

Regulatory Guide Number: 1.4, Revision 2

Title: Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Pressurized Water Reactors

Office/Division/Branch: NRR/DRA

Technical Lead: John Parillo

SUBJECT: Bases for Withdrawal

(1) What regulation(s) did the Regulatory Guide support?

Regulatory Guide (RG) 1.4, Revision 2, “Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Pressurized Water Reactors,” was published in June 1974, to provide guidance on meeting the requirements in Title 10 of the *Code of Federal Regulations* (10 CFR) 100.11, “Determination of exclusion area, low population zone, and population center distance.”

(2) What was the purpose of the Regulatory Guide?

The information in RG 1.4, Revision 2, “Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Pressurized Water Reactors,” published in June 1974, describes methods that the U.S. Nuclear Regulatory Commission (NRC) staff considers acceptable for complying with the NRC’s regulations regarding the evaluation of the design-basis loss-of-coolant accident (LOCA) for pressurized-water reactors.

(3) How was the Regulatory Guide used?

The information in RG 1.4 lists acceptable assumptions that may be used to evaluate the design basis LOCA of a pressurized-water reactor in order to demonstrate that the offsite dose consequences will be within the guidelines of 10 CFR Part 100.

(4) Why is the Regulatory Guide no longer needed?

The guidance contained in RG 1.4 has been updated and incorporated into RG 1.183, “Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors,” and RG 1.195, “Methods and Assumptions for Evaluating Radiological Consequences of Design Basis Accidents at Light-Water Nuclear Power Reactors.” The information in RG 1.183 provides guidance for new and existing light-water reactor (LWR) plants that have adopted the alternative source term (AST), and RG 1.195 provides guidance for those LWR plants that have not adopted the AST.

(5) What guidance is available once the Regulatory Guide is withdrawn?

The guidance contained in RG 1.4 has been updated and incorporated into RG 1.183 and RG 1.195. The information in RG 1.183 provides guidance for new and existing LWR plants that have adopted the AST, and RG 1.195 provides guidance for those LWR plants that have not adopted the AST.

(6) Is the Regulatory Guide referenced in other documents and what are the “ripple effects” on these documents if it is withdrawn?

RG 1.183, “Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Plants,” and **RG 1.195**, “Methods and Assumptions for Evaluating Radiological Consequences of Design Basis Accidents at Light-Water Nuclear Power Plants,” include a statement that several old RGs, including RG 1.4, will not be withdrawn. In future revisions, the staff intends to delete this statement from both RG 1.183 and RG 1.195.

RG 1.26, “Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants,” Revision 4, March 2007, refers to:

...conservatively calculated potential offsite doses [using meteorology as recommended in Regulatory Guide 1.3, “Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss-of-Coolant Accident for Boiling-Water Reactors,” and Regulatory Guide 1.4, “Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss-of-Coolant Accident for Pressurized-Water Reactors”...]

The meteorology described in RG 1.3 is generic and not suitable for modern dose consequence analyses. The information in RG 1.145, “Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants,” was first issued in August of 1979, several years after the issuance of RG 1.3, and was intended to replace the outdated and generic atmospheric diffusion models described in RG 1.3 and RG 1.4. Therefore, in the next revision to RG 1.26, the staff intends to replace the references to RGs 1.3 and 1.4 with a reference to the meteorology described in RG 1.145.

The introduction to RG 1.145 states, in part, the following:

The direction-dependent approach provides an improved basis for relating the Part 100-related review of a proposed reactor to specific site considerations. Accordingly, this guide provides an acceptable methodology for determining site-specific relative concentrations (X/Q) and should be used in determining X/Q values for the evaluations discussed in Regulatory Guide 1.3, “Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Boiling Water Reactors,” and Regulatory Guide 1.4, “Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Pressurized Water Reactors.”

With the next revision to RG 1.145 the staff intends to replace this reference to RG 1.3 and RG 1.4 with the following: “Accordingly, this guide provides an acceptable methodology for determining site-specific relative concentrations (X/Q) and should be used in determining X/Q values for the evaluation of the dose consequences from design basis accidents.”

RG 1.52, “Design, Inspection, and Testing Criteria for Air Filtration and Adsorption Units of Post-Accident Engineered-Safety-Feature Atmosphere Cleanup Systems in Light-Water-Cooled Nuclear Power Plants,” Revision 4, September 2012, states in section C.2.b that:

The location and layout of each ESF [engineered safety feature] atmosphere cleanup system should consider the radiation dose to essential services and personnel in the vicinity, integrated over the 30-day period following the

postulated DBA [design basis accident]. The radiation source term should be consistent with the assumptions found in RG 1.3, RG 1.4, RG 1.25, or RG 1.183. Other ESFs, including pertinent components of essential services such as power, air, and control cables, should be adequately shielded from the ESF atmosphere cleanup systems.

The staff intends to replace the references to RGs 1.3, 1.4, and 1.25 with a reference to RG 1.195 in the next revision to RG 1.52.

