

April 5, 2016

MEMORANDUM TO: Brian E. Thomas, Director  
Division of Engineering  
Office of Nuclear Regulatory Research

FROM: Joseph G. Giitter, Director /RA/  
Division of Risk Assessment  
Office of Nuclear Reactor Regulation

SUBJECT: RESULTS OF PERIODIC REVIEW OF REGULATORY GUIDE 1.98

This memorandum documents the U.S. Nuclear Regulatory Commission's (NRC) periodic review of Regulatory Guide (RG) 1.98, "Assumptions Used for Evaluating the Potential Radiological Consequences of a Radioactive Offgas System Failure in a Boiling Water Reactor," published in March 1976. The RG describes methods that the NRC staff considers acceptable for complying with the NRC's regulations regarding the evaluation of the potential radiological consequences of a boiling-water reactor radioactive gas storage tank failure. As discussed in Management Directive 6.6, "Regulatory Guides," the NRC staff reviews RGs approximately every 5 years to ensure that the RGs continue to provide useful guidance. Documentation of the Office of Nuclear Reactor Regulation (NRR) staff review is enclosed.

Based on the results of the periodic review, the NRR staff concludes that no changes to RG 1.98, are warranted at this time. However, the staff identified issues in the review that could warrant addressing in a future revision. These issues are primarily the result of the NRC publishing updated guidance that is applicable to this area, but is located in other documents (i.e., other RGs and NUREGs), as described in detail in the enclosed review.

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Enclosure:  
Regulatory Guide Periodic Review

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## **Regulatory Guide Periodic Review**

**Regulatory Guide Number:** 1.98, Revision 0

**Title:** Assumptions Used for Evaluating the Potential Radiological Consequences of a Radioactive Offgas System Failure in a Boiling Water Reactor

**Office/Division/Branch:** NRR/DRA/ARCB

**Technical Lead:** David Garmon

**Staff Action Decided:** Reviewed with issues identified for future consideration

**1. What are the known technical or regulatory issues with the current version of the Regulatory Guide (RG)?**

Regulatory Guide (RG) 1.98, Revision (Rev.) 0, was published in 1976 to provide boiling-water reactor licensees guidance in selecting appropriate assumptions for the analysis of radioactive offgas system failures. While the guidance in the current version of RG 1.98 remains adequate, there are several technical and regulatory issues that should be considered and addressed during future revisions of this RG. These issues are primarily the result of the Nuclear Regulatory Commission (NRC) publishing updated guidance that is applicable to this area in other documents (i.e., other RGs and NUREGs), as described below. The updated guidance provides additional flexibility and more accurate assumptions for use in analyzing radioactive offgas system failure events, and thus should be included in future revisions to RG 1.98.

RG 1.98, Rev. 0, Section B states that the staff assumes 100 percent release of noble gas inventory in the offgas system and a fractional release of the particulate matter on high-efficiency particulate air filters in the system. The RG does not provide guidance on what constitutes an adequate assumption for a fractional release of particulate matter, and instead directs licensees to select and justify their own levels. The RG states that specific release fractions are to be provided at a later date; however, this additional information was never published.

Section C to RG 1.98, Rev. 0, provides a noble gas release rate at the steam jet air ejectors of 350,000 microcuries per second ( $\mu\text{Ci/sec}$ ) (after 30 minute decay) for a period of 30 days preceding the accident, and 100,000  $\mu\text{Ci/sec}$  (after 30 minute decay) for times earlier than 30 days. These rates apply to a 3,500 megawatt thermal (MWt) reactor and should be scaled in a linear manner based on reactor power. However, the more current NRC Branch Technical Position (BTP) 11-5, "Postulated Radioactive Releases due to a Waste Gas System Leak or Failure," of the NUREG-0800 (Standard Review Plan), Chapter 11.3, "Gaseous Waste Management System," assumes a fission product release that is consistent with a noble gas release to the reactor coolant of 100  $\mu\text{Ci/sec}$  per MWt (after 30 minute decay). Additionally, BTP 11-5 allows licensees to apply techniques described in RG 1.112, Rev. 1, "Calculation of Releases of Radioactive

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Materials in Gaseous and Liquid Effluents from Light-Water-Cooled Power Reactors,” for source term determination. Furthermore, RG 1.98, Rev. 0, states that activation gases and iodine should be neglected; however, BTP 11-5 states that the inclusion of radioiodine in the source term should be determined by the type of event and whether the failed component could lead to the release of radioiodine.

The guidance applicable to atmospheric diffusion in Section C to RG 1.98, Rev. 0, refers to dated documents that may not be widely available. The source, or technical basis, for the figures at the end of the RG is not provided. In the techniques discussed in RG 1.145, Rev. 1, “Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants,” for example, the consideration of a meandering plume at, or, near ground levels, is not described or referenced in RG 1.98, Rev. 0. (Note: The NRC reviewed RG 1.145, Rev. 1, in 2014 and identified issues for future consideration; however, RG 1.145, Rev. 1 was not updated. The reader is directed to consider the review memoranda at Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML14114A735 and ML14114A736 before applying the guidance in RG 1.145, Rev. 1).

BTP 11-5 provides acceptance criteria for doses at the exclusion area boundary (EAB) that result from radioactive offgas system failures. While not specifically an assumption in the analysis of these types of events, the applicable acceptance criteria is information that should be provided in future versions of RG 1.98. For plants that have radioactive offgas systems that are designed in accordance with the guidance of RG 1.143, “Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light-Water-Cooled-Nuclear Power Plants,” to withstand the effects of a hydrogen explosion and earthquakes, the resulting dose to the whole body to an individual at the EAB shall not exceed 2.5 roentgen equivalent man (rem) (25 millisievert (mSv)). For plants with offgas systems that are not hardened, as prescribed in RG 1.143, the resulting dose to the whole body to an individual at the EAB shall not exceed 0.1 rem (1 mSv).

While the staff has identified these issues with RG 1.98, Rev. 0, this review did not identify any safety concerns or an immediate need to revise this RG.

**2. What is the impact on internal and external stakeholders of not updating the RG for the known issues, in terms of anticipated numbers of licensing and inspection activities over the next several years?**

For operating reactors, the staff anticipates few licensing activities that will involve the use of RG 1.98, Rev. 0, in the near future. For new reactors, there is a potential for several small modular reactor design certification applications and combined license applications to be submitted in the near future (next 3 to 5 years) that would require the guidance found in RG 1.98, Rev. 0. Since the issues that have been identified through this review represent potential improvements in the document and not deficiencies in the adequacy of the current guidance, there will be little to no impact on internal and external stakeholders if the RG is not revised at this time.

**3. What is an estimate of the level of effort needed to address identified issues in terms of full-time equivalent (FTE) and contractor resources?**

Revision of this RG will take approximately 0.2 FTE of NRC staff time and will require significant coordination between several NRC offices; in particular the Office of Nuclear Reactor Regulation and the Office of New Reactors. It is recommended that revision of this RG be coordinated with the revision of RG 1.24, Rev. 0. Contractor support is not needed to update this RG.

**4. Based on the answers to the questions above, what is the staff action for this guide (Reviewed with no issues identified, Reviewed with issues identified for future consideration, Revise, or Withdraw)?**

Reviewed with issues identified for future consideration.

**5. Provide a conceptual plan and timeframe to address the issues identified during the review.**

Although the NRC does not currently plan a revision to this RG, the NRC plans to continue periodic reviews of this guidance in accordance with agency procedures. The issues identified as part of this review will be considered in future reviews.

**NOTE: This review was conducted in February 2016 and reflects the staff's plans as of that date. These plans are tentative and are subject to change.**