

November 2, 2010

Melinda P. Krahenbuhl, Ph.D.
Facility Director
Dow Chemical TRIGA Research Reactor
Dow Chemical Company
Building 1602
Midland, MI 48674

SUBJECT: DOW CHEMICAL COMPANY - REQUEST FOR ADDITIONAL INFORMATION
REGARDING THE LICENSE RENEWAL AND POWER UPRATE APPLICATION
(TAC NO. ME1595)

Dear Dr. Krahenbuhl:

The U. S. Nuclear Regulatory Commission (NRC) is continuing its review of your application for the license renewal and power uprate of Facility Operating License No. R-108 for the Dow Chemical TRIGA Research Reactor, dated April 1, 2009.

We require additional information and clarification on questions that have arisen during our review. Please provide responses to the enclosed request for additional information within 60 days of the date of this letter. In accordance with Title 10 of the *Code of Federal Regulations*, Section 50.30(b), 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 security, 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."

If you have any questions about this review or if you need additional time to respond to this request, please contact Walter Meyer by telephone at 301-415-0897 or by electronic mail at Walter.Meyer@nrc.gov.

Sincerely,

/RA/

Geoffrey A. Wertz, Project Manager
Research and Test Reactors Licensing Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Docket No. 50-264

Enclosure:
As stated

cc w/encl: See next page

Dow Chemical Company Docket No. 50-264

cc:

Office of the Mayor
333 West Ellsworth
Midland, MI 48640

Office of the Governor
Room 1 – Capitol Building
Lansing, MI 48913

Alex Pollock
Chair, Radiation Safety Committee
2030/410 Dow Center
Midland, MI 48674

Dr. Kevin Hool, Level 1 Manager
The Dow Chemical Company
1897 Building
Midland, MI 48667

Test, Research, and Training
Reactor Newsletter
University of Florida
202 Nuclear Sciences Center
Gainesville, FL 32611

OFFICE OF NUCLEAR REACTOR REGULATION

REQUEST FOR ADDITIONAL INFORMATION

THE DOW CHEMICAL COMPANY TRIGA RESEARCH REACTOR LICENSE RENEWAL

AND POWER UPRATE APPLICATION REVIEW

LICENSE NO. R-108, DOCKET NO. 50-264

The U. S. Nuclear Regulatory Commission (NRC) is continuing its review of your application for the license renewal and power uprate of Facility Operating License No. R-108 for the Dow Chemical TRIGA Research Reactor (DTRR), dated April 1, 2009. Our review is performed in accordance with the guidance provided in NUREG-1537, "Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors." During this review, we have identified areas needing additional information. Please provide responses to the following request for additional information.

1. NUREG–1537, Part 1, Section 1.2, "Summary and Conclusions on Principal Safety Considerations" requests the applicant to provide a summary of the principal safety considerations for its reactor. The DTRR safety analysis report (DTRR SAR) includes Section A.2 with the same title, but the contents only briefly discuss operational safety based on "TRIGA reactor fuel, current instrumentation, and operation controls." Please provide a summary of the principal safety considerations applicable to DTRR (control rods and their active/passive operation, the reactor tank structure, site selection, ventilation systems, etc.).
2. NUREG–1537, Part 1, Section 1.3, "General Description of the Facility" requests the applicant to provide a brief description of facility features providing a general arrangement of the major structures and equipment, including drawings. The DTRR SAR does not provide sufficient information. Please provide drawings that illustrate the major components and rooms as described in the DTRR SAR (e.g. reactor bay, console, laboratories, vaults, monitoring stations, ventilation components and vents, etc.).
3. NUREG–1537, Part 1, Section 1.6, "Summary of Operations" requests the applicant to provide a discussion of the proposed operational plans for its reactor. The DTRR SAR does not provide sufficient information. Please provide a summary describing the operational plans for the DTRR that include the reasons for requesting an increase in licensed power.
4. NUREG–1537, Part 1, Section 1.8, "Facility Modifications and History" requests the applicant to provide descriptions of any changes that have been made, including changes made under Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.59. DTRR SAR, Section A.8, provides information about three changes without indicating the means used to implement them. Please provide a more detailed list of significant changes to the facility accomplished under 10 CFR Section 50.59.
5. NUREG–1537, Part 1, Section 2.2, "Nearby Industrial, Transportation, and Military Facilities" requests the applicant to provide a discussion of the potential for accidents in the vicinity of its site from present and potential industrial operations. The discussion of this topic in DTRR SAR, Section B.2.3 is limited to descriptions of site security and does not discuss potential on-site contributors such as chemical accidents arising from nearby

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Dow facilities. Please provide a description of postulated accidents attributable to nearby Dow facilities, how DTRR staff would become aware of such accidents and how they would affect operation of DTRR.

