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July 14, 2016

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

Serial No. 16-247
NRA/WDC R0
Docket No. 50-336
License No. DPR-65

DOMINION NUCLEAR CONNECTICUT, INC.
MILLSTONE POWER STATION UNIT 2
REQUEST FOR ADDITIONAL INFORMATION REGARDING
SPENT FUEL POOL HEAT LOAD ANALYSIS LICENSE AMENDMENT REQUEST

By letter dated January 26, 2016, in response to Confirmatory Order (CO) EA-13-188, Dominion Nuclear Connecticut Inc. (DNC) submitted a license amendment request (LAR) to the Nuclear Regulatory Commission (NRC) to request a change to the Spent Fuel Pool (SFP) heat load analysis description contained in the Final Safety Analysis Report (FSAR) for Millstone Power Station Unit 2 (MPS2). Specifically, DNC requested proposed changes to TS Bases 3/4.9.3, FSAR Section 9.5, and the SFP heat load analysis which support the proposed FSAR changes. In an email dated June 7, 2016, the NRC transmitted a request for additional information (RAI) related to the amendment request. DNC agreed to respond to the RAI by July 14, 2016.

The attachment to this letter provides DNC's response to the NRC's RAI. A proposed revision to the FSAR is provided in Attachment 2 as part of the RAI response. The proposed change does not require a revision to the conclusion of the no significant hazards consideration provided in the January 26, 2016 LAR. The proposed change was reviewed and approved by the Facility Safety Review Committee.

If you have any questions in regards to this submittal, please contact Wanda Craft at (804) 273-4687.

Sincerely,

Mark D. Sartain
Vice President – Nuclear Engineering

Vicki L. Hull
NOTARY PUBLIC
Commonwealth of Virginia
Reg. # 140542
My Commission Expires May 31, 2018

COMMONWEALTH OF VIRGINIA)
)
COUNTY OF HENRICO)

The foregoing document was acknowledged before me, in and for the County and Commonwealth aforesaid, today by Mark D. Sartain, who is Vice President – Nuclear Engineering of Dominion Nuclear Connecticut, Inc. He has affirmed before me that he is duly authorized to execute and file the foregoing document in behalf of that Company, and that the statements in the document are true to the best of his knowledge and belief.

Acknowledged before me this 14TH day of July, 2016.

My Commission Expires: 5-31-18.

Vicki L. Hull
Notary Public

A001
NRR

Commitments made in this letter: None.

Attachments:

1. Response to Request for Additional Information for License Amendment Request Spent Fuel Pool Heat Load Analysis
2. Revised Final Safety Analysis Report Pages

cc: U.S. Nuclear Regulatory Commission
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ATTACHMENT 1

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION FOR LICENSE AMENDMENT REQUEST SPENT FUEL POOL HEAT LOAD ANALYSIS

DOMINION NUCLEAR CONNECTICUT, INC.
MILLSTONE POWER STATION UNIT 2

By letter dated January 26, 2016, in response to Confirmatory Order (CO) EA-13-188, Dominion Nuclear Connecticut Inc. (DNC) submitted a license amendment request (LAR) to the Nuclear Regulatory Commission (NRC) to request a change to the Spent Fuel Pool (SFP) heat load analysis description contained in the Final Safety Analysis Report (FSAR) for Millstone Power Station Unit 2 (MPS2). Specifically, DNC requested proposed changes to Technical Specification Bases 3/4.9.3, FSAR Section 9.5, and the SFP heat load analysis which support the proposed FSAR changes. In an email dated June 7, 2016, the NRC transmitted a request for additional information (RAI) related to the amendment request. This attachment provides DNC's response to the RAI.

RAI SBPB-01

The U.S. Nuclear Regulatory Commission (NRC) Standard Review Plan (SRP) for the Review of Safety Analysis Reports for Nuclear Power Plants provided guidance for NRC staff review in Section 9.1.3, "Spent Fuel Pool Cooling and Cleanup System." The NRC SRP listed specific acceptance criteria derived from applicable general design criteria and other NRC regulations and a method acceptable to the staff to demonstrate compliance with those acceptance criteria for various SSCs at commercial Light Water Reactors (LWRs). The review criteria in SRP Section 9.1.3, Revision 2, specified the SFP cooling system considerations for SFP coolant temperature control. Paragraph III.1.H of Section 9.1.3 of the SRP provided the following criteria for evaluating measures to manage SFP heat load relative to heat removal capability:

