acceptable for constructing a plant falling within the applicant's plant parameter envelope (PPE), and that the site meets the relevant requirements of 10 CFR Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants," and 10 CFR Part 100, "Reactor Site Criteria."