UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

July 25, 2016

Mr. Oscar A. Limpias
Vice President-Nuclear and CNO
Nebraska Public Power District
72676 648A Avenue
Brownville, NE 68321

SUBJECT: COOPER NUCLEAR STATION - ISSUANCE OF AMENDMENT RE: ADOPTION OF TECHNICAL SPECIFICATION TASK FORCE CHANGE TRAVELER, TSTF-535, REVISION 0 (CAC NO. MF7442)

Dear Mr. Limpias:

The U.S. Nuclear Regulatory Commission (NRC) has issued the enclosed Amendment No. 254 to Renewed Facility Operating License No. DPR-46 for the Cooper Nuclear Station. The amendment consists of changes to the Technical Specifications (TSs) in response to your application dated March 11, 2016.

The amendment would revise TS 1.1, "Definitions, Shutdown Margin (SDM)," consistent with the proposed changes in Technical Specification Task Force (TSTF) Standard Technical Specifications Change Traveler, TSTF-535, Revision 0, "Revise Shutdown Margin Definition to Address Advanced Fuel Designs." Prior to this amendment, the plant's SDM (i.e., the amount of reactivity by which the reactor is subcritical) was calculated using a shutdown moderator temperature of 68 degrees Fahrenheit (°F). This value was conservative for standard fuel designs. However, new boiling-water reactor (BWR) fuel designs can result in a higher reactivity at moderator temperatures above 68 °F. The NRC staff has concluded that this phenomena is applicable to any BWR, regardless of its fuel design. Therefore, the amendment implements TSTF-535, Revision 0, which modifies the TSs to require the SDM to be calculated at whatever moderator temperature produces the maximum reactivity with moderator temperature greater than or equal to 68 °F.

A copy of the related Safety Evaluation is also enclosed. The Notice of Issuance will be included in the Commission's next biweekly *Federal Register* notice.

Sincerely,

Alan Wang For

Thomas J. Wengert, Project Manager
Plant Licensing IV-2 and Decommissioning
Transition Branch
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-298

Enclosures:
1. Amendment No. 254 to DPR-46
2. Safety Evaluation

cc w/encls: Distribution via Listserv

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

NEBRASKA PUBLIC POWER DISTRICT

DOCKET NO. 50-298

COOPER NUCLEAR STATION

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 254
License No. DPR-46

1. The U.S. Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by Nebraska Public Power District (the licensee), dated March 11, 2016, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this license amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment, and Paragraph 2.C.(2) of Renewed Facility Operating License No. DPR-46 is hereby amended to read as follows:

    (2) Technical Specifications

    The Technical Specifications contained in Appendix A as revised through Amendment No. 254, are hereby incorporated in the license. The licensee shall operate the facility in accordance with the Technical Specifications.

3. The license amendment is effective as of its date of issuance and shall be implemented within 60 days from the date of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

Shaun M. Anderson, Acting Chief
Plant Licensing IV-2 and Decommissioning
Transition Branch
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Attachment:
Changes to the Renewed Facility
Operating License No. DPR-46
and Technical Specifications

Date of Issuance: July 25, 2016

ATTACHMENT TO LICENSE AMENDMENT NO. 254

COOPER NUCLEAR STATION

RENEWED FACILITY OPERATING LICENSE NO. DPR-46

DOCKET NO. 50-298

Replace the following pages of the Renewed Facility Operating License No. DPR-46 and Appendix A Technical Specifications with the enclosed revised pages. The revised pages are identified by amendment number and contain marginal lines indicating the areas of change.

Renewed Facility Operating License

REMOVE	INSERT
-3-	-3-

Technical Specifications

REMOVE	INSERT
1.1-4	1.1-4
1.1-5	1.1-5

(5) Pursuant to the Act and 10 CFR Parts 30, 40, and 70, to possess, but not separate, such byproduct and special nuclear materials as may be produced by operation of the facility.

