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July 10, 2007

Mr. Alexander Adams
U. S. Nuclear Regulatory Commission
Research and Test Reactors Branch A
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Reference: Oregon State University TRIGA Reactor (OSTR)
Docket No. 50-243, License No. R-106
Questions from Site Visit on July 12, 2006

Subject: Answers to Site Visit Questions

Mr. Adams:

Representatives of the NRC and Brookhaven National Laboratory visited Oregon State University on July 12, 2006. This visit was in regards to the OSU license renewal application of October 5, 2004, as supplemented. Enclose are both the questions and our answers to the questions from the site visit.

If you have any questions, please call me at the number above. I declare under penalty of perjury that the foregoing is true and correct.

Executed on: 7/10/07.

Sincerely,

Steve Reese
Director

Enclosure

cc: Document Control, NRC
Al Adams, NRC
Craig Bassett, NRC
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Oregon State University

Responses to Site Visit Questions
From the NRC and BNL Visit of July 12, 2006.

Chapter 4: Reactor Description

4-1: *SAR Figure 4.1 shows the overall length of the fuel element assembly to be [redacted] inches while section 4.2.1 of the SAR specifies it to be [redacted] inches. Clarify the difference.*

The overall length of the fuel element is [redacted] inches if the lower alignment pin and the upper fuel handling pin are included in the measurement. If the pins are excluded, the overall length of the fuel element is [redacted] inches. Both measurements are valid depending upon what portions of the fuel element are being measured.

4-2: *LCO 3.1.5 states that the [redacted]-fueled region in a mixed core shall contain at least [redacted] fuel elements in a contiguous block of fuel in the central region of the reactor core. SAR Table 4-6 identifies six possible core loadings for mixed cores, [redacted] of which use less than [redacted] fuel elements. Please clarify this apparent discrepancy. Is there a preferred core?*

Cores #3-#6 in Table 4-6 were evaluated as part of the conversion to the [redacted] fuel and do not represent cores that were [redacted] in the OSTR. The current operational core is similar to [redacted] in Table 4-6.

4-4: *The SAR Section 13.2.3.2.2 states that daily inspections are performed to detect leakage. However, OSTR Surveillance Requirement 4.3 specifies only that the water temperature be checked daily, other inspections are performed less frequently (monthly, annually, etc). Please clarify what checks are performed daily. Why is the leak check not included as a surveillance requirement in the technical specifications?*

As a matter of practice, the water level is visually inspected twice a day during the startup and shutdown checklists. In addition, the water level in the reactor tank is continuously monitored by a level sensing system. Deviation of the tank level [redacted] above the nominal level will result in the actuation of a high level alarm in the control room. Deviation of the tank level [redacted] below the nominal level will result in the actuation of a low level alarm in the control room. If the low level alarm is received [redacted]

[redacted] investigate the alarm and take the appropriate corrective actions.

The proper operation of the reactor tank water level monitor is deemed a sufficient monitoring mechanism to detect the small chronic water loss that would be associated with the corrosion of the reactor tank postulated in Section 13.2.3.2.2. The frequency and quantity of make-up water added to the reactor tank are recorded in a log. Any changes in the frequency or quantity of water added to the reactor tank would be noticed by the reactor operations staff and further investigated.

4-5: *In the event of a total draining of the reactor tank ([redacted] reactor tank failure as discussed in SAR Section 13.2.3.1), what provisions would be taken to prevent the release of radioactive material to unrestricted areas, such as the groundwater?*

The current pump down level of the hold-up tank is 1800 gallons, yielding a combined capacity for the hold-up tank and drainage trench of 5950 gallons. The excess capacity of the hold-up tank and drainage trench (5950 – 1800 = 4150 gallons) is less than the volume of the reactor tank (4600 gallons). To address this, the pump down level of the hold-up tank should be changed to 1350 gallons. Doing so gives the radioactive waste hold-up tank combined with the drainage trench in the reactor bay sufficient capacity to contain all of the water in the reactor tank in the event of a catastrophic failure of the tank.

4-7: *In Table 4-5, should core #3 be labeled as core #2A?*

Yes, the core labeled as Core #3 in Table 4-5 is the core described in the text as Core #2A.

