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

October 06, 2020

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

SUBJECT: FINAL SAFETY EVALUATION REPORT FOR TOPICAL REPORT, FRAMATOME TOPICAL REPORT ANP-10337, REVISION 0, SUPPLEMENT 1P, REVISION 0, "DEFORMABLE SPACER GRID ELEMENT"

Dear Ms. Doane:

During the 678th meeting of the Advisory Committee on Reactor Safeguards, September 9-11, 2020, we reviewed the Framatome, Inc. (Framatome), Topical Report ANP-10337, Revision 0, Supplement 1P, Revision 0, "Deformable Spacer Grid Element" (Supplement 1), and the associated safety evaluation report (SER). Our Metallurgy and Reactor Fuels Subcommittee also reviewed this matter on July 7, 2020. During these meetings, we had the benefit of discussions with the staff and representatives of Framatome. We also had the benefit of the referenced documents.

## CONCLUSIONS AND RECOMMENDATIONS

1. Supplement 1 provides an adequate description of the addition of a non-linear deformable grid element (DGE) to the base cases described in the approved AREVA Topical Report ANP-10337P. The DGE provides for increased accuracy of grid deformation during seismic and Loss-of-Coolant Accident (LOCA) events.

2. The advanced methodology proposed in Supplement 1 allows analysis of advanced spacer grid designs in response to seismic and LOCA events, subject to the limitations and conditions specified in the SER.

3. The staff SER should be issued.

## BACKGROUND

Licensees are required to evaluate the fuel assembly structural response to seismic (safe-shutdown earthquake) or LOCA events to ensure that regulatory requirements are met with respect to fission gas release, fuel rod structural integrity, control rod insertability and core

coolability. In particular, the spacer grid performance is assessed to confirm that any permanent deformation of the grid remains within acceptable limits. The “base” analysis methodology is described in the approved ANP-10337P. The acceptance criteria for spacer grid performance are based on the expectation that the spacer grid will essentially maintain its original shape. Therefore, control rod insertability and core coolability will not be affected. However, there are some grid designs for which a non-linear deformation response may occur. Supplement 1 describes the implementation of an advanced element to augment the base methodology described in the approved ANP-10337P. The methodology proposed in Supplement 1 allows for analysis of spacer grid designs that may exhibit non-linear impact responses and/or accumulate permanent deformation.

## DISCUSSION

The base methodology within the approved ANP-10337P defines a generic modeling and analysis methodology to describe the structural response of pressurized water reactor fuel assemblies to applied loads in the horizontal and vertical directions. The base methodology includes finite element models, instructions on how to define the finite element models from test data, instructions on how to interpret the finite element model results, and acceptance criteria that the results of the finite element models are to be compared against to demonstrate that the design bases are met. The approved ANP-10337P also includes descriptions of the mechanical testing required, assumptions related to the methodology, and built-in limitations of the fuel assembly behavior.

The approved ANP-10337P remains acceptable and applicable for many grid designs. However, some modern grids behave differently under external loads and may be outside the applicability limits of ANP-10337P. Supplement 1 implements an advanced spacer grid model and associated changes to the base methodology to support these new grid designs. The DGE was developed to represent the behavior of new spacer grid designs and to predict spacer grid residual deformation under seismic and LOCA conditions. The procedure to define the numerical models to capture the dynamic response of the fuel assembly was altered by the inclusion of the advanced grid element. The primary outputs from the analysis are the spacer grid deformations due to spacer grid impacts, and the deflections experienced by the fuel assemblies.

Supplement 1 defines specific spacer grid behavior that must be satisfied for the methodology to be applicable. In their review, the staff explored topics such as test data requirements, the applicability of the confidence limit, and the impact of mixed cores. An independent analysis led to the staff imposing limitations and conditions on the size of the residual deformation and the applicability of the new methodology.

## SUMMARY

Supplement 1 provides an adequate description of the addition of a non-linear DGE to the base cases described in the approved AREVA Topical Report ANP-10337P. The DGE provides for increased accuracy of grid deformation during seismic and LOCA events.

The advanced methodology proposed in Supplement 1 allows analysis of advanced spacer grid designs in response to seismic and LOCA events, subject to the limitations and conditions specified in the SER. The staff SER should be issued.

We are not requesting a formal response from the staff to this letter report.

Sincerely,

Matthew W. Sunseri

Digitally signed by Matthew W. Sunseri
Date: 2020.10.06 11:45:08 -04'00'

Matthew W. Sunseri
Chairman

**REFERENCES**

1. U. S. Nuclear Regulatory Commission, “Final Safety Evaluation for Framatome Topical Report ANP-10337, Revision 0, Supplement 1P, Revision 0, ‘Deformable Spacer Grid Element’,” August 13, 2020 (ML20224A077).

2. Framatome Letter NRC:18:036, “Request for Review and Approval of ANP-10337, Revision 0, Supplement 1P, Revision 0, ‘Deformable Spacer Grid Element’,” September 21, 2018 (ML18268A153).

3. Framatome Topical Report ANP-10337P-A, Revision 0, “PWR Fuel Assembly Structural Response to Externally Applied Dynamic Excitations,” April 2018 (ML18144A816).

4. USNRC Information Notice 2012-09, “Irradiation Effects on Fuel Assembly Spacer Grid Crush Strength,” June 28, 2012 (ML113470490).

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