



**UNITED STATES
NUCLEAR REGULATORY COMMISSION**
WASHINGTON, D.C. 20555-0001

December 16, 2020

MEMORANDUM TO: Kevin Hsueh, Chief
Radiation Protection and Consequence Branch
Division of Risk Assessment
Office of Nuclear Reactor Regulation

FROM: Micheal Smith, Health Physicist */RA/*
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SUBJECT: SUMMARY OF NUCLEAR REGULATORY COMMISSION
PUBLIC MEETING ON NOVEMBER 19, 2020 TO DISCUSS THE
REVISION OF REGULATORY GUIDE 1.183

On November 19, 2020, the U.S. Nuclear Regulatory Commission (NRC) staff conducted a category 2 public meeting (Agencywide Documents Access and Management System (ADAMS) Accession No. ML20308A496) to communicate the process, schedule, and items under staff consideration for the revision of Regulatory Guide (RG) 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors."

Purpose

The purpose of the meeting was to communicate the process, schedule, and items under staff consideration for the revision of RG 1.183. In addition, the NRC staff answered questions and was provided feedback on potential improvements that the staff should consider during the revision of RG 1.183.

Meeting Summary

The NRC staff's presentation (ADAMS Accession No. ML20296A425) provided the staff's key messages for the revision of RG 1.183. The key messages included the overall objectives of the RG 1.183 revision such as the staff's plans to: incorporate lessons learned from recent license amendment requests (LARs); incorporate relevant operating experience; respond to changes in regulatory environment (e.g., SRM-SECY-18-0049 & SRM-SECY-19-0036); ensure that guidance is in place for licensing advanced light-water reactors, accident tolerant fuel (ATF), high-burnup, and increased enrichment fuel. The staff also informed external stakeholders that additional public meetings would be held in the future to allow the NRC additional opportunities to receive feedback from external stakeholders.

Enclosure:
Meeting Attendance List

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After communicating the key messages, the NRC staff presented background on the regulatory framework and guidance pertaining to accident source terms for light-water nuclear power plants. Furthermore, the NRC staff discussed the history of the staff's efforts to revise RG 1.183. Specifically, the staff communicated that in October 2009, the Draft Regulatory Guide (DG) – 1199 (ADAMS Accession No. ML12023A248) was issued for public comment as a proposed revision 1 of RG 1.183. Some of the main reasons for the revision of RG 1.183 in DG-1199 were to: provide additional guidance for modeling boiling water reactor (BWR) main steam isolation valve (MSIV) leakage; expand applicability of non-loss of coolant accident (non-LOCA) release fractions to support modern fuel utilization; extend the applicability of RG 1.183 to 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants," applicants and licensees; and, provide additional meteorological assumption guidance.

During this public meeting the NRC staff informed external stakeholders that since the RG 1.183 revision project will involve another opportunity for stakeholders to review and comment on an updated DG, that the staff will not be providing formal responses to the public comments on DG-1199. However, comments received on DG-1199 will still be considered by staff during the development of the new DG for revision 1 of RG 1.183. Staff also briefly discussed some of the LARs that have been approved by the NRC since the issuance of DG-1199. The staff noted that lessons learned from the evaluation of recent LARs are being considered by staff to further inform the revision of RG 1.183.

Following the background discussion, staff briefly reviewed the NRC's process for updating an RG. Staff informed external stakeholders that an RG may be developed or revised based on rulemakings, lessons learned, stakeholder feedback, and NRC staff's periodic reviews of RGs. If it is determined that an RG is going to be revised, the NRC staff will develop a draft revision of the RG through internal collaboration with the appropriate technical staff. Then, that DG is published for public comment. The staff further communicated that they are currently planning to make the DG for revision 1 of RG 1.183 available in the fourth quarter of calendar year of 2021. After the public comment period, the staff will address any public comments and update the RG as appropriate. The staff will then provide the final RG package for review by the Office of General Counsel (OGC) and Advisory Committee on Reactor Safeguards (ACRS). If OGC or ACRS have any issues, questions, or comments for the staff, they will be addressed by the staff prior to finalizing and issuing the RG. Staff informed stakeholders that the NRC plans to finalize RG 1.183 revision 1 in the second quarter of calendar year 2022.

