

VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

January 7, 2021

10 CFR 50.90

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
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Docket Nos.: 50-338
50-339
License Nos.: NPF-4
NPF-7

VIRGINIA ELECTRIC AND POWER COMPANY
NORTH ANNA POWER STATION UNITS 1 AND 2
PROPOSED LICENSE AMENDMENT REQUEST
REVISE REACTOR CORE SAFETY LIMIT TO REFLECT WCAP-17642-P-A,
REVISION 1

Pursuant to 10 CFR 50.90, Virginia Electric and Power Company (Dominion Energy Virginia) requests amendments to North Anna Power Station (NAPS) Units 1 and 2 Facility Operating License Numbers NPF-4 and NPF-7, respectively, in the form of a change to the Technical Specifications (TS). The proposed change revises the TS Reactor Core Safety Limit (SL) 2.1.1.2 to reflect the peak fuel centerline melt temperature specified in WCAP-17642-P-A, Revision 1, "Westinghouse Performance Analysis and Design Model (PAD5)." Attachment 1 provides discussion and evaluation of the proposed change. The marked-up and proposed pages for the TS are provided in Attachments 2 and 3, respectively.

Dominion Energy Virginia has evaluated the proposed amendment and has determined it does not involve a significant hazards consideration as defined in 10 CFR 50.92. The basis for this determination is included in Attachment 1. We have also determined operation with the proposed change will not result in a significant increase in the amount of effluents that may be released offsite or a significant increase in individual or cumulative occupational radiation exposure. Therefore, the proposed amendment is eligible for categorical exclusion from an environmental assessment as set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment is needed in connection with the approval of the proposed change.

The license amendment request has been reviewed and approved by the NAPS Facility Safety Review Committee. Dominion Energy Virginia requests approval of the proposed change by December 30, 2021 with a 90-day implementation period.

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Attachment 1

DISCUSSION OF CHANGE

**Virginia Electric and Power Company
(Dominion Energy Virginia)
North Anna Power Station Units 1 and 2**

DISCUSSION OF CHANGE

1.0 SUMMARY DESCRIPTION

Pursuant to 10 CFR 50.90, Virginia Electric and Power Company (Dominion Energy Virginia) requests amendments to North Anna Power Station (NAPS) Units 1 and 2 Facility Operating License Numbers NPF-4 and NPF-7, respectively, in the form of a change to the Technical Specifications (TS). The proposed change revises the TS Reactor Core Safety Limit (SL) 2.1.1.2 to reflect the peak fuel centerline melt temperature specified in WCAP-17642-P-A, Revision 1, "Westinghouse Performance Analysis and Design Model (PAD5)."

2.0 DETAILED DESCRIPTION

2.1 System Design and Operation

NAPS Units 1 and 2 must ensure acceptable fuel design limits are not exceeded during steady state operation, normal operational transients, and anticipated operational occurrences (AOOs), consistent with the NAPS Units 1 and 2 licensing bases. To accomplish this, the Reactor Core SLs for NAPS Units 1 and 2 specified in TS SL 2.1.1 ensure Departure from Nucleate Boiling (DNB) does not occur and the fuel centerline temperature remains below the fuel melting temperature. The proposed amendment revises the fuel centerline melt temperature specified in SL 2.1.1.2 but does not alter the SL associated with the DNB ratio.

Fuel centerline melting occurs when the local linear heat rate (LHR), or power peaking, in a region of the fuel is high enough to cause the fuel centerline temperature to reach the melting point of the fuel. Expansion of the fuel pellet following centerline melting could cause excessive cladding stress leading to failure of the cladding and uncontrolled release of fission products to the reactor coolant. Overheating of the fuel is prevented by maintaining the steady state peak LHR below the level at which fuel centerline melting occurs.

The proper functioning of the Reactor Protection System and steam generator safety valves prevents violation of the Reactor Core SLs.

2.2 Current Technical Specification Requirement

SL 2.1.1.2 defines the burnup-dependent fuel temperature below which the fuel centerline temperature must be maintained. SL 2.1.1.2 applies during MODES 1 and 2, (i.e. when the reactor is critical) and requires compliance be restored and that the plant be in MODE 3 within 1 hour in the event the SL is violated.

2.3 Reason for the Proposed Change

Plant-specific safety analyses are performed to ensure compliance with the SL is maintained. Westinghouse Performance Analysis and Design Model (PAD5) methodology (Reference 1) defined the fuel pellet melting limit based on available fuel pellet material properties. The NRC staff reviewed and approved the Westinghouse PAD5 methodology and concluded the melting limits defined in Reference 1 are acceptable.

