February 2, 2007

MEMORANDUM TO: Daniel S. Collins, Chief
Research and Test Reactors Branch A
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

FROM: William B. Kennedy, General Engineer ***/RA/***
Research and Test Reactors Branch A
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

SUBJECT: NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY TEST REACTOR (NBSR)- DRAFT REQUEST FOR ADDITIONAL INFORMATION (RAI), REGARDING AMENDMENT REQUEST FOR RE-LICENSING (TAC MD3410)

The enclosed draft RAI was transmitted by email on January 31, 2007, to Dr. Wade Richards of the National Institute of Standards and Technology test reactor in preparation for an upcoming site visit. Review of the RAI would allow the licensee to identify areas where clarification may be needed, as well as determine and agree upon a schedule for responding to the RAI. This memorandum and its attachment do not convey a formal request for information or represent a Nuclear Regulatory Commission position.

Docket No. 50-184
Enclosure: As stated

CONTACT: William B. Kennedy, NRR
301-415-2784

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Enclosure

REQUEST FOR ADDITIONAL INFORMATION
REGARDING LICENSE RENEWAL FOR THE
NATIONAL BUREAU OF STANDARDS REACTOR
DOCKET NO. 50-184

Technical Questions and Comments

2.1 The SAR text indicates that the 100-year return wind speed of 102.5 mph is within the uncertainty limits of the 100 mph design of the Confinement Building. The 102.5 mph value is calculated based on the 90 mph 50-year return gust taken from ASCE 7-98. However, virtually the entire country away from the coastline is rated with a 90 mph gust level. In all likelihood, a more appropriate value for the 50-year return wind speed is somewhat lower, and as a result, the 100-year return wind speed would be lower as well. In this discussion (Section 2.3.1.5, Table 2.13, and Figure 2.7) provide a more refined estimate of the 100-year return wind speed, which should be less than the design value.

2.2 The discussion in SAR Section 2.3.1.6 regarding snow density references a publication of the American Meteorological Society with a range of densities of 0.07 to 0.15. Clarify the text to reflect that this range of densities is for freshly fallen snow. Verify that the correct date of the reference is 1989, and make any necessary corrections to the text and references section.

4.1 Section 4.2.1.1, p. 4-3. In the “Fuel Composition” section, it is stated that the “fuel core is a slug type design.” Provide clarification of the term “slug type” or use more descriptive language to describe the fuel core design.

4.2 Section 4.2.1.2, p. 4-3. Provide sufficient overall fuel element dimensions for comparison with the unit cell dimensions provided in this section and TS 5.3.

4.3 Section 4.2.1.3, p. 4-5. Provide clarification that the fabrication of NBSR fuel elements is consistent with ANS 15.2.

4.4 Section 4.2.1.4, p. 4-6. The second paragraph states “Flow rates of 30 ft/sec which are over two times those seen in operation, (9.1 m/sec) were employed to measure flow conditions in each channel…” Provide clarification of whether the 9.1 m/sec is the flow rate seen in operation or the test flow rate. Also, provide discussion that justifies the use of test flow rates that are over two times the operational flow rates for both the inner and outer plenums.

4.5 Section 4.2.2.1, pp. 4-9,10. The description of the “operational travel of 41º and a maximum travel of 50º” appears inconsistent with the statement “To prevent over travel during normal operation of the shim arm, installed upper and lower limit switches are set to approximately 41º and 2º, respectively.” Clarify the operational shim arm travel ranges, limits, and corresponding angular positions.

4.6 Section 4.2.2.2, p. 4-11. This section states that the regulating rod is "$2^1/_2$ inches in diameter" and the last SER (NUREG-1007) says the regulating rod is "a 2.25 inch diameter solid aluminum rod." Clarify if the regulating rod design has been changed and describe any impact on the safety analysis.

4.7 Section 4.2.2.2, p. 4-11. This section states "The regulating rod acts as a poison designed with a reactivity worth approximately 0.58 $\Delta\rho$." The reactivity worth is inconsistent with the 0.58% $\Delta\rho$ stated elsewhere. Confirm the magnitude of this value and clarify if the reactivity worth is derived primarily from absorption (poison) or moderator displacement.

4.8 Section 4.2.4, p. 4-16. This section states that the source is placed into one of the existing experimental thimbles and does not contact the coolant. In the following section, Core Support Structure (p. 4-17), it is stated that coolant passes up through the experimental thimbles. Clarify how the source does not contact the coolant and justify why no cooling is required. Describe the source encapsulation material of construction (MOC) and the design and testing requirements.

4.9 Section 4.2.5, p. 4-17. This section states that the experimental thimbles are held down by poison tubes from the top plug. Describe the design of the poison tubes, including materials of construction and any age-related issues. Describe any other purpose(s) of the poison tubes.

4.10 Section 4.3.1, p. 4-18. The description of the reactor vessel design discussed the use of two stainless steel O-ring gaskets at the reactor vessel flange. Describe any periodic inspection, leak testing, and replacement requirements or justify why these are not necessary.

4.11 Section 4.3.1, pp. 4-19 & 4-20. This section discusses "grazing tubes" as a separate vessel attachment. Relate the "grazing tubes" in the nomenclature terms used in the experimental facility descriptions in Chapter 10, e.g., radial beam tubes, through tubes, etc. Ensure nomenclature is consistent.

4.12 Section 4.3.1, p. 4-20. The fourth paragraph states "Since the vessel is entirely closed, there is no credible mechanism of exerting such a tensile stress, or impact, on the beam tube tips during reactor operation." Describe how all credible mechanisms for stresses resulting from pressures or impacts on the outside (non reactor side) of the beam tubes have been eliminated. Justify that the change in material properties (reduced ductility and Charpy energy) due to irradiation from past and future operations (20 years) will not reduce the design margins of safety to unacceptable levels. Describe the effect of the change in material properties (reduced ductility and Charpy energy) on the reactor vessel design rating and relief valve set pressure.

4.13 Section 4.3.1, p. 4-21. The third paragraph states "The shim safety-arm drive and shock absorbing systems are mounted on the biological shield so that only the extremely small reaction between the outer faces and the balls is transmitted to the vessel." Describe what is meant by the "outer faces and balls."

4.14 Section 4.3. Describe any surveillance or inspection programs for the periodic assessment of corrosion or radiation damage or why it is not needed.

4.15 Section 4.4.2, p. 4-23. The second paragraph states "The results yield a fast neutron flux $2.8x10^{-3}$ n/cm^2-sec and a gamma flux of $2x10^{-7}$ mW/cm^2 at the outside face of the biological shield." Describe how these results were calculated, and how the subsequent 25% concrete, 75% thermal shield neutron capture gamma fractions were determined.