RG 1.206, Combined License Applications for Nuclear Power Plants, Section C.I.1.2.3.1, Facility Design Features, states the following:

...provide scaled layout and arrangement drawings of the facility. On these drawings, show the locations of all sources described in Section 12.2 of the FSAR [final safety analysis report] and identify those sources in a manner that can easily be related to tables containing the pertinent and necessary quantitative source parameters. Accurately locate positions, indicating the approximate size and shape of each source. On the layout drawings, provide the radiation zone designations, including zone boundaries for normal operations, refueling outages, and postaccident conditions (based on the applicable guidance in Regulatory Guide 1.3, "Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss-of-Coolant Accident for Boiling-Water Reactors," Regulatory Guide 1.4, "Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss-of-Coolant Accident for Pressurized-Water Reactors," Regulatory Guide 1.7, "Control of Combustible Gas Concentrations in Containment Following a Loss-of-Coolant Accident," and Regulatory Guide 1.183, "Alternative Radiological Source Terms for Evaluating Design-Basis Accidents at Nuclear Power Reactors"). Reference other chapters of the FSAR, as appropriate. ...

The staff intends to replace the references to RGs 1.3 and 1.4 with a reference to RG 1.195 in the next revision of RG 1.206.

NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition" (SRP), "Section 2.3.4, "Short-Term Atmospheric Dispersion Estimates for Accident Releases," Revision 3, March 2007, states, in part, that:

Older plants licensed under 10 CFR Part 50 may have also used the following regulatory guides instead of Regulatory Guide 1.145 for characterizing atmospheric dispersion conditions for evaluating the consequences of radiological releases to the EAB [exclusion area boundary] and LPZ [low-population zone]:

Regulatory Guide 1.3, "Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Boiling Water Reactors".

Regulatory Guide 1.4, "Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Pressurized Water Reactors".

Regulatory Guide 1.5, "Assumptions Used for Evaluating the Potential Radiological Consequences of a Steam Line Break Accident for Boiling Water Reactors".

Regulatory Guide 1.24, “Assumptions Used for Evaluating the Potential Radiological Consequences of a Pressurized Water Reactor Radioactive Gas Storage Tank Failure”.

Regulatory Guide 1.25, “Assumptions Used for Evaluating the Potential Radiological Consequences of a Fuel Handling Accident in the Fuel Handling and Storage Facility for Boiling and Pressurized Water Reactors”.

Regulatory Guide 1.77, “Assumptions Used for Evaluating a Control Rod Ejection Accident for Pressurized Water Reactors”.

Regulatory Guide 1.98, “Assumptions Used for Evaluating the Potential Radiological Consequences of a Radioactive Offgas System Failure in a Boiling Water Reactor”.

The reference to RG 1.4, as well as the other older guides mentioned in this excerpt from SRP Section 2.3.4, are historical in nature. Therefore, the withdrawal of RG 1.4, as well as the withdrawal of other older guides referenced in the above citation, would not necessitate a modification to SRP Section 2.3.4.

SRP Section 4.2, “Fuel System Design,” makes several references to old RGs such as RG 1.3 and 1.4. The SRP also states that RG 1.195 and RG 1.196, [“Control Room Habitability at Light-Water Nuclear Power Reactors,”] can be used in place of RG 1.3, RG 1.4, RG 1.5, RG 1.25, and RG 1.77.

This language should be changed to state that RG 1.195 and RG 1.196, should be used in place of RG 1.3, RG 1.4, RG 1.5, RG 1.25, and RG 1.77.

SRP Section 6.2.1, “Containment Functional Design,” includes RG 1.4 in the list of references; however, the guide is not mentioned in the text of SRP Section 6.2.1.

SRP Section 6.5.1, “ESF Atmosphere Cleanup Systems,” Section III.3.E, states that:

Environmental design guidelines for acceptability are based on the conditions following a DBA. Radiation source terms are consistent with the guidelines in RGs 1.3, 1.4, 1.183, 1.7, and 1.25.

The references to RG 1.3, RG 1.4 and RG 1.25 should be replaced with a reference to RG 1.195. It should be noted that while RG 1.195 is listed as a reference to SRP Section 6.5.1, it is not discussed in the text. In addition, it is not clear why RG 1.7, “Control of Combustible Gas Concentrations in Containment,” is included in a listing of RGs dealing with radiation source terms.

SRP Section 6.5.2, “Containment Spray as a Fission Product Cleanup System,” states, in part, the following:

4. Fission Product Removal Effectiveness (primary reviewer)

The fission product removal effectiveness of the system is calculated to establish the degree of dose mitigation by the containment spray system following the postulated accident. The mathematical model used for this calculation should reflect the preceding steps of the review. The analysis and assumptions are as follows:

- A. The amounts of fission products assumed to be released to the containment space are obtained from Regulatory Guide 1.3, Regulatory Guide 1.4, or Regulatory Guide 1.183 as appropriate. The amounts of airborne fission product inside the containment building depend on plateout on interior surfaces, removal by the spray system and other engineered safety features present, radioactive decay, and out-leakage from the containment building.

