11/15/07 from BNL

University of Missouri - Selected Site Visit Questions

The following questions were selected from the complete list of RAIs. These questions were selected because they appear to require a minimum level of effort to address and do not require a detailed written response.

CHAPTER 1 THE FACILITY

None.

CHAPTER 2 CHARACTERISTICS

2-1: Does the Burlington Northern Railway transport any freight (e.g., hazardous materials or explosives) which if involved in an accident, would present a risk to the UMRR which is not bounded by the analysis contained in Chapter 13 of the SAR? **The closest approach of the track is 0.25 miles away from the UMRR to the east of the campus. The prevailing winds are from either the west or southwest towards the northeast or east. The licensee has a call into BNR to ascertain if any hazardous material is transported on that rail line and at what frequency.**

2-2: The licensee states that most planes fly over in the 'commercial zone'. What is the commercial zone, and how is it related to UMRR? Are the runways for this airport situated such that planes taking off or landing fly over the UMRR? **No; planes takeoff or land over UMRR. The nearest airport is 15 miles north of the campus and only handles small planes.**

2- 5: The licensee has reported on detailed wind observation studies from the Vichy Station for the 1948-1954 time period. Why was this period selected, and what is the bases for the acceptability of this data, which is over 50 years old, for the period of extended operations? Is there more recent data which can verify the acceptability of the

conclusions obtained from the analysis of this data? **TBD - It was suggested by the licensee to call up the area on the Internet and obtain what is needed from there. Licensee could not understand why this data was needed, since nothing has changed in the area surrounding the campus.**

CHAPTER 3 DESIGN OF STRUCTURES, SYSTEMS AND COMPONENTS

3-1: Please provide copies of any administrative procedures that are used in the event of a weather-related emergency warning from the local disaster emergency planning organization. **See SOP 508 and 510.**

CHAPTER 4 REACTOR DESCRIPTION

(Questions in sections 4.1 - 4.4 are numbered 4A and Questions 4.5 and 4.6 are number 4B)

4A-2: The licensee has not discussed any periodic fuel inspections. Are any inspections performed on the fuel assemblies to detect degradation? **The outside of the fuel elements are visually inspected whenever the fuel elements are moved. The control rods are inspected for bowing, cracking, and bulging on a periodic basis. See applicable SOP.**

4A-3: In SAR Section 4.2.4, the licensee briefly discusses the neutron start-up source. Please provide additional information on the design and materials for the source holder, handling of the source in the reactor, and any special storage considerations associated with the source when not located in the reactor core. **Will the currently used source continue to be used for the extended period of operation? The PuBe startup source is incased in stainless steel. It hangs from a wire tied to the reactor bridge when it is not in use approximately 3 feet from the reactor core in the pool. There is no holder and it is never placed in the storage area. It is inspected for degradation twice a year and is expected to be used for the entire period of extended operation.**

4A-4: Have any inspections been performed on the reactor bridge structure and tower assembly to verify no age-related degradation? **These structures are visually inspected twice just before the reactor is placed online, every time. While at the site I did not observe any rust, or material degradation of these structures.**

4A-5: Has the reactor pool ever been drained for inspection of the walls and signs of degradation of the vinyl paint? If so, what were the results? Are the exterior walls inspected periodically for signs of degradation, cracks, or leaks? **The pool has never been drained since the reactor was placed in service, since only one side of the pools four outer wall is exposed. The five coats of epoxy paint appear to be holding up well. I only observed very minor pitting (less than ten locations) on the whole inside of the pool. Any leaks would be picked up by increased makeup**

demand and pool level (normal makeup is about one inch of makeup water per week for evaporation). Anything greater than that need triggers an investigation to locate what is causing the extra loss. Additionally, any crack in the concrete pool walls below the water line would produce bubbles at the crack location that would be readily observable.

4A-6: In the event of a reactor pool leak, what provisions are in place to prevent the water from getting into unrestricted areas, including the groundwater? **Three of the four pool walls are exposed directly to the outside earth. The licensee relies on any leak being quickly identified and repaired and the very low radioactivity in the pool water itself. Pool level change is monitored in the control room when the building is occupied and during off hours by the 24/7 campus security. See the SOP covering this situation.**

4A-7: The SAR Section 4.4 states that radiation levels in the vicinity of the closed beam port face and the periphery of the thermal column were measured to be 5 mrem/hr and 8 mrem/hr, respectively. What is the radiological designation of these areas, and what precautions are taken to minimize personnel exposure in these two areas? **There are two cameras that visually show the lower experimental area in the control room and there is also a locked gate to the area that would preclude access. When the reactor is off this area is designated a radiation area. When the reactor is on and the port is open, it is designated a high radiation area (but less than 1 Rad/hr).**

4B-1: Over the past decade, what has been the average number of hours per year that the reactor has operated and what has been the maximum number of hours of continuous operation? **Over the decade approximately 800 to 850 hrs/yr. And 7 hours maximum per day.**

4B-2: Please explain why Figure 4-3 shows the positions as being in a 6 x 8 array only? **This figure depicts a generic grid plate to provide a reference for fuel element positions. The figure will be retitled "generic grid plate".**

4B-3: What is considered to be the standard or most used core configuration? **The 101W configuration has been used since 1992.**

4B-4: What are the different configurations that have been used or plan to be used? **All other temporary configurations of the core use the same positions as 101W, only the fuel assemblies are interchanged.**

4B-8: What is considered the limiting core configuration and what is the associated power density? **Fuel elements are designed to preclude excess reactivity in each element and are designed for cooling by natural convection.**

4B-9: Please provide the correct void coefficient. **What is used in the SAR is correct. Section 4.5.2.2 will be changed to correct the number stated.**

4B-10: What is the correct void coefficient value for the present LEU fuel? **See Table 4.1 on page 4-2 of the SAR (void periphery).**