4.16 Section 4.4.3, p. 4-24. The fourth paragraph states "The radiation near the top of the center plug constitutes no health risk since it is in the well in the top floor that is covered with a 6-inch (15.2 cm) steel plate. This plate, an integral part of the transfer system, is always in place when fuel elements are being moved. The plate over each pick-up tool is penetrated by openings up to 6 inches (15.2 cm) in diameter that normally are plugged." It appears the dose rate of 0.5 mrem/hr stated in this section applies to an inaccessible area. Clarify what the radiation field would be in the area above the top shield plug where personnel may be located during transfer operations.

4.17 Section 4.5.1.2.2, p. 4-29. The fourth paragraph states "This 'loss' of material was dealt with by adding elemental Zr and Sn, and ^{138}Ba, to mock up those fission products." Provide the justification for this substitution.

4.18 Section 4.5.1.3.1, p. 4-29. The reactivity change, Δρ, is defined and the method for calculating presented. Elsewhere in the chapter, the values of reactivity are presented as Δk/k. Provide consistent terminology or additional definitions and methodology.

4.19 Section 4.5.1.3.2, p. 4-30. Explain how the reactivity change of 0.34 % Δρ from "su183" to "sucold" is consistent with the reactivity temperature coefficients, e.g., the calculated moderator reactivity temperature coefficient.

4.20 Section 4.5.1.5.1, p. 4-34. The second paragraph states "Multiplying the differential shim bank reactivity worth by the speed of the shim arm drives, 0.0445 °/s, one obtains the reactivity insertion rate vs. position, shown in Fig. 4.5.19." This does not appear to be what is shown in Figure 4.5.19. Clarify the statement or modify the figure to be consistent with the statement.

4.21 Section 4.5.1.5.3, p. 4-34. The first paragraph states "its average reactivity insertion rate is 3.8 x 10^{-4} Δρ/sec." Provide the maximum differential rod worth and insertion rate, and provide a comparison with the TS 3.4 limit.

4.22 Section 4.5.1.6.1, p. 4-35. The second paragraph states "The fuel mass in F-5 is just 138 g, so the normalized worth is 7.6 % Δρ/kg." In Figure 4.5.2A, p. 4-86, the F-5 mass is given as 125g. Clarify the apparent difference.

4.23 Section 4.5.1.7, p. 4-36. The second paragraph states "There are only three means of adding positive reactivity to the reactor while it is critical: (1) withdrawing the shim safety arms, (2) lowering the inlet D_2O temperature, and (3) rapidly removing experiments." Justify not including the regulating rod in this list.

4.24 Section 4.5.3.2, p. 4-47. The 0.2 % Δρ limit for the pneumatic irradiation system and the

1.3 % Δρ limit for movable experiments are not included in the criteria section of TS 3.12. Provide justification for why these limitations are not criteria in TS 3.12 or modify the criteria accordingly.

4.25 Table 4.2.3, p. 4-61. Provide operating conditions and calculations for the 3.66 m/sec channel flow velocity under the "NBSR" column in the table.

4.26 Table 4.2.3, p. 4-61. The units for Max. Heat Flux in the first column appear inconsistent with standard heat flux units, e.g., "BTU/hr-ft^2 (W/m^2)." Also, the max. heat flux given for NBSR as 1.54 x 10^5 W/m^2 appears inconsistent with the hot spot heat flux given on p. 4-54 for element H-1 and the conversion between heat flux units appears incorrect. Clarify or correct the differences, as appropriate.

4.27 Section 4.2.1.4, p. 4-6. This section indicates that the bypass flow was measured at substantially higher flow rates than the flow rates typically found during normal operation. As the dimensions of the gap for the bypass flow result from hydraulic drag, justify that the measured bypass flow rate is correct for normal operating conditions.

4.28 Section 4.2.5, p. 4-17. Provide clarification regarding the potential for the poison tubes to buckle due to upward coolant forces on the experimental thimbles. If buckling of the poison tubes is credible, provide analysis that shows it could not cause an accident not bounded by the maximum hypothetical accident.

4.29 Section 4.5.2.1.1, p. 4-37. The delayed neutron fraction is presented for steady reactor power conditions. Describe and quantify any variation that may occur in this parameter during transient conditions.

4.30 Section 4.2.2.2. The regulating rod withdrawal rate has been changed since NBSR-9 from 30" per minute to 120" per minute. The design of the regulating rod has also been changed. Describe how these changes affect the reactivity insertion rate of the regulating rod. Provide the evaluation that was performed to determine that the change did not impose any unreviewed safety questions.

4.31 Section 4.5.2.3.3. The analyses use 30 fuel elements instead of 24 fuel elements allowed by TS 3.3 when the corner positions of the hexagonal lower grid plate are filled with plugs. Provide analyses to show that the use of 30 fuel elements in these analyses represent the limiting case. Explain how the hot channel factors account for the uncertainties in instrumentation and fuel fabrication tolerances. Describe how the uncertainties are treated (statistical vs. deterministic).

4.32 Section 4.6.3. Justify the assumption that the coolant within a single channel mixes completely. Justify the assumption that the coolant mixes completely in the unfueled gap between the upper and lower core. Justify treating the uncertainties in a statistical manner. Describe the conservatism built into the correlations for DNB and OFI and quantitatively estimate the conservatism provided by these correlations for the NBSR analyses.

5.1 Section 5.2.10, p. 5-14. In the first paragraph, the SAR states "The upper section of the thermal shield has 2-inch (5 cm) thick lead and 6-inch (15 cm) thick steel. The lead thickness was chosen to minimize the gamma ray flux at the vessel wall." As indicated in the biological shield description in Chapter 4, the lead and steel reduce the gamma ray flux in the concrete to minimize heating that may lead to cracking. Clarify the purpose of the lead shielding.

5.2 Section 5.2.14.1, p. 5-17. The SAR states "Maintaining the integrity of the fuel cladding requires that it should remain below its melting temperature." The limiting criteria appears to be "blistering" temperature, as is stated in the next sentence. Provide clarification on the use of "melting temperature" vice "blistering."

5.3 Section 5.2.14.2, p. 5-17. This section states that if "all three parameters simultaneously reach their safety-system settings, the burnout ratio is at least 1.3." Provide reference to where in the SAR or elsewhere this analysis is performed or provide an analysis that demonstrates a bunrout ratio of 1.3 given those conditions.

5.4 Section 5.2.14.3, p. 5-18. The second paragraph states "Under this condition, the hot spot of the hottest plate remains below 160 ºF (70 ºC) (Chapter 13, Accident Analyses)." Provide reference to where in the SAR or elsewhere the corresponding analysis and results are presented supporting this temperature and explain if this temperature is consistent with values in Table 5-5, p. 5-18 of Chp. 13.

5.5 Section 5.2.14.3, p. 5-18. The second paragraph states "Further, analyzing the case of no-shutdown cooling flow (Chapter 13, Accident Analyses), the maximum temperature of the fuel plate would be less than 500 ºF (260 ºC), well below the temperature that would cause any damage." Provide reference to where in the SAR or elsewhere the corresponding analysis and results are presented supporting this temperature. Explain if this temperature is consistent with values in Table 5-10, p. 5-23 of Chp. 13, and with the temperature cited in TS 3.2 as 107 ºC (225 ºF).