6. NUREG–1537, Part 1, Section 2.3, “Meteorology” requests the applicant to indicate how the local (site) meteorology supports the dispersion calculations of airborne releases under normal and accident conditions. Please provide a description of the dispersion model based on this meteorological data.
7. NUREG–1537, Part 1, Section 3.1, “Design Criteria” and Section 3.5, “Systems and Components” requests the applicant to identify the safety related structures, systems, and components (SSC) for its facility and provide information pertaining to their design. DTRR SAR, Section C.1, does not provide sufficient information.
 - 7.1 Please provide a description of the design of DTRR SSCs that are required to assure safe reactor operation and shutdown such as the rod control system, the reactor control system, and control rod assemblies.
 - 7.2 Please provide the criteria applicable to the design and construction of building 1602 including building codes used at the time of construction.
8. NUREG–1537, Part 1, Section 3.3, “Water Damage,” requests the applicant to provide a description of the design of facility structures for protection against water damage that could impact instrumentation and control systems. Please provide a discussion of the design of the roof structure above the reactor room and provisions to maintain its integrity from water damage for the term of the renewed license.
9. NUREG–1537, Part 1, Section 4.2.2, “Control Rods” requests the applicant to provide a description of the control rod position indication system. DTRR SAR, Chapter D, does not provide this information. Please provide a description of the control rod position indication system.
10. NUREG–1537, Part 1, Section 4.2.4, “Neutron Source” requests the applicant to provide a description of the startup source including limitations on maximum power level with the source in place and surveillance requirements to assure source integrity. DTRR SAR, Chapter D, only discusses the source type and location. Please provide a discussion of the limitations such as the maximum power level of the reactor with the source in place and surveillance requirements to ensure source integrity.
11. NUREG–1537, Part 1, Section 4.2.5, “Core Support Structure” requests the applicant to provide design information pertaining to the core support structure. DTRR SAR, Chapter D, does not provide sufficient information. Please provide figures depicting the upper and lower core plates and provide the dimensions and locations of all penetrations that allow coolant to flow through them.
12. NUREG–1537, Part 1, Section 4.3, “Reactor Tank or Pool” requests the applicant to provide a description of the reactor tank and associated components including how those components will perform their intended functions to prevent possible leakage associated with chemical interactions, penetration and weld failures. The DTRR SAR, Chapter D, does not provide sufficient information. Please provide a discussion of preventative measures employed to monitor and maintain the integrity of the reactor tank from possible leakage.
13. NUREG–1537, Part 1, Section 4.4, “Biological Shield” requests the applicant to provide a description of the reactor’s biological shield and how it assures acceptable control of

- personnel exposure. DTRR SAR did not provide this information. Please provide typical doses measured at 300 kW and expected doses at the new requested power level.
14. NUREG–1537, Part 1, Section 4.5, “Nuclear Design” requests the applicant to provide a detailed description of analytical methods used in the nuclear design, including computer codes used to characterize technical parameters pertaining to its reactor. DTRR SAR, Chapter D, does not provide sufficient information. Please provide descriptions of the DTRR nuclear design analyses, including the methods and the computer codes used for the analyses.
 15. NUREG–1537, Part 1, Section 4.5.1, “Normal Operating Conditions” requests the applicant to provide a description of the limiting core configuration (LCC), the core configuration that would yield the highest power density using the fuel specified for the reactor. All other core configurations utilized by the applicant should be encompassed by the safety analysis of this configuration. The description should indicate the number, types, and locations of all core components on the grid plate including fuel, control rods, neutron reflectors, and moderators.
 - 15.1 DTRR SAR, Section D.5.5, provides a list of reactivity worths but control rod worths are not included. Please provide control rod worths specific to the LCC at the new requested power level.
 - 15.2 DTRR SAR, Section A.3, describes the original fuel configuration as having 75 stainless steel (SS)-clad elements and one Aluminum (Al)-clad element. The DTRR SAR does not provide information relating to the DTRR fuel element and control rod layout for the new requested power level. Please provide a complete description of the LCC for the new requested power level and provide a core diagram showing all components.
 - 15.3 The limit on excess reactivity is established in DTRR SAR Table 4. However, the actual excess reactivity of the DTRR LCC is not identified in the DTRR SAR. Please provide the calculated excess reactivity for the LCC at the new requested power level.
 16. NUREG–1537, Part 1, Section 4.5.2, “Reactor Core Physics Parameters” requests the applicant to provide a description of the full set of core physics parameters for the LCC that are used in their safety analyses and the methods used to determine them. DTRR SAR, Table 4, provides some of the values cited (i.e., β_{eff} , prompt-neutron-lifetime, fuel temperature and the void coefficient). However, it is unclear if these are generic values or if they are applicable to the LCC of the DTRR and to the safety analyses in Chapter M. Please provide a description of the full set of core physics parameters for the LCC that are used in the DTRR safety analyses and the methods used to determine them.
 17. NUREG–1537, Part 1, Section 4.5.3, “Operating Limits” requests the applicant to provide information regarding the operating limits applicable to the LCC of its reactor. DTRR SAR, Section D does not provide sufficient information.
 - 17.1 Please describe any limits or conditions on the evaluation of excess reactivity contributors, such as those due to temperature variations and poisons (e.g., xenon and samarium). Please describe algebraically how DTRR determines excess reactivity showing all components.
 - 17.2 Please describe any limits or conditions on the evaluation of shutdown margin, including a discussion of uncertainties.

