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

March 21, 2017

Mr. Victor M. McCree
Executive Director for Operations
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: NRC NON-LIGHT WATER REACTOR VISION & STRATEGY – NEAR-TERM IMPLEMENTATION ACTION PLANS AND ADVANCED REACTOR DESIGN CRITERIA

Dear Mr. McCree:

During the 641st meeting of the Advisory Committee on Reactor Safeguards, March 9-11, 2017, we reviewed the "NRC Non-Light Water Reactor (Non-LWR) Vision and Strategy Staff Report: Near-Term Implementation Action Plans," volumes 1 and 2 and draft regulatory guide DG-1330, "Guidance for Developing Principal Design Criteria for Non-Light Water Reactors." Our Future Plant Designs Subcommittee also reviewed this matter during meetings on February 22 and March 8, 2017. During these meetings we had the benefit of discussions with representatives of the NRC staff, the Department of Energy, and the nuclear industry, including advanced non-LWR developers. We also had the benefit of the referenced documents.

FINDINGS AND RECOMMENDATIONS

1. The draft NRC non-light water reactor vision and strategy – near-term implementation action plan reports represent a reasonable beginning and should be issued.

2. The highest priority should be given to implementing action plan Strategy 3, a flexible regulatory review process, and Strategy 5, technology-inclusive policy issues.

3. Development of the advanced reactor design criteria as described in draft regulatory guide DG-1330 is progressing and should continue.

4. Strategy 3, Contributing Activity 3.2, which develops approaches to licensing bases and will determine licensing bases for non-LWR technologies, is particularly important to implement early on. Identification of technology-specific licensing basis events need to be developed to ensure that the associated design criteria are complete.

5. The staff should consider making a number of the design criteria more explicit, as described in this report.

BACKGROUND

The NRC is developing its vision and strategy implementation action plans (IAPs) to assure staff readiness to efficiently and effectively conduct its mission, as it prepares to review and regulate a new generation of non-LWRs. In July 2016, the NRC published a draft vision and strategy document for public comment in the *Federal Register*. The details of the NRC IAPs were issued for public information in two volumes: Volume 1, an executive level summary including overviews of six individual strategies and contributing activities in the near-term IAPs, and Volume 2, providing the detailed IAPs for each strategy. Volume 2 addresses the readiness actions to be taken in the next five years (the near-term activities), and have been supplemented with mid-term and long-term plans, a draft of which was made public on February 24, 2017. The staff continues its work on the action plans through public meetings with stakeholders. Our Future Plant Designs Subcommittee reviewed the draft IAPs in a public meeting on March 8, 2017.

As part of developing a non-LWR regulatory review process (Strategy 3), the staff developed a draft regulatory guide, DG-1330, and issued it for public comment in February 2017. It describes the NRC's proposed guidance on how the general design criteria (GDC) in 10 CFR Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants," apply to non-LWR designs. Our Future Plant Designs Subcommittee reviewed the design criteria in a public meeting on February 22, 2017.

DISCUSSION

The staff has embarked upon developing a regulatory strategy for the safety evaluation of reactor designs that lack a substantial background of operational experience and accident analyses. This is enormously challenging. It places a premium on reviewers having a 'questioning, skeptical attitude' and a breadth of knowledge about the technologies being employed.

Advanced Reactor Implementation Action Plans

The NRC vision and strategy to assure readiness to review new non-LWR applications are reaching a suitable level of maturity for broad review concurrently with initial implementation. The six associated strategies cover all the activities we find necessary:

1. Knowledge, technical skills, and capacity
2. Computer codes and tools – this strategy includes data and methods needed to help resolve science and engineering technical gaps and uncertainties
3. Flexible regulatory review process
4. Industry codes and standards
5. Technology-inclusive policy issues
6. Communications.

Specific IAPs have been detailed to support each of the six strategies. We find that Strategies 3 and 5 are the keys to carrying out the other IAPs. Contributing Activity 3.2, which develops approaches for selecting licensing bases and events for non-LWR technologies, is particularly important. Identification of licensing basis events will help ensure that the associated design criteria are complete. This needs to be accomplished as early as possible, within the 'near-term' activities of the first five years, if the goals of the NRC and developers are to be met.

The staff should prioritize the schedule for completing all the strategies. Activities in Strategies 3 and 5 should have the highest priority.

Initial Strategy 2 effort should focus on tasks that will identify data and knowledge gaps, rather than activities related to model and code development. The detail in Strategy 2 is inconsistent with the detail in the other five strategies. It is a list of phenomenological topics, with no stated process for determining need or priority. The staff should first develop physical insights about the new reactor concepts. One way to do this is to collect experimental data relevant to the likely designs and concentrate on code benchmarking efforts instead of attempting to develop new codes.

There is growing reliance on modeling and simulation to address issues of safety. The staff is evaluating when experimental data are required to validate the results obtained from modeling and simulation. We would go further and ask the staff to develop associated bases that indicate when experimental data are needed. When applications are submitted, the staff should ensure that applicants provide sufficient experimental data to support calculations and design conclusions.