5.6 Section 5.3.2.1.2, p. 5-21. This paragraph states "At flows of 65 gpm (250 lpm) on the primary side…," while Section 5.4.2.3, p. 5-35, states "At flows of 35 gpm (132 lpm) on the primary side…." Both are apparently referring to the D_2O Purification Heat Exchanger (HE-2). Clarify the difference between these flow rates.

5.7 Section 5.3.2.5, p. 5-24. The first paragraph states "The 150 psi (1 MPa) air to operate the pneumatic control valves…." Similar wording appears in Section 5.4.2.6, p. 5-36. Chapter 9, p. 9-12, states "The NBSR is supplied with a source of 100 psig (680 kPa) air from the main NIST compressed air facility." Clarify the difference between these air pressures.

5.8 Section 5.3.8.1, p. 5-32. This paragraph states "Using this value, the limits ensure that tritium concentrations in effluents will be as low as practicable, and below concentrations allowed by 10 CFR 20.303 for liquid effluents and 10 CFR 20.106 for gaseous effluents (Chapter 11, Radiation Protection and Waste Management)." Explain the applicability of references to 10 CFR 20.303 and 10 CFR 20.106 in both the SAR and the TS, or update these references to current regulatory requirements, as applicable.

5.9 Section 5.3.8.2, p. 5-33. The 2nd and 3rd paragraphs mention a "36 gallon/day" value regarding primary to secondary leakage. The TS uses 40 gpd for minimum sensitivity in surveillance TS 4.5. Clarify the difference between the leakage rate sensitivity values.

5.10 Section 5.4.2, p. 5-34. In the 3rd paragraph, the last sentence states "Consequently, the minimum time to treat all of the primary coolant is approximately 21 ½ hours." Provide analysis to support the treatment time.

5.11 Sections 5.7.2.1 & 5.7.2.2, p. 5-42. The heat load is specified as "1.54×10^5 Btu/hr" and the heat sink is specified as "60×10^3 Btu/hr." Explain how these two values relate to one another.

5.12 Section 5.2.2.6.2, p. 5-8. The temperature ranges for TR-2, TR-3, TR-4 and TR-5 have inconsistent temperature ranges listed as the values for Fahrenheit and Celsius. Provide clarification as to which are the correct values and the appropriate temperature range conversions.

5.13 Section 5.2.2.7.1, p. 5-10. Provide clarification describing methods used to preclude the introduction of objects into the primary coolant system during maintenance associated with removal of the strainer.

5.14 Section 5.3.2.5, p. 5-24. Provide clarification on the response of the pneumatically positioned secondary valves to a loss of instrument air.

6.1 Section 6.1.1, p. 6-1. The first paragraph states "a minimum of 28 minutes of coolant flow is always available to the core from the Inner Reserve Tank…." In Chapter 13, Appendix A, p. 5-8, the last paragraph states "For at least 20 minutes after shutdown the tank flow is more than adequate to cool the fuel elements by boiloff." Clarify these statements regarding the amount of cooling time that would be provided by the IRT.

6.2 Section 6.2.1.2.1, p. 6-9. The last sentence in the second paragraph states "The water makeup capacity must be in excess of 25 gpm (95 lpm), which was calculated as adequate to prevent fuel damage." Provide an analysis and discussion of how this value was determined and compare with the flow from the D_2O Storage Tank and the Emergency Sump Pump during a loss of coolant accident.

6.3 Section 6.2.3, p. 6-13. Explain why the flowrates on Figure 6.4 are different from those on Figure 6.5 and the description on pp. 6-13 & 6-14.

6.4 Section 6.2.3.3.4, p. 6-18. The second paragraph states "The height of approximately 100 feet (30 meters) above grade level was chosen to meet the criteria of dilution and reduced potential exposure." Describe how the stack height compares to the guidance in Regulatory Guide 1.111 and GEP stack height criteria for elevated releases. If corrections are required also apply the corrections to all affected analyses.

6.5 Section 6.2.3.3.5, p. 6-19. The third and fourth paragraphs state that the Emergency Exhaust Fan motors (AC and DC) for EF-5 & EF-6 are powered from MCC DC. It appears from Chapter 8 that the power source for the AC motors is the A5 emergency bus. Explain and differentiate the power source and switchgear locations for these motors.

7.1 Section 7.2.1, p. 7-5. Explain why primary coolant temperature is absent from the list of main parameters which are monitored and provide inputs to the logic chains.

7.2 Section 7.2.3, p. 7-10. Provide a schematic of the control logic for confinement building isolation, i.e., door scram relays, fan scram relays, ventilation system alignment, etc.

7.3 Section 7.3.1.2, p. 7-16. Provide an explanation of the “all rods seated” contacts and the purpose of this interlock.

9.1 During the orientation tour, it was noted that neutron shielding for the cold neutron source and neutron guides consists of lead shot mixed in paraffin. The quantity of shielding material was significant. The paraffin is both a large transient combustible load, but also can melt and pool resulting in more dangerous fires. The SAR does not mention the paraffin as a flammable material that is present even though it is most likely the largest single combustible source in the confinement building. Provide a description of the paraffin in the shielding blocks and the design features that prevent or mitigate its involvement in a fire.

9.2 Section 9.2.4.1, p. 9-7. Provide justification for the extrapolation used to determine the minimum time a fuel element must remain submerged in the primary coolant prior to transfer. Include discussion/analyses of power distribution for both the 10 MW core and the 20 MW core, decay heat for worst-case fission density and irradiation time for fuel elements in both the 10 MW core and the 20 MW core, and any assumptions made and all uncertainties (measurement, instrumentation, fabrication, etc.) in all relevant analyses. The discussion/analyses should clearly show that nowhere will the local clad temperature of a worst-case-irradiated fuel element immersed in helium reach 450 °C.

10.1 Section 10.3 of the SAR references TS 6.2(2) and 6.2(3) regarding the requirement of the SEC to review experimental proposals. Verify that these are the correct references and change the references if appropriate.

11.1 Section 11.1.1.2, p. 11-3. The dose limit to members of the general public due to airborne effluents is 10 mrem/yr (10 CFR 20.1101(d)). Revise this section to reflect the appropriate dose limit.

11.2 Section 11.1.1.4.2, p. 11-9. Provide more detail in this section to clarify actions related to the disposal of the shim arms. Briefly describe the processes used to remove the shim arms from the reactor vessel (mechanical detachment and physical transfer), including discussions of ALARA practices, and the location where the reactor shims decay for three months.

11.3 Section 11.1.1.4.4, p. 11-10. Provide more detail as to the type of “materials designated as radioactive waste” that are transferred to H wing. Describe what methods are used to control access to the H wing, or justify not requiring access control.

13.1 Section 13.2.1, p. 13-5. Provide a discussion/analysis of potential metal-water reactions and associated potential consequences.

