

July 25, 2016

Dr. Robert. Bean, Director
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400 Central Drive
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SUBJECT: PURDUE UNIVERSITY - REQUEST FOR ADDITIONAL INFORMATION
REGARDING THE RENEWAL OF FACILITY OPERATING LICENSE NO. R-87
FOR THE PURDUE UNIVERSITY REACTOR (TAC NO. ME1594)

Dear Dr. Bean:

The U.S. Nuclear Regulatory Commission (NRC) is continuing its review of the Purdue University application dated July 7, 2008 (a redacted version of the SAR is available on the NRC's public Web site at www.nrc.gov under Agencywide Documents Access and Management System Accession No. ML083040443), as supplemented, for the renewal of Facility Operating License No. R-87 for the Purdue University Reactor.

During our review, questions have arisen for which additional information and clarification is needed. The enclosed request for additional information (RAI) identifies the additional information needed to continue our review. We request that you provide responses to the enclosed RAIs within 30 days from the date of this letter.

In accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.30(b), "Oath or affirmation," you must execute your response in a signed original document under oath or affirmation. Your response must be submitted in accordance with 10 CFR 50.4, "Written communications." Information included in your response that is considered sensitive or proprietary, that you seek to have withheld from the public, must be marked in accordance with 10 CFR 2.390, "Public inspections, exemptions, requests for withholding." Any information related to security should be submitted in accordance with 10 CFR 73.21, "Protection of Safeguards Information: Performance Requirements." Following receipt of the additional information, we will continue our evaluation of your renewal request.

R. Bean

- 2 -

If you have any questions regarding this review, please contact me at 301-415-3398 or by electronic mail at Cindy.Montgomery@nrc.gov.

Sincerely,

/RA/

Cindy K. Montgomery, Project Manager
Research and Test Reactors Licensing Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Docket No. 50-182
License No. R-87

Enclosure:
Request for Additional Information

cc: See next page

R. Bean

- 2 -

If you have any questions regarding this review, please contact me at 301-415-3398 or by electronic mail at Cindy.Montgomery@nrc.gov.

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ADAMS Accession No.: ML16187A371

*concurrence via e-mail NRR-106

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Purdue University

Docket No. 50-182

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OFFICE OF NUCLEAR REACTOR REGULATION

REQUEST FOR ADDITIONAL INFORMATION

REGARDING THE RENEWAL OF

PURDUE UNIVERSITY REACTOR

LICENSE NO. R-87; DOCKET NO. 50-182

The U.S. Nuclear Regulatory Commission (NRC) is continuing its review of the Purdue University license renewal application dated July 7, 2008 (a redacted version of the safety analysis report (SAR) is available on the NRC's public Web site at www.nrc.gov under Agencywide Documents Access and Management System (ADAMS) Accession No. ML083040443), as supplemented, for the renewal of Facility Operating License No. R-87 for the Purdue University Reactor (PUR-1).

The NRC staff's review used the guidance in NUREG-1537, Part 2, "Guidelines for Preparing and Reviewing Applications for the Licensing of Non Power Reactors: Standard Review Plan and Acceptance Criteria," and supporting information from American National Standards Institute/American Nuclear Society (ANSI/ANS)-15.1-2007, "The Development of Technical Specifications for Research Reactors." During our review, questions have arisen, for which additional information and clarification is needed. This request for additional information (RAI) identifies the additional information needed to continue our review and are based on the following documents:

- Purdue University – "Request for Additional Information Regarding the Purdue University Reactor License Renewal (TAC No. ME1594), Responses to RAIs (ML103400115 and ML103400250)," dated June 15, 2012 (ADAMS Accession No. ML12170B018)
- Purdue University – "Request for Additional Information Regarding the Purdue University Reactor License Renewal Application (TAC No. ME1594), Responses to Letter Dated August 29, 2014 (ML14115A221)," dated July 24, 2015 (ADAMS Accession Nos. ML15210A280 and ML15210A282)
- Purdue University – "Notice of ADAMS Document Correction, PUR-1, Docket 50-182, ML16187A371, Proposed Technical Specifications," dated July 7, 2016 (ADAMS Accession No. ML16193A681)
- Purdue University – "Purdue University Response to Request for Additional Information re PUR-1 License Renewal and Power Uprate," dated July 19, 2016 (ADAMS Accession No. ML16207A426)

Many of these RAIs below refer to the proposed technical specifications (TSs) provided in a letter dated July 7, 2016. We request that you provide responses to this request within 30 days from the date of the cover letter.

Enclosure

1. The regulation in Title 10 of Code of Federal Regulations (CFR) Section 50.36 (c)(4) requires the inclusion of design features of those features of the facility such as materials of construction and geometric arrangements, which, if altered or modified, would have a significant effect on safety and are not covered elsewhere in the specifications.

The proposed TS 5.1, "Site Description," Specification c, defines the area under the jurisdiction of the reactor license (licensed area), in part, as "The licensed areas include the reactor room..." and "Both of these areas are restricted to authorized..." This wording does not clearly indicate if these statements are licensing requirements. NUREG-1537 and ANSI/ANS-15.1-2007 suggest that TSs consist of "shall," "should," or "may" statements where these terms are defined in your TS 1.40, "Shall, Should, or May." For example, "The licensed areas shall include the reactor room..." and "Both of these areas shall be restricted to authorized..." Modify the TS to clarify that it contains requirements, or justify why no change is necessary.

2. TSs are fundamental criteria necessary to demonstrate facility safety and are required by 10 CFR 50.36 for each license authorizing operation of a production or utilization facility of a type described in 10 CFR 50.21. TSs are derived from the analyses and evaluation included in the SAR and submitted pursuant to 10 CFR 50.34. Due to the importance to overall facility safety of a uniform interpretation by both the licensee and regulator of terms and phrases used in TSs, definitions shall be included where necessary and consistently used to ensure that the TSs criteria necessary for compliance with regulatory requirements is uniformly understood by the licensee and regulator.

Guidance pertaining to the format and content of TSs previously found acceptable by the NRC staff is provided in NUREG-1537 Part 1, "Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors – Format and Content" and ANSI/ANS-15.1-2007, "The Development of Technical Specifications for Research Reactors." ANSI/ANS-15.1-2007, Section 1.3, "Definitions," includes criteria on the uniform interpretation of terms used in the TS.

The proposed TS 1.7, "Core Configuration," refers to "...fuel elements, reflector elements..." Proposed TS 5.3, "Reactor Core and Fuel," Specification a, refers to fuel assemblies. Modify TS 1.7, "Core Configuration," to ensure consistency with TS 5.3, Specification a, or justify why no change is necessary.

3. The regulation in 10 CFR 50.9 requires that information provided to the Commission by a licensee shall be complete and accurate in all material respects.

The proposed TS 1.10, "Excess Reactivity," uses non-facility specific terminology:

Excess reactivity is that amount of reactivity that would exist if all reactivity control devices were moved to the maximum reactive condition from the point where the reactor is exactly critical ($k_{\text{eff}} = 1$) at reference core conditions or at a specified set of conditions.

Modify TS 1.10, "Excess Reactivity," to be specific to the PUR-1 design, or justify why no change is necessary. For example:

Excess reactivity is that amount of reactivity that would exist if all control rods were fully withdrawn from the point where the reactor is exactly critical ($k_{\text{eff}} = 1$) at reference core conditions.

4. As was fully stated in RAI No. 2, above, the importance of TSs to overall facility safety requires a uniform interpretation by both the licensee and regulator of terms and phrases used in TSs. To that end, definitions shall be included where necessary and consistently used to ensure that the TSs criteria necessary for compliance with regulatory requirements is uniformly understood by the licensee and regulator.

The proposed TS 1.41, "Shutdown Margin," is not fully consistent with the guidance in ANSI/ANS-15.1-2007, Section 1.3, "Definitions." Revise the definition of shutdown margin to follow the guidance in ANSI/ANS-15.1-2007 applicable to your reactor design, or justify why no change is necessary.

5. The regulation in 10 CFR 50.9 requires that information provided to the Commission by a licensee shall be complete and accurate in all material respects.

The proposed TSs 1.43 through 1.46, have typographical errors with each definition followed by a colon (:) instead of a dash (-). Revise TSs 1.43 through 1.46 formatted to be consistent with the other definitions in TS 1, "Definitions," or justify why no changes are necessary.

6. Due to the importance to overall facility safety of a uniform interpretation by both the licensee and regulator of terms and phrases used in TSs, definitions shall be included where necessary and consistently used to ensure that the TS criteria necessary for compliance with regulatory requirements is uniformly understood by the licensee and regulator.

The proposed TS 1.43, "Reference Core Condition," defines the allowable reactivity worth of the xenon at reference core condition as negligible or less than 0.30 dollar. Proposed TS 3.1, "Reactivity Limits," use reactivity worth values in terms of $\Delta k/k$. Modify TS 1.43, "Reference Core Condition," defining the xenon reactivity worth value in terms of $\Delta k/k$ to be consistent with the reactivity units used in the rest of the TSs.

7. The regulation in 10 CFR 50.9 requires that information provided to the Commission by a licensee shall be complete and accurate in all material respects.

The proposed TS 1.44, "Rod, Control," uses non-facility specific terminology, "A control rod is a device fabricated from neutron-absorbing material or fuel, or both, that is used..." which is not applicable to or correct for PUR-1. Revise TS 1.44 to be specific to the PUR-1 design, or justify why no change is necessary. For example: "A control rod is a device fabricated from neutron-absorbing material that is used..."

8. Due to the importance to overall facility safety of a uniform interpretation by both the licensee and regulator of terms and phrases used in TSs, definitions shall be included where necessary and consistently used to ensure that the TS criteria necessary for compliance with regulatory requirements is uniformly understood by the licensee and regulator.

The proposed TS 3.1, "Reactivity Limits," Specification a, defines the shutdown margin in reference to "...to the cold xenon-free condition..." which is not consistent with proposed TS 1.43, "Reference Core Condition." Modify TS 3.1, Specification a to be consistent with TS 1.43, or justify why no change is necessary. For example: "The shutdown margin, relative to the reference core condition..."