4B-12: Please explain why the delayed neutron fraction is denoted as k_{eff} instead of β? **On page 4-15, Section 4.5.2.4 k_{eff} should be β and will be corrected.**

4B-15: What types of experiments are typically done at the UMRR? **Mainly foil activations and reactor theory experiments - such as shutdown margin and control rod worth determination. No human or animal subject irradiations are performed.**

CHAPTER 5 REACTOR COOLANT SYSTEMS

5-2: Is the discharge piping connection for the cleanup system at the same elevation as the suction pipe in the reactor pool or at least above the top of core elevation? If not, please specify location in relation to the top of core elevation. **Yes, at approximately 16 feet above TAF. The piping is 1.5" in diameter.**

5-4: Please state what the water source is for the diffuser pumps. If it is the reactor pool, please specify the elevation of the connection in relation to the top of the core. **The reactor pool, the suction is foot below the pool water surface and all piping and pumps are located within the confine of the pool perimeter, so all leakage would be into pool.**

CHAPTER 6 ENGINEERED SAFETY FEATURES

None.

CHAPTER 7 INSTRUMENTATION AND CONTROL SYSTEMS

7-14: Does the CAM system provide only a local alarm (at the detector) or will an alarm also occur at the console? If there is only a local alarm, can it be seen / heard at the console? **The CAMs alarm locally and in the control room.**

7-15: Will actuation of the CAM alarm cause the ventilation system to isolate? **No**

7-16: The diffuser pumps are needed to decrease the level of airborne N-16. Is their operation monitored / controlled from the control console? Please describe. **Yes, and**

operational status is monitored on hourly logs when reactor is online. Also, RAM on the reactor bridge would indicate higher radiation readings if diffuser malfunctioned.

7-17: Technical Specifications require that a ventilation fan with a rated capacity of at least 127 m3/min (4,500 cfm) be turned on within 10 minutes of reaching full power operations. Is there an alarm at the console to alert operators if the fan does not start within the prescribed time or if fan failure occurs after a successful start? **No annunciators or alarms. Status of fan (on/off light) is located on the switch that is located just outside control room on the reactor building wall. Building is small enough that fan operating would be heard and the air flow felt.**

7-18: 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 rabbit system is indicated and controlled from the reactor console, there is no local control.**

7-19: Will an "IN" signal from either the individual or gang rod position control switches override an "OUT" signal? **Yes, but it involves the manual operation of the shutdown/run switch (like a mode switch). This switch provides the override capability, and this capability is verified during every startup by procedure.**

7-20: In its description of the trip function provided for the log & linear channel, Table 7-1 uses the phrase "not operate mode." Please clarify this phrase. Specifically, it is not clear if the "not operate mode" is a function of a mode switch or is intended to mean that a channel is not operable due to a loss of power, input signal, or other failure. **Normal function is to test loss of channel. However, if reactor is at power and the switch is in not operate position, it will scram reactor.**

CHAPTER 8 ELECTRICAL POWER SYSTEM

8-1: Please provide a simplified one-line diagram of the electrical distribution system for review and incorporation into SER. **A diagram will be faxed to BNL.**

8-2: While a loss of normal AC power would not affect the ability to achieve and maintain safe shutdown conditions in the reactor, it is not clear if AC power is needed for other important services, such as performing the necessary emergency notifications, ensuring the safety of experiments, or providing power to any required radiation monitoring equipment. Please clarify. **RAMs are powered from a UPS (good for approximately 20 minutes). There are also about six hand held/battery powered radiation meters that can be used to monitor radiation during loss**

of electrical power to the facility. These meters are calibrated on a yearly basis.

CHAPTER 9 AUXILIARY FACILITIES

9-2: SAR Section 9.2 briefly discusses the use of manually operated fuel handling tools. Please describe the design and operation of these tools, which precludes damaging the fuel during handling. When not in use, where are the tools stored? Are there any special precautions taken at the UMRR to ensure that only authorized persons handle fuel in the core? **There are passive safety devices on the tools to preclude damage to the fuel elements and the tools are stored along wall of reactor pool. All fuel movements are under the direct supervision of SRO (see SOP-207.B.1). Note: NRC stated during this trip that new security requirements for research reactors preclude describing how fuel movements are performed in public documents. Therefore, we should be careful not to describe any fuel handling operations in our SERs.**

9-3: The SAR provides no discussion of new fuel inspection. In the event of new fuel being shipped to the UMRR, what inspections will be done to ensure that the new fuel meets all applicable procurement specifications and that all SNM is accounted for? **There is no anticipated need to have new fuel delivered to the UMRR. Existing fuel (LEU) should last (its good for 500 years) past reactor operational lifetime. For surveillance of SNM, see SOP 311.**

9-4: The SAR does not discuss storage of spent control rods at the UMRR. Please discuss how they are stored, or will be stored, at the facility. **They would be placed in the storage pit in any storage rack position because the design eliminates any k_{eff} concerns. None are stored there now, and the rods are expected to last as long as the fuel (500 years).**

9-5: Since there is no drain system within the reactor building, how would the fire suppression water be contained within the reactor building to prevent the suppression water from potentially carrying contamination to the environment? **There is one floor drain that goes to the sewer and two potentially contaminated drains that discharge to a 100 gallon holding tank in the basement of the reactor building. One of these drains is located in the demineralizer pit and the other in the floor next on the east side of the pool. There is no sprinkler system in the building and the building contains limited combustibles. Sensors for both pool level and level in a drain collection tank are monitored by campus security 24/7 when the UMRR is unoccupied. The alarm level for the pool level is + or - one foot, and the 100 gallon collection tank alarms at approximately 25% of its capacity. It is felt this provides a reasonable time**

frame to determine and fix the problem.