13.2 Section 13.2.1, p. 13-6. The 1st paragraph states “The inventory of noble gases and iodine fission products in the most heavily irradiated element is given below in Table 13.1, as determined by the computer code ORIGEN2 (Croff, 1980).” Describe or reference the assumptions on irradiation times, power levels, peaking factors, etc. to verify that this element has the maximum iodine and noble gas concentration.

13.3 Section 13.2.1, p. 13-6. The section states “...consideration of these effects leads to the conclusion that less than 3% of the total iodine release will be present as I_2.” Provide the analyses on which this conclusion is based. Include your analyses related to the effects of temperature, pH and the presence of other fission products and chemical forms on iodine release fractions. Evaluate the effect of differences in fuel material design and configuration. Specifically, the type of fuel used at NIST (U_3O_8) is different than the type of fuel for the NUREG 1465 analysis (UO_2), on which it is understood the 3% is partially based. Consider reviews such as presented in “The Technology of Nuclear Reactor Safety,” Volume 2, Copyright 1973 by the Massachusetts Institute of Technology, Chapter 3, “Fission Product Release” by G. W. Parker and C. J. Barton of ORNL, Section 3.3.2, “Uranium Oxide, U_3O_8." Also, since some of isotopes have relatively short half-lives relative to the accident duration, the daughter products may be released from solution. Describe how these parent and daughter products are accounted for in the source term and dose estimates. Provide a description of how the iodine daughter products were considered.

13.4 Section 13.2.2.2.2, p. 13-9 & the new calculation provided via email [Mendonca 9/29/2006] following the site orientation visit. The new calculation is for a ramp insertion of 0.5% $\Delta\rho$ in 0.5s, whereas the previous accident scenario is for a ramp insertion of 1.3% $\Delta\rho$ in 0.5s. SAR section 13.1.2.2.2 provides technical justification for the change in the accident scenario from the existing SAR, however this is not consistent with at least one of the bases in the TS. Specifically, the basis for TS 3.12 refers to the 1.3% $\Delta\rho$ insertion transient. Correct this reference and verify that any other renewal submissions are consistent with the revised analyses.

13.5 Section 13.2.3, p. 13-10. Under the assumptions for this accident, it states “The tritium concentration in the primary coolant is at the maximum level permitted by the TS (5,000 µCi/ml).” The statement regarding the estimated concentration in the Basis of TS 3.6 is not a TS limit. Provide a description of how and where this limit is protected in the TS. If there is no limitation established on this parameter in the TS, provide such.

13.6 Table 13.1, p. 13-16. Several of the isotopes in the fission product inventory are not in the HOTSPOT library. Provide a description of how these were modeled in the offsite dose projections.

13.7 Tables 13.3 & 13.4, p. 13-17. Provide the assumptions regarding iodine removal rates in confinement from deposition and filtration for public and staff dose estimates. What

DCFs were used for submersion, inhalation, and thyroid doses for staff doses presented in Table 13.4?

13.8 Table 13.2, p. 13-16. The values for removal rates from C-200 are not consistent. Determine the appropriate values and ensure that they are correct in both sets of units.

13.9 For each accident analysis, provide the limiting assumptions, conditions and safety system settings and where these limiting assumptions, conditions and safety system settings are required by Technical Specifications as required by 10CFR50.36. Compare the assumptions, conditions and safety system settings to those in ANSI 15.1 and NUREG 1537, which are applicable to test reactors.

Appendix A Technical Questions and Comments

13.16 Section 2.2, p. 2-4. The 1st paragraph states “About 4% of the total flow in each plenum bypasses the fuel elements and cools the in-core thimbles.” Chapter 4 (SAR), p. 4-4, states “A small amount of coolant, 4%, bypasses the external surface of the lower nozzle…preventing bulk stagnation in the moderator.” In Chp. 4 (SAR), p. 4-12, the description of the regulating rod states “A fixed orifice in the nozzle of the shroud delivers a coolant water flow of 8 gpm from the outer plenum.” In Chp. 4 (SAR), p. 4-50, the description of the core flow distribution states “Approximately 4% of the flow bypasses the core; this is treated conservatively in the next sections [T-H Analysis] by reducing both flows to 95% when calculating the flow through any element.” In the “Core Bypass Flow” section of Appendix A, p. 4-5, the RELAP model description states “About 4% of the total primary flow bypasses the fuel elements. In RELAP5 the areas of the bypass flow junctions have been adjusted so that 4% of flow to the inner and outer plenums is bypassed.” In Chp. 10, Section 10.2.6.1, p. 10-6, the description of the seven 3 ½ in. thimbles states “The end fitting largely blocks the normal flow, but contains a small opening that allows approximately 8 gpm (0.5 liter/sec) to flow upwards through the tube to cool it, and any experiment that may be in it.” In Chapter 10, Section 10.2.6.2, the description of the 2 ½ in. thimbles states “These smaller sockets have a small hole at the bottom that allows approximately 10 gpm (0.6 liter/sec) of plenum cooling water to flow up through the experimental thimble.”

There appear to be some discrepancies in the above statements regarding bypass flow. Some specific considerations are:

a. The 4% bypass flow is not predominately for in-core thimble cooling, since these have individual orifices for coolant flow.
b. Chp. 4 (SAR) indicates that fuel element flow is treated as 95% full flow while Appendix A indicates the RELAP model uses 96%.
c. If six of seven 3 ½ in. thimbles at 8 gpm and four 2 ½ in. thimbles at 10 gpm are fed separately from the outer plenum, then this accounts for approximately 88/6400 = 1.4% of outer plenum flow not accounted for in the RELAP model.

Provide clarification of the following comments (13.17-13.25).

13.17 Figure 3-5, p. 3-12. The ^{235}U content in this figure differs from that in Figure 4.5.2A, p.

4-86, in Chapter 4 of the SAR. Are these “BNL” versus “updated model” differences?

13.18 Figures 3-13 through 3-18, pp. 3-16 to 3-18. The orientation of the plates in these figures is north-south which differs from the east-west orientation in Figure 4.5.4 through 4.5.9, pp. 4-88 to 4-90. Is the orientation different in the two MCNP models? If so, provide clarification of the effect this has on the peaking factors.

13.19 Figure 3-28, p. 3-23. Provide analyses which demonstrate that the regulating rod maximum reactivity differential worth and withdrawal rates will not exceed the startup accident maximum reactivity insertion rate. Alternatively, propose limits on regulating rod reactivity insertion rates to limit them to the same rate as specified for the shim rods. Additionally, provide justification as to why the regulating rod worth should not be considered in conjunction with shim arm worth in the startup accident.

13.20 Figure 3-30, p. 3-24. The caption for the figure includes the description “Equilibrium Core at Startup” and the title includes the description “SU Core.” In previous nomenclature, the “SU Core” is defined as the startup core prior to equilibrium fission product poison concentrations, and the “BOC Core” as the startup core with equilibrium fission product poison concentrations. For which core was this figure developed? Provide consistent references in the renewal application documents.