9. TSs are derived from the analyses and evaluation included in the SAR and submitted pursuant to 10 CFR 50.34. TSs will include items in the following categories: *safety limits, limiting safety system settings, and limiting conditions for operation*. TS limiting condition for operation of a nuclear reactor must be established for each item meeting one or more of the criteria provided in 10 CFR 50.36(c)(2)(ii).

The proposed TS 3.1, "Reactivity Limits," Specification d, establishes a limit on maximum reactivity during operation as "The reactor shall be shutdown if the maximum positive reactivity of the core..." This statement does not specifically refer to the available excess core reactivity. Modify TS 3.1, Specification d to refer to excess reactivity, or justify why no change is necessary. For example: "The reactor shall be shutdown if the maximum positive excess reactivity of the core..."

10. The regulation in 10 CFR 50.36 requires the inclusion of surveillance requirements that prescribe the frequency and scope of the surveillance necessary to demonstrate the required performance in Section 4 of the TS.

The proposed TS 4.1, "Reactivity Limits," Specification a, states that the shutdown margin and the reactivity worth of the control rods are determined biennially. The guidance in ANSI/ANS-15.1-2007, Section 4.1, "Reactor Core Parameters," item (2) includes additional criteria to perform the surveillance following significant core configuration and/or control rod changes. Revise TS 4.1, Specification a to include the additional surveillance in ANSI/ANS-15.1-2007, or justify why no change is necessary. If the additional surveillance is added to the TS, state what constitutes a significant change. The NRC has accepted changes greater than 0.003 Δ k/k as significant. If proposing a less conservative value, provide a justification.

11. The regulation in 10 CFR 50.36 (c)(4) requires the inclusion of design features of those features of the facility such as materials of construction and geometric arrangements, which, if altered or modified, would have a significant effect on safety and are not covered elsewhere in the specifications.

The proposed TS 5.3, "Reactor Core and Fuel," Specification a, specifies the reactor fuel as Material Test Reactor (MTR) type in aluminum cladding with fuel meat enriched up to 20 percent in the U-235 isotope. The guidance in ANSI/ANS-15.1-2007, Section 5.3, "Reactor Core and Fuel," contains criteria on material specifications, which includes the

chemical form of the fuel and the cladding material as aluminum 6061. Revise TS 5.3, Specification a to include the material specifications for the aluminum cladding and fuel form, or justify why no change is necessary.

12. TSs are derived from the analyses and evaluation included in the SAR and submitted pursuant to 10 CFR 50.34. TSs will include items in the following categories: *safety limits, limiting safety system settings, and limiting conditions for operation*. TSs limiting condition for operation of a nuclear reactor must be established for each item meeting one or more of the criteria provided in 10 CFR 50.36(c)(2)(ii). The regulation in 10 CFR 50.36 also requires the inclusion of surveillance requirements that prescribe the frequency and scope of the surveillance necessary to demonstrate the required performance in Section 4 of the TS.

The guidance in NUREG-1537, Part 1, Chapter 14, Appendix 14.1, "Format and Content of Technical Specifications for Non-Power Reactors," Section 3.1, "Reactor Core Parameters," item (6)(a) together with Appendix 14.1, Section 4.1, "Reactor Core Parameters," item (6) include guidance on Limiting Conditions for Operations (LCOs) and surveillance requirements for certain fuel parameters including periodic inspection of the fuel.

The proposed TS 5.3, "Reactor Core and Fuel," contains specifications related to fuel inspection and surveillance:

Specification f – inspection requirements for the fuel to detect gross failure or visual deterioration

Specification g – inspection criteria to detect gross failure or visual deterioration of the PUR-1 fuel plates

Specification h – states the criteria to ensure that the PUR-1 fuel assemblies are not operated in a damaged condition

These specifications do not appear to be design features, rather they appear to be LCOs. Move TS 5.3, Specifications f through h and/or develop similar additional LCO specifications in proposed TS Section 3, "Limiting Conditions for Operation," with associated surveillance requirements in TS Section 4, "Surveillance Requirements," based on the guidance included in NUREG-1537, Appendix 14.1, or justify why no changes are necessary.

13. TSs required by 10 CFR 50.36 provided limitations and operational criteria intent on protecting the integrity of certain of the physical barriers that guard against the uncontrolled release of radioactivity. The first of these barriers and the most important is the fuel cladding.

The proposed TS does not have a specification for limiting burnup. NUREG-1537, Part 1, Appendix 14.1, Section 3.1, "Reactor Core Parameters," item (6)(c), "Materials Testing Reactor (MTR)-Type Fuel," provides guidance that the fuel matrix should have a limit on U-235 burnup. Provide a burnup limit consistent with the guidance in NUREG-1537 and ANSI/ANS-15.1-2007, Section 5.3, "Reactor Core and Fuel," or justify why no change is necessary.

14. TSs required by 10 CFR 50.36 provided limitations and operational criteria intent on protecting the integrity of certain of the physical barriers that guard against the uncontrolled release of radioactivity. The first of these barriers and the most important is the fuel cladding. The guidance in ANSI/ANS-15.1-2007, Section 5.3, "Reactor Core and Fuel," includes criteria for reactor operation with damaged or leaking fuel.

Provide a specification for reactor operation for locating damaged or leaking fuel following the guidance provided in ANSI/ANS-15.1-2007, Section 5.3, or justify why no LCO is needed.

15. The regulation in 10 CFR 50.36(c)(4) requires the inclusion of design features of those features of the facility such as materials of construction and geometric arrangements, which, if altered or modified, would have a significant effect on safety and are not covered elsewhere in the specifications.

The guidance in ANSI/ANS-15.1-2007, Section 5.3, "Reactor Core and Fuel," includes criteria for describing the normal core configuration including control rods. Propose a Section 5 design TS describing the PUR-1 core shim and regulating control rods following the guidance provided in ANSI/ANS-15.1-2007, Section 5.3, or justify why no changes are necessary.

16. TS limiting condition for operation of a nuclear reactor must be established for each item meeting one or more of the criteria provided in 10 CFR 50.36(c)(2)(ii).

The guidance in ANSI/ANS-15.1-2007, Section 3, "Limiting Conditions for Operations," includes constraints that shall be adhered to during the operation of the facility. Proposed TS 3.2, "Reactor Safety System," refers to only a critical reactor and states, "The reactor shall not be made critical..." Explain why these conditions do not need to be met if the reactor is in operation but sub-critical, or revise TS 3.2 to refer to reactor operation.

17. TS limiting condition for operation of a nuclear reactor must be established for each item meeting one or more of the criteria provided in 10 CFR 50.36(c)(2)(ii).

The proposed TS 3.3, "Primary Coolant Conditions," Specification d, specifies the limit for pool water temperature consistent with the thermal-hydraulic analysis in the PUR-1 SAR. It is not clear what steady-state operating power means as used in proposed TS 3.3. Proposed TS 1.26, "Power Level," states that steady state power should be 10 kW or less. Provide an explanation if this TS applies during reactor operation. If it does apply during reactor operation, revise the TS accordingly. If it does not, explain and justify when the temperature limit applies.

18. The regulation in 10 CFR 50.36 requires the inclusion of surveillance requirements that prescribe the frequency and scope of the surveillance necessary to demonstrate the required performance in Section 4 of the TSs. The guidance in ANSI/ANS-15.1-2007, Section 4, "Surveillance Requirements," includes surveillance criteria for specific systems specified in Section 3, "Limiting Conditions for Operations."

The proposed TS 4.3, "Primary Coolant System," Specification c states in part, "The reactor pool water will be at a height of the 13 feet over the top of the core whenever the reactor is operated." This appears to be a LCO, not a surveillance requirement, and is not consistent with the guidance in ANSI/ANS-15.1-2007. In addition, a LCO already exists for water level in proposed TS 3.3, "Primary Coolant Conditions," Specification c. Modify TS 4.3, Specification c as appropriate, or justify the TS as proposed.

19. The regulation in 10 CFR 50.36 requires the inclusion of surveillance requirements that prescribe the frequency and scope of the surveillance necessary to demonstrate the required performance in Section 4 of the TSs.

The proposed TS 4.3, "Primary Coolant System," Specification c specifies the weekly inspection of the reactor pool water level. The guidance in ANSI/ANS-15.1-2007, Section 4, "Surveillance Requirements," includes criteria under what conditions a surveillance activity can be deferred. Modify TS 4, Specification c specifying whether or not the water level inspection activity can be deferred during long term reactor shutdown to be consistent with the guidance in ANSI/ANS-15.1-2007, or justify why no change is necessary. If the surveillance can be deferred, provide a justification for deferment.

20. TSs are fundamental criteria necessary to demonstrate facility safety and are required by 10 CFR 50.36 for each license authorizing operation of a production or utilization facility of a type described in 10 CFR 50.21. The TSs are derived from the analyses and evaluation included in the SAR and submitted pursuant to 10 CFR 50.34. Due to the importance to overall facility safety of a uniform interpretation by both the licensee and regulator of terms and phrases used in TSs, definitions shall be included where necessary and consistently used to ensure that the TSs criteria necessary for compliance with regulatory requirements is uniformly understood by the licensee and regulator.

The proposed TS 1.26, "Power Level," defines two different power levels; steady state at 10 kW, and maximum power level at 12 kW, which appear to be used in determining the setpoints for the scram and control system. The definition appears to say that average power is limited to 10 kW, but transients up to the power scram setpoint of 12 kW or less is allowed. Based on the definition, it is not clear how the steady state power level is determined over time, since periodic deviations are allowed, and how the various setpoints for the scram and control logics are triggered. Explain how the 4-hour average power level is determined and how the average shows that steady-state power is 10 kW or less. Explain how the setpoints for scram and setback are calculated from the steady-state power level.

The proposed TS 1.40 defines "shall" as identifying a requirement. NUREG-1537 and ANSI/ANS-15.1-2007 suggest that TSs consist of "shall, should, or may" statements where these terms are defined in your TS 1.40, "Shall, Should, or May." Clarify what type of statements "is" statements and "will" statements are in TS 1.26, and modify the TS, as appropriate, to meet definition 1.40. TS 1.26, "Power Level," states, in part, that "the steady state operating power level should be 10 kW or less." Since "should" statements are not requirements, explain what the requirements for steady state power are, and modify the proposed TS, as appropriate.