Following the RG update process discussion, the staff began to discuss technical details of the update. First, the staff informed stakeholders that the expectation is that RG 1.183 revision 1 will not supersede revision 0. The two revisions of the RG will co-exist thus providing two methods acceptable to the NRC staff. The staff clarified that although the two revisions will co-exist, attempts by licensees to combined methods between the two versions of RG 1.183 would need additional justification. Next, the NRC staff discussed the updates that are being considered for revision 1 of RG 1.183. In addition, the staff communicated that during the development of the DG over the next several months the staff will consider the changes proposed in DG-1199 as modified in response to previous public comments. Examples of the changes under consideration from DG-1199 include: guidance for modern fuel utilization; changes due to relevant Regulatory Issue Summaries; clarifying dose terminology; and

removing environmental qualification guidance and referring to RG 1.89, "Qualification of Class IE equipment for Nuclear Power Plants."

NRC staff continued the presentation discussing the work staff has performed to assess the applicability of RG 1.183 for reviewing ATF, high-burnup and extended enrichment for the purposes of accident dose analyses. The Nuclear Energy Innovation and Modernization Act (NEIMA) has directed the NRC to be prepared to license ATF so staff have been actively working to meet the direction of NEIMA. Specifically, the NRC staff have been assessing the appropriateness of expanding applicability of LOCA fission product fractions and release phases. NRC staff informed stakeholders that staff recently performed an assessment with recommendations (ADAMS Accession No. ML20126G376) using accident source terms from Sandia National Laboratories (SNL) report SAND2011-0128, "Accident Source Terms for Light-Water Nuclear Power Plants Using High-Burnup or MOX Fuel," (ADAMS Accession No. ML20093F003) and non-LOCA source terms based on Fuel Analysis under Steady-state and Transients (FAST) fuel performance code calculations (similar to those calculated in DG-1199) to serve as a basis for a revision to RG 1.183. The assessment determined: the appropriateness for near-term designs (e.g., chromium-coated cladding and chromia-doped fuel) of burnups up to 68 GWd/MTU, excluding potential impacts related to fuel fragmentation, relocation, and dispersal; and enrichment between 5 to 8 percent.

The NRC staff further discussed how DG-1199 contained several components for non-LOCA release fractions including: revised RG 1.183 Table 3 non-LOCA release fractions based on an expanded power profile; new Table 4 reactivity-initiated accident (RIA) transient fission gas release fractions; and a new analytical procedure for revising release fractions. The planned updates the NRC staff are considering pertaining to non-LOCA release fractions include: 1) maintaining Table 3 release fractions up to 62 GWd/MTU rod average burnup; 2) a new table for release fractions with expanded applicability up to 68 GWd/MTU rod average burnup; 3) an updated Table 4 RIA transient fission gas release including burnup-dependent correlations; and 4) updating example calculations based on FAST. Staff informed stakeholders during this meeting that many of these planned updates were included in DG-1327, "Pressurized Water Reactor Control Rod Ejection and Boiling Water Reactor Control Rod Drop Accidents" (ADAMS Accession No. ML16124A200). However, staff determined that RG 1.183 would be the appropriate place for these updates. Specifically, during the public comment period for DG-1327, the NRC received several public comments on planned updates for non-LOCA release fractions. In response, NRC staff communicated that during the development of the DG for RG 1.183 revision 1 that the staff's disposition of certain public comments received on DG-1327 would be reflected.

The staff communicated that the NRC's FAST calculations have extended the rod average power profiles out to 68 GWd/MTU. The initial calculations have shown no increase in release fractions. In preparation for the development of the DG for RG 1.183 the NRC staff asked some specific questions during this public meeting. These questions included: 1) Is extrapolation of the prior fuel rod power envelope out to 68 GWd/MTU sufficient to support future reloads; 2) How should BWR partial length fuel rods be addressed in guidance; and 3) How should Gadolinia fuel rods be addressed in guidance?

During the meeting, industry stakeholders informed the staff that a better understanding of the rod average burn-up curves is needed to better understand if the NRC's proposed guidance would be sufficient to support future reactor fuel loads. In addition, industry stakeholders informed staff that there is potential for the need to go beyond 68 GWd/MTU and asked the staff whether the NRC has considered extending the rod average power profiles out to 75 GWd/MTU. Further, stakeholders asked the NRC staff if there was a timeframe for when staff could extend the rod average power profiles to 75 GWd/MTU. The NRC staff informed stakeholders that currently the staff does not have enough data to close the gap to use FAST to extend the rod average power profiles out to 75 GWd/MTU. Staff communicated that the current objective of the revision is to provide guidance for extending the rod average power profiles out to 68 GWd/MTU based on the data the staff currently has. Licensees would be able to implement higher fuel burnup (e.g., 75 GWd/MTU) by establishing plant-specific or fuel rod design-specific release fractions following the analytical procedure which will be included in the guidance along with an approved fuel rod thermal-mechanical model.