13.21 Table 3-2, p.3-28. As previously mentioned, the description for the voided thimbles indicates 5 thimbles voided whereas p. 3-6, App. A and Chapter 4 (SAR), p. 4-39 indicates 6 thimbles voided. The values of Δk/k appear to be calculated as $(k_{void} – k_{base\ case})/ k_{base\ case}$ instead of $(k_{void} – k_{base\ case})/ k_{void}$. What thimble volume was used for the void coefficients calculated for the voided thimbles case? These numbers appear to be inconsistent with those in Table 4.5.7, p. 4-67 of Chapter 4 of the SAR. What case or analysis supports the statement in Section 4.5.2.2.2, p. 4-39 of Chapter 4 of the SAR that “Finally, from the BNL analysis, if somehow only the unfueled regions between the upper and lower fuel sections were to be voided, the coefficient would be -0.025% Δρ/l…”?

13.22 Tables 3-3 & 3-4, p.3-28. The values of Δk/k appear to be calculated as $(k_{flooded} – k_{base\ case})/ k_{base\ case}$ instead of $(k_{flooded} – k_{base\ case})/ k_{flooded}$. Provide clarification as to which is the correct method for determining the values of Δk/k.

13.23 Section 4.2.2.4, p. 4-3. The fuel plate width is given as 2.3734 in. in this section, and 2.436 in. on p. 4-3 of Chapter 4 of the SAR. The 2.436 in. appears consistent with the peak heat flux given in Chapter 4 on p. 4-54, element H-1.

13.24 Section 5.3, p. 5-3. This section states “The minimum CHFR is 1.28 and 1.18 for BOC and EOC, respectively.” These values are both below the 99.9% limit values determined for CHFR on p. 4-10 of Appendix A. Provide justification to demonstrate that these provide acceptable margins.

13.25 Table 5-13, p. 5-26. This table presents CHFRs as determined by the Mirshak and Costa correlations for 500 kW operation under natural circulation. Provide justification that these correlations are applicable for natural circulation flow. Describe the flow velocity ranges and conditions where the correlations are valid.

Editorial Questions and Comments

4.34 Section 4.2.1.1, Fuel Composition, p. 4-3. It is stated that the aluminum powder used is ATA 101 (or equivalent). Clarify the “ATA” abbreviation and add to the “Acronyms” list.

4.35 Section 4.2.1.2, Fuel Element Description, p. 4-4. It is stated that “the fuel plate core frames and cladding are aluminum Alloy 6061-T0 (ASMT B209).” This is inconsistent with Table 4.2.2, which has “aluminum clad” as 6061-T6.

4.36 Section 4.2.1.2, Fuel Element Description, p. 4-3. It is stated that “fuel is contained in fuel plates approximately 13 inches in length by 2.793 inches in width….” The width dimension is inconsistent with that in Table 4.2.3, p. 4-61 (2.415 in).

4.37 Section 4.2.1.2, Fuel Element Description, p. 4-4. The first line states “curvature is 5 .5 inches (13.97 cm).” There is an extra space in “5 .5 inches.”

4.38 Section 4.2.1.3, Fabrication, p. 4-5. It is stated that “Dents greater than 0.250 inch (0.06 cm) in diameter…” These dimensions are inconsistent.

4.39 Section 4.2.2.1, Shim Safety Arm, p. 4-9. It is stated that “Helium at just slightly above atmospheric pressure (15 psig) is left in the void.” Is the pressure approximately twice atmospheric pressure, or 15 psia?

4.40 Section 4.2.2.6, Technical Specifications, p. 4-14. TS 4.3, item no. 5, states “a comparison of power range indication with flow time’s delta T….” The apostrophe in “time’s” appears unnecessary.

4.41 Section 4.2.2.6, Technical Specifications, p. 4-15. TS 4.3, the basis section states “The shim arms shall be considered operable if they drop the top five (5º) within 220 msec.” The “top five (5º)” apparently should read “top five degrees (5º).”

4.42 Section 4.2.5, p. 4-16. This is a general comment about units formatting, but it occurs here because this section switches from using English units with SI units in parentheses previously, and in this section that convention is intermittently swapped. ANS-15.21-1996 states “SI units shall be used, with English units posted in parentheses, except where the regulations require a different presentation.”

4.43 Section 4.3.1, Design, p. 4-20. The third paragraph has “$2x10^{23}$ n-cm^{-2}-s^{-1}.” From the context, it appears the units should be “$2x10^{23}$ n-cm^{-2}.”

4.44 Section 4.4, p. 4-22. In the first paragraph of this section, the sentence “Chapter 10 of NBSR-9 (NBS, 1966a) contains a thorough description the design considerations and shielding calculations for the construction of the biological shield,” is apparently missing an “of” in the phrase “description of the design….”

4.45 Section 4.5.1.3.4, Fission Product Poisons and the Equilibrium Core, p. 4-31. The second paragraph states “The reactivity difference between the SU benchmark, “su183,” and the BOC equilibrium core, "eqlib," is k_{eff} = 0.97911, and Δρ = - 2.86 %k/k, or –$3.78." Clarify the reactivity units.

4.46 Section 4.5.1.5.1, The Shim Safety Arms, p. 4-33. The first paragraph states "After the initial shim arm movement, there is a gradual withdrawal until the shim safety arms are above the core and larger withdrawal steps are needed to achieve the same negative reactivity insertion." In this context, it would appear the word "negative" should be "positive."

4.47 Section 4.5.1.5.1, The Shim Safety Arms, p. 4-34. The second paragraph states "The maximum calculated rate is $4.5x10^{-4}$ (% Δk/k)/s. The technical specifications limit the rate to $5.0x10^{-4}$ (% Δk/k)/s." The Technical specifications use the reactivity units Δρ/s. Clarify the difference between these units and those used in the TS.

4.48 Section 4.5.2.3.3, Hot Channels and Hot Spots from the Updated MCNP Model, p. 4-42. The last paragraph states "The rate of consumption of ^{235}U is 1.17 times the fission rate, or 7.1 x 10^{18} fis/cm^3/day." Clarify if this value and the appropriate units represent the average fission rate (fis/cm^3/day) or absorption rate (abs/cm^3/day).

449 Section 4.5.3.1.2, Moderator Dump, p. 4-46. In the first paragraph under "Basis" the phrase "with one shim arm know to be inoperable," is apparently missing an "n" in "known" as in "with one shim arm known to be inoperable."

4.50 Section 4.5.3.1.2, Moderator Dump, p. 4-46. In the second paragraph under "Basis" the sentence beginning "The analysis showed that the most sever accident…," is apparently missing an "e" in "severe" as in "The analysis showed that the most severe accident…."

4.51 Section 4.5.3.3, Safety Limits and Limiting Safety System Settings, p. 4-49. The "Basis" section for TS 2.2 uses the term "burnout ratio" whereas the term "Critical Heat Flux Ratio" is used on the previous page under section 4.5.3.3.1. When practical, use consistent terminology between the SAR and TS.