21. Due to the importance to overall facility safety of a uniform interpretation by both the licensee and regulator of terms and phrases used in TSs, definitions shall be included where necessary and consistently used to ensure that the TSs criteria necessary for compliance with regulatory requirements is uniformly understood by the licensee and regulator.

The proposed TS 1.33, "Reactor Secured," is not consistent with the guidance provided in ANSI/ANS-15.1-2007, Section 1.3, "Definitions," item "Reactor Secured," Section (2)(a), that states, in part, the reactor is secured with the "minimum number of neutron-absorbing control devices fully inserted." Revise TS 1.33, "Reactor Secured," to match the guidance in ANSI/ANS-15.1-2007, as follows, or justify why no change is necessary. For example:

- ...
2. Or the following conditions exist:
 1. All control rods inserted

22. Due to the importance to overall facility safety of a uniform interpretation by both the licensee and regulator of terms and phrases used in TS, definitions shall be included where necessary and consistently used to ensure that the TSs criteria necessary for compliance with regulatory requirements is uniformly understood by the licensee and regulator.

The guidance in ANSI/ANS 15.1-2007, Section 1.2.2, "Format," includes criteria on the format of specifications stating that individual specifications contain "Applicability," "Objective," "Specification," and "Basis" sections. The proposed TS 2.1, "Safety Limit," contains a description and justification of the safety limit on process variables before the applicability statement. Move the description to the Basis section of proposed TS 2.1, "Safety Limit," to be consistent with the guidance in ANSI/ANS-15.1-2007, or justify why no change is necessary.

23. Due to the importance to overall facility safety of a uniform interpretation by both the licensee and regulator of terms and phrases used in TSs, definitions shall be included where necessary and consistently used to ensure that the TSs criteria necessary for compliance with regulatory requirements is uniformly understood by the licensee and regulator.

Proposed TS 1.40 defines "shall" as identifying a requirement. Revise proposed TS 5.2, "Reactor Coolant System," to be consistent with TS 1.40, or justify why no changes are necessary. Examples of parts of TS 5.2 not consistent with TS 1.40 are:

Specification a – "The PUR-1 primary cooling system is a pool containing ..." to
"The PUR-1 primary cooling system shall be a pool containing ..."

Specification b – "The process water system is assembled ..." to
"The process water system shall be assembled ..."

"The demineralizer contains a removable cartridge..." to
"The demineralizer shall contain a removable cartridge..."

- Specification c – “Makeup water for the pool is taken batch wise...” to
“Makeup water for the pool shall be taken batch wise...”
- “A vacuum breaker excludes any possibility...” to
“A vacuum breaker shall exclude any possibility...”
- “The pool makeup water system, in addition to the demineralizer,
includes a...” to
“The pool makeup water system, in addition to the demineralizer, shall
include a...”
- Specification d – “The chiller is designed with three loops. Pool water passes through
the primary loop, a Freon refrigerant is in the secondary loop, and
water from the building water supply is used to remove heat, which is
then discharged to the building sewer system. The heat-removal
capacity of the heat exchanger is 10.5 kW” to
“The chiller shall contain three loops. Pool water shall pass through
the primary loop, a Freon refrigerant shall be in the secondary loop,
and water from the building water supply shall be used to remove
heat, which shall be discharged to the building sewer system. The
heat-removal capacity of the heat exchanger shall be at least
10.5 kW”

24. Due to the importance to overall facility safety of a uniform interpretation by both the licensee and regulator of terms and phrases used in TSs, definitions shall be included where necessary and consistently used to ensure that the TSs criteria necessary for compliance with regulatory requirements is uniformly understood by the licensee and regulator.

The guidance in ANSI/ANS-15.1-2007 includes criteria on the content of Basis statements, which provide the background or reason for the specification. The following parts of proposed TS 5.2, “Reactor Coolant System,” Specifications b and c, appear to be Basis statements:

- Specification b “This system limits, by the use of filters and ion-exchange resin, the aluminum corrosion rate, corrosion product buildup, and neutron activation of impurities in the coolant.”
- Specification c “It was designed to maintain the reactor pool temperature at 75°F during continuous operation at 10 kW.”

Modify the TS as appropriate, or explain why these are specifications and no change is needed.

25. The regulation in 10 CFR Part 20 requires that dose to members of the public be limited. To support meeting the public dose limits, 10 CFR Part 20 also limits the release of radioactive materials (e.g., 10 CFR Part 20, Appendix B, Table 3).

Section 5.3, "Secondary Coolant System," of the PUR-1 SAR, describes the secondary side of the heat exchanger that is operated at higher pressure than the primary side. Any tube leak would result in Freon leaking into the primary system. Provide a more comprehensive description of the heat exchanger including the process for detection of a potential leak, potential impact of Freon in the reactor pool, whether periodic surveillance is required, and the facility response upon detecting a leak. Is the secondary pressure higher than the primary at all times, for example, when the systems are turned off? Explain why the surveillance intervals for pH and conductivity are sufficient to detect a Freon leak.

26. TSs required by 10 CFR 50.36 provided limitations and operational criteria (Limiting Conditions for Operations and their corresponding Surveillance Requirements) intent on protecting the integrity of certain of the physical barriers that guard against the uncontrolled release of radioactivity. The first of these barriers and the most important is the fuel cladding.

The guidance in ANSI/ANS-15.1-2007 includes criteria on Section 4, "Surveillance Requirements," which are companion requirements to Section 3, "Limiting Conditions for Operations," specifications demonstrating the minimum performance requirements established in Section 3. The proposed TS 4.3, "Primary Coolant System," Specification d requires the measurement of the radionuclide content of the pool water for radioactivity content. There is no companion Section 3 LCO specification providing the minimum performance level for the radioactivity content of the coolant ensuring public health and safety. Revise/add a specification of maximum allowable radioactivity content of primary water in proposed TS 3.3, "Primary Coolant Condition," to be consistent with the guidance in ANSI/ANS-15.1-2007, or justify why no change is necessary.

27. The regulation in 10 CFR 50.9 requires that information provided to the Commission by a licensee shall be complete and accurate in all material respects.

The proposed TS 1.6 "Containment," definition is not applicable to the PUR-1 facility and is not fully consistent with ANSI/ANS-15.1-2007 and NUREG-1537, Appendix 14.1, Section 1.3 that provides guidance for including facility specific definitions. Revise or remove TS 1.6 as applicable or justify why no change is necessary.

28. Due to the importance to overall facility safety of a uniform interpretation by both the licensee and regulator of terms and phrases used in TSs, definitions shall be included where necessary and consistently used to ensure that the TSs criteria necessary for compliance with regulatory requirements is uniformly understood by the licensee and regulator.

Proposed TS 1.40 defines "shall" as identifying a requirement. Revise proposed TS 5.1, "Site Description," to be consistent with TS 1.40, or justify why no changes are necessary. Examples of parts of TS 5.1 not consistent with TS 1.40 are:

Specification d – "The reactor room remains locked at all times ..." to
"The reactor room shall remain locked at all times ..."

Specification e – “The PUR-1 reactor room is a closed room ...” to
“The PUR-1 reactor room shall be a closed room ...”

Specification h – “Openings into the reactor room consist of the following...” to
“Openings into the reactor room shall consist of the following...”

29. Due to the importance to overall facility safety of a uniform interpretation by both the licensee and regulator of terms and phrases used in TSs, definitions shall be included where necessary and consistently used to ensure that the TSs criteria necessary for compliance with regulatory requirements is uniformly understood by the licensee and regulator.

Proposed TS 1.40 defines “shall” as identifying a requirement. The proposed TS 3.4, “Confinement,” Specification a, is not fully consistent with NUREG-1537, Part 2, Section 9.1, “Heating, Ventilation, and Air Conditioning Systems,” acceptance criteria, which states system design should address all normal sources of airborne radioactive material. Confinement integrity must be established when radioactive material with the potential for airborne release is being handled. In addition, TS 3.4 “Confinement,” Specification a should also be stated as a “shall” requirement to conform to TS definitions. Propose modifications to TS 3.4, as appropriate, or justify why no changes are necessary. For example:

Specification a – “During reactor operation the following conditions will be met...” to
“During reactor operation and when radioactive material is being handled with potential for airborne release the following conditions shall be met...”

The following applies to RAIs No. 30, 31 and 31, below. The regulation in 10 CFR 50.34(b) states, in part, that each application for an operating license shall include information that describes the facility, presents the design bases and the limits on its operation, and presents a safety analysis of the structures, systems, and components and of the facility as a whole, and shall include per 10 CFR 50.34(b)(2), a description and analysis of the structures, systems, and components of the facility, with emphasis upon performance requirements, the bases, with technical justification therefor, upon which such requirements have been established, and the evaluations required to show that safety functions will be accomplished.

30. NUREG-1537, Part 1, Chapter 7, “Instrumentation and Control Systems,” includes guidance on the detail and operating characteristics of the instrumentation & control (I&C) system. The increase in the maximum licensed power to 12 kWt may require changes and/or adjustments in the I&C system, which are not included or otherwise specified in the PUR-1 SAR. As stated in the SAR the power increase would require the adjustment of two instruments. Provide additional information on the adequacy of the current I&C design and required adjustment to the I&C system required due to the increase in the maximum licensed power level to 12 kWt.
31. Chapter 7 of the PUR-1 SAR describes an operating mode of the regulating rod using a servo-amplifier. Provide additional information on the operation of the regulating rod in this mode. Is there an interlock preventing the raising of more than one control rod when in

servo-mode operation? If so, propose a TS limiting condition of operation for this interlock and related surveillance requirement, or justify why no change is necessary.

32. NUREG-1537, Part 1, Chapter 14, Appendix 14.1, Section 3.2, "Reactor Control and Safety Systems," item (4), "Scram Channels" and item (5), "Interlocks," include criteria on the detail and operating characteristics of the scram channels, scram signals, and interlocks providing guidance that all scram conditions, signals, and interlocks required for operation should be described in the proposed TSs. Revise proposed TS 3.2, Table I and Table II, to include all scram conditions and interlocks described in the PUR-1 SAR, Chapter 7, or justify why no change is necessary.
33. Due to the importance to overall facility safety of a uniform interpretation by both the licensee and regulator of terms and phrases used in TSs, definitions shall be included where necessary and consistently used to ensure that the TSs criteria necessary for compliance with regulatory requirements is uniformly understood by the licensee and regulator.