> *i. The SAR [Safety Analysis Report] describes a method of performing decay heat load calculations using a conservative model that evaluates multiple fission product groups and considers offload size, decay time, power history, and inventory of previously discharged assemblies.*
>
> *ii. The SAR describes a method of calculating heat removal capability for a bulk SFP temperature of 60°C (140°F) and considering ultimate heat sink temperature, cooling system flow rates, and heat exchanger performance (i.e., fouling and tube plugging margin).*
>
> *iii. The SAR describes appropriate administrative controls in the SAR to ensure that the full heat removal capability at a SFP temperature of 60°C (140°F) will exceed the calculated decay heat load at all times during the refueling offload.*

Section 9.5.1.1 of the mark-up the MPS2 FSAR provided in Attachment 3 to the LAR states:

> *"In the event of a full core offload, the spent fuel pool water temperature will be limited to 150°F. This would utilize one train of the shutdown cooling system for the limiting emergency full core offload. Under less limiting full core offload conditions, the Spent Fuel Pool Cooling system or Spent Fuel Pool Cooling supplemented by the Shutdown Cooling [SDC]*

> *system may be used, provided that a Spent Fuel Pool temperature of less than 150°F is maintained."*

Similarly, after discussion of the analysis of a full core offload as normal refueling using only the shutdown cooling system for decay heat removal in Section 9.5.2.1 of the MPS2 FSAR, the mark-up included the following statement:

> *"While the above analysis is for the limiting heat load case at end of plant life, it is acceptable to use SFP cooling, or SFP cooling supplemented by lesser amounts of SDC, during any portion of the core offload, provided that spent fuel pool bulk water temperature can be maintained below 150°F."*

Operation of the shutdown cooling system and SFP cooling and cleanup system is governed by procedures required to be established by MPS2 TS 6.8.1. The analyses provided as Attachment 4 to the LAR indicate that the SFP cooling system alone (i.e., without assistance from the shutdown cooling system) can maintain SFP temperature below 150°F during full core offload conditions after 216 hours of decay at an Reactor Building Closed-Cooling Water (RBCCW) temperature of 55°F and after 427 hours of decay at an RBCCW temperature of 75°F (Table 18 of Proprietary HOLTEC Report HI-2094491). The above excerpts from the MPS2 FSAR provide inadequate information regarding how maintenance of SFP temperature below 150°F would be ensured. Explain how the SFP cooling system operating procedures provide adequate administrative control of SFP cooling to satisfy the applicable quality assurance requirements and ensure the SFP temperature does not exceed the operating temperature limit of 150°F. Propose an update to the MPS2 FSAR consistent with the administrative controls provided by the operating procedure.

DNC Response

As discussed in the MPS2 FSAR Section 9.5.2.1, the SFP Cooling system is not capable of removing the decay heat load during a full core offload. As a consequence, both the SFP Cooling and SDC systems are used to cool the SFP during a refueling outage.

During normal plant operation, temperature in the SFP is typically below 100°F and plant operating procedures limit SFP temperature to a conservative temperature of 120°F. SFP temperatures increase during fuel movement from the reactor to the SFP. Prior to reaching the 120°F limit, operators begin the transition from SFP Cooling to SDC. When the majority of the fuel remains in the reactor, operators augment SFP Cooling with up to 500 gpm of SDC. As more fuel is moved to the SFP and the reactor coolant temperature decreases, the operators secure SFP Cooling and re-align SDC to provide up to 1900 gpm to the SFP. A proposed revision to the FSAR to address the transition to SDC during fuel movement is provided in Attachment 2. Only the affected FSAR pages from the January 26, 2016 LAR are included and the new proposed changes are indicated by bolded text boxes.

FSAR Table 9.5-1 indicates that the SFP temperature is monitored and alarmed in the control room. The high temperature alarm is set at 130°F. This provides time for operators to provide increased cooling to the SFP to ensure the SFP remains below the Technical Requirements Manual maximum normal temperature limit of 150°F.

There are periods of time when SFP Cooling and supporting systems may not be aligned to cool the SFP. As described in FSAR Section 9.5.2,

> "Periodic maintenance of the Spent Fuel Pool Cooling system and associated supporting systems is required. During the performance of maintenance activities it may be necessary to remove system components and portions of various support systems from service. While these components and systems are out of service, the ability of the Spent Fuel Pool Cooling system to meet single failure criteria will be limited. These maintenance activities do not conflict with system design or licensing basis."

During these activities, the shutdown risk program ensures that SFP temperature is maintained with suitable redundancy available. These activities may require system re-alignments. However, in all cases, the shutdown cooling system and/or the spent fuel pool cooling system are used to maintain the spent fuel pool temperature below the TRM limit of 150 °F.