9-6: Do the Rolla fire department personnel receive training in radiological hazards and UMRR Reactor specific familiarization training? **Yes, once per year.**

9-7: Who maintains the fire detection system, and how often is the fire detection system tested to verify operability and who performs the periodic testing? **This system is maintained and tested for operability twice per year by the UMRR.**

9-8: Please specify which telephones in the reactor building are capable of dialing directly offsite. Additionally, is the building evacuation alarm separate or part of the intercom system? Please describe. **All phones in the UMRR can dial offsite, but through the campus centrex. UMRR manager to determine if campus centrex has UPS. The separate building evacuation alarm is activated either by a high radiation alarm from the reactor bridge RAM or manually from the control room.**

9-9: How is emergency information communicated to people within the reactor building? Does the two way intercom also serve as the emergency PA system? **The PA system from the UMRR control room and the reactor building front administrative office is the primary means of communications. There is also an intercom system that could be used as a backup capability that services eleven locations within the reactor building.**

9-10: Are the SNM storage areas in the reactor building inventoried periodically? If so, who performs them? **Check sources are kept under lock& key. SMN storage areas are inventoried annually by the HP staff.**

CHAPTER 10 EXPERIMENTAL FACILITIES

10-1: Is there a written operating procedure stating that the Senior Reactor Operator controls loading, unloading or movement of experiments affecting the reactivity of the core? It is not a technical specification requirement (see Question 13 in Chapter 12). **See SOP 702 and 710.**

CHAPTER 11 RAD. PROTECTION PROGRAM AND WASTE MANAGEMENT

11-1: Are unanticipated or unusual reactor related exposures investigated to develop methods to prevent reoccurrence? If so, are they investigated by the Radiation Safety Office or another organization? **None have occurred since the reactor has been licensed and there is no procedure stating such. However, if one were to occur, the**

RSO would be involved in the process.

11-2: Is a radiation survey performed by procedure in the reactor bay prior to every startup of the reactor? Also, is any airborne particulate monitoring performed routinely in the reactor bay or experimental areas? **Prior to every startup, RAM readings and one CAM at the mid plane level of the reactor building are used to determine abnormal radiation conditions in the building. There are no long-term experiments performed at the UMRR.**

CHAPTER 12 CONDUCT OF OPERATIONS

12-1: Is the RSO able to suspend facility operations, when necessary? SAR section 11.2.2 states that waste management activities at UMRR follow ANSI/ANS 15.11. ANS 15.1, Section 6.3, specifies that the full radiation protection program should follow the guidelines of ANS15.11-1987. Is that the case at UMRR? **The RSO can suspend facility operations when necessary. Remainder of question to be answered in writing by UMRR subsequently.**

12-6: ANS 15.1 specifies that a list of reactor personnel with phone numbers shall be readily available in the control room for use by the operator. This is not included in the SAR. Is such a list available and maintained at UMRR? **Required by SOP. See SOP-501**

12-7: The SRP and ANS 15.1 specify certain rules for the RSC, which are not addressed in the SAR or TSs. These may be in the RSC charter which was not submitted to NRC. Please discuss if and how these items are addressed: review and approval of RSC minutes, dissemination of minutes in a timely manner (no longer than 3 months from meetings), appointment of qualified RSC member(s) not on the staff of the University, and a written report of the findings and recommendations of the committee submitted to Level 1 and RSC members in a timely manner after the review is complete. **Question to be answered in writing by UMRR subsequently.**

12-8: ANS Standard 15.1 lists the items that should be reviewed by the RSC. The following Items from the ANS Standard, Section 6.2.3 were not included in the SAR or TSs as part of the review responsibility of the RSC:

All new procedures.
Review of violations of surveillance requirements of TSs or violations of internal procedures or instructions having safety significance.
Review of Audit reports.

Additionally, the responsibilities of the RSC and Director of the Reactor Facility for procedures is not completely clear. The section on RSC responsibilities does not list the either review or the approval of new procedures or procedure changes. However, the

section on procedures notes that the RSC must review and approve substantive changes to procedures. Please clarify who has the review and the approval responsibility for procedures and procedure changes. **Question to be answered in writing by UMRR subsequently.**

12-10: ANS Standard 15.1 specifies that deficiencies uncovered by an audit that affects reactor safety shall be immediately reported to level I management. Also, a written report of audit findings shall be submitted to level I management and the review/audit group members within 3 months of completing the audit. How are these addressed? **Question to be answered in writing by UMRR subsequently.**

12-11: ANS Standard 15.1 lists the activities to be addressed by procedures. One area not addressed in the SAR or TSs is Administrative controls for operations, maintenance and the conduct of irradiations. Are there procedures for these activities at UMRR? **Yes, see SOPs for details**.

12-12: The NRC SRP notes that the procedure development process should include reviews by staff from reactor operations, radiation protection, and reactor administration. Is this the case at UMRR? **See SOP 100 for details.**

CHAPTER 13 ACCIDENT ANALYSIS

13-2: What is the material for the thermal column and beam pipe and could there be a rupture of the thermal column or beam tube that could cause a rapid drain of the pool? **Tubes are made of Aluminum. Outer surface of tubes within the reactor pool are visually inspected prior to startup. Licensee is considering modifying SOP 102 to ensure wording specifically states all beam tube surfaces within the pool, not just in the core.**

13-4: What would the consequences be if cladding were to fail during operation at full power? **Pool radioactivity would go up and be picked up by reactor bridge RAM. Any subsequent airborne activity would be picked up on the CAM, in the unlikely event that any was emitted from the pool.**

13-5: What computer code was used for accident analysis calculations? **See Reference 13-12 (Jim Higgins and Rich Deem have copy).**

1/31/06

Remainder of the Rolla site visit questions

2- 5: The licensee has reported on detailed wind observation studies from the Vichy Station for the 1948-1954 time period. Why was this period selected, and what is the bases for the acceptability of this data, which is over 50 years old, for the period of extended operations? Is there more recent data which can verify the acceptability of the conclusions obtained from the analysis of this data?