4.52 Section 4.6.1.2, Power Distribution in the Core, p. 4-51. In this section, the terms "horizontal strips" and "vertical strips" are used. Clarify the use of these terms as compared to the terms "slices" and "stripes" defined previously.

4.53 Section 4.6.2.2 & 4.6.2.3, Departure from Nucleate Boiling & Onset of Flow Instability, p. 4-53. The definition of the term "T_s" (both sections) is given as "saturation pressure." It would appear from the context this term should be "saturation temperature."

4.54 Section 4.6.3, Determination of Limiting Conditions, p. 4-54. The pressure at the hot spot is estimated as "3.34m D_2O, or 138.5 kPa, or 1.37 bar." The conversion from kPa to bar is 1 bar = 100 kPa, so these numbers appear inconsistent.

4.55 Section 4.7, References, p. 4-58. Correct the date in the reference for "NIST Center for Neutron Research (s004b)."

4.56 Table 4.5.5, p. 4-67. In the second column, β_i, the values appear to be in percentage units, i.e. β_i (%).

4.57 Table 4.6.1, p. 4-72. Check the grammar in the statement “These are the minimum flows to assure that there be no nucleate boiling at any point in the core.”

5.15 Section 5.2.4.3, p. 5-11. In the 2nd paragraph, the phrase “and a reactor scram occur due to…,” is apparently missing an “s” at the end of “occur.”

5.16 Section 5.2.14.3, p.5-18. The third paragraph states “Calculations show that tritium releases offsite are below concentrations allowed by 10 CFR 20 (Chapter 11, Radiation Protection and Waste Management).” TS 3.2 references Chapter 13 for these calculations. Clarify the difference between the locations of the supporting calculations.

5.17 Section 5.3.2, p. 5-20. In the 3rd paragraph, the word “Deminerizer” appears incorrect.

5.18 Section 5.3.2.8, p. 5-29. In the 2nd paragraph, in the phrase “on room D100” it appears the word “on” should be “in.”

5.19 Section 5.3.8.2, p. 5-32. This paragraph states “It also requires that, when the N-16 monitor is inoperable, the secondary cooling water is sampled and analyzed for tritium at least monthly.” The word “inoperable” should apparently be “operable” to agree with the TS.

5.20 Section 5.4.2.5, p. 5-36. In the 1st paragraph, should “cellulose, acetate cartridges” be hyphenated as in “cellulose-acetate cartridges”?

5.21 Section 5.7.2.1, p. 5-42 & Section 5.7.2.6.1, p. 5-43. Two uses of nomenclature appear inconsistent with the “Cold Neutron Source” terminology used elsewhere.

5.22 Section 5.7.2.6.2, p. 5-43. In the 1st paragraph, the phrase “thermowell located the 1 ½-inch (3.8 cm) piping” appears to be missing an “in.”

6.7 Section 6.1.1, p. 6-1. The first sentence appears to contain a typo in “Figures 6.1.”

6.8 Section 6.1.1, p. 6-2. The third paragraph apparently contains a typo in the phrase “this tank will start draining though the two nozzles.”

6.9 Section 6.1.2, p. 6-2. The first paragraph apparently contains a typo in the phrase “power distribution gears.”

6.10 Section 6.2.3.2.2, p. 6-17. The first sentence in the second paragraph lists “filters F-26, F-27, F-59 in subsystem A.” Figure 6.4 shows F-26, F-27, and F-57. Clarify the apparent mismatch.

6.11 Section 6.2.3.2.2, p. 6-17. The sentence “Since one of the two trains is in operational during an emergency...,” apparently contains a typo.

6.12 Section 6.2.3.3.4, p. 6-18. The first paragraph states “discharge from Reactor Basement Exhaust System fan EF-27 through ACF-3.” The “ACF-3” is apparently a typo for "ACV-3."

6.13 Section 6.2.3.4.4, p. 6-21. The last sentence uses the acronym "WSSC." Spell out the abbreviation on first use and add to the "acronyms" list.

7.4 Section 7.2.3, p. 7-9. In the 4th paragraph, the 1st sentence refers to Figure 7.7 and the "relay logic ladder." It appears that this paragraph is referring to the logic diagram in Figure 7.8. If this is true, check and correct the subsequent references to Figure 7.7 in this chapter, as appropriate.

7.5 Section 7.3.3.1, p. 7-19, Item 6. (2) and the definition of Reactor Shutdown in the TS are not the same. Clarify the difference between the wording in the two locations.

7.6 Section 7.3.3.1, item 8, top of page 20. TS definition 1.3 includes an item (4) "Moderator Dump." Clarify the diference between the wording in the two locations.

7.7 Section 7.3.3.2, p. 7-20. In the 1st paragraph, clarify that the 3rd item is intended to be operable 'in accordance with' Table 3.1 of the TS.

7.8 Section 7.3.3.2, p. 7-20. In the 3rd paragraph, check and correct the wording and grammar in the 1st sentence "A rod withdrawal accident for the NBSR has been analyzed and are discussed Chapter 13 and Appendix A of this SAR…."

7.9 Section 7.4.1, p. 7-23. In the 2nd paragraph, check and correct the wording and capitalization in the sentence "A minimum of one decade of overlap is designed into the transition between the Source Range and Intermediate Range Nuclear Instrumentation and between Intermediated Range and Power range Nuclear Instrumentation." In the following sentence, check and correct the use of the word "form" in "channels form the source range."

7.10 Section 7.4.1, p. 7-24. In the 1st sentence on p. 7-24, check and correct the usage of "from" and "the" in the second line, "power from directly from the the +/- 10Vdc."

7.11 Section 7.6.1, p. 7-26. Check and correct the word "inn" in the sentence beginning, "The instrument panels inn the control room display…."

7.12 Section 7.6.3, p. 7-27. In the 5th paragraph, the last sentence appears to be missing a "the" before "reactor operator."

7.13 Sections 7.7.1 through 7.7.5, pp. 7-30 & 7-31. There are multiple references to Appendix 8 (8A, 8H, 8I, 8J, 8E, 8G, 8F). Explain or correct the use of these reference numbers.

7.14 Section 7.7.3, p. 7-30. In the last line, check "AN47" for correctness.

7.15 Section 7.8, p. 7-32. Explain the use and applicability of the ANSI/ANS 15.20 standard for the NBSR I&C system design.

7.16 Section 7.8, p. 7-32. The IEEE Standard 7-4.3.2 title appears to contain an extra "Systems" after "Computers."

7.17 Table 7.5B, p. 7-35. Check and correct the 1st column heading in the table.

7.18 Table 7.5G, p. 7-41. Check and correct the range on the D_2O IX Inlet/Outlet Conductivity Recorder.

7.19 Table 7.5G, p. 7-41. It appears there are several instances of "HE" that should be "He", i.e., to represent helium instead of heat exchanger.