- 17.3 The Safety Limit (SL) is based on fuel temperature, and the Limiting Safety System Setting (LSSS) is based on core power (DTRR TS 2.1 and DTRR TS 2.2). Please describe the relationship between these parameters and how the DTRR operation using the LCC at the new requested power level will result in fuel temperatures that are bounded by the SL.
18. NUREG–1537, Part 1, Section 4.6, “Thermal-Hydraulic Design” requests the applicant to provide information and analyses of thermal-hydraulic conditions in its reactor demonstrating that sufficient cooling capacity exists for steady-state operations at the maximum licensed power level. DTRR SAR, Chapter D, does not provide sufficient information. Please provide information pertaining to the minimum DNBR for the DTRR using the LCC at the new requested power level. Please describe the analytical methods used to determine the DNBR, including the core inlet and exit conditions assumed and other assumptions and correlations employed.
19. NUREG–1537, Part 1, Section 5.2, “Primary Coolant System” requests the applicant to provide a description of the primary coolant system, including information to substantiate the removal of heat from the fuel during maximum licensed power operation and decay heat when the reactor is shutdown. DTRR SAR, Sections E.1 and E.3, do not provide information demonstrating the adequacy of the primary system to perform this task. Please provide information showing the adequacy of the primary system to cool the reactor under all anticipated conditions of operation at the new requested power level.
20. NUREG–1537, Part 1, Section 5.2, “Primary Coolant System” requests the applicant to provide information regarding the coolant system control and safety instrumentation, including the location and functions of sensors and instruments. The SCRAM or interlock functions that prevent exceeding the SLs should be shown and discussed. DTRR SAR, Section E.3, does not include this information. Please provide a description of the primary coolant system control and safety instrumentation, including the location and function of sensors and instruments. Please include in this description a discussion of the SCRAM or interlock functions that prevent exceeding the SLs.
21. NUREG–1537, Part 1, Section 5.2, “Primary Coolant System” requests the applicant to include in this section tables of allowable ranges of operating parameters and specifications for the primary coolant system and its components. The DTRR SAR does not provide sufficient information on this subject. Please describe what primary coolant parameters are monitored and provide information regarding appropriate ranges of coolant conditions, levels, and temperatures.
22. NUREG–1537, Part 1, Section 5.2, “Primary Coolant System” requests the applicant to provide a discussion of primary coolant radioactivity concentration limits, including isotopes of interest. It is not clear in DTRR SAR, Section E.2, how the Geiger tube is able to measure the isotopes of interest in the primary water. Please indicate how the concentrations of these radioisotopes are obtained and the basis for the limits stated in DTRR TS 3.4.
23. NUREG–1537, Part 1, Section 5.3, “Secondary Coolant System” requests the applicant to provide a description of the secondary coolant system, including schematics and flow diagrams for the secondary coolant system.
- 23.1 DTRR SAR, Section E.1, states that “the heat rejection systems can be operated independently or in tandem.” DTRR SAR, Section E.1, Figure 6, Reactor Coolant System, shows no valve arrangement that accomplishes these functions.