The 1948 – 1954 time period is data collected nearest to Rolla. I am still trying to obtain recent wind directions that would be similar to table 2.9 and will let you know what I obtain.

I am sending two tables of recent wind data. The first is 2000 – 2005 average monthly wind speeds and direction. The second table consists of monthly highest wind speed speeds for 2000 - 2005. This data was obtained from a Mr. John Senne, who collects and sends weather data to the National Weather Service in Springfield Missouri. Mr. Senne collects the data at his home, which is about five miles northwest of Rolla and nine miles southwest of the Vichy Station.

Rolla, Missouri - Monthly Average Wind Speeds (mph) and Dominant Direction (wind is from this direction)

	2000		2001		2002		2003		2004		2005	
January	2.2	S	2.0	SW	2.6	SW	2.7	SW	2.4	NNE	1.5	S
February	3.0	S	2.2	S	3.0	S	2.3	N	2.5	N	1.2	SW
March	2.0	S	1.4	N	2.9	S	2.8	S	3.1	S	1.3	N
April	2.2	S	2.8	S	2.8	S	3.1	S	2.3	S	1.2	S
May	1.1	SW	0.7	SW	1.2	SW	1.0	SSW	0.8	SW	0.2	SW
June	0.8	SW	0.6	SW	0.6	SW	0.6	SW	0.3	SW	0.2	SW
July	0.5	SW	0.5	SW	0.6	SW	0.8	SW	0.3	SW	0.1	SW
August	0.6	SW	0.5	SW	0.8	SSW	0.7	ENE	0.3	SW	0.1	ENE
September	0.6	SW	0.5	E	0.8	ENE	0.7	SW	0.2	ENE	0.1	ENE
October	0.8	SW	0.4	SW	0.8	ENE	1.2	SW	0.7	SW	0.1	SSW
November	1.5	SW	0.0	NE	2.1	SW	2.5	S	1.2	S	1.4	SW
December	1.5	NW	2.2	S	2.9	SSW	2.5	SE	1.8	S	1.0	SW
Average	**1.4**	**NW**	**1.1**	**SW**	**1.8**	**SW**	**1.7**	**SW**	**1.3**	**SW**	**0.7**	**SW**

Rolla, Missouri - Monthly High Wind Speeds (mph)

	2000	2001	2002	2003	2004	2005
January	29.0	25.0	20.2	22.0	26.0	22.0
February	23.0	36.0	23.0	21.0	30.0	26.0
March	36.0	31.0	26.0	28.0	28.0	32.0
April	35.0	35.0	22.0	29.0	23.0	21.0
May	15.0	18.0	33.0	21.0	14.0	16.0
June	22.0	15.0	14.0	20.0	12.0	17.0
July	16.0	14.0	19.0	18.0	18.0	12.0
August	14.0	13.0	13.0	18.0	11.0	14.0
September	14.0	15.0	13.0	15.0	12.0	18.0
October	16.0	25.0	17.0	15.0	21.0	11.0
November	18.0	8.0	20.0	21.0	20.0	28.0
December	21.0	28.0	28.0	22.0	21.0	18.0

4B-4: What are the different configurations that have been used or plan to be used?

UMRR has been using the 101 core configuration since 1992. It is used primarily in the W (water) mode and a few times a year in the T (thermal) mode. A few temporary core configurations have been used for a few days at low powers.

12-1: Is the RSO able to suspend facility operations, when necessary? SAR section 11.2.2 states that waste management activities at UMRR follow ANSI/ANS 15.11. ANS 15.1, Section 6.3, specifies that the full radiation protection program should follow the guidelines of ANS15.11-1987. Is that the case at UMRR?

The RSO can suspend facility operations. UMRR does follow the guidelines of ANS15.11-1993. The ANS15.11-1987 version could not be obtained by UMRR.

12-7: The SRP and ANS 15.1 specify certain rules for the RSC, which are not addressed in the SAR or TSs. These may be in the RSC charter which was not submitted to NRC. Please discuss if and how these items are addressed: review and approval of RSC minutes, dissemination of minutes in a timely manner (no longer than 3 months from meetings), appointment of qualified RSC member(s) not on the staff of the University, and a written report of the findings and recommendations of the committee submitted to Level 1 and RSC members in a timely manner after the review is complete.

RSC minutes are sent to RSC members prior to the following meeting, which are approved at the beginning of the meeting.

All RSC members are either active staff or faculty members of the UMR campus and appointed by the Vice Chancellor of Administrative Services.

A written report of the findings and recommendations of the committee is submitted to RSC members in a timely manner after the review is complete. The Reactor Director, level 2, is a member of the RSC and receives reports. The Reactor Director reports to the Dean of the School of Materials, Energy, and Earth Resources (SoMEER), Level 1, if an issue of significance exists.

12-8: ANS Standard 15.1 lists the items that should be reviewed by the RSC. The following Items from the ANS Standard, Section 6.2.3 were not included in the SAR or TSs as part of the review responsibility of the RSC:

All new procedures.
Review of violations of surveillance requirements of TSs or violations of internal procedures or instructions having safety significance.
Review of Audit reports.

Additionally, the responsibilities of the RSC and Director of the Reactor Facility for procedures is not completely clear. The section on RSC responsibilities does not list the either review or the approval of new procedures or procedure changes. However, the section on procedures notes that the RSC must review and approve substantive changes to procedures. Please clarify who has the review and the approval responsibility for procedures and procedure changes.

The RSC does not approve all new procedures, only substantive changes to existing procedures.

The RSC would review violations of surveillance requirements of TSs or violations of internal procedures or instructions having safety significance as they are reported to the RSC during quarterly meetings.

The RSC reviews audit reports, which consist of biennial NRC inspections, annual independent audits, and annual audits performed by the RSC.