The discussion continued with the stakeholders questioning whether any of the proposed changes in the guidance would allow licensees to increase fuel burn-ups using the 10 CFR 50.59, "Changes, tests, and experiments" process. The staff clarified that in order for licensees to increase fuel burn-ups, licensees would be required to submit a licensee amendment request consistent with 10 CFR 50.90, "Application for amendment of license, construction permit, or early site permit."

Next, the staff communicated that the NRC has developed an alternative fuel handling accident (FHA) model to demonstrate compliance with the various numerical radiological criteria set forth in regulation (e.g., 10 CFR 50.67, 10 CFR 100.11, and 10 CFR Part 50 General Design Criteria 19). The current technical basis for the fission product transport model is largely contained in studies reported from the early 1970s. A staff review of the current NRC staff practices and assumptions for the FHA analysis identified considerable margin exists regarding the scrubbing effects of iodine in the spent fuel or reactor pool water, as captured in NRC memorandum "Closeout to Research Assistance Request for Independent Review of Regulatory and Technical Basis for Revising the Design-Basis Accident Fuel Handling Accident" (ADAMS Accession No. ML19270E335). In addition, the staff identified that improvements to the fission product transport model can provide operations flexibility and increase staff review efficiencies while still maintaining conservatism. The alternative FHA model incorporates several improvements in the NRC's current understanding of reactor fuel pin physics and iodine chemistry. After development of the alternative FHA model, the staff performed a case study to determine the impact of the model on current licensing-basis FHA analyses. The case study showed that dose estimates at the applicable dose-receptors are 91-98% lower than those computed with the current FHA models.

Staff continued the presentation by discussing how revision 0 of RG 1.183 does not include an acceptable method for aerosol deposition in the main steam lines. As a result, the staff communicated that adding a method for aerosol deposition models is being considered for RG 1.183 revision 1. In the past, licensees have used a method which was developed by NRC staff to review the Perry pilot submittal also known as AEB-98-03, "Assessment of Radiological Consequences for the Perry Pilot Plant Application using the Revised (NUREG-1465) Source Term," (ADAMS Accession No. ML011230531) while some licensees have used other

proprietary methods. During implementation of AEB-98-03 in several LARs, the NRC staff noted a few issues. In response to these identified issues, the NRC staff issued Regulatory Issue Summary 2006-04 (RIS 2006-04), "Experience with Implementation of Alternative Source Terms" (ADAMS Accession No. ML053460347). RIS 2006-04 was meant to communicate to licensees the information NRC staff would need to approve amendments that utilized AEB-98-03. In addition, the NRC staff worked with SNL to develop a holistic, state of the art model for aerosol deposition in the main steam lines and condenser. This model was documented in SAND2008-6601, "Analysis of Main Steam Isolation Valve Leakage in Design Basis Accident Using MELCOR 1.8.6 and RADTRAD" (ADAMS Accession No. ML083180196). This model was also included in DG-1199. However, as of now, no applicant or licensee has adopted the methodology from SAND2008-6601. The NRC informed stakeholders that the staff's intent is to consider stakeholder feedback to inform the NRC's decision on what methodology to include in RG 1.183 revision 1. Following this discussion, external stakeholders asked NRC staff whether a licensee or applicant could use RG 1.183 revision 0 and the AEB-98-03 methodology. NRC staff clarified that RG 1.183 revision 0 does not specifically refer to AEB-98-03, with RIS 2006-04 stating that it is acceptable with appropriate justification. The NRC has accepted some LARs using the AEB-98-03 methodology, with additional conservatism. In addition, the staff clarified that if a licensee uses RG 1.183 revision 0 and the AEB-98-03 methodology, it will be evaluated by the staff on a case by case basis.

The NRC staff continued the meeting by discussing several lessons learned from licensing reviews that the staff are considering providing clarification for in revision 1 of RG 1.183. The items include: 1) expectations for containment spray in BWR drywells; 2) expectations for performing and using sensitivity analysis; 3) whether crediting pathways should be consistent with design requirements for safety; 4) when the loss of offsite power is assumed to occur in the design basis accident; and 5) expectations for BWR MSIV leakage LOCA analysis assumptions with respect to pipe breaks.