FSAR Sections 9.5.2.1 and 9.5.3.1 describe when SDC can be removed from service. SDC provides protection from single failure of the SFP Cooling system until 616 hours after sub-criticality or until the decay heat load in the SFP is less than 10.16 x 10^6 BTU/hr. After this point, the SDC system may be re-aligned to fully support the Emergency Core Cooling System.

ATTACHMENT 2

REVISED FINAL SAFETY ANALYSIS REPORT PAGES

DOMINION NUCLEAR CONNECTICUT, INC.
MILLSTONE POWER STATION UNIT 2

9.5 SPENT FUEL POOL COOLING SYSTEMSUBCRITICAL HOURS

9.5.1 DESIGN BASES

9.5.1.1 Functional Requirements

or the equivalent heat load

The function of the spent fuel pool cooling system is to remove decay heat generated by spent fuel assemblies stored in the pool by limiting the temperature of the borated pool water to an acceptable level, thereby ensuring the cladding integrity of stored spent fuel assemblies. In order to ensure that spent fuel pool water temperature limits and fuel integrity are maintained two different refueling operations are analyzed: (1) Normal refueling involves movement of a maximum of 80 fuel assemblies or 14.35 x 10^6 BTU/HR from the reactor vessel to the spent fuel pool, and (2) A full core offload of all 217 fuel assemblies from the reactor vessel to the spent fuel pool. A full core offload comprises of an end-of-cycle full core offload or a mid-cycle emergency full core offload. In the event of a full core offload, the spent fuel pool water temperature will be limited to 150°F. This would utilize one train of the shutdown cooling system for the limiting emergency full core offload. Under less limiting full core offload conditions, the Spent Fuel Pool Cooling system or Spent Fuel Pool Cooling supplemented by the Shutdown Cooling system may be used, provided that a Spent Fuel Pool temperature of less than 150°F is maintained

the Technical Requirements Manual (TRM) limit of

The spent fuel pool cooling system is provided with a cleanup system for maintaining the purity and clarity of water in the spent fuel pool, refueling pool and the refueling water storage tank after completion of refueling operations. The cleanup systems limit operating personnel radiation exposures from these sources by reducing the concentrations of radioactive constituents introduced into these waters.

9.5.1.2 Design Criteria

The spent fuel pool cooling system is designed in accordance with the following criteria:

a. The system shall be designed to ensure adequate decay heat removal capability under normal and postulated accident conditions.

b. The system shall be designed with the ability to permit appropriate periodic inspection and testing of components important to decay heat removal.

c. The system shall be provided with suitable shielding for radiation protection.

d. Reliable and frequently tested monitoring equipment to detect conditions that may result in loss of decay heat removal shall be provided.

e. The system shall be designed with an adequate spent fuel pool makeup system with appropriate provisions for a backup system for filling the pool.

f. Design shall prevent significant reduction in fuel storage cooling water inventory due to equipment failure, maloperation or accident conditions.

Move paragraph to (B) with rest of paragraph

the core defueled. The CS pump supplemented by a SFP cooling train (if required) will be the means of backup to SDC during SDC maintenance activities. Suitable redundancy is ensured per the Shutdown Risk program.

~~The last full core offload at end of plant life, calculated in the above manner, produces a maximum conservative heat loading of 29.88 x 10^6 BTH/hr.~~ Insert 4 With 1 train of SDC available during the core offload to cool both the reactor vessel and the core, spent fuel pool water temperature will be maintained to less than 150°F. One train of SDC is assumed to be capable of delivering 3000 gpm, however the split of SDC flow going to the reactor vessel, or cooling the SFP will change during the core offload as the heat load shifts from the core to the SFP. With this limiting heat load, at the start of the offload most of the SDC flow will go to the reactor vessel (approximately 2000 gpm), with lesser SDC flow going to the SFP (approximately 1000 gpm). By the end of the offload most of the SDC flow will go to the SFP (~~approximately~~ up to 1900 gpm), with lesser SDC flow going to the reactor vessel (>1000 gpm). See Section 9.3 for a description of the SDC system.

Add Insert 10 as a stand alone paragraph

Key SDC parameters used in this analysis are:

- Credited SDC flow is 3000 gpm per LPSI pump, with a maximum of 1900 gpm diverted to cooling the SFP.
- Credited RBCCW flow to SDC heat exchangers is 3500 gpm ~~at 85°F~~. Insert 5
- SFP and SDC heat exchangers have a 1% tube plugging penalty.

While the above analysis is for the limiting heat load case at end of plant life, it is acceptable to use SFP cooling, or SFP cooling supplemented by lesser amounts of SDC, during any portion of the core offload, provided that spent fuel pool bulk water temperature can be maintained below 150°F.