The Reactor Director reviews and approves procedure changes, which are the Standard Operating Procedures (SOPs). The Reactor Director, with support of the UMRR staff, determines if a procedure is substantive in change to existing procedures. If a new procedure is found to be substantive in change, the Reactor Director submits the procedure to the RSC for review and approval.

12-10: ANS Standard 15.1 specifies that deficiencies uncovered by an audit that affects reactor safety shall be immediately reported to level I management. Also, a written report of audit findings shall be submitted to level I management and the

review/audit group members within 3 months of completing the audit. How are these addressed?

Level 1 management is immediately notified regarding deficiencies uncovered by an audit that affects reactor safety.

A written report of audit findings is submitted to the Reactor Director, level 2. The RSC receives a verbal report of audit findings during the RSC meeting following an audit.

13-5: What computer code was used for accident analysis calculations?

The computer code used was PARET.

The written responses to the below RAIs are based on verbal responses from the licensee and observations of the facility during the site visit on 1/26/06. A copy of all the UMRR SOPs was also obtained, copy in Jim Higgins office and another copy with Rich Deem. Answers to some of the RAIs can be found in these SOPs. The licensee will also be sending digital pictures of the facility and formal written responses to all RAIs, including those below. They will be placed on the H-drive in the UMRR folder when they are received.

It is suggested that each reviewer look at ALL responses, since some of the information in the answer may pertain to your section. Case in point, I was concerned about the drains for chapter 9, and found out that both pool level and level in a drain collection tank are monitored by campus security 24/7 when the UMRR is unoccupied. This information may also be used in Chapters 5, 7, 12, and possibly 13, even though it appears in a Chapter 9 RAI.

University of Missouri - Selected Site Visit Questions

The following questions were selected from the complete list of RAIs. These questions were selected because they appear to require a minimum level of effort to address and do not require a detailed written response.

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None.

CHAPTER 2 CHARACTERISTICS

2-1: Does the Burlington Northern Railway transport any freight (e.g., hazardous materials or explosives) which if involved in an accident, would present a risk to the UMRR which is not bounded by the analysis contained in Chapter 13 of the SAR? **The closest approach of the track is 0.25 miles away from the UMRR to the east of the campus. The prevailing winds are from either the west or southwest towards the northeast or east. The licensee has a call into BNR to ascertain if any hazardous material is transported on that rail line and at what frequency.**

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CHAPTER 3 DESIGN OF STRUCTURES, SYSTEMS AND COMPONENTS

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4A-5: Has the reactor pool ever been drained for inspection of the walls and signs of degradation of the vinyl paint? If so, what were the results? Are the exterior walls inspected periodically for signs of degradation, cracks, or leaks? **The pool has never been drained since the reactor was placed in service, since only one side of the pools four outer wall is exposed. The five coats of epoxy paint appear to be holding up well. I only observed very minor pitting (less than ten locations) on the whole inside of the pool. Any leaks would be picked up by increased makeup demand and pool level (normal makeup is about one inch of makeup water per week for evaporation). Anything greater than that need triggers an investigation to locate what is causing the extra loss. Additionally, any crack in the concrete pool walls below the water line would produce bubbles at the crack location that would be readily observable.**

4A-6: In the event of a reactor pool leak, what provisions are in place to prevent the water from getting into unrestricted areas, including the groundwater? **Three of the four pool walls are exposed directly to the outside earth. The licensee relies on any leak being quickly identified and repaired and the very low radioactivity in the pool water itself. Pool level change is monitored in the control room when the building is occupied and during off hours by the 24/7 campus security. See the SOP covering this situation. – Is this still OK (Jim)**

4A-7: The SAR Section 4.4 states that radiation levels in the vicinity of the closed beam port face and the periphery of the thermal column were measured to be 5 mrem/hr and 8 mrem/hr, respectively. What is the radiological designation of these areas, and what precautions are taken to minimize personnel exposure in these two areas? **There are two cameras that visually show the lower experimental area in the control room and there is also a locked gate to the area that would preclude access. When the reactor is off, this area is designated a radiation area. When the reactor is on and the port is open, it is designated a high radiation area (but less than 1 Rad/hr).**

4B-1: Over the past decade, what has been the average number of hours per year that the reactor has operated and what has been the maximum number of hours of continuous operation? **Over the decade approximately 800 to 850 hrs/yr. And 7 hours maximum per day.**

4B-2: Please explain why Figure 4-3 shows the positions as being in a 6 x 8 array only? **This figure depicts a generic grid plate to provide a reference for fuel element positions. The figure will be retitled "generic grid plate".**

4B-3: What is considered to be the standard or most used core configuration? **The 101W configuration has been used since 1992.**

4B-4: What are the different configurations that have been used or plan to be used? **All other**

temporary configurations of the core use the same positions as 101W, only the fuel assemblies are interchanged.

4B-8: What is considered the limiting core configuration and what is the associated power density? **Fuel elements are designed to preclude excess reactivity in each element and are designed for cooling by natural convection.**

4B-9: Please provide the correct void coefficient. **What is used in other parts of the SAR is correct. Section 4.5.2.2 will be changed to correct the number stated.**

4B-10: What is the correct void coefficient value for the present LEU fuel? **See Table 4.1 on page 4-2 of the SAR (void periphery).**

4B-12: Please explain why the delayed neutron fraction is denoted as k_{eff} instead of β? **On page 4-15, Section 4.5.2.4 k_{eff} should be β and will be corrected.**

4B-15: What types of experiments are typically done at the UMRR? **Mainly foil activations and reactor theory experiments - such as shutdown margin and control rod worth determination. No human or animal subject irradiations are performed.**

CHAPTER 5 REACTOR COOLANT SYSTEMS

5-2: Is the discharge piping connection for the cleanup system at the same elevation as the suction pipe in the reactor pool or at least above the top of core elevation? If not, please specify location in relation to the top of core elevation. **Yes, at approximately 16 feet above TAF. The piping is 1.5" in diameter.**

5-4: Please state what the water source is for the diffuser pumps. **The reactor pool.** If it is the reactor pool, please specify the elevation of the connection in relation to the top of the core. **The suction is 1 foot below the pool water surface and all piping and pumps are located within the confines of the pool perimeter, so all leakage would be into pool.**

CHAPTER 6 ENGINEERED SAFETY FEATURES

None.