In addition, the staff discussed plans for the use of risk and engineering insights as directed by the Commission in Staff Requirements Memorandum for SECY-19-0036, "Applications of The Single Failure Criterion to NuScale Power LLC's Inadvertent Actuation Block Valves" (ADAMS Accession No. ML19060A081). In response to the Commission direction, the NRC staff reviewed four LARs requesting changes to BWR MSIV leakage limits and issued safety evaluations supported by risk and engineering insights. The staff developed the risk and engineering insights through a technical assessment considering over 20 years of operational and seismic experience. The staff informed stakeholders that this assessment will be made publicly available for feedback via the NRC's Interim Staff Guidance (ISG) process. The ISG under development is intended to be used by the NRC technical reviewers for qualitative risk-informed insights related to the power conversion system (PCS) providing for deposition of radionuclides and delay of releases.

The staff also communicated that the NRC is exploring an overall streamlined approach for providing quantitative credit for hold-up and retention of MSIV leakage within the PCS for BWRs. During the meeting staff asked external stakeholders whether there is interest in a streamlined approach and if there are any portions of the alternative pathway justification (e.g., pathway availability, seismic robustness steps, etc.) in RG 1.183 revision 0 that are resource intensive. In response, industry stakeholders asked whether the NRC staff are using past

precedents as a framework for this streamlined approach. The NRC staff clarified that currently the streamlined approach considers past precedents in the development of a framework to provide quantitative credit for hold-up and retention of MSIV leakage within the PCS. Industry stakeholders also asked if other risk insights were considered such as the very low likelihood of the input assumptions provided in RG 1.183 actually occurring. The staff responded that during the review of the LARs regarding MSIV leakage, an integrated review team was formed to develop and use risk insights. Several risk insights were developed, however, the staff focused on the condenser and later the PCS holdup volumes because of the significant reduction in the calculated dose to account for uncertainties in other areas of the dose calculation. The staff is open to receive feedback on any other risk insights that would be appropriate to consider for the RG update.

Lastly, the staff discussed the consideration of revising footnote 7 of RG 1.183 revision 0 which provides an incorrect method for converting thyroid dose to total effective dose equivalent (TEDE). During the development of RG 1.183 revision 0, the ACRS recommended to the staff that a method be provided in the RG to convert from thyroid dose to TEDE as a screening criterion for 10 CFR 50.59 changes. Upon further staff review it was determined that the method provided in footnote 7 is incorrect. The method in footnote 7 implies a back-of-the-envelope calculation which converts between International Commission on Radiological Protection (ICRP) Publication 2 "Report of Committee II, Permissible Dose for Internal Radiation," and ICRP Publication 26 "Recommendations of the International Commission on Radiological Protection" and ICRP Publication 30, "Limits for Intakes of Radionuclides by Workers" dosimetry methodologies. However, there is no methodology to convert between these two systems of dosimetry. In order to correctly calculate the radiological dose consequences for design basis accidents the appropriate dose methodology must be applied.

The NRC staff ended the public meeting presentation by reviewing the schedule for the revision of RG 1.183. Staff communicated that the staff will continue to consider feedback received from stakeholders to develop a draft RG 1.183 revision 1. The staff are planning on holding an additional public meeting in the first quarter of calendar year 2021 to further discuss the key elements of the draft RG 1.183 revision 1. The current staff schedule plans for an agency draft RG 1.183 revision 1 (DG) to be formally issued for public comment in the fourth quarter of calendar year 2021. After the public comment period for the DG the staff will review and disposition any public comments that are received and update the DG as necessary, with plans to issue RG 1.183 revision 1 in the second quarter of calendar year 2022.

Public Feedback

There was no feedback provided by members of the public during the public meeting. However, after the meeting the NRC staff received feedback from a member of the public via email (See ADAMS Accession No. ML20343A064 and ML20351A321).

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Meeting Attendance List:

A total of 138 people attended the meeting via teleconference; however, only speakers for this meeting are listed below.

Mark Blumberg	NRC	Tom Eichenberg	TVA
Paul Clifford	NRC	Shane Gardner	Exelon
Elijah Dickson	NRC	Steve Geier	NEI
Mike Franovich	NRC	Lisa Gerken	Framatome
Michelle Hart	NRC	Ben Holtzman	NEI
John Parillo	NRC	Stan Jones	Framatome
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