Proposed TS 1.40 defines "shall" as identifying a requirement. Revise proposed TS 3.2, "Reactor Safety System," Specification a to be consistent with TS 1.40, or justify why no changes are necessary. For example:

Specification a – "The reactor safety channels and safety-related instrumentation are operable ..." to
"The reactor safety channels and safety-related instrumentation shall be operable containing ..."

34. The regulation in 10 CFR 50.34(b)(2), requires the SAR to include a description and analysis of the structures, systems, and components of the facility, with emphasis upon performance requirements, the bases, with technical justification therefor, upon which such requirements have been established, and the evaluations required to show that safety functions will be accomplished.

Section 7.2.3, "Channel 3 – Linear Power," of the PUR-1 SAR, describes the design and operation of the flux measuring channel that has an adjustable range instrument. The PUR-1 SAR indicates that this channel has two setpoints that will initiate a reactor set back at either zero or 100% of the selected range and also a 120% range setpoint of the selected range that will initiate a reactor trip. The proposed TS 3.2, "Reactor Safety System," Table I specifies two setpoints, 110% and 120% range, which initiate a reactor power setback and trip respectively. Provide additional details to ensure that the SAR description and TS 3.2 Table I contains consistent information. Does "110% range" and "120% range" refer to the selected power range of the linear channel? If so, clarify the wording of the setpoint of the linear channel, as appropriate, or justify why no change is necessary.

35. TS LCOs of a nuclear reactor must be established for each item meeting one or more of the criteria provided in 10 CFR 50.36(c)(2)(ii).

NUREG-1537, Part 1, Appendix 14.1, Section 3.2(4), "Scram Channels," includes criteria for licensees and applicants on the detail and operating characteristics of the scram channels and associated setpoints to include in the SAR and TS.

- a. The proposed TS 3.2, "Reactor Safety System," Table I, specifies setpoints for the safety channels, but does not indicate the trip signal based on the direction of change in the process variable. Revise TS 3.2, Table I setpoint values indicating whether the trip is actuated when the signal is "less than..." or "greater than..." the setpoints.
 - b. The proposed TS 3.2, "Reactor Safety System," Table I, specifies setpoints based on the reactor power level as "110% steady state power level" and "120% steady state power level." Consider adding the explicit power level to the setpoint definitions as "110% steady state power level (11 kW)," and "120% steady state power level (12 kW)," or justify why no changes are necessary.
36. The regulation in 10 CFR 50.36 requires the inclusion of surveillance requirements that prescribe the frequency and scope of the surveillance necessary to demonstrate the required performance in Section 4 of the TSs.

ANSI/ANS-15.1-2007, Section 4, "Surveillance Requirements," provides guidance on the frequency of functional testing of the reactor safety system channels. Provide clarification for the following:

- a. Proposed TS 4.2, "Reactor Safety System," Specification a states, in part, that "a channel test of the reactor safety system channels listed in Table III shall be performed prior to each reactor startup following a shutdown in excess of 8 hours." Discuss the basis for establishing 8 hours as the limit. Does the 8-hour limit apply if the reactor was secured for being unstaffed and there were no reactor operators in the facility (e.g., overnight)? Revise the TS as necessary based on your answers.
- b. Proposed TS 4.2, "Reactor Safety System," Specification b states, in part, that "a channel check of each of the reactor safety system measuring channels in use or on scale..." Provide clarification if the reactor safety measuring channels are equivalent to the reactor safety channels listed in TS 3.2, "Reactor Safety System," Table I.
- c. Proposed TS 4.2, "Reactor Safety System," Specification b states, in part, that "...shall be performed approximately every four hours when the reactor is in operation." Is a channel check performed if the reactor is operated for a period of time less than 4 hours? If not, provide a justification. How often does the reactor operator take reactor logs and is this channel check part of the reactor logs? What is the definition of "approximately" as used in the proposed TS? Modify the TS, as appropriate, based on your answers, or justify why no change is necessary.
- d. Proposed TS 4.2, "Reactor Safety System," Specification c states, in part, that "a channel calibration of the reactor safety channels shall be performed at the following average intervals..." Explain what average intervals means and how that would

impact the requirement of “annually, with no interval to exceed 15 months.” How is this different from stating “the following intervals?” Clarify what the reactor safety channels referenced in this TS consist of. Modify the TS, as appropriate, or justify why no change necessary.

The following applies to RAIs No. 37, 38 and 39, below. Due to the importance to overall facility safety of a uniform interpretation by both the licensee and regulator of terms and phrases used in TSs, definitions shall be included where necessary and consistently used to ensure that the TSs criteria necessary for compliance with regulatory requirements is uniformly understood by the licensee and regulator.

37. Proposed TS 1.40 defines “shall” as identifying a requirement. Revise proposed TS 5.1, “Site Description,” to be consistent with TS 1.40, or justify why no changes are necessary. For example:

Specification g – “The ventilation system is designed...” to
“The ventilation system shall be designed...”

38. Proposed TS 1.40 defines “shall” as identifying a requirement. Revise proposed TS 3.4, “Confinement,” to be consistent with TS 1.40, or justify why no changes are necessary. For example:

Specification a – “During reactor operation the following conditions will be met ...” to
“During reactor operation the following conditions shall be met ...”

Specification a

1. “The reactor room will be maintained at ...” to
“The reactor room shall be maintained at ...”

Specification c – “Dampers in the ventilation system inlet and outlet ducts are capable ...” to
“Dampers in the ventilation system inlet and outlet ducts shall be capable ...”

Specification d – “The air conditioner can be shut off ...” to
“The air conditioner shall be able to be shut off ...”

39. Proposed TS 1.40 defines “shall” as identifying a requirement. Revise proposed TS 4.4, “Confinement,” to be consistent with TS 1.40, or justify why no changes are necessary. For example:

Specification a – “The negative pressure of the reactor room will be recorded weekly...” to
“The negative pressure of the reactor room shall be recorded weekly...”

40. The regulation in 10 CFR 50.36 requires the inclusion of surveillance requirements that prescribe the frequency and scope of the surveillance necessary to demonstrate the required performance in Section 4 of the TS. Additionally, 10 CFR 50.36(c)(4) requires the inclusion of design features of those features of the facility such as materials of construction and geometric arrangements, which, if altered or modified, would have a significant effect on safety and are not covered elsewhere in the specifications.

The proposed TS 4.4, "Confinement," Specification d appears to be a duplicate statement in part of TS 5.3, "Reactor Core and Fuel," Specification f. The guidance in NUREG-1537, Part 1, Appendix 14.1, Section 3.1 "Reactor Core Parameters," item (6)(a) together with Appendix 14.1, Section 4.1, "Reactor Core Parameters," item (6) include guidance on LCO and surveillance requirements for certain fuel parameters including periodic inspection of the fuel. Revise both TS 4.4 and TS 5.3, Specification f based on the guidance in NUREG-1537, Part 1, Appendix 14.1, also considering RAI No.12, above, or justify why no change is necessary.

41. The regulation in 10 CFR 50.36(c)(4) requires the inclusion of design features of those features of the facility such as materials of construction and geometric arrangements, which, if altered or modified, would have a significant effect on safety and are not covered elsewhere in the specifications.

The proposed TS 5.4, "Fuel Storage," Specification a is not consistent with the guidance in ANSI/ANS-15.1-2007, Section 5.4, "Fissionable Material Storage," which states that fuel including fuel devices and fueled experiments are to be stored in controlled configurations. TS 5.4 states, in part, that "...fuel assemblies shall be stored..." which may not clearly define all situations, for example, may exclude the storage of fuel in the form of individual plates. Revise TS 5.4 to be consistent with the guidance, or justify why no change is necessary. For example:

Specification a – "All reactor fuel assemblies shall be stored in a geometric array ..." to "All reactor fuel and fueled devices shall be stored in a geometric array ..."

42. The regulation in 10 CFR 50, Appendix E, Section F establishes training requirement for emergency response personnel, including reactor operators. Subsection iv, includes fire control teams.

The PUR-1 reactor room contains two fire extinguishers, which are inspected annually and maintained by the Purdue University Fire Department. In the event of a fire, the PUR-1 staff must be able to operate the fire extinguishers. Provide more comprehensive information on the training of reactor staff in the use of the fire extinguishers.

43. Due to their importance to overall facility safety, TSs require a uniform understanding by both the licensee and regulator of terms and phrases used in TSs. To that end, definitions shall be included where necessary and used consistently to ensure that the TSs criteria necessary for compliance with regulatory requirements is uniformly understood by the licensee and regulator.

The proposed TS 1.47, "Tried Experiment," states, in part, "...of approximately the same nuclear characteristic," which is not clearly defined. Explain what nuclear characteristics are considered in determining if an experiment is a tried experiment. Revise TS 1.47 to provide a clearer definition of which nuclear parameters and their values used to determine whether an experiment is considered a "tried experiment" or justify why no changes are necessary.

44. The regulation in 10 CFR 50.9 requires that information provided to the Commission by a licensee shall be complete and accurate in all material respects.

The proposed TS 1.50, "Unsecured Experiment," appears to have a typographical error referring to an incorrect definition "...secured as defined in part 1.37 of this section..." Should this be part 1.38 of the definitions? Modify the proposed TS as appropriate.

The following applies to RAIs No. 45, 46, 47, and 48, below. TSs LCOs of a nuclear reactor must be established for each item meeting one or more of the criteria provided in 10 CFR 50.36(c)(2)(ii). The LCOs for operation are the lowest functional capability or performance levels of equipment required for safe operation of the facility.

