UNITED STATES DEPARTMENT OF COMMERCE
National Institute of Standards and Technology
Gaithersburg, Maryland 20899-

November 17, 2017

Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Subject: Supplement for request for changes to NBSR Technical Specifications to allow low power testing.

Ref: Docket 50-184, TR-5 Facility License

Sirs/Madams:

On November 16, 2017, NRC sent a request for additional information regarding our license amendment request of March 2, 2017. Attached is our response to that request. Also attached is a copy of the Technical Specification pages to be changed, with change bars. It should be noted, that as a result of this request, additional changes were made to technical specifications 1.3.31, 3.1.3, and 3.3.2.

Please contact Dr. Thomas Newton at (301) 975-6260 if you have any questions.

Respectfully,

Robert Dimeo, Director
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I declare under penalty of perjury that the foregoing is true and correct.

A020
NRR

Executed on November 17, 2017

By: ________________

cc: Xiaosong Yin, BRR/DPR/PRLB

NIST

NCNR response to NRC Supplemental Information request of 11/16/17

1. *Explain why the shim arm failure no longer needs to be controlled by this TS and why safe operation of the reactor is maintained without this TS or restore the objective and basis to controlling shim arm failure. Revise the proposed TS as needed.*

   A failure in which a shim arm falls outside the shim arm stop would only occur during a shim arm changeout or other activity with the fuel removed. Any such failure would result in a negative reactivity insertion. Accordingly, Technical Specification 3.1.3 will be changed to read: "The reactor shall not operate unless all grid positions are filled with full length fuel elements or thimbles *except during startup testing."*

   A new definition will be added after TS 1.3.30:
   <u>Startup Testing</u>
   Subcritical and critical testing, including inverse multiplication tests, during and after fuel loading. Such tests will only take place with natural convection flow.

2. *Explain why it is safe to operate the reactor with the channel bypassed under the proposed conditions. Explain how the limiting conditions for operation will be met when the reactor is operating under TSs 2.2(4) and 3.3.1 conditions but the entire reactor outlet temperature channel is bypassed.*

   As analyzed in SAR section 4.6.5, the reactor can be safely operated with natural convection up to 500 kW, well above the 10 kW limit of TS 2.2(4). The temperatures generated by the reactor at 10 kW are insignificant and even if they were, they would not be detected by the reactor outlet temperature sensor, since the pumps are not running. Power level indication via neutron detection is the best and only way to provide indication of the reactor status in natural convection mode. For this the reactor is equipped with more than one detection channel, all of which will be operable during TS 2.2(4) operation.

3. *Explain why it is safe to operate the reactor under TS 2.2(4) conditions without the emergency core cooling system operable. Why is this change necessary if your emergency cooling system is standing by to be initiated. Revise the proposed TS as needed.*

   The basis was revised because, under natural convection operation with lowered coolant level, the inner reserve tank, which is part of the emergency core coolant system containing about 20 minutes of emergency cooling water, will be empty. However, the emergency cooling tank, located outside the reactor vessel will still be available to supply 3000 gallons of D_2O via the same flow path were the inner reserve tank full. The emergency cooling tank holds about 2 hours' worth of cooling water even without the emergency sump pump and an alternate source of makeup water, ie. potable water via spool piece. It is unlikely that the NBSR will be operated for an extended time with natural convection with a low coolant level, so to avoid confusion, Technical Specification 3.3.2 will be changed to read: "The reactor shall not be operated, *except during startup testing*, unless: (1) The D2O emergency core cooling system is operable. (2) A source of makeup water to the D2O emergency cooling tank is available. "

4. *Your proposed changes to TS 3.9.2.1 would allow reactor operation with natural convection cooling*

without have fuel elements locked in the core grid structure. What precautions exist to prevent accidental starting of primary pumps and the establishment of primary flow when the reactor is in natural convection operation?

As a part of the fuel element insertion procedure, the latching mechanism is engaged before the refueling tool is removed (the tool cannot be withdrawn without doing so). Thus, under normal operations, all elements are locked into the grid and it is thus unlikely that a fuel element would move even if the primary pumps were started. However, the latching verification as required in TS 3.9.2.1, is not normally performed until just prior to full power startup. For natural convection operations and startup testing following refueling, this verification is not performed because the flow verification cannot be made. Procedures are in place (RP-19 and RP-20) directing the operator to complete the latching verification prior to starting primary pumps.