Please provide schematics and flow diagrams for the secondary system, including valves, which show how the secondary coolant system can be operated independently or in tandem.

- 23.2 DTRR SAR, Section E.1, does not provide sufficient information describing the secondary system. Please provide a more detailed description of the secondary coolant system and describe how primary to secondary leakage would be detected.
24. NUREG–1537, Part 1, Section 5.3, “Secondary Coolant System” requests the applicant to provide a discussion and functional analyses showing how the system provides the necessary cooling for all potential reactor conditions at the maximum licensed power level. DTRR SAR, Section E.3 does not provide this information. Please provide a discussion and functional analysis showing the adequacy of the secondary system to provide necessary cooling at the new requested power level. Also include a discussion of the potential consequences of a glycol leak from the SR-1 system into the primary water and the methods used to detect and prevent such leakage.
25. NUREG–1537, Part 1, Section 5.4, “Primary Coolant Cleanup System” requests the applicant to provide a summary of methods for predicting and limiting exposure of personnel in the event of an inadvertent release of radioactivity into the primary coolant system and deposited in filters and demineralizer columns. DTRR SAR, Section E.4, does not provide this information. Please provide a summary showing how such a condition would be recognized and methods that would be employed to limit personnel exposures.
26. NUREG–1537, Part 1, Section 5.6, “Nitrogen-16 [N¹⁶] Control Systems” requests the applicant to provide a description of the nitrogen control system employed and how personnel exposure to N¹⁶ is consistent with the facility’s as low as reasonably achievable (ALARA) Program. DTRR SAR, Section E.6, does not provide a description of the system or information for estimating the dose. Please provide the N¹⁶ dose measurements and calculations that demonstrate the N¹⁶ dose at the new requested power level will be within regulatory limits.
27. NUREG–1537, Part 1, Chapter 6, “Engineered Safety Features (ESF)” requests the applicant to provide a description of any systems with active or passive features designed to mitigate the consequences of accidents in order to keep radiological exposures to the public, the facility staff, and the environment within regulatory limits. DTRR SAR, Section F.1, states that the DTRR uses a “confinement type engineered safety system” but it is not clear if it is considered an ESF. Please indicate if the DTRR confinement system should be considered an ESF.
28. NUREG–1537, Part 1, Section 7.1, “Summary Description” requests the applicant to provide a summary of the technical aspects, safety, philosophy, and objectives of the instrumentation and control (I&C) system design. DTRR SAR, Chapter G, does not provide sufficient information.
- 28.1 Please describe any bypass and interlock functions in the I&C system.
- 28.2 Please describe the types of parameters monitored, both nuclear and non-nuclear; the number of channels designed to monitor each parameter; and the actuating logic that determines the need for actions to safely shutdown the reactor.

- 28.3 Please describe the parameter display systems and equipment by which the operator can observe and control the operation of the reactor and important subsystems.
- 29. NUREG–1537, Part 1, Section 7.2, “Design of Instrumentation and Control Systems” requests the applicant to provide information regarding the basis for evaluating the reliability and performance of the I&C systems. DTRR SAR, Chapter G, does not provide sufficient information.
 - 29.1 Please describe the design basis for the I&C system.
 - 29.2 Please provide a system description that includes block, logic, and schematic diagrams of the I&C system.
 - 29.3 Please describe the methodology and acceptance criteria used to establish and calibrate the trip and actuation setpoints or interlock functions.
 - 29.4 Please summarize how the system design is sufficient and suitable for performing the functions required for operation at the new requested power level.
- 30. NUREG–1537, Part 1, Section 7.3, “Reactor Control Systems (RCS)” requests the applicant to provide information regarding the functions of the RCS. DTRR SAR, Chapter G, does not provide sufficient information.
 - 30.1 Please describe the ranges of the reactor control instrumentation and justify the adequacy of the ranges to monitor power up to the new requested power level.
 - 30.2 Please describe how the instrumentation will be tested before operating at the new requested power level, to assure that rod shadowing will not affect direct monitoring of the neutron flux density for the presentation of the reactor power level and the power rate-of-change.
- 31. NUREG–1537, Part 1, Section 7.4, “Reactor Protection Systems” requests the applicant to provide a description of the SCRAM circuits and functions, neutron flux monitoring channels, and log power channels. DTRR SAR, Chapter G, does not provide sufficient information. Please provide a description of the SCRAM circuits and functions, indicating which channels are analog, the neutron flux monitoring channels and the log power channels.
- 32. NUREG–1537, Part 1, Section 7.6, “Control Console and Display Instruments” requests the applicant to provide a complete description of all console functions, as they relate to the proper operation and shutdown of the reactor. DTRR SAR, Chapter G, does not provide sufficient information.
 - 32.1 Please describe the console controls and operator interfaces.
 - 32.2 Please describe the location of the instruments and how the locations relate to the reactor and other system controls in the main console and auxiliary control room racks.
 - 32.3 Please provide drawings or photographs showing the arrangement of the display instruments and console control equipment.
- 33. NUREG–1537, Part 1, Section 8.1, “Normal Electrical Power” requests the applicant to provide schematic diagrams showing the basic distribution systems and circuits of the normal electrical power distribution system. DTRR SAR, Chapter H, does not provide