45. The proposed TS 3.1, "Reactivity Limits," Specification d limits the total maximum positive reactivity of the core and any installed experiment to 0.006 $\Delta k/k$. The irradiation facility in the reflector contains six tubes that are filled with graphite when not in use. If the six tubes are transitioned from containing experiments to graphite the reactivity change is 0.01 $\Delta k/k$, which is larger than the TS 3.1 reactivity limit. Describe the type of irradiation tube facility activities that potentially result in reactivity changes exceeding the TS 3.1 limit for reactivity and how these activities are controlled. Discuss the need for controlling the use of the tubes by TS requirement.
46. The guidance in ANSI/ANS-15.1-2007, Section 3.8.1, "Reactivity Limits," includes criteria for reactivity limits for experiments and states that the limits should be established using the absolute reactivity worth values. Revise proposed TS 3.1, "Reactivity Limits," to be consistent with the guidance or justify why no changes are needed. For example:

Specification e - "The reactivity worth of each experiment shall be limited as follows..." to
"The absolute value of the reactivity worth of each experiment shall be limited as follows..."

Specification f - "The total worth of all movable and unsecured experiments ..." to
"The sum of the absolute value of the total worth of all movable and unsecured experiments ..."

Specification g - "The total worth of all secured experiments ..." to
"The sum of the absolute value of the total worth of all secured experiments ..."

47. The proposed TS 3.5, "Limitations on Experiments," Specification c states that no explosive material may be placed in the reactor pool. The PUR-1 SAR and TS 3.5 "Limitations on Experiments," Basis, do not indicate whether explosive material can be placed and/or stored in the PUR-1 facility. Provide information that describes the potential placement, movement, storage, and /or limitation on the maximum quantity of any explosive material and its administrative control.
48. The proposed TS 3.5 "Limitations on Experiments," Specification d states that experiments will be cooled, to prevent the experiment surface temperature exceeding 100 degrees Celsius. The safe temperature for an experiment is determined only through the experiment-specific safety evaluation. Provide information why TS 3.5, Specification d would ensure the safety of specific experiments. Propose and justify changes to TS 3.5, Specification d as needed.
49. Due to the importance to overall facility safety of a uniform interpretation by both the licensee and regulator of terms and phrases used in TSs, definitions shall be included where necessary and consistently used to ensure that the TSs criteria necessary for compliance with regulatory requirements is uniformly understood by the licensee and regulator.

Proposed TS 1.40 defines "shall" as identifying a requirement. Revise proposed TS 3.5, "Limitations on Experiments," to be consistent with TS 1.40, or justify why no changes are necessary. For example:

"The reactor will not be operated unless..." to "The reactor shall not be operated unless..."

Specification b - "All experiments and experimental procedures must receive approval by..." to
"All experiments and experimental procedures shall be approved by..."

Specifications f and g - Contain "should" statements which are defined by TS 1.40 as a recommendation. Explain why these are "should" statements as opposed to "shall" statements which indicate a requirement.

The following applies to RAIs No. 50 and 51, below. The regulations in 10 CFR Part 20 require that dose to members of the public be limited. To support meeting the public dose limits answer the following.

50. The proposed TS 3.5, "Limitations on Experiments," Specification f states that the radioactive exposure dose for a member of the public occupying unrestricted areas for 2 hours will be limited below the dose limits in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 20, "Standards for Protection Against Radiation," after a release. Provide a justification for the 2-hour time period, since the dose limits in 10 CFR 20.1301 are applicable for the full duration of any potential radioactivity release.

51. The proposed TS 3.5, "Limitations on Experiments," Specification g states the dose limits for a member of the public and facility staff after an experiment failure resulting in the release of radioactive products. Since these dose limits are in full compliance of the 10 CFR Part 20 limits, consider simplifying TS 3.5, Specification g stating that the dose limits will satisfy the requirements in 10 CFR Part 20.
52. The regulation in 10 CFR 50.36(c)(5) requires administrative controls necessary to assure operation of the facility in a safe manner.

The proposed TS 4.5, "Experiments," Specification b does not clearly define the review and approval requirements for new experiments. Revise TS 4.5 to provide a clear presentation of those requirements, or justify why no changes are necessary.

Also, due to the importance to overall facility safety of a uniform interpretation by both the licensee and regulator of terms and phrases used in TSs, definitions shall be included where necessary and consistently used to ensure that the TSs criteria necessary for compliance with regulatory requirements is uniformly understood by the licensee and regulator.

Proposed TS 1.40 defines "shall" as identifying a requirement. Revise TS 4.5, "Experiments," to be consistent with TS 1.40, or justify why no changes are necessary. For example:

"No experiments will be performed unless..." to "No experiments shall be performed unless..."

Specification b – "The experiment has been properly reviewed ..." to
"It is a new experiment that has been properly reviewed..."

53. The regulation in 10 CFR 50.36(c)(5) requires administrative controls necessary to assure operation of the facility in a safe manner.

The proposed TS 3.5, "Limits on Experiments," Specification b governs the approval process for experiments. Proposed TS 6.2, "Review and Audit," Specification d states that significant changes to previously approved experiments are reviewed through the 10 CFR 50.59 process ("Changes, Tests and Experiments"). Provide a clarification whether minor changes to experiments that do not significantly alter the experiment are also entered to the 10 CFR 50.59 process and describe the approval and review structure for such changes.

54. The regulations in 10 CFR 20.1101(d) or 10 CFR 20.1301 establish regulatory requirements for a radiation protection program and dose limits for individual members of the public both of which contain criteria addressing, in part issues related to effluents.

NUREG-1537, Part 1, states that the format and content of the TS follow that of ANSI/ANS-15.1-2007. ANSI/ANS-15.1-2007, Section 4.7.2, "Effluents," provides guidance for surveillance requirements for monitoring the facility boundary with dosimeters and

environmental monitoring, specifically “sampling of soil, vegetation, or water in the vicinity of the facility.” Discuss whether the proposed TSs are consistent with the guidance.

55. TSs are fundamental criteria necessary to demonstrate facility safety and are required by 10 CFR 50.36 for each license authorizing operation of a production or utilization facility of a type described in 10 CFR 50.21. The TSs are derived from the analyses and evaluation included in the SAR and submitted pursuant to 10 CFR 50.34. TSs LCOs of a nuclear reactor must be established for each item meeting one or more of the criteria provided in 10 CFR 50.36(c)(2)(ii). LCOs are the lowest functional capability or performance levels of equipment required for safe operation of the facility.

For the proposed TS 3.2, “Reactor Safety System,” Table II, “Safety-Related Channels (Area Radiation Monitors),” address the following items:

- a. The Basis does not indicate how the alarm setpoints are established, in order to protect the workers or public. NUREG-1537, Part 1, Appendix 14.1, Section 3.7.1, “Monitoring Systems,” item (3) “Area Monitors,” provides guidance that the alarm and automatic setpoints should be specified to ensure that personnel exposures and potential doses remain below the limits of 10 CFR Part 20. Provide the basis for the area monitor setpoints, or justify why no change is necessary.
 - b. It is not clear whether the “Continuous air sampler” refers to the Geiger-Mueller (GM) detector, the monitor, or the whole channel. Provide clarification, whether it refers to a Continuous Air Monitor (CAM) channel and describe the monitor and/or alarm indicator and location. Discuss how footnote “(c)” would be used to replace a continuous air sampler.
 - c. The proposed TS 3.2, Table II, footnote (c) allows the replacement of a radiation monitor for a one week duration (or reactor run). Provide the basis for the one week replacement period.
 - d. The setpoint for the Pool Top Monitor contains a typographical error “...or2x full power...” Modify the TS as appropriate.
56. The regulation in 10 CFR 50.36(c) states TSs will include Surveillances. The regulation in 10 CFR 50.36(c)(3) states, “surveillance requirements 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 limiting conditions for operation will be met.”

For the proposed TS 4.2, “Reactor Safety System,” Specification d, address the following items:

- a. NUREG-1537, Part 1, states that the format and content of the TS follow that of ANSI/ANS 15.1. ANSI/ANS-15.1-2007, Section 4.7.2, “Effluents,” provides guidance related to operability testing requirements for radiation monitoring systems. The proposed TS 4.2, “Reactor Safety System,” Specification d states, “The operation of

the radiation monitoring equipment shall be verified...” It is not clear whether “verified” refers to a channel check or test or some other action. Discuss whether TS 4.2 is consistent with the standard guidance and modify the TS as appropriate.

- b. NUREG-1537, Part 1, states that the format and content of the TS follow that of ANSI/ANS 15.1. ANSI/ANS-15.1-2007 Section 4.7.2, “Effluents,” provides guidance related to calibration requirements for radiation monitoring systems. The proposed TS 4.2, “Reactor Safety System,” Specification d states that the “Calibration of these monitors shall be performed annually...” Provide additional information whether “radiation monitoring equipment” includes detecting and measuring instruments used for performing routine radiation surveys in the reactor room.

57. The regulation in 10 CFR Part 20, Subpart K – *Waste Disposal* provides the regulatory requirements related to the disposal of licensed materials.

NUREG-1537, Part 1, Section 11.2.3, “Release of Radioactive Waste,” includes criteria on the release and disposal of radioactive waste. The PUR-1 SAR states that all low-level radioactive waste is transferred for disposal to Purdue University under the By-Product License (Broadscope) and stored until final disposition is determined. Provide a description of the administrative controls for transfer of material to storage. Provide a brief description of the waste storage facility.

58. Due to the importance to overall facility safety of a uniform interpretation by both the licensee and regulator of terms and phrases used in TSs, definitions shall be included where necessary and consistently used to ensure that the TSs criteria necessary for compliance with regulatory requirements is uniformly understood by the licensee and regulator.

ANSI/ANS-15.1-2007, Section 1.3, “Definitions,” includes criteria on the uniform interpretation of the terms used in the TS. For the proposed TS Section 1, “Definitions,” address the following items:

- a. TS 1.16, “License,” contains the phrase “...by the responsible authority...” Modify the phrase to reflect that PUR-1 is licensed by the U.S. NRC.
- b. Section 1, “Definitions,” contain items which do not appear to be used within the TSs. Review all definitions and eliminate those which are not used, or justify why they are needed (for example, TS 1.37, “Responsible Authority.”)
- c. TS 1.35, “Readily Available on Call,” revise ...”senior operator shall insure that he is within...” to “senior operator shall be within...” to provide TSs that are gender neutral.

