

**Interim Staff Guidance on the use of the  
GALE86 Code for Calculation of Routine Radioactive Releases in Gaseous and Liquid  
Effluents from Boiling-Water Reactors and Pressurized-Water Reactors  
to Support Design Certification and Combined License Applications**

**Purpose:**

The purpose of this interim staff guidance (ISG) is to clarify the U.S. Nuclear Regulatory Commission (NRC) position on the use of the "GALE86" computer code. The computer code is used for calculating routine radioactive releases in gaseous and liquid effluents (GALE) from boiling-water reactors (BWR) and pressurized-water reactors (PWR) for design certification (DC) and combined license (COL) applications submitted under Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52 that were finalized in August 2007. This guidance provides a clarification on the use of a newer version (GALE86) of the BWR-GALE and PWR-GALE codes that is not referenced in current NRC guidance.

**Background:**

Several NRC documents provide guidance on the use of acceptable methods for calculating annual average releases of radioactive materials present in GALE from BWRs and PWRs. The NRC guidance consists of:

- Regulatory Guide (RG) 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)," Sections C.I.11 and C.III.1, June 2007.
- RG 1.112, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Light-Water-Cooled Nuclear Power Reactors," March 2007.
- Standard Review Plan (SRP), "Chapter 11, Radioactive Waste Management," NUREG-0800, March 2007.
- NUREG-0016, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Boiling Water Reactors (BWR-GALE Code)," Rev. 1, January 1979.
- NUREG-0017, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Pressurized Water Reactors (PWR-GALE Code)," Rev. 1, April 1985.

Specifically, the guidance provides information on the review and evaluation of system design, design objectives and criteria, methods of treatment, expected releases, and analytical methods used in calculating effluent source terms and releases of radioactive materials in GALE during normal operation and anticipated operational occurrences (AOO). The guidance identifies specific analytical parameters used by the codes, including types of processing methods and flow rates, characteristics of filtration, ion-exchange resins, adsorbent media to treat process and effluent streams, and expected removal efficiencies, decontamination factors, and holdup or decay times.

Enclosure

On March 19, 2008, the staff issued the proposed ISG “Use of the GALE86 Code for Calculation of Routine Radioactive Releases in Gaseous and Liquid Effluents to Support Design Certification and Combined License Applications,” (COL/DC-ISG-005) (ADAMS Accession No. ML080650651) to solicit public and industry comment. The staff did not receive any comments on the draft ISG. Therefore, the ISG is now being issued for use.

**Issue:**

Pursuant to 10 CFR 52.47(a) and 52.79(a), DC and COL applicants must include the design bases, such as descriptions of methods and parameters, used in calculating releases of radioactive materials in GALE. In order to meet these requirements, the NRC has provided guidance for applicants to follow in RGs 1.206 and 1.112, NUREG-0016 and NUREG-0017. If this guidance is not followed, the applicant must fully describe the alternate method used and provide sufficient details of the bases for all parameters that are different from, or are not contained in the current NRC guidance. The NRC staff will need this detailed information to conduct its review.

Since the publication of NUREG-0016 and NUREG-0017, the NRC issued on November 10, 1986 a revised version of the GALE code to the Radiation Shielding Information Center (RSIC), run by the U.S. Department of Energy at the Oak Ridge National Laboratory, Oak Ridge, TN. The NRC letter<sup>1</sup> to RSIC states that the code versions are no longer accurately described in NUREG-0016 and NUREG-0017, the letter includes a set of errata sheets for each NUREG, and notes that both NUREGs are being revised. However, both NUREGs have not been updated since the issuance of the 1986 letter. As a result, the GALE86 code offers a revised method that is still consistent with existing NRC guidance, but its existence and possible use are not formally cited nor referenced in current NRC guidance, as listed above.