C. This license shall be deemed to contain and is subject to the conditions specified in the following Commission regulations in 10 CFR Chapter I: Part 20, Section 30.34 of Part 30, Section 40.41 of Part 40, Sections 50.54 and 50.59 of Part 50, and Section 70.32 of Part 70; is subject to all applicable provisions of the Act and to the rules, regulations, and orders of the Commission now or hereafter in effect; and is subject to the additional conditions specified or incorporated below:

(1) Maximum Power Level

The licensee is authorized to operate the facility at steady state reactor core power levels not in excess of 2419 megawatts (thermal).

(2) Technical Specifications

The Technical Specifications contained in Appendix A as revised through Amendment No. 254, are hereby incorporated in the license. The licensee shall operate the facility in accordance with the Technical Specifications.

(3) Physical Protection

The licensee shall fully implement and maintain in effect all provisions of the Commission-approved physical security, training and qualification and safeguards contingency plans including amendments made pursuant to provisions of the Miscellaneous Amendments and Search Requirements revisions to 10 CFR 73.55 (51 FR 27817 and 27822) and to the authority of 10 CFR 50.90 and 10 CFR 50.54(p). The combined set of plans, which contain Safeguards Information protected under 10 CFR 73.21, are entitled: "Cooper Nuclear Station Safeguards Plan," submitted by letter dated May 17, 2006.

NPPD shall fully implement and maintain in effect all provisions of the Commission-approved cyber security plan (CSP), including changes made pursuant to the authority of 10 CFR 50.90 and 10 CFR 50.54(p). The NPPD CSP was approved by License Amendment No. 238 as supplemented by changes approved by License Amendments 244 and 249.

(4) Fire Protection

NPPD shall implement and maintain in effect all provisions of the approved fire protection program that comply with 10 CFR 50.48(a) and 10 CFR 50.48(c), as specified in the license amendment request dated April 24, 2012 (and supplements dated July 12, 2012, January 14, 2013, February 12, 2013, March 13, 2013, June 13, 2013, December 12, 2013, January 17, 2014, February 18, 2014, and April 11, 2014), and as approved in the safety evaluation dated April 29, 2014. Except where NRC approval for changes or deviations is required by 10 CFR 50.48(c), and provided no other regulation, technical specification, license condition or requirement would require prior NRC approval, the licensee may make changes to the fire protection program without prior approval of the Commission if

1.1 Definitions

LOGIC SYTEM FUNCTIONAL TEST (continued)	from as close to the sensor as practicable up to, but not including, the actuated device, to verify OPERABILITY. The LOGIC SYSTEM FUNCTIONAL TEST may be performed by means of any series of sequential, overlapping, or total system steps so that the entire logic system is tested.
MINIMUM CRITICAL POWER RATIO (MCPR)	The MCPR shall be the smallest critical power ratio (CPR) that exists in the core for each class of fuel. The CPR is that power in the assembly that is calculated by application of the appropriate correlation(s) to cause some point in the assembly to experience boiling transition, divided by the actual assembly operating power.
MODE	A MODE shall correspond to any one inclusive combination of mode switch position, average reactor coolant temperature, and reactor vessel head closure bolt tensioning specified in Table 1.1-1 with fuel in the reactor vessel.
OPERABLE – OPERABILITY	A system, subsystem, division, component, or device shall be OPERABLE or have OPERABILITY when it is capable of performing its specified safety function(s) and when all necessary attendant instrumentation, controls, normal or emergency electrical power, cooling and seal water, lubrication, and other auxiliary equipment that are required for the system, subsystem, division, component, or device to perform its specified safety function(s) are also capable of performing their related support function(s).
RATED THERMAL POWER (RTP)	RTP shall be a total reactor core heat transfer rate to the reactor coolant of 2419 MWt.
REACTOR PROTECTION SYSTEM (RPS) RESPONSE TIME	The RPS RESPONSE TIME shall be that time segment from the time the sensor contacts actuate to the time the scram solenoid valves deenergize.
SHUTDOWN MARGIN (SDM)	SDM shall be the amount of reactivity by which the reactor is subcritical or would be subcritical throughout the operating cycle assuming that: a. The reactor is xenon free;

(continued)

