



**UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, DC 20555 - 0001**

April 21, 2021

Ms. Margaret M. Doane
Executive Director for Operations
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

**SUBJECT: REGULATORY GUIDE 4.26, "VOLCANIC HAZARDS ASSESSMENT
FOR PROPOSED NUCLEAR POWER REACTOR SITES"**

Dear Ms. Doane:

During the 684th meeting of the Advisory Committee on Reactor Safeguards (ACRS), April 8-9, 2021, we reviewed Regulatory Guide 4.26, "Volcanic Hazards Assessment for Proposed Nuclear Power Reactor Sites." Our Future Plant Designs and Regulatory Policies and Practices Subcommittees also reviewed this matter during a meeting on February 20, 2020. During these meetings we had the benefit of discussions with representatives of the NRC staff and other stakeholders. We also had the benefit of the referenced documents.

CONCLUSIONS AND RECOMMENDATIONS

1. Regulatory Guide 4.26 provides reasonable guidance for conducting volcanic hazards assessments for nuclear facilities.
2. The staff should consider enhancing the text as described in this report. Trial applications of the guide for specific facilities and locations are needed to ensure it can be effectively and efficiently applied. Any problems identified during trial applications should be addressed by timely revisions.
3. Research is needed to establish the impact of volcanic hazards on the performance of equipment and personnel, inside and outside a facility, if applicants and staff are to fully implement the proposed analyses.

BACKGROUND

The NRC staff is preparing to review and regulate a new generation of nuclear power reactors. It has become apparent that some developers and vendors might site a reactor in an area of potential volcanic hazard. In the past, the staff had conducted reviews of volcanic hazards for

existing facilities but had not issued guidance on considering these hazards. We reviewed Draft Regulatory Guide (DG)-1364 (renumbered to DG-4028) on this topic.

DISCUSSION

DG-4028 was issued for public comment about a year ago. Most public comments and issues discussed at our Subcommittee meeting were incorporated into a new Regulatory Guide 4.26. In developing the guide, the staff relied heavily on two International Atomic Energy Agency documents—Technical Document (TECDOC)-1795 and Special Safety Guide (SSG)-21—as well as NRC reports on previous reviews of volcanic hazard assessments and guidance on other environmental hazards.

Section B of the guide, “Discussion,” provides an overview of the kinds of hazards volcanic eruptions present, the kinds of volcanic activity to be considered, and the indications that evidence of past volcanic activity may present a risk today. It describes an acceptable approach for a volcanic hazards assessment but does not define the details of performing the associated analyses. It does provide citations to existing technical documents that give more details. Rather than providing a prescriptive recipe, the staff urges applicants to engage in pre-application discussions of their specific site, the associated volcanic hazards, and facility design details, to seek agreement on the best detailed approach. In a number of areas, substantial new descriptive text was added to clarify issues that caused confusion. These include developing a rationale for the regions of interest, considerations of proximate hazards, the development of a tectono-magmatic model, some details of using a risk-informed approach, and the use of expert judgment in an approach based on the Senior Seismic Hazards Analysis Committee approach.

Section C, “Staff Regulatory Guidance,” (the technical positions) describes a general approach for organizing the assessment that provides a graded process for the risk-informed evaluation of volcanic hazards. The details of how an applicant might implement this process are again not prescribed, and again references are provided for detailed methodologies. The process is outlined in a seven-step flowchart. The flowchart has been improved and the descriptions of each of the steps have been expanded and clarified. There is an initial screening process that would eliminate detailed consideration of volcanic hazards at most sites. This is followed by two possible pathways through the flowchart: a bounding approach with specified screening levels and a probabilistic hazard analysis. When the staff discussed these pathways with us, they used two copies of the flowchart with the paths highlighted. This would be a nice enhancement for the guide to make these alternatives more salient. Also, reordering the discussion to put the screening pathway first would emphasize the graded approach.

There are several areas where additional clarification is needed. If an applicant chooses (or is driven to) a probabilistic hazard analysis and associated probabilistic risk assessment, there is no guidance on equipment failure rates, conditional on a particular volcanic hazard. Admittedly, this is a difficult problem. We suggested several possible sources of such information but expect that research will be needed for resolution. This can be done separately from this regulatory guide, but the guide currently indicates that ASME/ANS-RA-S-1.4-2020 and NEI 18-04 provide sufficient guidance on this issue. However, these documents only warn analysts to consider such challenges.

An associated situation deserves expanded discussion in the guide. Steps 6 and 7 of the process (evaluate structure, system, and component performance in the presence of a volcanic hazard and evaluate possible mitigating actions) must be approached with clear knowledge of the pernicious effects of very fine ash. It can get into unexpected places and can be difficult to clear. Possible mitigating actions must be examined in this light. These actions should also be carefully evaluated for unintended consequences.

We raised the issue of possible impacts on a proposed facility by failures in nearby facilities caused by the same volcanic event. This would in principle be covered by a review of other manmade hazards, but, because volcanic events are outside our normal considerations and such analyses are reviewed separately, a caution in Regulatory Guide 4.26 to coordinate the reviews would be useful.

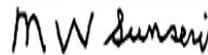
The title of Regulatory Guide 4.26 refers to nuclear power reactor sites. However, this guide can equally apply to any nuclear facility. Changing the title to refer to 'facilities' rather than 'reactors' would be consistent with shifting the regulatory guide from Division 1 on reactors to Division 4 on environmental and siting topics.

Some participants in our meeting suggested that pilot studies are needed to ensure the approach described in the regulatory guide can be used effectively and efficiently as currently organized. We agree that trial applications are needed, but find it important to publish the guide now, before anticipated applications arrive. The staff should plan to revise the guide as necessary, as trials progress.

SUMMARY

The staff has brought together a broad base of knowledge and organized it in an accessible way. Regulatory Guide 4.26 provides reasonable guidance for conducting volcanic hazards assessment for nuclear facilities and should be issued for trial use. The staff should consider enhancing the text as described in this report. They should support trial applications of the guide for specific facilities and locations to ensure it can be effectively and efficiently applied. Research is needed on the impact of volcanic hazards on the performance of equipment and personnel, inside and outside a facility, if applicants and staff are to fully implement the proposed analyses.

Sincerely,



Signed by Sunseri, Matthew
on 04/21/21

Matthew. W. Sunseri
Chairman

REFERENCES

1. U.S. Nuclear Regulatory Commission, "Volcanic Hazards Assessment for Proposed Nuclear Power Reactor Sites," Draft Regulatory Guide 4.26, Revision 0, April 2021 (ML21064A403).
2. U.S. Nuclear Regulatory Commission, "Volcanic Hazards Assessment for Proposed New and Advanced Nuclear Power Reactor Sites," Draft Regulatory Guide 4028, February 2020 (ML20007D621).
3. International Atomic Energy Agency, "Volcanic Hazard Assessments for Nuclear Installations: Methods and Examples in Site Evaluation," IAEA TECDOC 1795, 2016.
4. International Atomic Energy Agency, "Volcanic Hazards in Site Evaluation for Nuclear Installations," Specific Safety Guide SSG-21, 2012.
5. The American Society of Mechanical Engineers, "Probabilistic Risk Assessment Standard for Advanced Non-LWR Nuclear Power Plants," ASME/ANS-RA-S-1.4-2020, 2020.
6. Nuclear Energy Institute, "Risk-Informed Performance-Based Technology Inclusive Guidance for Non-Light Water Reactor Licensing Basis Development," NEI 18-04, Revision 1, August 2019 (ML19241A472).

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