7.20 Table 7.5I, p. 7-43. The 1st column lists "Storage Pool IX Inlet/Outlet Conductivity" and "Thermal Shield Inlet/Outlet Conductivity." It appears that there are only "Outlet" instruments.

7.21 Table 7.7B, p. 7-46. The nomenclature of the 1st column header "Cubicle" appears to be incorrect.

7.22 Figures 7.4B & 7.4C, p. 7-54 & 7-55. The figure titles appear to be backwards for these two figures, i.e. "Intermediate Range Channel" should go with Figure 7.4c and "Power Range Channel" with Figure 7.4b.

7.23 Appendix 7A, Section 5, p. 7-75. In the second paragraph, the source range channels in the last line are referred to as "ND-1 and ND-2." These appear to be typos for "NC-1 and NC-2."

7.24 Appendix 7A, Section 5, p. 7-77. In the 3rd paragraph, the 1st sentence appears to be missing an "of" after "rate of change."

7.25 Appendix 7A, Section 7, p. 7-83. In number 13, check and correct the units "pisg" in the last sentence.

7.26 Appendix 7A, Section 8, p. 7-88. In number 11, the last sentence is apparently missing a "than" after "rather."

9.4 The first sentence of Section 9.3.2 is: "The NBSR is equipped with both automatic and manual fire detection capability." This sentence is only true when people are in the building, or more specifically in the areas where fire may occur.

9.5 Section 9.9.4 – Page 9-15 – The last sentence of this section should say "Principal metal components…" rather than "Principle metal components…."

13.10 Section 13.1.4, p. 13-3. This section states "Five different scenarios for loss of primary coolant flow have been analyzed," and in Section 13.2.4, p. 13-11, it states "Four scenarios have been given for an accident of this type [Loss of Primary Coolant Flow]…." Clarify the apparent discrepancy.

13.11 Section 13.2.1, p. 13-7. In the second paragraph, the phrase “for estimation of long-term (>1 day)” seems to be related to dose. Should it be “for estimation of long-term doses (>1 day)”?

13.12 Section 13.2.2.2.1, p. 13-8. In the first paragraph, the reactivity insertion rate, “$5x10^{-4}$ Δk/s” appears to be inconsistent. Should the units be “$5x10^{-4}$ Δρ/s”?

13.13 Section 13.2.3, p. 13-10. The 1st paragraph states “Thus, with only one operator action (which can be accomplished at any time in the first 20 minutes), the core is fully protected for several hours.” In Chapter 6, p. 6-2, the time the IRT and D_2O Emergency Cooling Tank provide cooling is 2 ½ hours. The term “several” used in the statement from section 13.2.3 appears to be subjective.

13.14 Section 13.2.3, p. 13-11. The last paragraph states “For the conditions analyzed, this will result in a concentration approaching $1.25x10^{-4}$ DAC.” Shouldn’t this be $1.25x10^{4}$ DAC?

13.15 Figures 13.2, 13.3 & 13.4, p. 13-21, 13-22. Provide clarification if these are plots of MCHFR versus time, or CFHR versus time.

Appendix A

13.26 Section 2.1, p.2-1. The 2nd paragraph states “The fuel elements are located on 0.177m (7 in) centers in a hexagonal array.” Chapter 4, p. 4-4 indicates 0.175m and p. 4-17 indicates a 17.6 cm pitch for exp. thimbles.

13.27 Section 2.1, p. 2-2. Paragraphs 7 & 8 (next to last & last) indicate reactivity worths of 26%, 6 ½%, and 0.6%. Should the units be % Δρ?

13.28 Section 2.1, p.2-3. The 2nd paragraph states “The uranium content is about 1 gm/cm^3.” Data from Chapter 4, p. 4-3 indicates 1.23 gm/cm^3.

13.29 Section 2.2, p. 2-3. The 1st paragraph indicates a nominal core flow of 9000 gpm. Chapter 4, p. 4-50, Table 4.1.1, p. 4-59, indicates 8700 gpm as nominal flow.

13.30 Section 2.2, p. 2-4. The 1st paragraph indicates an outer plenum flow of 6700 gpm. Chapter 4, p. 4-50, Table 4.1.1, p. 4-59, indicates 6400 gpm as outer plenum flow.

13.31 Section 3.3, p. 3-4. The 1st paragraph states “Also included in this figure is the percent decrease in the ^{235}U content for each fuel element during a single 38-day cycle.” Figure 3-5, p. 3-12 shows “Decrease in ^{235}U (grams).”

13.32 Section 3.4.3, p. 3-5. The 2nd paragraph states “The D-4 element is separated from the shim arm by one row of elements….” Should the element described “D-1”?

13.33 Section 3.5.2, p. 3-6. The 1st paragraph states “In the first case, the six vacant irradiation thimbles …are voided.” In Table 3-2, p. 3-28, this case is described as “SU with 5 thimbles voided.”

13.34 Section 3.5.2, p. 3-6. The 1st paragraph states “The calculations were performed for the SU and EOC cores for two different void cases.” Table 3-2, p. 3-28 shows three cases.

13.35 Section 3.5.8, p. 3-8. The 1st paragraph states “In the present work, the maximum relative power peaking was 1.16. In the updated model, the maximum value was 1.11.” In the SAR, Chapter 4, Figure 4.5.3, p. 4-87, the maximum peaking factor is 1.15 calculated with the updated model.

13.36 Figures 3-29 & 3-32, p. 3-24 & 3-25. The y-axis labels appears to be missing the units “(%).”

13.37 Figures 3-26 through 3-33, pp. 3-22 to 3-26. The y-axis labels are not discernable on provided copy.

13.38 Section 4.2.3.8, p.4-6. In the 2nd paragraph, the sentence beginning states “A set of power factor is determined….” Should this be “A set of power factors is determined….”

13.39 Table 4-5, p.4-26. “Normal” primary flow in the table is given as 8800 gpm and 9000 gpm in the footnote.

13.40 Section 5.2, p. 5-2. In the 1st paragraph, the shim arm withdrawal reactivity rate is given as “5×10^{-4} Δk per second.” Use consistent reactivity units.

13.41 Section 5.4, p. 5-3. In the 2nd paragraph it states “After a 0.4s delay a reactor scram is initiated at 1.286 s.” If the flow trip is initiated at 0.896 s, shouldn’t the reactor scram be initiated at 1.296 s?

13.42 Tables 5-1 through 5-4, pp. 5-14 to 5-17. Shouldn’t the column headings be CHFR instead of MCHFR?

Technical Specifications

Format and Content

In Chapter 14 of the Safety Analysis Report (NBSR 14), page 14-1, the text states “The TS have also been reformatted in accordance with the NRC-approved Standard, ANSI/ANS 15.1.” The proposed Technical Specifications vary from the NUREG-1537 accepted consensus guidance of ANSI/ANS15.1. Chapter 14 and the TS should provide a one to one comparison to ANSI 15.1 and provide applicable technical specifications or justification for differences. Chapter 12 of the SAR should appropriately reflect changes to the TS. Provide justification for or modification to accommodate the following:

14.1. Section 1.3, Definitions, does not contain the following definitions or the definitions provided differ from the guidance.