If the value in Position C.1.a of Regulatory Guides 1.3 and 1.4 is used in the calculation of fission product removal, then deposition by plateout, as described in paragraph III.4.c of this SRP section, should not be considered as an additional removal mechanism. Deposition by plateout is already accounted for in the regulatory guide values.

References to RG 1.3 and RG 1.4 in the first paragraph of 4.A should be replaced with a reference to RG 1.195. With the reference to RG 1.195 instead of RG 1.3 and RG 1.4, the second paragraph under 4.A should be eliminated.

SRP Section 12.2, “Radiation Sources,” Section II, “SRP Acceptance Criteria” states, in part, the following:

The following regulatory guides, standards, and NUREGs provide information, recommendations, and guidance and in general describe a basis acceptable to the staff for implementing the requirements of 10 CFR 50.34(b)(3), 10 CFR 52.47(a)(5), 10 CFR 52.79(a)(3) and 10 CFR 52.157(e), 10 CFR 20.1201, 10 CFR 20.1202, 10 CFR 20.1203, 10 CFR 20.1204, 10 CFR 20.1206, 10 CFR 20.1207, 10 CFR 20.1301, 10 CFR 20.1406, 40 CFR Part 190, 10 CFR 20.1801 and 10 CFR 50.49.

1. Regulatory Guide (RG) 1.3¹, as it relates to assumptions used in evaluating gaseous concentrations of radionuclides in containment and plant systems following a loss-of-coolant accident, for boiling-water reactors (BWRs).
2. RG 1.4¹, as it relates to assumptions used in evaluating gaseous concentrations of radionuclides in containment and plant systems following a loss-of-coolant accident, for pressurized-water reactors (PWRs).

The references to RG 1.3 and 1.4 should be replaced with a reference to RG 1.195. It should be noted that while SRP Section 12.2 references RG 1.3 and 1.4 it does not reference 10 CFR 100.11, “Determination of exclusion area, low population zone, and population center distance,” which is the regulation that these outdated guides support.

SRP Section 12.3 - 12.4, “Radiation Protection Design Features,” Section I.1.B. states that:

The radiation zone designations, including zone boundaries for normal operation (including AOOs [anticipated operational occurrence] refueling, and accident conditions (based on Regulatory Guides (RG) 1.3, 1.4, 1.7, or 1.183) (CP [construction permit] PSAR [preliminary safety analysis report] and updates in the OL [operating license] FSAR, DC [design certification]

¹ Regulatory guides 1.3 and 1.4 provide guidance related to Technical Information Document (TID) 14844, “Calculation of Distance Factors for Power and Test Reactor Sites.” This guidance is applicable to a holder of an operating license issued prior to January 10, 1997 or a holder of a renewed license under 10 CFR Part 54 whose initial operating license was issued prior to January 10, 1997. These license holders may voluntarily revise the accident source term.

FSAR, or the COL [combined license] FSAR to the extent that they are not addressed in a referenced certified design).

References to RGs 1.3 and 1.4 should be replaced with a reference to RG 1.195.

NUREG/CR-6624, "Recommendations for Revision of Regulatory Guide 1.78," Section 4.3 item b. states the following:

For a maximum concentration-duration accident, the continuous release of hazardous chemicals from the largest safety relief valve in a stationary, mobile, or onsite source falling within the guidelines of Table C-2 should be considered. Guidance on the atmospheric diffusion model is presented in Regulatory Guide 1.3, "*Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss-of-Coolant Accident for Boiling Water Reactors*," and Regulatory Guide 1.4, "*Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss-of-Coolant Accident for Pressurized Water Reactors*."

Future revisions to NUREG/CR-6624 should replace the references to RGs 1.3 and 1.4 with reference to the meteorology described in RG 1.145.

(7) What is the basis for believing that no guidance similar to that in the Regulatory Guide will ever be needed?

The NRC is withdrawing RG 1.4 because it is outdated. The guidance contained in RG 1.4 has been updated and incorporated into RG 1.183 and RG 1.195. The information in RG 1.183 provides guidance for new and existing LWR plants that have adopted the AST, and RG 1.195 provides guidance for those LWR plants that have not adopted the AST.

(8) Will generic guidance still be needed?

The guidance contained in RG 1.4 has been updated and incorporated into RG 1.183 and RG 1.195. The information in RG 1.183 provides guidance for new and existing LWR plants that have adopted the AST and RG 1.195 provides guidance for those LWR plants that have not adopted the AST.

(9) What is the rationale for withdrawing this Regulatory Guide instead of revising it?

The guidance contained in RG 1.4 has been updated and incorporated into RG 1.183 and RG 1.195. The information in RG 1.183 provides guidance for new and existing LWR plants that have adopted the AST and RG 1.195 provides guidance for those LWR plants that have not adopted the AST.

(10) Do other agencies rely upon the Regulatory Guide (e.g., the Agreement States, National Aeronautical and Space Administration, Department of Energy)?

The staff is unaware of any other agency that uses or relies on the guidance included in RG 1.4.