Issuance of final license or certification based on a risk-informed approach requires a complete design, understanding of operations, and probabilistic risk assessment. However, during the design development process, risk insights can be used to improve the design. The staff and the applicant need to place a greater emphasis on the use of quantitative risk analysis for the identification of areas for safety evaluation of innovative designs. There are many examples in the nuclear industry, as well as the process and aerospace industries, where design and risk assessment have progressed in parallel.

There is an obligation under NRC regulations for an applicant to be responsible for assuring the adequate quality of information presented in its application. In developing a review plan, the staff should not imply that its own role is to validate the information that is presented in support of an application. Rather, the staff should make clear that its role is to ensure that the information submitted by an applicant has been developed and validated by the applicant, in accordance with the programmatic requirements of 10 CFR Part 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants." Urgency in the progression of licensing puts a premium on the quality of applications submitted to the NRC. It is the responsibility of an applicant to assure this quality and implement appropriate corrective action when errors are found. An applicant does need, however, guidance and advice from the staff prior to submission of the application.

The near-term IAP for Strategy 1 focuses on identification of work, critical skills, and staff capacity requirements with assessment of the staff's current non-LWR technical readiness, and technical readiness gap closure by a variety of methods. The mid-term and long-term IAPs will address related long-range training and staff development, mentoring programs, and attrition planning. We would like the staff to identify, in their planning documents, how the near-term training meshes with expected application reviews and how the staff plans to leverage past Department of Energy efforts.

The near-term IAP for Strategy 6, communications, is a reasonable first step; however, the staff needs to reach out further to the larger technical community that can be found in the professional societies such as the American Nuclear Society and the Health Physics Society. The staff has focused on standards committees to a large extent and does not take advantage of the larger professional cohorts and their combined expertise to discuss, test, and challenge these concepts.

Advanced Reactor Design Criteria

Strategy 3 of the IAPs includes development of the advanced reactor design criteria (ARDC). The draft guide on design criteria includes technology-specific criteria for sodium-cooled fast reactors and modular high-temperature gas-cooled reactors (MHTGR), as well as general ARDC that the staff expects to be applicable to most other designs.

MHTGR Design Criterion 10, as presently written, is cryptic. The phrase, 'specified acceptable system radionuclide release design limit' (SARRDL), needs to be clearly defined. Replacing the GDC specific acceptable fuel design limit (SAFDL) concept with the proposed SARRDL concept in the ARDCs is acceptable. However, during design, reactor designers will need to develop their own design-specific limits in order to characterize and evaluate their reactor design. The new SARRDL concept requires additional analysis that the staff will have to review and approve. Later, during operation, licensees will monitor both circulating activity and plate-out activity to ensure acceptable fuel performance, i.e., as evidence that the SARRDLs are being met.

ARDC 16, the functional containment performance requirement, is vague and needs to be defined. For example, the phrases 'essentially leak tight' or 'low leakage' are not adequately defined. An examination for the possibility of reactor pressure boundary failure to induce containment failure should be included explicitly.

The staff should improve the clarity of ARDC 17 with respect to the term 'vital functions.' Even if electric power is not needed for operational equipment, reliable power is still needed for monitoring plant status, habitability, lighting, and communications.

ARDC 26 eliminated the GDC 26 requirement for controlling the rate of reactivity changes resulting from planned, normal power changes. For harder spectrum reactors, particularly for liquid fuel systems, control of the rate of reactivity insertion can be very important and should be retained.

Finally, it would be useful to ensure that the language of the ARDCs facilitate, or at least does not preclude, the use of probabilistic risk assessment, especially in areas where graded compliance is suggested.

Sincerely,

/RA/

Dennis C. Bley
Chairman

REFERENCES

1. U.S. Nuclear Regulatory Commission, "NRC Non-Light Water Reactor (Non-LWR) Vision and Strategy Staff Report: Near-Term Implementation Action Plans, Volume 1 – Executive Information," Draft, November 5, 2016 (ML16264A023).

2. U.S. Nuclear Regulatory Commission, "NRC Non-Light Water Reactor (Non-LWR) Vision and Strategy Staff Report: Near-Term Implementation Action Plans, Volume 2 – Detailed Information," Draft, November 30, 2016 (ML16270A217).

3. U.S. Nuclear Regulatory Commission, Draft Regulatory Guide DG-1330, "Guidance for Developing Principal Design Criteria for Non-Light-Water Reactors," February 2017 (ML16301A307).

4. U.S. Nuclear Regulatory Commission, "NRC Advanced Reactor Vision and Strategy: Mid-Term and Long-Term Implementation Action Plans," Draft, February 24, 2017 (ML17054D483).

5. U.S. Nuclear Regulatory Commission, "A Regulatory Review Roadmap for Non-Light Water Reactors," Draft, October 2016 (ML16291A248).

6. U.S. Nuclear Regulatory Commission, "NRC Vision and Strategy: Safely Achieving Effective and Efficient Non-Light Water Reactor Mission Readiness," Draft Revision 1, July 15, 2016 (ML16139A812).

7. U.S. Nuclear Regulatory Commission, "Next Generation Nuclear Plant Assessment of Key Licensing Issues," July 17, 2014 (ML14174A626).

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