Protective Action

Confinement and confinement integrity
Experiments
Secured experiments
Moveable experiments
Core excess reactivity
Shutdown margin
Reactivity worth
Safety systems
Scram time
Measured value
Reactor secured
Channel
Channel Check
Channel Test
Reactor shutdown (include consideration of minimum number of control/shim rods and no work in progress)
Senior Reactor Operator
Reactor Operator

14.2. Each limiting condition of operation does not have a corresponding surveillance technical specification.

14.3 Surveillance for fuel handling and storage is not provided.

14.4 Surveillance for experiments is not provided.

14.5 Provide an LCO and a surveillance specification for rod drop times.

14.6 TS 6.1, Organization, is not consistent with organization chart, Figure 6.1.

14.7 TS 6.1.3, Staffing, is not consistent with Section 6.1.3 of the guidance.

14.8 TS 6.2, Review and Audit, is not consistent with Section 6.2 of the guidance.

14.9 The TS do not have a section that corresponds to Section 6.3 of the guidance.

14.10 TS 6.3, Procedures, is not consistent with Section 6.4 of the guidance.

14.11 The TS do not have a section that corresponds to Section 6.5 of the guidance.

14.12 TS 6.4, Required Actions, is not consistent with Section 6.6 of the guidance.

14.13 TS 6.5, Reporting Requirements, is not consistent with Section 6.7 of the guidance or with NUREG 1537.

14.14. TS 6.6, Records, is not consistent with Section 6.8 of the guidance.

14.15 Section 5, Design Features, has been reformatted to include Applicability, Objective, Specification, and Basis. Section 1.2.2 of the guidance states that the section should state the specification without the related information.

Technical Questions and Comments

14.16 The basis of TS 2.2, p. 4, states "Even in the extremely unlikely event that all three parameters, reactor power, coolant flow, and outlet temperature simultaneously reach their Limiting Safety System Settings; the burnout ratio is at least 1.3." Provide an explanation of where these calculations and results are presented in the SAR.

14.17 The basis of TS 2.2, p. 4, states "Overall uncertainties in process instrumentation have been incorporated in the Limiting Safety System Setting." The statistical analysis in Appendix A of the SAR, Section 4.4, pp. 4-9 & 4-10, determines that to account for uncertainties in the hot channel variables, the 99.9% limit value for CHFR is 1.538. Provide an explanation of how the statistical analysis includes the process instrumentation uncertainties mentioned above (temperature measurement is not explicitly listed in Table D-1, p. D-10 of Appendix D to NBSR Appendix A), and why the basis should not refer to an analysis in the SAR which demonstrates that at coincident LSSS values the CHFR exceeds 1.538.

14.18 TS 3.1, p. 8. Provide an explanation of the level of confinement integrity required during operations involving sawing the fuel elements and fuel transfer.

14.19 TS 3.1, p. 8 and TS 3.7, p. 14, contains time limits for the transfer of fuel. The time limit calculations for fuel transfer were not found in the SAR. Provide the calculations for the fuel transfer times.

14.20 Provide the units for the activity level concentrations used in TS 3.11, p. 17.

14.21 TS 2.2 provides for a rundown at a reactor outlet temperature of 147 ºF. The last parameter in Table 5.3 of the SAR, p. 5-46, provides a rundown safety function at a setpoint of 130 ºF. Provide an explanation of which temperature is correct.

14.22 The basis of TS 3.2 cites a no shutdown cooling maximum fuel plate temperature of 107 ºC (225 ºF). Section 5.2.14.3 of the SAR , p. 5-18, states "Further, analyzing the case of no-shutdown cooling flow (Chapter 13, Accident Analyses), the maximum temperature of the fuel plate would be less than 500 ºF (260 ºC), well below the temperature that would cause any damage." These values appear inconsistent with Table 5-10, p. 5-23 of Chapter 13, Appendix A. Provide an explanation of which temperature is correct and where and how it was calculated.

14.23 TS 2.1, Safety Limit Bases states: "Maintaining the integrity of the fuel cladding requires that the cladding remain below its blistering temperature 752 °F (450 °C)." The temperature quoted in °F does not correlate to that for °C. Provide correction. Ensure that other conversions in the Technical Specifications are correct. Example: the basis for TS 3.1 states, "This provides a margin of safety from the lowest temperature at which blistering can occur 850 °F (450° C)." Ensure the bases are consistent with the SAR.

14.24 TS 5.3 does not specify the aluminum alloys used for various components of the fuel element. Provide justification for why this is acceptable.

14.25 NUREG 1537, Section 8.1, page 8-3, states “The technical specifications, including testing and surveillance provisions, ensure that the normal electrical system will be operable.” Provide justification for why there is no TS for the normal electrical power system.

14.26 TS 4.1 requires routine verification of the confinement function of the confinement building and the instrumentation that provides the confinement closure signal. Provide an explanation of why no in-service testing of the confinement building structure is specified in the SAR or TS other than the periodic confinement closure system testing and leakage testing.

Editorial Questions and Comments

14.27 Specification (1) of TS 2.1, p. 3, refers to Figures 2.1 and 2.2. These figures on p. 5 & 6 are labeled “Table 2-1” and “Table 2-2.”

14.28 The last sentence in the basis section of TS 2.1, p. 3, states “The analysis done in the SAR, NBSR 14, Appendix A, clearly show that the reactor can be operated at 500 kW with reduced or no flow.” The tense of the sentence is not correct.

14.29 TS 2.1, Figures 2-1 & 2-2, pp. 5-6. When using a black and white print of the figures, it is not clear which curve represents which temperature.

14.30 TS 3.1, p. 8. In the 4th paragraph of the “Basis” section, it appears something is missing in the sentence beginning “Experiments are usually…,” and finishing, “in the reactor at any time.”

14.31 TS 3.2 references Chapter 13 of the SAR for the allowable tritium releases offsite. It appears that section 5.2.14.3 of the SAR, p. 5-18, should be the referenced.

14.32 TS 3.4, p. 11. In the 2nd paragraph of the “Basis” section, the word “sever” should be “severe.”

14.33 TS 6.2.1 d), p. 32. In the last phrase “a change in Technical Specifications incorporated in the facility license or an questions pursuant to 10 CFR 50.59,” the “an” should be removed.

14.34 TS 6.3, p. 33. In the 1st paragraph, the phrase “may be approved by the Chief, Nuclear Engineer, or his Deputy,” should be “may be approved by the Chief Nuclear Engineer, or his Deputy.”

14.35 TS 6.3 (1), p. 33. There should be a space between “and systems” in the 1st line.

14.36 TS 6.5 (1) c), p. 34. It appears the information under “d)” belongs with “c).”