1.1 Definitions

SHUTDOWN MARGIN (SDM) (continued)	b. The moderator temperature is ≥ 68°F, corresponding to the most reactive state; and c. All control rods are fully inserted except for the single control rod of highest reactivity worth, which is assumed to be fully withdrawn. With control rods not capable of being fully inserted, the reactivity worth of these control rods must be accounted for in the determination of SDM.
STAGGERED TEST BASIS	A STAGGERED TEST BASIS shall consist of the testing of one of the systems, subsystems, channels, or other designated components during the interval specified by the Surveillance Frequency, so that all systems, subsystems, channels, or other designated components are tested during *n* Surveillance Frequency intervals, where *n* is the total number of systems, subsystems, channels, or other designated components in the associated function.
THERMAL POWER	THERMAL POWER shall be the total reactor core heat transfer rate to the reactor coolant.
TURBINE BYPASS SYSTEM RESPONSE TIME	The TURBINE BYPASS SYSTEM RESPONSE TIME consists of two components: a. The time from initial movement of the main turbine stop valve or control valve until 80% of the turbine bypass capacity is established; and b. The time from initial movement of the main turbine stop valve or control valve until initial movement of the turbine bypass valve. The response time may be measured by means of any series of sequential, overlapping, or total steps so that the entire response time is measured.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 254 TO

RENEWED FACILITY OPERATING LICENSE NO. DPR-46

NEBRASKA PUBLIC POWER DISTRICT

COOPER NUCLEAR STATION

DOCKET NO. 50-298

1.0 INTRODUCTION

By application dated March 11, 2016 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML16076A433), Nebraska Public Power District (NPPD, the licensee) requested changes to the Technical Specifications (TSs) for Cooper Nuclear Station (CNS).

Specifically, the licensee requested to adopt Technical Specifications Task Force (TSTF) Standard Technical Specifications (STSs) Change Traveler TSTF-535, Revision 0, "Revise Shutdown Margin Definition to Address Advanced Fuel Designs" (ADAMS Accession No. ML112200436), dated August 8, 2011. As announced in the *Federal Register* on February 26, 2013 (78 FR 13100 – 13101), the U.S. Nuclear Regulatory Commission (NRC) staff previously reviewed the model application for TSTF–535 and found it acceptable for use by licensees. The announcement reminded licensees that licensees opting to apply for this TS change are responsible for reviewing the NRC staff's model safety evaluation (SE) for TSTF-535 and the applicable technical bases, and providing any necessary plant-specific information, and further, assessing the completeness and accuracy of their license amendment request.

The proposed change would revise the TS definition of shutdown margin (SDM) to require calculation of SDM at the reactor moderator temperature corresponding to the most reactive state throughout the operating cycle (68 degrees Fahrenheit (°F) or higher). The purpose is to address newer boiling-water reactor (BWR) fuel designs, which result in more reactivity from moderators at temperatures above 68 °F.

The licensee stated that it did not propose any variations or deviations from the TS changes, as described in TSTF-535, Revision 0, or the applicable parts of the NRC staffs model safety evaluation.

Enclosure 2

2.0 REGULATORY EVALUATION

2.1 Background

In water-moderated reactors, water is used to slow down, or moderate, high energy fast neutrons to low energy or "thermal" neutrons through multiple scattering interactions. More specifically, the hydrogen in the water scatters the neutrons and brings the neutrons into thermal equilibrium with the water. To a much lesser extent, the oxygen in the water will also scatter neutrons. The thermal neutrons are much more likely to be captured by fissile material and cause fission. However, not all of the thermal neutrons are available to the fuel; at rates significantly lower than the rates of scattering, some neutrons are captured by the hydrogen and oxygen in the water. The density of the moderator heavily influences how many thermal neutrons are available to the fuel.

Water-moderated reactors are designed such that they tend to operate in what is known as an under-moderated condition. In this condition, the ratio of the moderator-to-fuel in the core is small enough that the overall effectiveness of water as a moderator decreases with increasing temperature. As temperature increases, fewer neutrons are absorbed in the moderator due to the decrease in its density. These neutrons, which would have otherwise been absorbed by the moderator, are now available to the fuel, manifesting as an increase in reactivity. At the same time, this increase in reactivity is overshadowed by fewer neutrons being moderated (i.e., slowed enough to cause fissions) as a result of the decrease in moderator density, which reduces overall reactivity. The negative reactivity feedback from the increase in moderator temperature will eventually result in a stabilization in fission rate and, therefore the reactor becomes self-regulating.