- sufficient information. Please provide schematic diagrams showing the basic distribution systems and circuits of the normal electrical power distribution system.
34. NUREG–1537, Part 1, Section 9.1, “Heating, Ventilation and Air Conditioning System” requests the applicant to provide a description of the heating, ventilation and air conditioning system (HVAC) and any manual or automatic functions. There is a brief description in DTRR SAR I.1 regarding this function with no schematics or illustrations. Please provide a more detailed description of the HVAC system and system functions and provide schematics of the HVAC system.
 35. NUREG–1537, Part 1, Section 9.2, “Handling and Storage of Reactor Fuel” requests the applicant to provide an analysis or a reference to an analysis that shows that subcriticality is assured under all conditions of fuel handling and storage. The DTRR SAR does not provide this information. Please provide an analysis that shows that K_{eff} is maintained below 0.90 for all storage configurations and that dose limits are met.
 36. NUREG–1537, Part 1, Section 9.2 requests the applicant to provide a discussion of the handling and storage of new, spent, and failed fuel elements.
 - 36.1 DTRR SAR, Section I.2, does not discuss the tools used to insert or remove fuel from the core, as well as the physical and administrative methods specified to control their use. Please provide this information.
 - 36.2 DTRR SAR, Section I.2, does not discuss whether Technical Specifications are required for or are applicable to the handling and storage of spent or damaged fuel. Please provide this information.
 37. NUREG–1537, Part 1, Section 9.3, “Fire Protection Systems and Programs” requests the applicant to provide a description of fire prevention and protection processes in use at the site. DTRR SAR, Section I.3, does not provide sufficient information. Please provide a description of the DTRR systems and processes designed to protect the facility from damage by fire. Please include descriptions of the protective equipment available and the fire barriers that could affect a safe reactor shutdown or the release of radioactive material.
 38. NUREG–1537, Part 1, Section 9.7, “Other Auxiliary Systems” requests the applicant to provide a description of other auxiliary systems in use at the site. DTRR SAR, Section I.7 does not provide sufficient information. Please provide a complete description of the location of the hoods, the relation of their exhaust piping to the HVAC system, the size of the piping used, and the exhaust height of their effluent relative to nearby buildings.
 39. NUREG–1537, Part 1, Section 10.2, “Experimental Facilities” requests the applicant to provide a description of specifications and important design and operating parameters for the experimental facilities. DTRR SAR, Section J.2.2 does not provide sufficient information regarding the pneumatic transfer system. Please provide a more detailed description of the pneumatic transfer system and how its use is controlled by reactor operators.
 40. NUREG–1537, Part 1, Section 10.2, “Experimental Facilities” requests the applicant to provide information regarding the potential for any experimental systems to affect the functioning of the reactor protection system. DTRR SAR, Section J.2, does not provide this information. Please provide a discussion of the experiment control systems and whether they are separate from the reactor control and safety systems. Please discuss

whether operation or malfunction of the experimental systems could affect the proper functioning of the reactor control and safety systems.