The proposed change will maintain consistency between the value in SL 2.1.1.2 and the criteria used when performing confirmatory safety analyses that rely on the NRC approved methodology in Reference 1.

2.4 Description of Proposed Changes

The proposed change revises the peak fuel centerline temperature specified in SL 2.1.1.2, but does not alter the Required Action that must be taken following a violation of the SL. The following changes are proposed to the NAPS Units 1 and 2 TS.

The current version of SL 2.1.1.2 reads:

“The peak fuel centerline temperature shall be maintained <5080°F, decreasing by 58°F per 10,000 MWD/MTU of burnup, for Westinghouse fuel and <5173°F, decreasing by 65°F per 10,000 MWD/MTU of burnup, for Framatome fuel.”

The revised version of SL 2.1.1.2 would read:

“The peak fuel centerline temperature shall be maintained <5080°F, decreasing by 9°F per 10,000 MWD/MTU of burnup, for Westinghouse fuel and <5173°F, decreasing by 65°F per 10,000 MWD/MTU of burnup, for Framatome fuel.”

The marked-up and proposed pages for the TS are provided in Attachments 2 and 3, respectively.

3.0 TECHNICAL EVALUATION

The principal design tool used by Westinghouse for evaluating fuel rod performance is the Performance Analysis and Design (PAD) code (Reference 1). This computer program iteratively calculates the interrelated effects of fuel and cladding deformations including fuel densification, fuel swelling, fuel relocation, fuel rod temperatures, fill and fission gas release (FGR), and rod internal pressure (RIP) as a function of time and linear power. PAD evaluates the power history of a fuel rod as a series of steady-state power levels with instantaneous jumps from one power level to another. The length of the fuel rod is divided into several axial segments, and each segment is assumed to operate at a constant set of conditions over its length. Fuel densification and swelling, cladding stresses and strains, temperatures, burnup and fission gas releases are calculated separately for each axial segment and the effects are integrated to obtain the overall fission gas release and resulting internal pressure for each time step. The coolant temperature rise along the fuel rod is calculated based on the flow rate and axial power distribution, and the cladding surface temperature is determined with consideration of corrosion effects and the possibility of local boiling.

Model updates incorporated into the PAD5 code address all of the fuel and cladding performance models required for high burnup fuel design. Key fuel performance updates to the PAD5 models include fuel thermal conductivity degradation (TCD) with burnup, enhanced high burnup athermal fission gas release (pellet rim effects) and enhanced high burnup fission gas bubble swelling. Cladding creep and growth models are also updated to reflect high burnup cladding performance. In addition to high burnup analysis capability, a key driver for the implementation of the PAD5 models in fuel design is to address regulatory concerns associated with fuel thermal conductivity degradation with burnup.

The PAD5 models are the latest evolutions of the Westinghouse PAD code (Reference 1). As part of the Reference 1 development, the burnup-dependent term of the fuel melting limits in PAD5 was updated based on journal-published fuel material data. Additional validation performed in Section 2.1 of Appendix A of Reference 1 shows that the PAD5 code in conjunction with the new fuel melt limit accurately predicts fuel melt based on comparisons to experimental observations. Section 3.7.12 of the NRC Safety Evaluation Report in Reference 1 concluded that the fuel melting limits in PAD5 are acceptable.

The peak fuel centerline temperature SL is independent of the PAD5 methodology as noted in the Safety Evaluation of Reference 2. The current licensing basis safety analyses use the existing SL 2.1.1.2 for fuel melt as an acceptance criterion as required by the current methodology. Thus, Dominion Energy Virginia will continue to meet the existing SL when using its current licensing basis safety analyses even with the implementation of the revised SL. Since the existing SL for peak fuel centerline temperature is more restrictive than the proposed SL, the

current licensing basis safety analyses remain conservative with respect to the proposed SL.

A comprehensive description of all PAD5 models, NRC Requests for Additional Information, and the subsequent NRC Safety Evaluation are documented in Reference 1. The NRC Safety Evaluation Limitations and Conditions are discussed in Section 3.1 of this amendment request. As described in Section 3.1, the proposed SL will only be applicable for analyses performed with the method described in Reference 1.

3.1 Limits of Applicability

The proposed amendment will only be used in applicable safety analyses that are performed with the approved fuel performance methods in Reference 1. The Limitations and Conditions from the NRC Safety Evaluation in Reference 1 pertinent to this amendment request are detailed below along with details of how each is satisfied.

