

March 1, 2017

Dr. Ralph Meyer  
28705 Hope Circle  
Easton, MD 21601

Dear Dr. Meyer:

I am writing to follow up on your letter dated August 7, 2016, requesting that the U.S. Nuclear Regulatory Commission (NRC) perform *de novo* reviews of ballooning (swelling) and rupture models used in licensees' Loss-Of-Coolant Accident analyses required by Title 10 of the *Code of Federal Regulations* (10 CFR) 50.46, "Acceptance criteria for emergency core cooling systems for light water nuclear power reactors." In a letter dated September 22, 2016, the NRC informed you that staff evaluated your request and determined it refers to a generic technical matter rather than a request to modify, suspend, or revoke a license. In addition, the NRC staff committed to engage with you to better understand your technical concerns and then respond to them by separate letter.

On December 14, 2016, NRC staff conducted a conference call with you to gain a better understanding of your technical concerns and provide some additional information. The NRC staff who participated in the call expressed that the call was productive and that it was very valuable to get a better understanding of your technical concerns. Nevertheless, the staff concluded that the information presented during the call was not sufficient to justify a *de novo* review of vendor strain models that have been previously reviewed and approved by the agency.

This letter and the attached meeting summary will be placed in NRC's Agencywide Documents Access and Management System as publicly available documents. Thank you for sharing your concerns and engaging in the regulatory process.

Sincerely,

**/RA/**

Robert M. Taylor, Acting Director  
Division of Safety Systems  
Office of Nuclear Reactor Regulation

Enclosure:  
Summary of Conference Call with Dr. Ralph Meyer  
on December 14, 2016

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## **SUMMARY OF CONFERENCE CALL WITH DR. RALPH MEYER**

On December 14, 2016, U.S. Nuclear Regulatory Commission (NRC) staff conducted a conference call with Dr. Ralph Meyer regarding technical concerns he raised in an August 7, 2016 (ML16238A507) letter. In addition to Dr. Meyer, the participants in the call were Michelle Bales, Harold Scott and Ian Porter from the Office of Nuclear Regulatory Research (RES) and Paul Clifford, John Lehning, and Benjamin Parks from the Office of Nuclear Reactor Regulation (NRR).

The following background was provided at the start of the call:

In the letter dated, August 7, 2016, Dr. Meyer (ML16238A507) requested that the NRC perform *de novo* reviews of ballooning and rupture models used in licensees' LOCA analyses required by Title 10 of the Code of Federal Regulations (10 CFR) 50.46, "Acceptance criteria for emergency core cooling systems for light water nuclear power reactors."

NRR staff responded by letter on September 22, 2016 (ML16263A198). The letter stated that Dr. Meyer's request referred to a generic technical matter rather than a request to modify, suspend, or revoke a license. Therefore the letter did not meet the requirements for acceptance as a 2.206 petition. The letter went on to state that, "The staff will engage with [Dr. Meyer] to better understand [his] technical concerns and then respond to them by separate letter." In October, the staff provided Dr. Meyer with talking points (ML16285A527) for a potential future conference call. Dr. Meyer responded by email (ML16320A483) with some commentary on the talking points. In the email, Dr. Meyer advocated for the use of statistical modeling for ballooning behavior, rather than simply updating, improving or confirming balloon models remain appropriate for new alloys.

The objective of the conference call was to gain a better understanding of Dr. Meyer's technical concerns and provide some additional information related to his letter and later email.

Dr. Meyer then had an opportunity to elaborate on the following points:

Dr. Meyer disagreed with the NRC determination that his request did not meet the criteria for review under 10 CFR 2.206. The NRC letter of September 22, 2016, stated that his request did not include a request to modify, suspend, or revoke a license. Dr. Meyer pointed out that the language of 2.206 in full states, "Any person may file a request to institute a proceeding pursuant to § 2.202 to modify, suspend, or revoke a license, or for any other action as may be proper" and that he believes his letter identified "other action as may be proper."