However, if the amount of moderator becomes too large with respect to the amount of fuel, the reactor can enter an over-moderated condition. In this condition, the overall effectiveness of water as a moderator increases with the temperature. The number of neutrons moderated (i.e., slowed down) enough to fission outweighs the loss of neutrons being absorbed in the moderator. This causes an increase in power that leads to a further increase in temperature creating a potentially dangerous positive reactivity feedback cycle.

As practical examples in support of the proposed changes to the definition of SDM, TSTF-535, Revision 0 discussed SDM with regards to fuel assembly-GE14 (GE14) and Global Nuclear Fuel-2 (GNF2) fuels. TSTF-535, Revision 0 indicated that for historical fuel products leading up to, and including GE14, the maximum reactivity condition for SDM always occurred at a moderator temperature of 68 °F. These fuel products were designed so that the core is always under-moderated when all control rods are inserted, except for the single most reactive rod. In cores with GNF2 fuel, TSTF-535, Revision 0 projected that the maximum reactivity condition at the beginning-of-cycle (BOC) will remain at 68 °F, but later in the cycle the most limiting SDM may occur at a higher temperature. Thus the GNF2 fuel design could potentially cause an over-moderated condition in the core.

2.2 Technical Specification Changes

NPPD's adoption of TSTF-535, Revision 0 for CNS proposes to revise the TS definition of SDM to require calculation of SDM at the reactor moderator temperature corresponding to the most reactive state throughout the operating cycle (68 °F or higher).

The current definition of SDM in Section 1.1, "Definitions," of the CNS TS is:

> SDM shall be the amount of reactivity by which the reactor is subcritical or would be subcritical assuming that:
>
> a. The reactor is xenon free;
>
> b. The moderator temperature is 68 °F; and
>
> c. All control rods are fully inserted except for the single control rod of highest reactivity worth, which is assumed to be fully withdrawn.
>
> With control rods not capable of being fully inserted, the reactivity worth of these control rods must be accounted for in the determination of SDM.

The licensee proposes the following changes (**shown in bold**) to the definition of SDM in accordance with TSTF-535, Revision 0:

> SDM shall be the amount of reactivity by which the reactor is subcritical or would be subcritical **throughout the operating cycle** assuming that:
>
> a. The reactor is xenon free;
>
> b. The moderator temperature is ≥ 68 °F, **corresponding to the most reactive state**; and
>
> c. All control rods are fully inserted except for the single control rod of highest reactivity worth, which is assumed to be fully withdrawn.
>
> With control rods not capable of being fully inserted, the reactivity worth of these control rods must be accounted for in the determination of SDM.

Within the TS, the definition of SDM in TS 1.1 is used along with CNS TS 3.1.1 "SHUTDOWN MARGIN (SDM)." Within TS 3.1.1, the TS provides limiting conditions for operation (LCOs) based on SDM. As described in 10 CFR 50.36(c)(2)(i), LCOs are the lowest functional capability or performance levels of equipment required for safe operation of the facility. When an LCO of a nuclear reactor is not met, the licensee shall shut down the reactor or follow any remedial action permitted by the technical specifications until the condition can be met. TS 3.1.1 also has a surveillance requirement (SR) for SDM. As described in 10 CFR 50.36(c)(3), SRs are requirements relating to test, calibration, or inspection to assure that the necessary quality of systems and components is maintained, that facility operation will be within safety limits, and that the LCO will be met. Accordingly, the NRC staff's review assessed how the proposed change in the definition of SDM affects TS 3.1.1 and the associated LCOs and SRs.

2.3 Regulatory Review

The TSTF-535 Traveler and model SE discuss the applicable regulatory requirements and guidance, including the Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Appendix A, General Design Criteria (GDC). Specifically, TSTF-535 refers to GDC 26, "Reactivity control system redundancy and capability," as the applicable regulatory criteria for review while the model SE identified that GDC 27, "Combined reactivity control systems capability," is also applicable. GDC 26 and GDC 27, respectively, require that reactivity within the core be controllable to ensure subcriticality is achievable and maintainable under cold conditions, with appropriate margin for stuck rods; and that reactivity within the core be controllable to assure that under postulated accident conditions and with appropriate margin for stuck rods the capability to cool the core is maintained.