1.3.30 Shutdown Margin

The minimum shutdown reactivity necessary to provide confidence that the reactor can be shutdown by means of the control and safely systems starting from any permissible operating condition, with the most reactive shim arm in the most reactive position and the regulating rod fully withdrawn, and that the reactor will remain shutdown without further operator action.

1.3.31 Startup Testing

Subcritical and critical testing, including inverse multiplication tests, during and after fuel loading. Such tests will only take place with natural convection flow.

1.3.32 Surveillance Activities

Those tests, checks and calibrations done to predict the operability of the equipment described in Section 4.0.

1.3.33 Surveillance Intervals

Maximum intervals are established to provide operational flexibility and not to reduce frequency. Established frequencies shall be maintained over the long term. The surveillance interval is the time between a check, test or calibration, whichever is appropriate to the item being subjected to the surveillance, and is measured from the date of the last surveillance. Surveillance intervals are:

(a) Five Year
Interval not to exceed six years.

(b) Biennial
Interval not to exceed two and one-half years.

(c) Annual
Interval not to exceed 15 months.

(d) Semi-annual
Interval not to exceed seven and a half months.

(e) Quarterly
Interval not to exceed four months.

(f) Monthly
Interval not to exceed six weeks.

(g) Weekly
Interval not to exceed ten days.

1.3.34 Unscheduled Shutdown

Any unplanned shutdown of the reactor caused by actuation of the reactor safety system, operator error, equipment malfunction, or a manual shutdown in response to conditions that could adversely affect safe operation, not including shutdowns that occur during testing or equipment operability check

Basis

(1) An excess reactivity limit provides adequate excess reactivity to override the xenon buildup and to overcome the temperature change in going from zero power to 20 MW, without affecting the required shutdown margin. In addition, the maximum reactivity insertion accident at startup, which assumes the insertion of 0.5% $\Delta\rho$ into a critical core, is not affected by the total core excess reactivity.

(2) These specifications ensure that the reactor can be put into a shutdown condition from any operating condition and remain shutdown even if the maximum worth shim arm should stick in the fully withdrawn position with the regulating rod also fully withdrawn.

3.1.3 Core Configuration

Applicability: Core grid positions

Objective: To ensure that effective fuel cooling is maintained during forced flow reactor operation.

Specification

The reactor shall not operate unless all grid positions are filled with full length fuel elements or thimbles, except during startup testing.

Basis

Core grid positions shall be filled to prevent coolant flow from bypassing the fuel elements for operation of the reactor with forced coolant flow.

3.1.4 Fuel Burnup

Applicability: Fuel

Objective: To remain within allowable limits of burnup effectiveness of the moderator dump or approach to critical for a previously unmeasured core loading, it is necessary to operate the reactor without restriction on reactor vessel level. This is permissible under conditions when forced reactor cooling flow is not required, such as is permitted in the specifications of Section 2.2(4).

(2) Deuterium gas will collect in the helium cover gas system because of radiolytic disassociation of D_2O. Damage to the primary system could occur if this gas were to reach an explosive concentration (about 7.8% by volume at 77°F (25°C) in helium if mixed with air). To ensure a substantial margin below the lowest potentially explosive value, a 4% limit is imposed.

(3) Materials of construction, being primarily low activation alloys and stainless steel, are chemically compatible with the primary coolant. The stainless steel pumps are heavy walled members and are in areas of low stress, so they should not be susceptible to chemical attack or stress corrosion failures. A failure of the gaskets or valve bellows would not result in catastrophic failure of the primary system. Other materials should be compatible so as not to cause a loss of material and system integrity.

3.3.2 Emergency Core Cooling

Applicability: Emergency Core Cooling System

Objective: To ensure an emergency supply of coolant.

Specifications

The reactor shall not be operated, except during startup testing, unless:

(1) The D_2O emergency core cooling system is operable.

(2) A source of makeup water to the D_2O emergency cooling tank is available.

Basis

(1) In the event of a loss of core coolant, the emergency core cooling system provides adequate protection against melting of the reactor core and associated release of fission products.

(2) The emergency core cooling system employs one sump pump to return spilled coolant to the overhead storage tank. Because only one sump pump is used, it must be operational whenever the reactor is operational. There is sufficient D_2O available to provide approximately 2.5 hours of cooling on a once-through basis. In the event that the sump pump fails and the D_2O