59. The regulation in 10 CFR 50.36(c)(5) requires administrative controls necessary to assure operation of the facility in a safe manner. Due to the importance to overall facility safety of a uniform interpretation by both the licensee and regulator of terms and phrases used in TSs, definitions shall be included where necessary and consistently used to ensure that the TSs criteria necessary for compliance with regulatory requirements is uniformly understood by the licensee and regulator.

NUREG-1537, Part 1, states that the format and content of the TS follow that of ANSI/ANS-15.1-2007. For the proposed TS Section 6.1, "Organization," address the following items:

- a. The proposed TS 6.1, "Organization," does not follow the guidance in ANSI/ANS-15.1-2007, Section 6.1, "Organization," that provides guidance to include an overall description of the organizational functions, structure, staffing, responsibility, and selection and training of personnel. Revise TS 6.1 to follow the guidance in ANSI/ANS-15.1-2007, or justify why no change is necessary.
- b. The proposed TS 6.1, "Organization," has a numbering scheme that is not clear (letter followed by letter). Revise the numbering lists in TS Section 6.1, Specification a, "Structure," and TS 6.1, Specification c, "Minimum Qualification of Reactor Personnel," or justify why no change is necessary.
- c. ANSI/ANS-15.1-2007, Section 6.1.1, "Structure," provides guidance related to organizational structure. Proposed TS 6.1, "Organization," Figure 6.1, does not clearly indicate the reporting and communication lines between the organizational structures. Clarify the reporting structure for the PUR-1 organization, or justify why no change is necessary.
- d. The proposed TS 6.1, Specification b, "Staffing," item (1)(c) specifies the conditions when the senior operator "...shall be present or readily available on call..." The specification further provides a definition of "Readily Available on Call" that is also specified in proposed TS 1.35, "Readily Available on Call." However, the two definitions are not consistent. In order to reduce unnecessary redundancy and ensure consistency, modify TS 6.1, Specification b, item (1)(c) together with TS 1.35, as appropriate, or justify why no change is necessary.
- e. ANSI/ANS-15.1-2007, Section 6.1.3, "Staffing," provides guidance for minimum staffing, when the reactor is not secured. The proposed TS, 6.1, Specification b, "Staffing," item (2) states that no senior reactor operator (SRO) or licensed reactor operator (RO) is required in the facility, when the reactor is in secured position. However, the proposed TS definition of reactor secure does not address items such as status and alignment of systems to leave the facility unstaffed and security requirements. What are the additional steps beyond meeting the definition of reactor secure that must be met for leaving the reactor facility unattended? Some licensees have captured these requirements in a definition titled "secure shutdown." Modify the TS as appropriate.
- f. ANSI/ANS-15.1-2007, Section 6.1.3, "Staffing," item (2) provides guidance for maintaining a list of reactor facility personnel. Evaluate proposed TS 6.1, Specification b, "Staffing," against the guidance, and modify the TS as appropriate, or provide a basis for not providing a specification for a list of reactor personnel.

- g. The regulations in 10 CFR 50.54(m)(1) states that recovery from a unplanned significant reduction in power requires the presence of a senior reactor operator. In addition, ANSI/ANS-15.1-2007, Section 6.1.3, "Staffing," item (3)(d) includes guidance on events requiring the presence of an SRO at the facility. Evaluate the proposed TS 6.1, Specification b, "Staffing," item (3)(c) against 10 CFR 50.54(m)(1) and the guidance and modify the TS as appropriate, or provide a basis for not including significant power reduction events in the specification. If recovery from a significant reduction in power is added to the TS, define what constitutes a significant reduction in power. Initial startup appears to be defined as the startup following a core change. The NRC staff's interpretation of initial startup is that it is the first startup after the facility was placed in a status where it could be unstaffed. Proposed a modification of the TS consistent with this interpretation, or justify how your interpretation meets 10 CFR 50.54(m)(1).
- h. Proposed TS 1.40 defines "shall" as identifying a requirement. Revise sections of proposed TS 6.1 as identified below to be consistent with proposed TS 1.40, or justify why no changes are necessary. Additional typographical errors and other issues are also addressed below. Revise sections of TS 6.1 as identified below to address the typographical errors and other issues, or justify why no changes are necessary.
- TS 6.1, Specification a, "Structure,"

Item a – "The Dean of the College of Engineering (Level 1) will be the individual responsible for the facility's license or charter" to "The Dean of the College of Engineering (Level 1) shall be the individual responsible for the facility's license."

Issues: Not consistent with TS 1.40 with "will" statement. Reference to charter.

 - TS 6.1, Specification b, "Staffing,"

Item (1)(a) – A licensed reactor operator in the reactor room" to "A licensed reactor operator shall be in the control room"

Issue: Not consistent with TS 1.40.

 - Item (1)(c) – "...operation. "Readily Available on Call means..." to "...operation. "Readily Available on Call" means..."

Issue: Apparent typographical error.

 - Item (1)(c)(i) – "Has been specifically designates and..." to "Has been specifically designated and..."

Issue: Apparent typographical error.

Item (1)(c)(iii) – "...within a reasonable time under normal conditions." To "...within a reasonable time (30 minutes) under normal conditions."

Issue: Define reasonable time.

- TS 6.1, Specification c, "Minimum Qualifications of Reactor Personnel,"

NUREG-1537, Section 12.1.4, "Selection and Training of Personnel," includes guidance on the selection and training of personnel for research reactors and states that ANSI/ANS-15.4 may also be used for additional guidance. The proposed TS 6.1, Specification c refers to the ANSI/ANS-15.4 standard without identifying the year of issue. Add the year of the standard to the TS (current version of the standard is 2016) or justify why no change is necessary. The guidance in ANSI/ANS-15.1, Section 6.1.4, "Selection and Training of Personnel," states that operations personnel shall meet or exceed the requirements of ANSI/ANS-15.4. However, the TS contain a "should" statement about the applicability of ANSI/ANS-15.4. Justify the use of a "should" statement or propose wording for the TS consistent with ANSI/ANS-15.1.

Item b

- The guidance in ANSI/ANS-15.4-2016, Section 4.3, "Level 2," states that a Level 2 person shall have a minimum of six years of nuclear experience. Modify TS 6.1, Specification c, item (b), "...shall have a minimum five years..." to "...shall have a minimum six years..." or justify why no change is necessary.
- The phrase "...meets the certification requirements of the licensing agency..." is unclear. Modify the phrase to reflect that the license is issued by the U.S. NRC, or justify why no change is necessary.

Item c Reactor Supervisor

- To have TSs that are gender neutral modify "He shall have a baccalaureate degree..." to "The reactor supervisor shall have a baccalaureate degree..."

Item d Licensed Senior Operator (Level 4)

- ANSI/ANS-15.1-2007, Section 6.1.1, "Structure," includes criteria on the structure of the organization. The PUR-1 operating staff (Level 4) is not clearly identified in the proposed TS Section 6.1 and Figure 6.1 as Level 4 organizational structure. Clarify the organizational and reporting structure for the Level 4 personnel.

- To have TSs that are gender neutral, modify “He shall hold a valid NRC Senior Reactor Operator’s license” to “The senior operator shall hold a valid NRC Senior Reactor Operator’s license.”

Item e Licensed Operator

- To have TSs that are gender neutral, modify “He shall hold a valid NRC Reactor Operator’s license” to “The licensed operator shall hold a valid NRC Reactor Operator’s license.”
- TS 6.1, Specification d, “Radiation Safety Officer,”
 - “...including some formal training in radiation protection.” Define and justify the use of the word “some” or remove the word from the proposed TS.
 - “The RSO should have at least five years...” Justify the use of a “should” statement or propose a “shall” statement.
 - “At least three years of this professional experience should be...” Justify the use of a “should” statement or propose a “shall” statement.
- TS 6.1, Specification e, “Reactor Supervisor,”
 - To be consistent with the requalification program, modify “...shall be responsible for the facility retraining...” to “...shall be responsible for the facility requalification and...,” or justify why the current wording is acceptable.

60. The regulation in 10 CFR 50.36(c)(5) requires administrative controls necessary to assure operation of the facility in a safe manner. Due to the importance to overall facility safety of a uniform interpretation by both the licensee and regulator of terms and phrases used in TSs, definitions shall be included where necessary and consistently used to ensure that the TSs criteria necessary for compliance with regulatory requirements is uniformly understood by the licensee and regulator.

Proposed TS 1.40 defines “shall” as identifying a requirement. Revise sections of proposed TS 6.2, “Review and Audit”, as identified below to be consistent with TS 1.40, or justify why no changes are necessary. Additional typographical errors and other issues are also addressed below. Revise sections of TS 6.2 as identified below to address the typographical errors and other issues, or justify why no changes are necessary.

- a. TS 6.2, Specification a. “CORO will advise the Laboratory Director and/or the Reactor Supervisor ...”

Issue: Not consistent with TS 1.40.

- b. The proposed TS Section 6.2 has a numbering scheme that is not clear (letter followed by letter). Revise the numbering lists in TS Section TS 6.2. Specifically, TS 6.2 Specification b, TS 6.2, Specification e, and TS 6.2, Specification f, or justify why no change is necessary.
- c. TS 6.2, Specification c. "Sub committees may be formed as needed, which may consist of a minimum of 3 (three) members, only one of which may have line..."

Issue: Justify second and third use of "may" statements.

- d. The proposed TS 6.2, Specification d refers in Items a through c, to "unreviewed safety question," which is not consistent with 10 CFR 50.59, "Changes, tests, and experiments," or the guidance in ANSI/ANS-15.1-2007. Modify TS 6.2, Specification d, Items a through c, by updating the reference to "unreviewed safety questions" to comply with 10 CFR 50.59 and the guidance in ANSI/ANS-15.1-2007, or justify why no changes are necessary.
- e. TS 6.2, Specification d, Item d "Proposed changes in Technical Specifications or licenses."

Issue: Appears to have a typographical error, more than one license is referenced.

- f. The proposed TS 6.2, Specification d, Item f provides requirements for reviewing operating abnormalities. The requirements do not follow the guidance in ANSI/ANS-15.1-2007 Section 6.2.3(6), "Review Functions." For example:

"Significant operating abnormalities or deviations from normal and expected performance of facility equipment that might affect nuclear safety" to "Operating abnormalities or deviations from normal and expected performance of facility equipment having safety-significance."