- The NRC staff limits the applicability of the PAD5 code and methodology to the cladding, fuel, and reactor parameters listed in Section 4.1 of the Safety Evaluation in Reference 1.

Response: Dominion Energy Virginia will apply PAD5 within the limits specified in Section 4.1 of Reference 1 for cladding, fuel, and reactor parameters to be used at NAPS Units 1 and 2. Because these PAD5 inputs depend on the reload design, these parameters are validated on a cycle-specific basis.

- The application of PAD5 should at no time exceed the fuel melting temperature as calculated by PAD5 due to the lack of properties for molten fuel in PAD5 and other properties such as thermal conductivity and fission gas release.

Response: Dominion Energy Virginia will limit the peak fuel centerline temperature per this amendment request.

4.0 REGULATORY EVALUATION

Applicable Regulatory Requirements and Criteria

Section 182a of the Atomic Energy Act requires applicants for nuclear power plant operating licenses to include TS as part of the license. The TS ensure the operational capability of structures, systems, and components that are required to protect the health and safety of the public.

- 10 CFR 50.90 requires NRC approval for any modification to, addition to, or deletion from the plant TS. Therefore, this activity requires NRC approval prior to making the proposed plant-specific changes.
- 10 CFR 50.36 requires that the TS include items in the following specific categories: (1) safety limits, limiting safety systems settings, and limiting control settings; (2) limiting conditions for operation (LCOs); (3) surveillance requirements per 10 CFR 50.36(c)(3); (4) design features; and (5) administrative controls. This amendment is related to the first category above since a change to the peak fuel centerline melt temperature SL is proposed.
- 10 CFR 50, Appendix A, GDC 10 requires that the reactor core and associated coolant, control, and protection systems shall be designed with appropriate margin to assure that specified acceptable fuel design limits are not exceeded during any condition of normal operation, including the effects of anticipated operational occurrences. The restrictions of SL 2.1.1.2 prevent overheating of the fuel and cladding.

Overheating of the fuel is prevented by maintaining the steady state peak temperature below the level at which fuel centerline melting occurs. Expansion of the pellet upon centerline melting may cause the pellet to stress the cladding to the point of failure, allowing an uncontrolled release of activity to the reactor coolant. The proposed change to SL 2.1.1.2, Reactor Core Safety Limits, revises the limit to be consistent with the limit approved in Reference 1, thus the requirement of 10 CFR 50 Appendix A General Design Criteria 10 continues to be met.

4.2 Precedents

The proposed change to TS 2.1.1.2 changes the fuel centerline temperature to reflect that specified in WCAP-17642-P-A, Revision 1. The NRC has approved changes for Turkey Point Units 3 and 4 (Reference 2).

A proposed change requesting a similar change for Surry Power Station Units 1 & 2 (Reference 3) is currently under NRC review. The NAPS proposed change follows a similar format and contains similar content as this submittal.

4.3 No Significant Hazards Consideration

The proposed change would revise the NAPS Units 1 and 2, TS SL 2.1.1.2 associated with peak fuel centerline temperature to reflect the peak fuel centerline melt temperature specified in WCAP-17642-P-A, Revision 1.

As required by 10 CFR 50.91 (a)(1), Dominion Energy Virginia has performed an evaluation to determine whether or not a significant hazards consideration is involved with the proposed amendment by focusing on the three standards set forth in 10 CFR 50.92, "Issuance of amendment," Part 50.92(c), and has determined that the proposed change does not involve a significant hazards consideration, as discussed below:

1. *Does the proposed amendment involve a significant increase in the probability or consequences of an accident previously evaluated?*

Response: No

There are no design changes associated with the proposed change. All design, material, and construction standards that were applicable prior to this amendment request will continue to be applicable.

The proposed change will not affect accident initiators or precursors or alter the design, conditions, and configuration of the facility, or the manner in which the plant is operated and maintained, with respect to such initiators or precursors.

Compliance with SL 2.1.1.2 is required to ensure that fuel cladding failure does not occur as a result of fuel centerline melting. The fuel centerline melt temperature limit is established to preclude centerline melting. The NRC staff reviewed the fuel material properties in WCAP 17642-P-A, Revision 1, "Westinghouse Performance Analysis and Design Model (PAD5)," and found them to be appropriately conservative.

