

11. RADIOLOGICAL EFFLUENT RELEASE DOSE CONSEQUENCES FROM NORMAL OPERATIONS

11.1 Source Terms

The U.S. Nuclear Regulatory Commission (NRC) staff reviewed the information on radiological effluents and solid radioactive waste provided in Site Safety Analysis Report (SSAR) Section 3.1 of the Exelon Generation Company, LLC (EGC or the applicant) early site permit (ESP) application to determine whether site characteristics are such that the radiation dose to members of the public would be within regulatory requirements.

11.1.1 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 would be collected, processed, stored, and discharged in a controlled manner to the local environment or transported offsite for long-term storage or disposal. The facility to be built on the ESP site would have the ability to handle these radiological effluents and solid waste material in a manner that minimized radioactive releases to the environment and maintained exposure to the public and plant personnel during normal plant operation and maintenance at levels that were as low as is reasonably achievable (ALARA).

11.1.2 Regulatory Evaluation

NRC regulations require that applicants for an ESP address characteristics of the proposed site that could affect the radiation dose to a member of the public from radiological effluents. In Request for Additional Information (RAI) 1.5-1, the staff asked the applicant to provide a comprehensive list of NRC regulations applicable to its ESP SSAR. In its response to RAI 1.5-1, the applicant stated that SSAR Section 3.1 addresses radiological effluents in accordance with Title 10 of the *Code of Federal Regulations* (10 CFR), Section 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. The staff reviewed this portion of the application for conformance with the applicable regulations.

11.1.3 Technical Evaluation

11.1.3.1 *Gaseous Effluents*

The gaseous waste management system would 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 would be released to the environment through the waste gas processing systems, which minimize the releases to the environment. Radioactive gases that might be present in the plant buildings as a result of leakage from systems would also be monitored and released through the building ventilation systems. The release of radioactive gaseous effluents from the facility would be controlled and monitored to be within the regulatory limits in 10 CFR Part 20, "Standards for Protection Against Radiation," and maintained ALARA in accordance with

10 CFR Part 50, 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.”

The applicant estimated the bounding quantity of radioactive gaseous effluents that might be released from the gaseous waste management and 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 reactors designs under consideration.

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

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,” 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.

11.1.3.2 Liquid Effluents

The liquid waste management system would control, collect, process, store, and dispose of potentially radioactive liquids during plant operation, including startup, normal operation, shutdown, refueling, and anticipated operational occurrences. The system would typically be operated in a manner that minimized the release of radioactivity into the environment. Normal liquid effluents would discharge through the existing discharge of the Clinton Power Station (CPS).

Currently, the CPS facility does not routinely discharge radioactive liquid wastes into Clinton Lake. EGC stated that it would likely continue this practice with its ESP facility. However, to provide operating flexibility, the applicant gave a bounding estimate to demonstrate its capability to comply with the regulatory requirements in 10 CFR Part 20 and Appendix I to 10 CFR Part 50.

The applicant provided the estimated bounding annual average quantity of radioactivity projected to be released in Table 1.4-4 of the SSAR. This quantity represents the highest activity content of the individual isotopes from the alternative reactor designs presented in SSAR Section 1.4, “Plant Parameters Envelope,” and would bound the activity of the isotopes for any selected reactor design. SSAR Table 3.1-5 compares the projected liquid effluent release concentrations to the 10 CFR Part 20 liquid effluent concentration limits. The data shows that the bounding liquid effluent release concentrations are within the 10 CFR Part 20 effluent concentration limits.

The applicant estimated the 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," and the LADTAP II program (NUREG/CR-4013, "LADTAP II—Technical Reference and User Guide," 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 lake near the point of discharge.

11.1.3.3 Solid Waste

The solid waste management system of the EGC ESP facility would control, collect, handle, process, package, and temporarily store the wet and dry solid radioactive waste materials generated during normal plant operations before they are shipped offsite. The solid waste materials might consist of wet waste sludge, dewatered resins, and contaminated solids such as cartridge filters, rags, paper, clothing, tools, and equipment. The applicant would periodically ship solid radioactive waste material between the EGC ESP site and the permanent waste disposal facility.

The applicant estimated that it would ship an average of 15,087 ft³ of radioactive waste offsite each year. The applicant estimated the maximum curie content of the shipped waste at 5100 curies. The waste would be packaged and shipped 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."

11.1.4 Conclusion

The applicant has provided adequate information to provide reasonable assurance that it would control, monitor, and maintain radioactive gaseous and liquid effluents and solid waste from the EGC ESP facility within the regulatory limits in 10 CFR Part 20, 10 CFR Part 71, and 49 CFR Part 173 and maintain them at ALARA levels in accordance with the effluent design objectives set forth in Appendix I to 10 CFR Part 50. A COL applicant that references an ESP for the EGC ESP site should verify that the calculated radiological doses to members of the public from radioactive gaseous and liquids effluents for any facility to be built on the EGC ESP site are bounded by the radiological doses in the SSAR for the ESP application and reviewed by the NRC staff as described above. This is **COL Action Item 11.1-1**.