(B) →

Therefore, for a full core offload as normal refueling, the system is conservatively designed to maintain the water in the spent fuel pool water below 150°F during all normal conditions or single active failure conditions.

<u>Emergency Full Core Offload</u>

The third design basis for the spent fuel pool cooling system is for an emergency full core offload. ~~Fuel movement to the SFP is assumed to start after 150 hours of decay, and proceed at a rate of 4 fuel assemblies per hour, until all 217 fuel assemblies are in the SFP and the reactor vessel is empty of fuel.~~ Insert 6 The case analyzed is during the final fuel cycle at end of plant life to maximize the fuel inventory, therefore decay heat, of spent fuel in the pool. At end of plant life, decay heat removal is needed for a total of 1343 fuel assemblies and 3 consolidated fuel storage boxes. The number of fuel assemblies analyzed in the heat load analysis bounds the number of fuel assemblies which can be physically stored in the spent fuel pool. Decay heat calculations are performed with ORIGEN2. Significant conservatism is used in the calculation of the decay heat values. A conservatively short decay time of 36 days is chosen for the previous batch of discharge

To facilitate the removal of accumulated dust from the surfaces of both the spent fuel pool and refueling pool, skimmer assemblies with a pump and filters are provided for each pool.

9.5.2.2 Components

A description of the components of the spent fuel pool cooling system is given in Table 9.5-2.

9.5.3 SYSTEM OPERATION

9.5.3.1 Normal Operation

below the Technical Requirements Manual (TRM) limit of 150°F

During normal operation of the pool, both pumps and heat exchangers are in continuous service. As the decay heat generated by the spent fuel decreases, one pump is stopped. As the decay heat further decreases, operation of the system is intermittent as required to limit the pool water temperature to less than or equal to 150°F.

As described in Section 9.5.2.1, during refuel operations, the spent fuel cooling system, with assistance from the shutdown cooling system when needed, is capable of maintaining spent fuel pool water temperature ~~≤150°F~~ for a normal refueling through (and including) the end of plant life refueling. This includes allowance for a single active failure of the spent fuel pool cooling system, or shutdown cooling system, as appropriate.

As described in Section 9.5.2.1, the spent fuel pool heat load must decay to a value of 10.16×10^6 BTU/HR, for the SFP cooling system to be capable of withstanding the worst single active failure, and maintain spent fuel pool water temperature ≤ 150°F. For the time period before the SFP heat load drops to 10.16 MBTU/hr, should the limiting single failure occur, 1 train of the shutdown cooling (SDC) system may be used to cool the SFP, or the SDC system may be used to supplement the SFP cooling system, to maintain spent fuel pool water temperature ≤ 150°F.

As a result of this need to depend on the SDC for potential SFP cooling single failure per Technical Requirements Manual (TRM), entry into Mode 4 following a refueling is not allowed until either:

(a) 616 hours has passed since subcriticality for the fuel bundles remaining in the spent fuel pool which were discharged from the previous refueling, of ≤ 80 fuel bundles, or

(b) the heat load to the SFP is less than 10.16 x 106 BTU/hr. At a SFP heat load of 10.16×10^6 BTU/hr, adequate cooling is available to maintain the SFP bulk water temperatures less than or equal to 150°F should a single failure occur in the SFP cooling system.

These TRM limits assure that the shutdown cooling system would be available for supplemental cooling and not committed to its emergency core cooling system functions.

While water temperatures up to 150°F are allowed in the spent fuel pool, the demineralizers in the spent fuel pool cleanup system should not be exposed to spent fuel pool water temperatures in

INSERT 4

The last full core offload at end of plant life, calculated in the above manner, produces a maximum conservative heat loading of 34.59 MBTU/hr with a 100 hour core hold time and produces 30.90 MBTU/hr with a 150 hour core hold time.

INSERT 5

- Credited RBCCW temperature to SDC heat exchangers is 75°F for fuel movement starting after 100 hours of decay and 85°F for fuel movement starting after 150 hours of decay.

INSERT 6

Fuel movement to the SFP is assumed to start after 100 hours with a RBCCW temperature of less than or equal to 75°F or after 150 hours with RBCCW temperature of less than or equal to 85°F. The fuel movement is assumed to proceed at an average rate of 6 assemblies per hour until all 217 fuel assemblies are in the SFP and the reactor vessel is empty of fuel.

INSERT 10

During the refueling evolution, cooling is transitioned from the spent fuel pool cooling system to the shutdown cooling system when the temperature in the spent fuel pool is observed to rise. This transition begins before challenging the conservatively established normal operating pool temperature limit of 120°F.