CHAPTER 7 INSTRUMENTATION AND CONTROL SYSTEMS

7-1: SAR Section 1.3 states: *Areactivity of the reactor core is changed by the operator moving the control rods that are suspended from fail-safe electromagnets located on the support bridge.@* Since it infers that all control rods are suspended from electromagnets, this statement should be clarified. As described in SAR Section 4.4.2, one rod (the regulating rod) is bolted directly to the rod drive assembly.

A page correction is made to chapter 1, section 1-3, on page 1-2 of the SAR. The existing sentence in section 1-3 reads "Reactivity of the reactor core is changed by the operator moving the control rods that are suspended from fail-safe electromagnets located on the support bridge". This sentence is changed to "Reactivity of the reactor core is changed by the operator moving control rods located on the support bridge, three control rods are suspended from fail-safe electromagnets and the forth is mechanically coupled to the rod drive assembly". Chapter 1 of the SAR with this correction accompanies this response.

7-2: SAR Section 1.8 states: AUMRR has not undergone significant or safety-related physical or operational modifications since the last renewal was issued.@ In addition, Chapter 7 of the SAR is silent on modifications to the Instrument and Control (I&C) systems. However, Section 7.4 of the Annual Progress Report for 2002-2003, states that certain I&C systems were significantly upgraded in the Spring of 2002. Specific examples include the Reactor Console, Safety Channels and the control rod magnet power supply. If this is correct, include a description of the modifications performed.

UMRR has upgraded the following equipment in the control room since the last license renewal:

- **Two Safety Channels**
- **Magnet power supply**
- **Temperature recorder**
- **Constant Air Monitor (CAM) recorder**
- **Log & Linear drawer and recorder**
- **Camera system and Monitor**
- **Intercom**
- **Rabbit Controller**
- **AC Line Conditioner**

The equipment that was upgraded performs the same functions as the equipment it replaced; it only is newer equipment containing later types of electronics, such as transistors in place of vacuum tubes. Since the upgraded equipment performs the same functions of the equipment it replaced a significant modification does not exist.

7-3: TS 14.2.2, ALimiting Safety System Settings Basis@ states: *The Safety Analysis Report (Section 4.6) shows that at a reactor power of 300 kWt, the maximum cladding temperature is well below 105 C (221 F).* SAR Section 4.6 states:

AThe peak cladding temperature associated with the Limiting Safety System Setting of 300 kWt would be below 100°C (212°F).@ Which value is correct?

SAR section 4.6 has the correct value. A page correction is made to chapter 14, section 14.2.2 on page14-5 of the SAR. This correction changes the temperature value 105ºC (221ºF) to 100ºC (212ºF). Chapter 14 of the SAR with this correction accompanies this response.

7-4: For the linear power channel, Section 7.2.2.2 of the SAR states that a reactor Rundown is actuated if the HV drops to 80% of its rated value. For the Log and Linear Power Channel, SAR Section 7.2.2.3 states that a reactor scram and reactor rundown will be initiated if detector HV drops to less than 80% of its nominal value. Is there a difference between Arated value@ and Anominal value?@ If, so please describe.

No. The linear channel HV is a nonadjustable 540VDC and the Log and Linear Channel HV is an adjustable 540VDC.

7-5: The SAR states that, the Log and Linear Power Channel will actuate both a reactor scram and reactor rundown if detector voltage falls to less than 80% of its nominal voltage. However, Table 7.1 indicates that a loss of voltage will only cause a reactor rundown. Please clarify.

The Log & Linear Channel initiates a rundown if HV lowers to less than 80% of its nominal value, as does the Linear Channel. Also, a loss of power supply voltages in the Log & Linear Channel will activate a non-operative scram. A loss of HV can cause both a rundown and scram for the Log & Linear Channel. The Linear Channel has only a rundown for a loss of HV.

7-6: Please describe the type of electrical isolation/physical protection provided for voltage and signal cables associated with the redundant Safety Channels. For example, are they routed in separate conduits from the reactor to the control room?

Voltage and signal cables for the Safety Channels are routed into a floor trough with other nuclear instrumentation cables that go to the reactor bridge. The trough is covered with steel plates to protect the cables.

7-7: The SAR states that the reactor pool and demineralizer system holding tank have level alarms that are Acontinuously monitored by campus police.@ Please provide a more detailed description of this capability.

The reactor pool and holding tank have float switches that monitor the water level. The pool's switches will activate if the water level lowers or rises more than one foot. The holding tank float switch will activate with a rise of water. The activation of these switches sends an alarm to the campus police department. The float switch alarm system is active on a

24/7 basis. UMR Campus Police will contact reactor staff when receiving this alarm.

7-10: Table 7.2, AReactor Instrumentation Protective Actions,@ indicates that a reactor rundown will be initiated if the regulating rod is at the insert limit while in auto control. This feature is not described in SAR Section 7.2.2.6. Please clarify.

A page correction is made to chapter 7, section 7.2.2.7 on page 7-9 of the SAR. The following statement "A rundown will occur if the servo system maintains stable power while inserting the regulating rod to its insert limit" is added to the end of section 7.2.2.7. Chapter 7 of the SAR with this correction accompanies this response.

7-11: The purpose, design function, and method of accomplishing a reactor rundown should be described in the SAR.