**Rationale:**

The NRC staff finds the use of the “GALE86” code acceptable even in the absence of updated versions of supporting documents [NUREG-0016 (1979) and NUREG-0017 (1985)] for either version of the GALE code. This conclusion is based on the following reasons:

- The 1986 NRC letter provides information on specific changes made to each version of the BWR- and PWR-GALE code;
- The procurement of GALE86 from RSIC includes sample problem input and output files, which permit users to benchmark the installation and initial testing of each code;
- Regardless of which version of the GALE code is used, the purpose and objective of current NRC guidance remains unchanged in the context of what DC and COL applicants need to include in applications characterizing radioactive GALE; and

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<sup>1</sup> Letter from: Patricia A. Bell, Information Technology Services Section, Systems Support Branch, Division of Automated Information Services, Office of Resource Management, U.S. Nuclear Regulatory Commission; to: Ms. McGill, RSIC (Radiation Shielding Information Center), P.O. Box X, Oak Ridge, TN 37830, dated November 10, 1986. Note: Since then, RSIC has been renamed as the Radiation Safety Information Computational Center (RSICC).

- If a DC or COL applicant were to use GALE86, the applicant is still required to provide the necessary technical information and details for the staff to conduct an independent evaluation of the results generated by the use of GALE86 and confirm compliance with NRC regulatory requirements and guidance.

#### **Final Interim Staff Guidance:**

In addition to the versions of the BWR-, and PWR-GALE codes described in NUREG-0016 (1979) and NUREG-0017 (1985), the use of GALE86 is found acceptable for calculating expected releases of radioactive materials in GALE from light-water reactors during normal operations and AOO.

For DC or COL applicants using GALE86, applicants are required to provide sufficient technical information for the staff to conduct an independent evaluation of the results generated by the use of GALE86. The technical information necessary in using GALE86 is described in RG 1.112 and SRP Sections 11.2 and 11.3.

In evaluating the information used in calculating quantities of radioactive materials released annually in GALE during normal operation and AOO, the staff should confirm that the assumptions and parameters are consistent with the methods given in NUREG-0016 or NUREG-0017 and RG 1.112, regardless of which versions of the GALE code is used by the applicant.

In presenting the results of its evaluation in the safety evaluation report (SER), the staff should confirm that the performance of radioactive waste management systems described in the application meet or exceed that noted in NRC guidance (NUREG-0016 or NUREG-0017) and indicate which version of the GALE code the applicant has used in its DC or COL application.

In its evaluation findings, the staff should state in the SER that the applicant has provided the necessary technical information for the staff to conduct an independent evaluation of the results generated by the use of GALE86 and the staff confirms that assumptions and parameters used in estimating expected yearly amounts of radioactivity present in GALE were derived in compliance with NRC regulatory requirements and guidance.

#### **Final Resolution:**

In the near-term, the issue will be resolved in upcoming updates of RG 1.206 and SRP Chapter 11 (NUREG-0800) that will provide a formal endorsement of GALE86 and clarifying the use of GALE86 in DC and COL applications.

For the long-term, the NRC has initiated in 2007 a review of the BWR-GALE and PWR-GALE codes for the purpose of revising both computer programs to model current and new reactor technologies and radioactive waste processing methods. The review includes parallel revisions of RGs 1.206 and 1.112, and NUREG-0016 and NUREG-0017 and Chapter 11 of the SRP once both computer codes are revised.

**Applicability:**

This ISG is applicable to all DC and COL applications submitted under 10 CFR Part 52. This ISG shall be implemented on the day following its issuance. It shall remain in effect until it has been superseded, withdrawn, or incorporated into a revision of the SRP and RG 1.206.

**References:**

1. 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants"
2. 10 CFR 52.47, "Contents of applications; technical information"
3. 10 CFR 52.79, "Contents of applications; technical information in final safety analysis Report"
4. NRC letter from: Patricia A. Bell, Information Technology Services Section, Systems Support Branch, Division of Automated Information Services, Office of Resource Management, U.S. Nuclear Regulatory Commission; to: Ms. McGill, RSIC (Radiation Shielding Information Center), P.O. Box X, Oak Ridge, TN 37830, dated Nov. 10, 1986.
5. GALE86, "Calculation of Routine Radioactive Releases in Gaseous and Liquid Effluents from Boiling Water and Pressurized Water Reactors," code package CCC-506, Radiation Safety Information Computational Center, Department of Energy, Oak Ridge National Laboratory, Oak Ridge, TN 37831. RSIC is reachable via the World Wide Web <http://rsicc.ornl.gov/>.