However, CNS is not licensed to the 10 CFR 50, Appendix A, GDC. CNS was designed and constructed to meet the principal design criteria described in the Atomic Energy Commission's (AEC's) proposed rule, "General Design Criteria for Nuclear Power Plant Construction Permits," published in the *Federal Register* on July 11, 1967 (32 FR 10213). The degree of conformance to the 1967 proposed GDC is described in Appendix F, "Conformance to AEC Proposed General Design Criteria" to the Updated Safety Analysis Report (USAR) for CNS. Therefore, the following information provides the equivalent criteria for CNS from the 1967 proposed GDC Group V, "Reactivity Control," to the final GDC.

The equivalent criteria to GDC 26 from the 1967 proposed GDC are Criteria 27, 28, and 30.

Criterion 27, of Group V, "Redundancy of Reactivity Control," states:

> At least two independent reactivity control systems, preferably of different principles, shall be provided.

Criterion 28, of Group V, "Reactivity Hot Shutdown Capability," states:

> At least two of the reactivity control systems provided shall independently be capable of making and holding the core subcritical from any hot standby or hot operating condition, including those resulting from power changes, sufficiently fast to prevent exceeding acceptable fuel damage limits.

Criterion 30, of Group V, "Reactivity Holddown Capability," states:

> At least one of the reactivity control systems provided shall be capable of making and holding the core subcritical under any conditions with appropriate margins for contingencies.

The equivalent criteria to GDC 27 from the 1967 proposed GDC is Criteria 29.

Criterion 29, of Group V, "Reactivity Shutdown Capability," states:

> At least one of the reactivity control systems provided shall be capable of making the core subcritical under any condition (including anticipated operational transients) sufficiently fast to prevent exceeding acceptable fuel damage limits.

Shutdown margins greater than the maximum worth of the most effective control rod when fully withdrawn shall be provided.

CNS's conformance to the proposed GDCs is described in Appendix F to CNS's USAR on pages F-2-13 through F-2-14, dated December 29, 1999. As discussed in Section 2.5 of Appendix F to the USAR, CNS meets the proposed GDC for the following reasons:

Criterion 27 of Group V:

The two reactivity control systems provided are completely independent and of different principal. The operational control system accommodates fuel burnup, load changes and long-term reactivity changes. The standby liquid control system provides independent shutdown capability if it is needed.

Criterion 28 of Group V:

Both the control rod drive system and the standby liquid control system are capable of making and holding the core subcritical from any hot standby or hot operating condition up through full power. Consistent with current practice, this criterion is not interpreted to require a fast scram capability of both systems but only the stated shutdown capability.

Criterion 29 of Group V:

Reactor shutdown by the control rod drive system is sufficiently rapid to prevent violation of fuel damage limits for normal operation and abnormal operational transients for which control rod motion is available, even with the most reactive control rod fully withdrawn. The nuclear design assures that sufficient reactivity compensation is always available to make the reactor subcritical from its most reactive condition including compensation for positive and negative reactivity changes resulting from nuclear coefficients, fuel depletion and fission product transients and buildup.

Criterion 30 of Group V:

As indicated in the previous criterion response, the control rod drive system is designed to make and hold the reactor subcritical from its most reactive condition under "normal" credible operating conditions.

In summary, CNS's current licensing basis incorporates the proposed GDC that are equivalent to the 10 CFR Part 50, Appendix A, GDC 26 and 27.