- g. The proposed TS 6.2, Specification d provides requirements for items to be reviewed by the Committee on Reactor Operations (CORO), which does not include a review of the facility radiation protection program. Provide a description of the review process and the organization responsible for the review of the radiation protection program and how it complies with the guidance in ANSI/ANS-15.1-2007, Section 6.3, "Radiation Safety."
- h. The proposed TS 6.2, Specification e, Item b requires an annual audit of the training and qualification of the licensed facility staff. The guidance in ANSI/ANS-15.1-2007 Section 6.2.4(2), "Audit Function," states that the periodic audit is for the retraining and requalification program for the operating staff. Revise TS 6.2, Specification e, Item b to follow the guidance in ANSI/ANS-15.1-2007, or justify why no change is necessary.

- i. The guidance in ANSI/ANS-15.1-2007, Section 6.2.4(3), "Audit Function," states the audit requirements for corrective actions that affect reactor safety. The proposed TS 6.2, Specification e, Item c does not fully consistent with the guidance. Revise TS 6.2, Specification e, Item c, as appropriate, or justify why no change is necessary. For example:

 "...method of operation that affect nuclear safety..." to
 "...method of operation that affect reactor safety..."
- j. The proposed TS 6.2, "Review and Audit," Specification f, Items a and b states, in part, that CORO meeting minutes will be distributed to the Reactor Supervisor, and in Specification f, Item c to CORO Chairman. The guidance in ANSI/ANS-15.1-2007, Section 6.2, "Audit Function," states that the meeting minutes and reactor safety issues are to be provided to Level 1 management and the CORO group members. Revise TS 6.2, Specification f, Items a through c to include these additional organizational members or justify why no changes are necessary.
- k. The proposed TS Section 6.2, Specification f, Item b refers to items, "... by section 6.2.4 e, f, and g above," while Specification f, Item c refers to "...Section 6.2.5," which appear to be incorrectly numbered. Revise the numbering lists in TS Section 6.2 together with the appropriate references, or justify why no changes are necessary.

The following applies to RAIs No. 61 through 65, below. The regulation in 10 CFR 50.36(c)(5) requires administrative controls necessary to assure operation of the facility in a safe manner.

61. The proposed TS 6.3, "Operating Procedures," includes requirements for written operational procedures. The guidance in ANSI/ANS-15.1-2007, Section 6.4 "Procedures," includes additional technical and administrative activities, which require the development of additional procedures, specifically Section 6.4(5), 6.4(6), and 6.4(8). Revise TS 6.3 to include the additional procedures to be consistent with the guidance in ANSI/ANS-15.1-2007, Section 6.4, or justify why no changes are necessary.
62. The proposed TS 6.3, "Operating Procedures," states that "The Reactor Supervisor or Laboratory Director may make changes to procedures," but does not include a reference that all changes are made under the 10 CFR 50.59 process. NUREG-1537, Part 1, Section 12.3, "Procedures," provides guidance that the review should include the determinations that the proposed changes were allowed without prior NRC approval. Revise TS 6.3 to include the review for proposed changes consistent with the guidance, or provide a justification for the proposed TS 6.3.
63. The proposed TS Section 6, "Administrative Controls," is not fully consistent with the guidance in ANSI/ANS-15.1-2007, Section 6.5, "Experiment Review and Approval." Revise TS 6 to include the guidance provided in ANSI/ANS-15.1-2007, Section 6.5, or justify why no changes are necessary.

64. The proposed TS 6.4, "Operating Records," Specification b includes the word "certified." Modify TS 6.4, Specification b to reflect that the PUR-1 operational personnel is licensed by the NRC, or justify why no changes are necessary. For example:

"Record of retraining and requalification of certified operations personnel shall be maintained at all times the individual is employed or until the certification is renewed" to
"Record of retraining and requalification of licensed operations personnel shall be maintained at all times the individual is employed or until the license is renewed."

65. The proposed TS 6.5, "Required Actions," Specification a, Items (1) through (4), provide requirements in case of safety limit violations. However, TS 6.5, Specification a, Item (1) through (4) are not fully consistent with the guidance in ANSI/ANS-15.1-2007, Section 6.6.1, "Action to be taken in case of Safety Limit Violation." For example, Specification a, Item 3 states "...applicable circumstances preceding the violation," but does not mention any requirement for cause and contributing factors as in the ANSI/ANS-15.1-2007, Section 6.6.1 guidance. Revise TS 6.5, Specification a, Items (1) through (4), to include the guidance included in ANSI/ANS-15.1-2007, Section 6.6.1, or justify why no changes are necessary.

66. The regulation in 10 CFR 50.36 (c)(5) requires administrative controls necessary to assure operation of the facility in a safe manner. Additionally, due to the importance to overall facility safety of a uniform interpretation by both the licensee and regulator of terms and phrases used in TSs, definitions shall be included where necessary and consistently used to ensure that the TSs criteria necessary for compliance with regulatory requirements is uniformly understood by the licensee and regulator.

The proposed TS 1.40 defines "shall" as identifying a requirement. Revise sections of TS 6.5, "Required Actions," as identified below to be consistent with TS 1.40, or justify why no changes are necessary. In addition, the TS 6.5 contains phrases, which are not specific to the facility or do not express requirements. Revise TS 6.5 to be specific to the PUR-1 or justify why no changes are necessary. For example:

- TS 6.5, Specification a, Item (1)

"The reactor will be shut down immediately and reactor operation will not be resumed without authorization by the Commission" to

"The reactor shall be shut down immediately and reactor operation shall not be resumed without authorization by the U.S. NRC."

- TS 6.5, Specification b, Item (1)

"...unless authorized by Level 2 or designated alternates;" to

"...unless authorized by the Laboratory Director or designated alternates;"

- TS 6.5, Specification b, Item (2)

“Occurrence shall be reported to Level 2 or designated alternates and to chartering or licensing authorities as required;” to

“Occurrence shall be reported to the Laboratory Director or designated alternates and to the US NRC;”

- TS 6.5, Specification b, Item(3)

“Occurrence shall be reviewed by the review group at its next scheduled meeting” to

“Occurrence shall be reviewed by the CORO at its next scheduled meeting.”

67. The regulation in 10 CFR 50.36(c)(5) requires administrative controls necessary to assure operation of the facility in a safe manner.

The proposed TS 6.6, “Reporting Requirements,” contains phrases, which are not specific to the facility or do not express requirements. Revise TS 6.6, as appropriate, to follow the guidance in ANSI/ANS-15.1-2007, or justify why no changes are necessary. For example:

- TS 6.6, Specification a

“...shall be submitted to the Director of the Office of Nuclear Reactor Regulation with a copy to the NRC Regional Administrator by March 31 of each year” to

“...shall be submitted to the U.S. NRC Document Control Desk by March 31 of each year.”

- TS 6.6, Specification a, Item d

“...corrective maintenance (excluding preventive maintenance) performed...” to

“...corrective maintenance and major preventive maintenance performed...”

- TS 6.6, Specification b, Item a(1)

“...in writing by facsimile or similar conveyance to licensing authorities, to be followed by a written report to NRC Document Control that describes the circumstances of the event within 14 days of any of the following:” to

“...in writing by facsimile or similar conveyance to the NRC Headquarters Operations Center, and followed by a written report that describes the circumstances of the event and sent within 14 days to the U.S. NRC Document Control Desk any of the following:”

- TS 6.6, Specification b, Item a(1)(b)

“...established in the technical specifications unless prompt remedial action is taken as permitted in Sec. 3,” to

“...established in the technical specifications,”

- TS 6.6, Specification b, Item a(1)(d)
“...change in reactivity greater than 0.6% $\Delta k/k$,” to
“...change in reactivity greater than 0.6% $\Delta k/k$. Reactor trips resulting from a known cause are excluded”
- TS 6.6, Specification b, Item a(1)(e)
“...abnormal and significant degradation in reactor fuel or cladding, or both, coolant boundary,” to
“...abnormal and significant degradation in reactor fuel or cladding, or both, coolant boundary, or containment boundary,”
- TS 6.6, Specification b, Item a(2)
“There shall be a written report within 30 days to the chartering or licensing authorities of the following:” to
“There shall be a written report within 30 days to the U.S. NRC Document Control Desk, of the following:”
- TS 6.6, Specification b, Item b
“A written report shall be forwarded within 30 days to the Director, Office of Nuclear Reactor Regulation with a copy to the in the event of:” to
“A written report shall be forwarded within 30 days to the U.S. NRC Document Control Desk in the event of:”

The following applies to RAIs No. 68 and 69, below. The regulation in 10 CFR 50.36(c)(5) requires administrative controls necessary to assure operation of the facility in a safe manner. NUREG-1537, Part 1, states that the format and content of the TS follow that of ANSI/ANS-15.1-2007.

68. The proposed TS Section 6.6, “Reporting Requirements,” Specification a “Annual Reports,” is not consistent with the guidance in ANSI/ANS-15.1-2007, Section 6.7.1, “Operating Reports,” item (5) that includes reporting criteria for the results of environmental surveys. Revise TS 6.6, Specification a to include the guidance provided in ANSI/ANS-15.1-2007, Section 6.7.1, or justify why no changes are necessary.
69. The proposed TS Section 6.6, “Reporting Requirements,” Specification b, Item a “Special Reports,” Sub-item (1) is not consistent with the guidance in ANSI/ANS-15.1-2007, Section 6.7.2, “Special Reports,” item (1)(b) that includes reporting criteria for the release of radioactivity from the site. Revise TS 6.6, Specification b to include the guidance provided in ANSI/ANS-15.1-2007, Section 6.7.2, or justify why no changes are necessary.

The following applies to RAI No. 70 through 74, below. The regulation in 10 CFR 50.34(b) requires a final SAR that shall include information that describes the facility, presents the design

bases and the limits on its operation, and presents a safety analysis of the structures, systems, and components and of the facility as a whole.