4-8: *Tables 4-11 and 4-12 show fuel powers in the rings, along with minimum and maximum powers in the core. SAR Section 13.2.2.2.2 states that the OSTR can operate with three different inserts in position A: an aluminum slug, an In-Core Irradiation Tube, and a Cadmium-Lined In-Core Irradiation Tube. What insert in position A is used for the calculations resulting in Tables 4-11 and 4-12? What effect will the other two inserts have on the power distributions?*

As a point of clarification, the only insert that is put into grid position A-1 (the central thimble) is an aluminum slug, which is present in all core configurations. The inserts mentioned in Section 13.2.2.2.2 go into grid position B-1 and consist of:

- A [redacted] fuel element for the normal core
- A cadmium-lined irradiation tube for the CLICIT core

- An irradiation tube for the ICIT core

The calculations presented in Tables 4-11 and 4-12 had the aluminum slug in grid position A-1 and a fuel element in grid position B-1. The OSTR does not operate with mixed cores. Core [redacted]s representative of the nominal OSTR core.

The presence of the various inserts in grid position B-1 does not significantly change the average or maximum fuel element powers.

4-11: *Section 4.2.2 discusses the worth of the different control rods and Technical Specification 3.1.2 dictates the shutdown margin provided by the control rods shall be greater than $0.55. How often is this determined and what is the life expectancy of the control rods? In the event of depletion, where are depleted control rods stored?*

The shutdown margin is determined at the start of every day's operation or at the start of every period of continuous operation (i.e. an operational period longer than the usual [redacted] operation of the reactor).

The projected lifetime of the control rods extends beyond the duration of the requested license. As such, we do not anticipate the need to replace or store any depleted control rods.

Chapter 7: Instrumentation and Control Systems

7-12: *Section 7.3.2 of the SAR does not describe operational conditions that must be satisfied in order to transfer control from manual to Automatic modes of operation. For example, in addition to other variables, automatic control typically may only be entered if the control rods are withdrawn beyond a certain point. Please describe the conditions required to ensure transfer to, and maintain, automatic control.*

There are no conditions required to transfer operation from steady-state (manual) to automatic. It is true that the regulating rod must be "off the bottom" (i.e., foot and down switches not actuated) for the servo to control its movement. However, this is just one of several unusual configurations that a reactor operator could place the reactor in. Regardless, the same measuring and safety channels are required for both modes.

7-14: *Section 7.2.3.1 states that a period signal in excess of a predetermined limit will initiate a scram. How is this set point determined? Does it vary?*

There is no safety significance to the period scram signal. The only function it serves is to prevent the operator from increasing power with a reactor period that is too small to effectively "roll" power over as they are approaching full power. This scenario may result in a high reactor power scram. However, the reactor was designed for pulsing which definitely bounds any high power scram scenario. The set point does not vary.

7-17: *Section 7.6.3 describes the annunciate panel but does not identify the specific alarms displayed on the panel. As described in Section 7.6 of NUREG 1537, Part 2, annunciator or alarms on the control console should clearly show the status of systems. Please provide a list of annunciator alarms available at the control console.*

The following should be added to Section 7.6.3 of the SAR: "The annunciator panel displays the alarm status of various instrumentation found in the facility. It is located above the console. The display for the annuciator panel is [redacted] the display for the instrumentation on the console itself such that the reactor operator [redacted] from the console. An example of what is typically displayed on the annunciator panel can be found in Figure 7.6."

7-23: *In general, this chapter should provide a more detailed description of the control and monitoring features provided at the reactor console for experimental facilities. Are the "open" and "closed" positions of the experimental facility beam tube shutter assembly indicated and/or controlled from the reactor console? Is the rabbit system controlled from the reactor console, locally or both?*

The following section should be added to the SAR: "Section 7.6.4 Irradiation Facility Indication and control of irradiation facility status is available on the console for the pneumatic system and the beam ports. For the pneumatic system, a switch on the console turns the fan blower on and off. In the event that the operator suspects a malfunction or loss of control of the system or samples, the reactor operator [redacted] This will prevent a sample from being inserted into the reactor or prevent the return of a sample to the receiving station if the sample has already at the terminus assembly. A detailed description of the pneumatic system can be found in section 10.2.4. A diagram of this control capability can be found in Figure 10.1. Each of the four beam ports may internally contain a wooden plug equipped with an electrical circuit consisting of a position switch mounted on the inner face of the plug and an electrical connector on the outer face of the plug. The switch can be actuated only by the inner concrete plug when it is installed in the beam port. This switch is connected to the control room annunciator such that the reactor operator will have indication when the plugs have not been properly installed. Annunciation of status for other irradiation facilities or reactor experiments are done on an case-by-case basis.

Chapter 8: Electric Power

8-1: *Chapter 13 states that emergency power is necessary to monitor an orderly shutdown of the reactor, but review of the TSs showed no requirement for verifying operability or performing surveillance testing. Please clarify why there are no requirements placed on the OSTR emergency electrical power system.*

The emergency electrical power system is not necessary to safely shutdown the reactor. The last paragraph of Section 13.2.7.2 should be deleted to make it consistent with Chapter 8 and true to the intent.