Per 10 CFR 50.92(a), in determining whether an amendment to a license will be issued to the applicant, the Commission will be guided by the considerations which govern the issuance of initial licenses to the extent applicable and appropriate. The required findings for an initial operating license are in 10 CFR 50.57, "Issuance of operating license," and include findings that there is reasonable assurance (i) that the activities authorized by the operating license can be conducted without endangering the health and safety of the public, and (ii) there is reasonable assurance that such activities will be conducted in compliance with the regulations in this chapter; and the issuance of the license will not be inimical to the common defense and security or to the health and safety of the public. Per 10 CFR 50.36(b), each operating license will include technical specifications that are derived from the analyses and evaluation included in the safety analysis report, and amendments thereto, submitted pursuant to 10 CFR 50.34, "Contents of applications; technical information." The Commission may include such additional TSs as the Commission finds appropriate. Per 10 CFR 50.36(c)(2) and (c)(3), TSs are required to include items in the categories of LCOs and SRs.

As defined in 10 CFR 50.36(c)(2)(i), LCOs are the lowest functional capability or performance levels of equipment required for safe operation of the facility. In addition, 10 CFR 50.36(c)(2)(ii)(B) requires an LCO must be established for "A process variable, design feature, or operating restriction that is an initial condition of a design basis accident or transient analysis that either assumes the failure of or presents a challenge to the integrity of a fission product barrier." The TS definition of SDM and the LCOs placed on SDM serve, in part, to satisfy proposed GDC 27, 28, 29, and 30 by ensuring there is always sufficient negative reactivity worth available to offset the positive reactivity worth of changes in moderator and fuel temperature, the decay of fission product poisons, the failure of a control rod to insert, and reactivity insertion accidents. Given this margin, the core can be held subcritical for conditions of normal operation, including anticipated operational occurrences.

NUREG-0800, "Standard Review Plan [SRP] for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR [Light-Water Reactor] Edition," Chapter 4.3, "Nuclear Design," Revision 3, dated March 2007 (ADAMS Accession No. ML070740003), provides the procedures concerning the review of control systems and SDM to help ensure compliance with GDC 26 and 27 (and by equivalence, proposed GDC 27 through 30). Specifically, Chapter 4.3, Section I.4.F states:

> The adequacy of the control systems to assure that the reactor can be returned to and maintained in the cold shutdown condition at any time during operation. The applicant shall discuss shutdown margins (SDM). Shutdown margins need to be demonstrated by the applicant throughout the fuel cycle,

and Chapter 4.3, Section III.4.C states:

> The reviewer determines that one of the control systems is capable of returning the reactor to the cold shutdown condition and maintaining it in this condition at any time in the cycle. It is necessary that proper allowance must be made for all of the mechanisms that change the reactivity of the core as the reactor is taken from the cold shutdown state to the hot full-power operating state. The reviewer should determine that proper allowance is made for the decrease in fuel temperature, moderator temperature, and the loss of voids (in BWRs) as the reactor goes from the power operating range to cold shutdown.

While the SRP does not precisely prescribe that the temperature of minimum shutdown margin be determined, the requirement of shutting down the reactor and maintaining it in a shutdown condition at any time in the cycle suggests that considering a range of thermal and exposure conditions is appropriate in the determination of the minimum SDM.

3.0 TECHNICAL EVALUATION

3.1 Current Definition of Shutdown Margin

In BWR plants, the control rods are used to hold the reactor core subcritical under cold conditions. The control rod negative reactivity worth must be sufficient to ensure the core is subcritical by a margin known as the SDM. It is the additional amount of negative reactivity worth needed to maintain the core subcritical by offsetting the positive reactivity worth that can occur during the operating cycle due to changes in moderator and fuel temperature, the decay of fission product poisons, the failure of a control rod to insert, and reactivity insertion accidents.

The three criteria provided in the definition of SDM (Section 2.2 of this SE) help exemplify what has traditionally been the most reactive design condition for a reactor core. Xenon is a neutron poison produced by fission product decay and its presence in the core adds negative reactivity worth. Assuming the core is xenon-free removes a positive reactivity offset and is representative of fresh fuel at the BOC.