A page correction has been made to chapter 7 on page 7-7. The following rundown logic description has been added as section 7.2.2.4:

"Rundown logic lowers rods into the fuel elements to shutdown the reactor unlike a scram, which drops the rods. During routine reactor shutdowns the operator manually positions the operate/shutdown switch to the shutdown mode to initiate the rundown action.

The rundown circuit consists of a set of open-on-failure relay contacts wired in series with a rundown relay. The rundown relay can only be reset after the condition causing a rundown has been removed and the reset relay has been manually energized by pushing the reset button. Rundowns trips are used in the Linear, Log & Linear, and RAM channels, which are describe in their appropriate sections of the SAR."

Chapter 7 of the SAR with this correction accompanies this response.

7-12: Section 7.3 identifies a Amagnet power key switch.@ It is assumed that actuation of this switch while the reactor is operating will actuate the scram logic. If so, the design function of this switch should be included in Section 7.2.2.5, AScram Logic.@

A page correction has been made to chapter 7, section 7.2.2.6 on page 7-8 of the SAR. "Turning on the magnet key switch and depressing the scram reset button activates the scram circuit" has been added to the beginning of the second paragraph in section 7.2.2.6. Chapter 7 of the SAR with this correction is included with this response.

7-13: Editorial comment: change Aresistively@ to: Aresistivity@ in first paragraph Section 7.5.

A page correction has been made to chapter 7, section 7.5 on page 7-11 of the SAR. The misspelled word "resistively" has been changed to "resistivity". Chapter 7 of the SAR with this correction accompanies this response.

7-14: Does the CAM system provide only a local alarm (at the detector) or will an alarm also occur at the console? If there is only a local alarm, can it be seen / heard at the console? **The CAMs alarm locally and in the control room.**

7-15: Will actuation of the CAM alarm cause the ventilation system to isolate? **No**

7-16: The diffuser pumps are needed to decrease the level of airborne N-16. Is their operation monitored / controlled from the control console? Please describe. **Yes, and operational status is monitored on hourly logs when reactor is online. Also, RAM on the reactor bridge would indicate higher radiation readings if diffuser malfunctioned.**

7-17: Technical Specifications require that a ventilation fan with a rated capacity of at least 127 m3/min (4,500 cfm) be turned on within 10 minutes of reaching full power operations. Is there an alarm at the console to alert operators if the fan does not start within the prescribed time or if fan failure occurs after a successful start? **No annunciators or alarms. Status of fan (on/off light) is located on the switch that is located just outside control room on the reactor building wall. Building is small enough that fan operating would be heard and the air flow felt.**

7-18: 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 rabbit system is indicated and controlled from the reactor console, there is no local control.**

7-19: Will an "IN" signal from either the individual or gang rod position control switches override an "OUT" signal? **Yes, but it involves the manual operation of the shutdown/run switch (like a mode switch). This switch provides the override capability, and this capability is verified during every startup by procedure.**

7-20: In its description of the trip function provided for the log & linear channel, Table 7-1 uses the phrase "not operate mode." Please clarify this phrase. Specifically, it is not clear if the "not operate mode" is a function of a mode switch or is intended to mean that a channel is not operable due to a loss of power, input signal, or other failure. **Normal function is to test loss of channel. However, if reactor is at power and the switch is in "not operate" position, it will scram reactor.**

CHAPTER 8 ELECTRICAL POWER SYSTEM

8-1: Please provide a simplified one-line diagram of the electrical distribution system for review and incorporation into SER. **A diagram will be faxed to BNL.**

8-2: While a loss of normal AC power would not affect the ability to achieve and maintain safe shutdown conditions in the reactor, it is not clear if AC power is needed for other important services, such as performing the necessary emergency notifications, ensuring the safety of experiments, or providing power to any required radiation monitoring equipment. Please clarify. **RAMs are powered from a UPS with a battery (the battery is good for approximately 20 minutes). There are also about six hand held/battery powered radiation meters that can be used to monitor radiation during loss of electrical power to the facility. These meters are calibrated on a yearly basis.**

CHAPTER 9 AUXILIARY FACILITIES

9-2: SAR Section 9.2 briefly discusses the use of manually operated fuel handling tools. Please describe the design and operation of these tools, which precludes damaging the fuel during handling. When not in use, where are the tools stored? Are there any special precautions taken at the UMRR to ensure that only authorized persons handle fuel in the core? **There are passive safety devices on the tools to preclude damage to the fuel elements and the tools are stored along wall of reactor pool. All fuel movements are under the direct supervision of SRO (see SOP-207.B.1).**
Note: NRC stated during this trip that new security requirements for research reactors preclude describing how fuel movements are performed in public documents. Therefore, we should be careful not to describe any fuel handling operations in our SERs.

9-3: The SAR provides no discussion of new fuel inspection. In the event of new fuel being shipped to the UMRR, what inspections will be done to ensure that the new fuel meets all applicable procurement specifications and that all SNM is accounted for? **There is no anticipated need to have new fuel delivered to the UMRR. Existing fuel (LEU) should last (its good for 500 years) past reactor operational lifetime. For surveillance of SNM, see SOP 311.**

9-4: The SAR does not discuss storage of spent control rods at the UMRR. Please discuss how they are stored, or will be stored, at the facility. **They would be placed in the storage pit in any storage rack position because the design eliminates any k_{eff} concerns. None are stored there now, and the rods are expected to last as long as the fuel (500 years).**

9-5: Since there is no drain system within the reactor building, how would the fire suppression water be contained within the reactor building to prevent the suppression water from potentially carrying contamination to the environment? **There is one floor drain that goes to the sewer and two potentially contaminated drains that discharge to a 100 gallon holding tank in the basement of the reactor building. One of these drains is located in the demineralizer pit and the other in the floor next on the east side of the pool. There is no sprinkler system in the building and the building contains limited combustibles. Sensors for both pool level and level in a drain collection tank are monitored by campus security 24/7 when the UMRR is unoccupied. The alarm level for the pool level is + or - one foot, and the 100 gallon collection tank alarms at approximately 25% of its capacity. It is felt this provides a reasonable time frame to determine and fix the problem.**