Chapter 9: Auxiliary Systems

9-2: *SAR Section 9.2.1 generally discusses the in-tank storage racks. Please provide a brief description of the storage racks including the use of any poison material and design details to ensure adequate natural circulation through the racks to ensure the stored fuel elements will not exceed design values.*

The storage racks do not contain any poison materials. [redacted] Each rack has a upper "grid plate" and a lower "grid plate" that the fuel slides through. Once in the grid plates, the fuel rests on a plate that contains no penetrations. Per the reference cited in that section, the racks were designed to maintain a multiplication constant below 0.8 and provide for adequate convective cooling to maintain any stored fuel elements below the design criteria for the fuel.

9-3: *SAR Section 9.2 discussed the handling and storage of fresh unirradiated fuel elements. Are any new, unirradiated fuel elements stored dry before placement in to the core or in-stank storage racks? If so, is criticality monitoring provided?*

The numbers and location of fuel storage should be withheld from public disclosure and will not be addressed here.

9-4: *SAR Section 9.2 discusses handling and storage of fresh unirradiatied fuel elements. Are any inspections performed on new, unirradiatied fuel elements upon arrival at the OSTR to ensure compliance with procurement specification and to ensure no damage was incurred during shipping and handling?*

A procedure for handling fresh fuel was developed but not implemented. Because of the unique characteristics of [redacted] fuel, no new fuel is anticipated for the lifetime of the license.

9-5: *Section 9.3 of the SAR states there is a fire detection system and fire extinguishers in the OSTR. There is no mention of* [redacted] *Does the OSTR have fire protection systems* [redacted]*? Are the doors to the reactor bay fire rated? Is there a floor drain system in the OSTR reactor bay to collect fire fighting water to prevent flooding, and if so, to where or what does the floor drain system drain to* [redacted]

There are [redacted] fire hydrants located next to the site boundary to the southeast and west. The doors to the reactor bay [redacted] The floor in the reactor bay is slightly sloped such that it drains to the trench. The trench drains to the holdup tank where it can be sampled and discharged to the sanitary sewer if appropriate.

9-6: *In Section 9.3 of the SAR, there is no mention of who provides fire protection service for the OSTR. Does OSU have a 24/7 fire protection service or is it an offsite service, and do the fire department personnel receive training in radiological hazards and OSTR specific familiarization training?*

Fire alarms at the OSTR transmit to the OSU Department of Public Safety dispatch center which is occupied 24/7/365. They in turn call Corvallis Fire Department to respond to the alarm. Corvallis Fire Department receives specific OSTR annual training, as required by the Emergency Response Plan.

9-7: *In Section 9.1.2 of the SAR, it states that the ventilation system provides 4.4E6 $cm^3\ s^{-1}$. to the reactor bay. Later on at the bottom of that paragraph, it states that air is discharged at approximately 1.97E3 $cm\ s^{-1}$ from the reactor bay. Is this discharge rate correct, since the SAR also state that the reactor bay is kept at a negative pressure in relation to the rest of the facility? Please clarify.*

The value of 1.97E3 $cm\ s^{-1}$ is a velocity. It was intended to show that the exit velocity of the air carries to higher elevations.

Chapter 11: Radiation Protection and Radioactive Waste Management

11-1: *Section 11.1.5.5 of the SAR states that all occupational doses are within 10 CFR 20 limits. Table 11-5 specifies typical radiation levels are various locations in the OSTR. Since the holdup tank is a potential radiation source, and is not specified in this table, please provide the typical contact dose rate from the holdup tank.*

The typical contact dose rate from the holdup tank is zero (i.e., background readings).

Chapter 12: Conduct of Operations

12-1: *Neither the SAR nor TSs state which version of the ANSI/ANS Standard 15.4 is followed. The version recommended in the NRC SRP is 1988. Does OSU meet that version of the standard?*

The OSTR follows the applicable recommendations of ANSI/ANS Standard 15.4 – 1988.

12-2: *Neither the SAR or TS fully address three of the 10 CFR 50.54 requirements, as explained below. How are these addressed at the OSTR?*

10 CFR 50.54 Conditions of licenses

"(k) An operator or senior operator licensed pursuant to part 55 of this chapter shall be present at the controls at all times during the operation of the facility." (OSTR TSs only require an operator in the control room, not at the controls – are they the same at the OSTR, or are there portions of the control room, such as a kitchen, that are not accessible to the controls?)