The minimum temperature the reactor moderator is anticipated to experience is 68 °F, making it the point at which the moderator will be at its densest and therefore, under the previous fuel designs and core loads, capable of providing the highest positive reactivity worth. By assuming the highest worth rod is fully withdrawn and that 68 °F corresponded to the highest moderation, the core can be designed with adequate SDM to ensure it remains safely shutdown even in the event of a stuck control rod. TS 3.1.1 provides the operational restrictions upon SDM, which depend on whether the highest worth control rod was analytically determined or determined by test. TS 3.1.1 helps to ensure:

a. the reactor can be made subcritical from all operating conditions and transients and design basis events,

b. the reactivity transients associated with postulated accident conditions are controllable within acceptable limits, and

c. the reactor will be maintained sufficiently subcritical to preclude inadvertent criticality in the shutdown condition,

3.2 Proposed Definition of Shutdown Margin

The specified moderator temperature of 68 °F facilitates the maximum reactivity condition only if the core exists in an under-moderated condition. In addition to burnable poisons, many modern fuel designs also incorporate partial length rods for increased neutron economy, which are employed in order to extend the operating cycle. Both of these affect the ratio of moderator-to-fuel. The strong local absorption effects of the burnable poisons in fresh fuel make the core under-moderated. As burnable poisons are depleted during the fuel cycle, the core becomes less under-moderated, potentially leading to a slightly over-moderated condition wherein the core will be more reactive at a moderator temperature higher than the 68 °F specified in the SDM definition. Thus, the maximum core reactivity condition and the most limiting SDM may occur later in the fuel cycle at a temperature greater than 68 °F. Consequently, calculation of the SDM at the currently defined moderator temperature of 68 °F may not accurately determine the available margin.

Consistent with TSTF-535, Revision 0, the licensee proposed a change to the definition of SDM to be the margin at a reactor moderator temperature of 68 °F or a higher temperature corresponding to the most reactive state throughout the operating cycle. The revised definition would be used in TS SR 3.1.1.1, which requires the licensee to verify that SDM is within the limits specified in SR 3.1.1.1.a. or 3.1.1.1.b., depending on whether the reactivity value of the highest worth control rod was determined analytically or by test. The SDM surveillance requirement must be performed prior to each in vessel fuel movement during fuel loading sequence, and once within 4 hours after criticality following fuel movement within the reactor pressure vessel or control rod replacement.

In support of the proposed change, TSTF-535, Revision 0 cited the requirements for SDM as specified in Topical Report NEDO-24011-A, Revision 18, "General Electric Standard Application for Reactor Fuel (GESTAR II)," dated April 2011 (ADAMS Accession No. ML111120046). Section 3.2.4.1, "Shutdown Reactivity," of GESTAR II states, in part:

> The core must be capable of being made subcritical, with margin, in the most reactive condition throughout the operating cycle with the most reactive control rod fully withdrawn and all other rods fully inserted.

TSTF-535 also cited SRP Section 4.3, which states, in part, the following concerning the review of control systems and SDM:

> The adequacy of the control systems to assure that the reactor can be returned to and maintained in the cold shutdown condition at any time during operation. The applicant shall discuss shutdown margins (SDM). Shutdown margins need to be demonstrated by the applicant throughout the fuel cycle.

Although the licensing basis requirements for SDM in GESTAR II are only applicable for cores licensed with GNFs methods, they are consistent with the review procedures set forth in the SRP Section 4.3, and therefore, the NRC staff concludes that the change is applicable to any BWR, regardless of its fuel design.

In its letter dated March 11, 2016, the licensee stated, in part:

> The proposed amendment would modify the TS definition of "Shutdown Margin" (SDM) to require calculation of the SDM at a reactor moderator temperature of 68°F or a higher temperature that represents the most reactive state throughout the operating cycle. This change is needed to address new Boiling Water Reactor fuel designs which may be more reactive at shutdown temperatures above 68 °F.