Accident analysis acceptance criteria will continue to be met with the proposed change. The proposed change will not affect the source term, containment isolation, or radiological release assumptions used in evaluating the radiological consequences of any accident previously evaluated. The proposed change will not alter any assumptions or change any mitigation actions in the radiological consequence evaluations in the Updated Final Safety Analysis Report (UFSAR). Consequently, the applicable radiological dose acceptance criteria will continue to be met.

Therefore, it is concluded that the proposed amendment does not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. *Does the proposed amendment create the possibility of a new or different kind of accident from any accident previously evaluated?*

Response: No

There are no proposed design changes nor are there any changes in the method by which any safety-related plant structures, systems, and components perform their specified safety functions. The proposed change will not affect the normal method of plant operation or change any operating parameters. No equipment performance requirements will be affected. The proposed change will not alter any assumptions made in the safety analyses.

The proposed change does not involve a physical modification of the plant.

No new accident scenarios, transient precursors, failure mechanisms, or limiting single failures will be introduced as a result of this proposed change. There will be no adverse effect or challenges imposed on any safety-related system as a result of this proposed change.

Therefore, it is concluded that the proposed amendment does not create the possibility of a new or different kind of accident from any previously evaluated.

3. *Does the proposed amendment involve a significant reduction in a margin of safety?*

Response: No

The proposed revision to SL 2.1.1.2 has been calculated based on NRC-approved methods which ensure that the plant operates in compliance with applicable regulatory criteria.

There will be no effect on plant systems necessary to perform protection functions.

No instrument setpoints or system response times are affected and none of the acceptance criteria for any accident analysis will be changed.

Consequently, the proposed change will have no impact on the radiological consequences of a design basis accident.

Therefore, it is concluded that the proposed amendment does not involve a significant reduction in a margin of safety.

Therefore, Dominion Energy Virginia concludes that the proposed amendment does not involve a significant hazards consideration, under the standards set forth in 10 CFR 50.92(c), "Issuance of Amendment," and accordingly, a finding of "no significant hazards consideration" is justified.

4.4 Conclusion

In summary, in accordance with Title 10 of the Code of Federal Regulations (CFR) 50.90, Dominion Energy Virginia requests NRC review and approval of the change to Technical Specification Safety Limit 2.1.1.2 for NAPS Units 1 and 2.

Based on the above discussions, (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

5.0 ENVIRONMENTAL CONSIDERATIONS

The proposed amendment would revise the NAPS Units 1 and 2, TS SL 2.1.1.2 associated with peak fuel centerline temperature.

A review of the anticipated construction and operational effects of the requested amendment has determined the requested amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9), in that:

- (i) *There is no significant hazards consideration.*

As documented in Section 4.3, No Significant Hazards Consideration, of this license amendment request, an evaluation was completed to determine whether or not a significant hazards consideration is involved by focusing on the three standards set forth in 10 CFR 50.92, "Issuance of Amendment." The Significant Hazards Consideration determined that (1) the proposed amendment does not involve a significant increase in the probability or consequences of an accident previously evaluated; (2) the proposed amendment does not create the possibility of a new or different kind of accident from any accident previously evaluated; and (3) the proposed amendment does not involve a significant reduction in a margin of safety. Therefore, it is concluded that the proposed amendment does not involve a significant hazards consideration under the standards set forth in

10 CFR 50.92(c), and accordingly, a finding of “no significant hazards consideration” is justified.

- (ii) *There is no significant change in the types or significant increase in the amounts of any effluents that may be released offsite.*

The proposed change is unrelated to any aspects of plant construction or operation that would introduce any changes to effluent types (e.g., effluents containing chemicals or biocides, sanitary system effluents, and other effluents) or affect any plant radiological or non-radiological effluent release quantities. The proposed change does not adversely impact any functions associated with containing, controlling, channeling, monitoring, or processing radioactive or non-radioactive materials, nor do they diminish the functionality of any design or operational features that are credited with controlling the release of effluents during plant operation. The types and quantities of expected plant effluents are not changed. No effluent release path is associated with this amendment. Neither radioactive nor non-radioactive material effluents are affected by this activity. Furthermore, the proposed change does not diminish the functionality of any design or operational features that are credited with controlling the release of effluents during plant operation. Therefore, it is concluded that the proposed amendment does not involve a significant change in the types or a significant increase in the amounts of any effluents that may be released offsite.