"(m)(1) A senior operator licensed pursuant to part 55 of this chapter shall be present at the facility or readily available on call at all times during its operation, and shall be present at the facility during..., recovery from an unplanned or unscheduled significant reduction in power..." The OSTR TS require the SRO to "direct" the 50.54(m)(1) activities but do not state that the SRO be present at the facility." Is the intent that the SRO be present to accomplish the direction? Also, the TSs include all 50.54(m)(1) activities except for recovery from an unplanned or unscheduled significant reduction in power. Why was this one item deleted? Please justify or add to TSs.

None of the requirements of 10 CFR 50.55 are found in the TSs. It would be redundant. However, because the controls are accessible from all portions of the control room, an operator in the control room does meet the implied definition of 10 CFR 50.54(k).

Again, regulatory requirements should not be included in the TSs. All requirements of 10 CFR 50.54(m) are found in our operating procedures.

The portion of 50.54(m)(1) that discusses "..., recovery from an unplanned or unscheduled significant reduction in power ..." is not deemed to be applicable to the OSTR as the OSTR reactor protective system does not have a "cutback" or "rundown" feature that would produce an unplanned or unscheduled significant reduction in power.

12-5: *Several of the specifics of ANS 15.1 and The SRP for the ROC are not addressed in the SAR, but appear to be in the charter. Please provide a copy of the written charter for the ROC described in TS 6.2.2.*

This has been provided.

12-6: *Neither the SAR nor the TS specify that the ROC will review violations of TS surveillance requirements or violation of internal procedures having safety significance, as noted in ANS 15.1. Please clarify.*

Technical Specification Section 6.2.3 should be revised to include ROC review of violations of TS Surveillance Requirement as well as violations of internal OSTR procedures that have safety significance.

12-8: *The SAR is not clear on who has approval authority for procedures. SAR Section 12.3 states that the Reactor Administrator approves procedures and SAR Section 12.2.3 states that the ROC reviews and approves procedures. There is also a discussion of approval of changes to procedures in TS 6.4 that should be made consistent with the SAR. Either approach is acceptable, but it should be clear where the approval authority resides.*

The second sentence in Section 12.3 should be changed to say, "Unsubstantive changes to existing procedures may be made with the approval of the Reactor Administrator. New procedures or substantive changes to existing procedures shall be approved by the ROC."

12-9: *The SAR and TS list those areas requiring approved written procedures. Two areas specified for procedures by the SRP and ANS 15.1, but not in the SAR or TS are: surveillance requirements of the TSs and implementation of the security plan. Please address.*

SAR Section 12.3.1 should be amended to include "Technical Specification Surveillance Requirements."

Physical security plan procedures should not be address or discussed in the SAR or TSs. It is a separate license document.

Chapter 13: Accident Analysis

13-1: *Section 13.2.1.2 provides the conservative analysis for a fuel failure in air. Is there a technical specification or a standard operating procedure dictating how long a fuel element should be allowed to decay prior to removal from the pool?*

There is no technical specification or procedure dictating how long a fuel element should be allowed to decay prior to removal from the pool. Because of the unique nature of [redacted] fuel, no [redacted] fuel elements have been removed from the pool since the initial core loading in 1976. Additionally, the analysis in Section 13.2.1.2 shows that all doses as a result of a single element failure in air are below the annual applicable limits in 10 CFR 20.

13-2: *SAR Section 13.2.1 discusses the maximum hypothetical accident for the OSTR and Section 13.2.1.2 discusses the consequences associated with this accident. Occupational doses are provided based on a five minute evacuation. Is a five minute evacuation reasonable? Does this include time operator would spend checking out the system to assure it is not a false alarm and that the reactor is shut down?*

Five minutes is a reasonable amount time to perform an evacuation including the time it takes to check out the system to assure it is not a false alarm.

13-4: *SAR Section 13.2.5 discusses the mishandling or malfunction of fuel, and the consequences from such an accident. Occupational doses are provided based on a five minute evacuation. Is five minute evacuation reasonable? Does this include time operators would spend checking out the system to assure it is not a false alarm and that the reactor is shutdown?*

Five minutes is a reasonable amount time to perform an evacuation including the time it takes to check out the system to assure it is not a false alarm.

13-5: *Why does it state on page 35 of the SAR that the reactivity worth of all experiments is limited to $3.00, but technical specification 3.8.1 states the limit is $2.55.*

This is an error. Technical specification 3.8.1.c should state $3.00.

Chapter 16: Other License Considerations

16-2: *The licensee did not specifically discuss any medical uses for the OSTR in the SAR. As discussed in the SRP Chapter 16.2, relevant information on medical use (if any) should be presented and evaluated during license renewal. Please discuss any medical uses planned for the OSTR.*

At this time, there are no current or planned medical uses of the OSTR. SAR Chapter 16.2 should be changed to include this information.