9-6: Do the Rolla fire department personnel receive training in radiological hazards and UMRR Reactor specific familiarization training? **Yes, once per year.**

9-7: Who maintains the fire detection system, and how often is the fire detection system tested to verify operability and who performs the periodic testing? **This system is maintained and tested for operability twice per year by the UMRR.**

9-8: Please specify which telephones in the reactor building are capable of dialing directly offsite. Additionally, is the building evacuation alarm separate or part of the intercom system? Please describe. **All phones in the UMRR can dial offsite, but through the campus centrex. UMRR manager to determine if campus centrex has UPS. The separate building evacuation alarm is activated either by a high radiation alarm from the reactor bridge RAM or manually from the control room.**

9-9: How is emergency information communicated to people within the reactor building? Does the two way intercom also serve as the emergency PA system? **The PA system from the UMRR control room and the reactor building front administrative office is the primary means of communications. There is also an intercom system that could be used as a backup capability that services eleven locations within the reactor building.**

9-10: Are the SNM storage areas in the reactor building inventoried periodically? If so, who performs them? **Check sources are kept under lock& key. SMN storage areas are inventoried annually by the HP staff.**

CHAPTER 10 EXPERIMENTAL FACILITIES

10-1: Is there a written operating procedure stating that the Senior Reactor Operator controls loading, unloading or movement of experiments affecting the reactivity of the core? It is not a technical specification requirement (see Question 13 in Chapter 12). **See SOP 702 and 710.**

CHAPTER 11 RAD. PROTECTION PROGRAM AND WASTE MANAGEMENT

11-1: Are unanticipated or unusual reactor related exposures investigated to develop methods to prevent reoccurrence? If so, are they investigated by the Radiation Safety Office or another organization? **None have occurred since the reactor has been licensed and there is no procedure stating such. However, if one were to occur, the RSO would be involved in the process.**

11-2: Is a radiation survey performed by procedure in the reactor bay prior to every startup of the reactor? Also, is any airborne particulate monitoring performed routinely in the reactor bay or experimental areas? **Prior to every startup, RAM readings and one CAM at the mid plane level of the reactor building are used to determine abnormal radiation conditions in the building. There are no long-term experiments performed at the UMRR.**

CHAPTER 12 CONDUCT OF OPERATIONS

12-1: Is the RSO able to suspend facility operations, when necessary? SAR section 11.2.2 states that waste management activities at UMRR follow ANSI/ANS 15.11. ANS 15.1, Section 6.3, specifies that the full radiation protection program should follow the guidelines of ANS15.11-1987. Is that the case at UMRR? **The RSO can suspend facility operations when necessary. Remainder of question to be answered in writing by UMRR subsequently.**

12-6: ANS 15.1 specifies that a list of reactor personnel with phone numbers shall be readily available in the control room for use by the operator. This is not included in the SAR. Is such a list available and maintained at UMRR? **Required by SOP. See SOP-501**

12-7: The SRP and ANS 15.1 specify certain rules for the RSC, which are not addressed in the SAR or TSs. These may be in the RSC charter which was not submitted to NRC. Please discuss if and how these items are addressed: review and approval of RSC minutes, dissemination of minutes in a timely manner (no longer than 3 months from meetings), appointment of qualified RSC member(s) not on the staff of the University, and a written report of the findings and recommendations of the committee submitted to Level 1 and RSC members in a timely manner after the review is complete. **Question to be answered in writing by UMRR subsequently.**

12-8: ANS Standard 15.1 lists the items that should be reviewed by the RSC. The following I tems from the ANS Standard, Section 6.2.3 were not included in the SAR or TSs as part of the review responsibility of the RSC:

All new procedures.
Review of violations of surveillance requirements of TSs or violations of internal procedures or instructions having safety significance.
Review of Audit reports.

Additionally, the responsibilities of the RSC and Director of the Reactor Facility for procedures is not completely clear. The section on RSC responsibilities does not list the either review or the approval of new procedures or procedure changes. However, the section on procedures notes that the RSC must review and approve substantive changes to procedures. Please clarify who has the review and the approval responsibility for procedures and procedure changes. **Question to be answered in writing by UMRR subsequently.**

12-10: ANS Standard 15.1 specifies that deficiencies uncovered by an audit that affects reactor safety shall be immediately reported to level I management. Also, a written report of audit findings shall be submitted to level I management and the review/audit group members within 3 months of completing the audit. How are these addressed? **Question to be answered in writing by UMRR subsequently.**

12-11: ANS Standard 15.1 lists the activities to be addressed by procedures. One area not addressed in the SAR or TSs is Administrative controls for operations, maintenance and the conduct of irradiations. Are there procedures for these activities at UMRR? **Yes, see SOPs for details**.

12-12: The NRC SRP notes that the procedure development process should include reviews by staff from reactor operations, radiation protection, and reactor administration. Is this the case at UMRR? **See SOP 100 for details.**

CHAPTER 13 ACCIDENT ANALYSIS

13-2: What is the material for the thermal column and beam pipe and could there be a rupture of the thermal column or beam tube that could cause a rapid drain of the pool? **Tubes are made of Aluminum. Outer surface of tubes within the reactor pool are visually inspected prior to startup. Licensee is considering modifying SOP 102 to ensure wording specifically states all beam tube surfaces within the pool, not just in the core.**

13-4: What would the consequences be if cladding were to fail during operation at full power? **Pool radioactivity would go up and be picked up by reactor bridge RAM. Any subsequent airborne activity would be picked up on the CAM, in the unlikely event that any was emitted from the pool.**

13-5: What computer code was used for accident analysis calculations? **See Reference 13-12 (Jim Higgins and Rich Deem have copy).**