Dr. Meyer expressed concern that the ECCS safety assessment of February 10, 2012, is not accurate because it necessarily relied on results from vendor codes, which Dr. Meyer believes are suspect. Dr. Meyer expressed that he sees a vulnerability for industry to "game the system" with balloon models. Dr. Meyer also stated that he believes balloon models were never critically reviewed.

**ENCLOSURE**

Dr. Meyer referred to a figure on page two of his letter, which showed measurements of circumferential strain as a function of rupture temperature. The graph indicates a large amount of scatter, which Dr. Meyer explained should be expected due to the stochastic nature of ballooning behavior. Because ballooning behavior is fundamentally stochastic in nature, Dr. Meyer expressed that he is convinced that mechanistic or empirical strain models can't work. Rather, statistical treatment is needed.

Dr. Meyer also provided an account of events from the 1970s and 1980s to explain the issues raised and resolved in the 1973 ECCS hearings, the history and importance of internal heating in ballooning behavior tests, the basis for NUREG-0630, "Cladding Swelling and Rupture Models for LOCA Analysis" (ML053490337) and his experience as a staff member in the Core Performance Branch in NRR.

The staff responded to Dr. Meyer's points and further discussion included the following topics:

Staff explained that 2.206 petitions require identification of new information that affects at least one licensee, and a request, with sufficient justification, for enforcement-related NRC action (e.g., modification, suspension, or revocation of a license).

Staff responded to Dr. Meyer's characterization of the NRC review of balloon models, by elaborating on several points. First, ballooning models are critically reviewed as a part of staff review of topical reports that describe either proprietary fuel cladding materials, or fuel rod performance analysis codes. Second, these reviews are typically completed before vendors incorporate such models into thermal-hydraulics codes used for Loss-Of-Coolant Accident (LOCA) evaluation. Third, in the discussion, the staff elaborated at a non-proprietary level on some aspects of the most recent fuel performance code reviews that were relevant to the issues raised by Dr. Meyer.

Dr. Meyer expressed concern that the review process did not require review by staff in RES that have extensive knowledge of the nuances and complexities of ballooning behavior. Dr. Meyer also stated his opinion that the vendor ballooning models and their parameters should not be proprietary if they are developed using data from government-sponsored research programs. The NRC staff noted that the reviews of vendor fuel performance codes have been performed by knowledgeable reviewers in NRR, often with assistance from contractors specializing in the area of fuel performance. The staff also noted that the Advisory Committee on Reactor Safeguards has typically reviewed the NRC staff's conclusions regarding vendor fuel performance codes. The NRC staff further discussed at a high level how the agency conducts reviews of vendor determinations of what information can be withheld as proprietary.

The staff expressed continued confidence that approved ballooning models are acceptable for use in LOCA evaluation s. Nevertheless, the staff acknowledged that the state-of-the-art practices for statistical analysis, including statistical treatment of balloon behavior, have not yet been incorporated into regulatory guidance. The staff stated their intention to incorporate state-of-the-art methods and lessons learned from recent code reviews into a future update of Regulatory Guide 1.157, "Best-Estimate Calculation of Emergency Core Cooling System Performance" (ML003739584). This could include providing an updated position on the use of NUREG-0630 ballooning models for equivalent cladding reacted calculations, along with many other aspects of the guidance related to fuel cladding performance and other LOCA phenomena. The staff noted that revisions to regulatory guidance require concurrence from

RES. Revisions to regulatory guidance also require public comment, which would provide an opportunity for international experts, responsible for experimental programs to characterize and model ballooning behavior, to review and comment.

At the end of the call, Dr. Meyer agreed that his technical concerns appeared to be sufficiently understood by the staff and that the staff had adequately explained their position. Dr. Meyer repeated his position that the staff should perform a *de novo* review of at least one or two strain models and confirm the adequacy of the empirical database used in the model development. The NRC staff concluded that the information presented by Dr. Meyer is not sufficient to justify a *de novo* review of vendor strain models that have been previously reviewed and approved by the agency. However, the NRC staff agreed that NRR staff would conduct an internal seminar on one or more recently approved vendor strain models to ensure sufficient alignment between cognizant reviewers in both RES and NRR.