70. NUREG-1537, Part 1, Chapter 13, "Accident Analyses," states that non-power reactors should analyze events that could affect their safe operation or shutdown including evolution of scenarios and evaluating the consequences of postulated events. For estimating occupational doses after the postulated maximum hypothetical accident (MHA) the PUR-1 SAR assumed that the facility personnel would evacuate from the reactor pool room within a 1-minute timeframe based on "past experience." In the response to RAI No. 96 (dated June 15, 2012), it was estimated, using analytical estimates, that the maximum amount of time required for a staff member to evacuate the reactor room is less than 15 seconds. Discuss whether there is an evacuation procedure, how the staff members and/or member of the public, if escorted in the reactor room, have training to follow the plan, and whether there is any evacuation exercises practiced periodically that would provide data for the evacuation time.
71. NUREG-1537, Part 1, Chapter 13, "Accident Analysis," provides guidance on analyzing credible postulated accidents. The postulated bounding MHA scenario assumes that fission products escape from one of the fuel plates and instantaneously disperse into the reactor room air. One of the potential consequences is a leak of reactor room air containing fission products around the reactor room door into unrestricted areas. Provide a discussion regarding the consequences of the leak around the reactor room door, list any assumptions for the MHA leakage, and provide dose calculations to the maximally exposed member of the public assuming inhalation and submersion of radioactive products in the leakage as well as the direct gamma-ray radiation shine from the radioactive products dispersed in the reactor room.
72. NUREG-1537, Part 1, Chapter 13, "Accident Analysis," provides guidance on analyzing credible postulated accidents including the potential radiation levels in unrestricted areas after the MHA. In the response to RAI No. 14 (dated July 19, 2016), an analysis was provided for the gamma-ray exposure and the consequent maximum dose rate to the member of the public in the unrestricted area above the reactor room. One of the assumptions used in the model is that members of the public would eventually evacuate. Discuss whether there is a general evacuation procedure, how that procedure is consistent with the facility emergency plan, how the members of the public are instructed to follow the plan, how it is insured that all members of the public actually evacuate the building, and whether there is any evacuation exercises practiced periodically.
73. NUREG-1537, Part 1, Chapter 13, "Accident Analysis," provides guidance on analyzing credible postulated accidents including the potential radiation levels in unrestricted areas after the MHA. In the response to RAI No. 14 (dated July 19, 2016) the PUR-1 MHA calculations provided the maximum dose to the member of the public at the maximally exposed location, 100 m away from the facility. Provide a dose calculation to an exposed member of the public located at the closest continuously occupied location such as a private residence, residence hall, and/or dormitory.

74. NUREG-1537, Part 1, Chapter 13, "Accident Analysis," provides guidance on analyzing credible postulated accidents including potential consequences of a loss-of-coolant event (LOCA). In the response to RAI No. 15 (dated July 19, 2016), an analysis was provided for a LOCA event resulting in a partial loss of coolant, with a reduced amount of coolant, but still leaving the reactor core submerged. In a hypothetical total loss-of-coolant, the reactor core is fully uncovered resulting in an unshielded gamma-ray exposure in the reactor room and floors above the reactor room. In the response to RAI No. 14 (dated July 24, 2015), an analysis was provided for a total LOCA including the maximum dose rates for the occupational staff and the member of the public located above the reactor room shielded only by the concrete floor. The analysis states that the potential dose rate to a member of the public would be 6.6 rem/hr and "...in such an event the building would be immediately evacuated such that the actual dose received by a member of the public would be significantly reduced." Provide the doses to members of the public assuming realistic evacuation times verified by past evacuation drills. Verify that these actions are consistent with your emergency plan.

75. The regulation in 10 CFR 50.36(c)(4) requires the inclusion of design features of those features of the facility such as materials of construction and geometric arrangements, which, if altered or modified, would have a significant effect on safety and are not covered elsewhere in the specifications.

The proposed TS 5.3, "Reactor Core and Fuel," Specification f describes the periodic inspection requirements for fuel assemblies. NUREG-1537, Part 1, Appendix 14.1, Section 4.1, "Reactor Core Parameters," item (6), provides guidance for fuel inspection. The anticipated gamma-ray exposure during the inspection of the fuel assemblies may increase due to the requested increase in licensed reactor power to 12 kWt. Provide a description of the protective measures and changes in the inspection procedures required to prevent exceeding the occupational dose limits in 10 CFR 20.1201 for staff performing the fuel inspections.

76. The regulation in 10 CFR 50.34(b) requires a final SAR that shall include information that describes the facility, presents the design bases and the limits on its operation, and presents a safety analysis of the structures, systems, and components and of the facility as a whole. The PUR-1 SAR, Chapter 4 (pages 4 through 44) describes two accident event scenarios, rapid and slow insertion of reactivity, which may be inconsistent with the analysis presented in Chapter 13, where the maximum reactivity insertion is $0.006 \Delta k/k$. The slow insertion scenario assumes that the rate is limited by a maximum allowable rate of $0.0004 \Delta k/(k*s)$. It is not clear, how this maximum rate limit is controlled, since the TSs have no limits on control rod reactivity insertion rate. In addition, it is also unclear, what the reactivity insertion rate is due to the control rod operating rates presented in Chapter 4 of the SAR (regulating rods - 17.7 in/min, shim rods - 4.4 in/min). Provide further information on how the maximum allowable reactivity insertion rates due to control rod movements are controlled and are consistent with the analysis. Propose a limiting condition for operation and associated surveillance requirement or justify why TSs are not necessary.

77. The regulation in 10 CFR 50.34(b) requires a final safety analysis report that shall include information that describes the facility, presents the design bases and the limits on its

operation, and presents a safety analysis of the structures, systems, and components and of the facility as a whole.

The PUR-1 SAR Chapter 4 indicates that the radiation monitors would trigger an alarm in the reactor room console, if the reactor water tank level decreases below a certain level due to an unexpected leakage. Provide additional information how reactor staff or university personnel would be alerted if the leak occurred when the reactor is shut down and no operational staff is present in the reactor room to observe the alarm, for example, on nights and weekends.

78. Subpart F of 10 CFR Part 20 provides the regulatory requirements for radiation surveys and monitoring.

The PUR-1 SAR states that routine radiation surveys are performed by health physics staff. It is not clear if the health physics personnel are considered PUR-1 reactor staff or Purdue University personnel. Provide a description of the organizational arrangement for the health physics staff.

79. The regulation in 10 CFR 50.36(c)(2) requires that limiting condition for operation of a nuclear reactor shall be established in TSs for each item meeting one or more of the criteria provided in 10 CFR 50.36(c)(2)(ii). Additionally, 10 CFR 50.34(b) requires a final SAR that shall include information that describes the facility, presents the design bases and the limits on its operation, and presents a safety analysis of the structures, systems, and components and of the facility as a whole.

The PUR-1 SAR Chapter 3.5, "Systems and Components," describes the emergency shutdown of the reactor via manual scram buttons, one located on the reactor console, another one outside the main personnel access door to the reactor room. The scram functions are also included in TS 3.2, Table I, "Safety Channels Required for Operation." Provide additional information on the design and operation of the manual scram button that is located outside the personnel access door, specifically: (a) is the location considered controlled or do members of the public have access to the button, (b) who controls the operation of the emergency button, (c) what are the design features preventing inadvertent actuation, (d) is there a procedure that controls the activation sequence?

80. The regulation in 10 CFR 50.34(b) requires a final SAR that shall include information that describes the facility, presents the design bases and the limits on its operation, and presents a safety analysis of the structures, systems, and components and of the facility as a whole.

The PUR-1 SAR, Chapter 5.5, describes the "Primary Coolant Makeup Water System," and its operation to maintain the reactor pool water level at 13 feet above the reactor core. Provide additional information on the operation of the makeup water system, specifically: (a) how is the filling process initiated, (b) does the magnetrol level switch in the pool turn the filling process on and/or off, (c) how is water loss trended, if the system operates automatically, (d) is there a chance for over pressurizing the water tank and consequently the university water supply line, (e) is the water level maintained, when operation staff is not

present (nights and week-ends), (f) and what is minimum water loss rate that can be detected?

81. The regulation in 10 CFR 50.36(c)(2) requires that limiting condition for operation of a nuclear reactor shall be established in TSs for each item meeting one or more of the criteria provided in 10 CFR 50.36(c)(2)(ii). Additionally, 10 CFR 50.34(b) requires a final SAR that shall include information that describes the facility, presents the design bases and the limits on its operation, and presents a safety analysis of the structures, systems, and components and of the facility as a whole.

NUREG-1537, Chapter 14, Section 3.2 "Reactor Control and Safety Systems," item (8) "Control Systems and Instrumentation Requirements for Operation (Added by the NRC)," includes criteria on the detail and operating characteristics of the measuring channels required for operation (not necessarily having scram capability). The guidance suggests to include all required measuring channels including protective functions in the TS. Add a table to TS 3.2 to include all measuring channels required for operation or justify why no changes are necessary.

82. The regulation in 10 CFR 50.36(c) states TSs will include Surveillances. The regulation in 10 CFR 50.36(c)(3) states "surveillance requirements 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 limiting conditions for operation will be met."

The guidance in ANSI/ANS-15.1-2007 includes criteria on Section 4, "Surveillance Requirements," which are companion requirements to Section 3, "Limiting Conditions for Operation," specifications demonstrating the minimum performance requirements established in Section 3. The proposed TS 3.3, "Primary Coolant Conditions," Specification d specifies that the primary coolant bulk temperature is maintained below 30 degrees Celsius. There is no companion Section 4 surveillance specification ensuring the minimum performance level for the bulk water temperature. Revise/add a surveillance specification of the maximum allowable bulk water temperature in proposed TS 4.3, "Primary Coolant System," to be consistent with the guidance in ANSI/ANS-15.1-2007, or justify why no change is necessary.

83. The regulation in 10 CFR 70.32 provides the regulatory requirements related to conditions of licenses for the possession of special nuclear material (SNM). The regulation in 10 CFR 70.32(b) states, in part, that the Commission may incorporate in any license such additional conditions and requirements with respect to the licensee's ownership, receipt, possession, use, and transfer of special nuclear material as it deems appropriate or necessary. However, the NRC staff review of the license renewal application does not find a possession limit for SNM.

Provide a propose limit for the possession of SNM for irradiation, including a mass (gram) limit and a description of the material form, as needed for operation of the reactor and its experimental programs.