Because newer fuel designs employ elements such as partial length rods and burnable absorbers, which may cause the maximum core reactivity conditions and the most limiting SDM to occur later in the fuel cycle at a temperature greater than 68 °F, the NRC staff agrees with the TSTF-535, Revision 0, assessment in this regard. The NRC staff finds that applying the redefined SDM within TS 3.1.1 shows that the new definition will provide the appropriate levels of safety and regulatory compliance. First, LCO 3.1.1, which sets minimum limits for SDM, will continue to do so under the new definition of SDM, but with the appropriate consideration of over-moderated fuel loads. Thus, with the new definition of SDM, LCO 3.1.1 will continue to satisfy 10 CFR 50.36(c)(2)(i), in that it will provide for the lowest functional capability or performance levels of equipment required for safe operation of the facility even during usage of new BWR fuel designs that might be more reactive at shutdown temperatures above 68 °F. Second, with the new definition of SDM being used in TS SR 3.1.1.1, the surveillance requirement will continue to satisfy 10 CFR 50.36(c)(3) in that it will still assure that the necessary quality of systems and components is maintained, that facility operation will be within safety limits, and that the limiting conditions for operation will be met, even during usage of new BWR fuel designs that might be more reactive at shutdown temperatures above 68 °F.

3.3 Summary

As noted in Section 2.3 of this SE, CNS was licensed to the proposed GDCs while TSTF-535 was based on the final GDCs. The NRC staff has reviewed the licensee's implementation of TSTF-535, Revision 0, proposed revisions to the definition of SDM using CNS's licensing basis. Based on the considerations discussed above, the NRC staff concludes that the proposed revisions are acceptable and will provide a conservative and improved approach to the calculation of SDM that ensures use of the appropriate limiting conditions for all fuel types at any time in the life of the core. The NRC staff concludes the revised definition of SDM, when applied to TS 3.1.1, and in particular to LCO 3.1.1 and SR 3.1.1.1, results in TSs that continue to meet the requirements of 10 CFR 50.36(c)(2)(i) and 50.36(c)(3). The NRC staff also concludes the proposed revisions serve to satisfy the requirements set forth in the proposed GDC 27, 28, 29, and 30 as incorporated into CNS's licensing basis. Based on the considerations discussed above, the NRC staff concludes that the proposed revisions are acceptable and will provide a conservative and improved approach to the calculation of SDM that ensures use of the appropriate limiting conditions for all fuel types at any time in the life of the core. Additionally, the NRC staff concludes the proposed changes to the definition of SDM would require the licensee to calculate SDM in consideration of the most limiting conditions in the core.

4.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Nebraska State official was notified of the proposed issuance of the amendment. The State official had no comments.

5.0 ENVIRONMENTAL CONSIDERATION

The amendment changes a requirement with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20. The NRC staff has determined that the amendment involves no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendment involves no significant hazards consideration, and there has been no public comment on such finding published in the Federal Register on April 12, 2016 (81 FR 21600). Accordingly, the amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendment.

6.0 CONCLUSION

The Commission has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) there is reasonable assurance that 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.

Principal Contributor: K. Heller
A. Wang

Date: July 25, 2016

A copy of the related Safety Evaluation is also enclosed. The Notice of Issuance will be included in the Commission's next biweekly *Federal Register* notice.

Sincerely,

/RA/ Alan Wang for

Thomas J. Wengert, Project Manager
Plant Licensing IV-2 and Decommissioning
Transition Branch
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-298

Enclosures:
1. Amendment No. 254 to DPR-46
2. Safety Evaluation

cc w/encls: Distribution via Listserv

DISTRIBUTION:
PUBLIC
LPL4-2 r/f
RidsACRS_MailCTR Resource
RidsNrrDssStsb Resource
RidsNrrDssSnpb Resource
RidsNrrDorlDpr Resource
RidsNrrDorlLpl4-2 Resource
RidsNrrPMCooper Resource
RidsNrrLAPBlechman Resource
RidsRgn4MailCenter Resource
CTilton, NRR
KHeller, NRR

ADAMS Accession No. ML16119A433 ***concurrence via email**

OFFICE	NRR/DORL/LPL4-2/PM	NRR/DORL/LPL4-2/LA	NRR/DSS/SNPB/BC*	NRR/DSS/STSB/BC*
NAME	AWang	PBlechman	JDean	AKlein
DATE	05/16/16	05/13/16	06/15/16	07/25/16
OFFICE	OGC - NLO	NRR/DORL/LPL4-2/BC(A)	NRR/DORL/LPL4-2/PM	
NAME	DRoth	SAnderson	TWengert (AWang for)	
DATE	07/19/16	07/25/16	07/25/16	

OFFICIAL RECORD COPY