- (iii) *There is no significant increase in individual or cumulative occupational radiation exposure.*

The proposed change does not affect plant radiation zones described in UFSAR Section 11 and controls under 10 CFR Part 20 preclude a significant increase in occupational radiation exposure. The proposed change does not adversely impact radiologically controlled zones. Plant radiation zones, radiation controls established to satisfy 10 CFR Part 20 requirements, and expected amounts and types of radioactive materials are not affected by the proposed amendment. Therefore, individual and cumulative radiation exposures are not significantly affected by this change. Therefore, the proposed amendment does not involve a significant increase in individual or cumulative occupational radiation exposure.

Based on the above review of the proposed amendment, it has been determined that anticipated construction and operational effects of the proposed amendment do not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluents that may be released

offsite, or (iii) a significant increase in the individual or cumulative occupational radiation exposure. Accordingly, the proposed amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), an environmental impact statement or environmental assessment of the proposed amendment is not required.

6.0 REFERENCES

1. Westinghouse Topical Report WCAP-17642-P-A, Revision 1, "Westinghouse Performance Analysis and Design Model (PAD5)," November 2017.
2. Letter from USNRC to Mano Nazar (Florida Power & Light Company), "Turkey Point Generating Unit Nos. 3 and 4 – Issuance of Amendment Nos. 288 and 282 Regarding Revised Reactor Core Safety Limit to Reflect Topical Report WCAP-17642-P-A, Revision 1 (EPID L-2018-LLA-0120)," August 15, 2019 (ADAMS Accession Number ML19031C891).
3. Letter from M. D. Sartain (Virginia Electric and Power Company) to the USNRC (Serial No. 20-341), "Virginia Electric and Power Company, Surry Power Station Units 1 and 2, Proposed License Amendment Request, Revise Reactor Core Safety Limit to Reflect WCAP-17642-P-A, Revision 1," September 30, 2020 (ADAMS Accession Number ML20274A329).

Attachment 2

MARKED-UP TECHNICAL SPECIFICATIONS PAGE

**Virginia Electric and Power Company
(Dominion Energy Virginia)
North Anna Power Station Units 1 and 2**

2.0 SAFETY LIMITS (SLs)

2.1 SLs

2.1.1 Reactor Core SLs

In MODES 1 and 2, the combination of THERMAL POWER, Reactor Coolant System (RCS) highest loop average temperature, and pressurizer pressure shall not exceed the limits specified in the COLR; and the following SLs shall not be exceeded.

2.1.1.1 The departure from nucleate boiling ratio (DNBR) shall be maintained greater than or equal to the 95/95 DNBR criterion for the DNB correlations and methodologies specified in Section 5.6.5.

2.1.1.2 The peak fuel centerline temperature shall be maintained < 5080°F, decreasing by 58°F per 10,000 MWD/MTU of burnup, for Westinghouse fuel and < 5173°F, decreasing by 65°F per 10,000 MWD/MTU of burnup, for Framatome fuel.

2.1.2 RCS Pressure SL

In MODES 1, 2, 3, 4, and 5, the RCS pressure shall be maintained ≤ 2735 psig.

9°F

2.2 SL Violations

2.2.1 If SL 2.1.1 is violated, restore compliance and be in MODE 3 within 1 hour.

2.2.2 If SL 2.1.2 is violated:

2.2.2.1 In MODE 1 or 2, restore compliance and be in MODE 3 within 1 hour.

2.2.2.2 In MODE 3, 4, or 5, restore compliance within 5 minutes.

Attachment 3

PROPOSED TECHNICAL SPECIFICATIONS PAGE

**Virginia Electric and Power Company
(Dominion Energy Virginia)
North Anna Power Station Units 1 and 2**

2.0 SAFETY LIMITS (SLs)

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In MODES 1 and 2, the combination of THERMAL POWER, Reactor Coolant System (RCS) highest loop average temperature, and pressurizer pressure shall not exceed the limits specified in the COLR; and the following SLs shall not be exceeded.

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2.1.1.2 The peak fuel centerline temperature shall be maintained < 5080°F, decreasing by 9°F per 10,000 MWD/MTU of burnup, for Westinghouse fuel and < 5173°F, decreasing by 65°F per 10,000 MWD/MTU of burnup, for Framatome fuel.

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2.2.1 If SL 2.1.1 is violated, restore compliance and be in MODE 3 within 1 hour.

2.2.2 If SL 2.1.2 is violated:

2.2.2.1 In MODE 1 or 2, restore compliance and be in MODE 3 within 1 hour.

2.2.2.2 In MODE 3, 4, or 5, restore compliance within 5 minutes.