41. NUREG–1537, Part 1, Section 10.2, “Experimental Facilities” requests the applicant to provide a description of the radiological considerations associated with the design and the use of the experimental facilities, generation of radioactive gases, release of fission products or other radioactive contaminants, and exposure of personnel to neutron and gamma beams. DTRR SAR, Section J.2, does not provide this information. Please provide this information for operation at the new requested power level.
42. NUREG 1537, Section 10.3 “Experimental Review” states that the documentation of experiment review methodology should describe how 10 CFR Section 50.59 will be used to review all new experiments and changes to currently authorized experiments not described in a reactor’s SAR. DTRR SAR, Section J.3.3.2 does not provide this information. Please provide a discussion regarding experiment review methodology and how currently approved experiments and experimental facilities will be reviewed for the new requested power level.
43. NUREG–1537, Part 1, Section 11.1.1.1, “Airborne Radiation Sources” requests the applicant to provide a description of airborne radiation sources. DTRR SAR, Section K, does not provide sufficient information. Please provide a discussion of the generation of and potential doses from Argon-41 (Ar-41) for the new requested power level and discuss the overall impact on compliance with the 10 CFR Part 20 dose limits for workers and for the maximally exposed member of the public from airborne releases.
44. NUREG–1537, Part 1, Section 11.1.1.2, “Liquid Radioactive Sources” requests the applicant to provide identification and description of liquid radioactive sources, and a discussion of compliance with 10 CFR Part 20, including 10 CFR Section 20.2003 (disposal to sanitary sewers). DTRR SAR, Section K, does not provide sufficient information.
 - 44.1 Please identify expected liquid radioactive sources such as reactor primary coolant and experimental solutions that result from reactor operation or post irradiation processes.
 - 44.2 Please provide a discussion of compliance with 10 CFR Section 20.2003 with respect to disposal of radioactive liquids by release into the sanitary sewer.
 - 44.3 Please provide a discussion of the impact of operating the reactor at the new requested power level on the estimated liquid radioactive sources, releases and doses.
45. NUREG–1537, Part 1, Section 11.1.1.3, “Solid Radioactive Sources” requests the applicant to provide identification and description of solid radioactive sources, with limited descriptions of solid radioactive waste. DTRR SAR, Section K, does not provide sufficient information.
 - 45.1 Please provide a description of all solid radioactive sources, such as calibration and test sources, experiment samples, and facility components, including radionuclides, curie strengths, and physical characteristics, and if these sources are sealed or unsealed.
 - 45.2 Please provide information on any anticipated changes to the inventory of solid radioactive sources at the new requested power level.

46. NUREG–1537, Part 1, Section 11, “Radiation Protection Program and Waste Management,” requests the applicant to provide information on various aspects of a reactor’s Radiation Protection Program, including: a description of the structure of the organization that administers the radiation protection program; methods and procedures for surveys and monitoring; implementation of contamination control procedures; and implementation of environmental monitoring procedures. The DTRR SAR, Chapter K, provides an overview regarding some aspects of the radiation protection and radioactive waste management programs, but more detail is needed.
 - 46.1 Please provide a description of the DTRR Radiation Protection Program that shows how it meets the requirements of 10 CFR Section 20.1101(a).
 - 46.2 Please describe how the DTRR Radiation Protection Program implements the requirements of 10 CFR Section 20.1101(b) with respect to achieving occupational and public doses ALARA.
 - 46.3 Please describe how the DTRR meets the requirements of 10 CFR Section 20.1101(c) which requires licensees to at least annually review the DTRR Radiation Protection Program content and implementation.
 - 46.4 Please provide a description of the training program that is part of the DTRR Radiation Protection Program.
 - 46.5 Please describe the methods and procedures used for surveys and monitoring that meet the requirements of 10 CFR Section 20.1501(a), (b), and (c) in regards to surveys, calibration of equipment, and personnel dosimetry respectively.
 - 46.6 Please describe how the DTRR Radiation Protection Program implements contamination control in accordance with NUREG–1537, Part 1, Section 11.1.6, “Contamination Control.”
 - 46.7 Please describe how the DTRR Radiation Protection Program implements the environmental monitoring program.
47. NUREG–1537, Part 1, Section 11.2, “Radioactive Waste Management” requests the applicant to provide information concerning waste management. DTRR SAR, Section K, does not provide sufficient information. Please describe how the DTRR Radiation Protection Program controls, manages, and releases radioactive waste.
48. NUREG–1537, Part 1, Section 12.1 “Organization” requests the applicant to provide a description of the organizational structure, responsibilities, and staffing, including the selection and training of personnel. DTRR SAR, Section L.1, Figure 8, “Organizational Structure,” does not agree with DTRR TS 6.1, “Organization,” Figure 6.1. The duties of the Facility Director are not described. Please provide clarification of the differences in the two organization charts and describe the duties of the Facility Director.
49. NUREG–1537, Part 1, Section 12.1.3, “Staffing” requests the applicant to provide a description showing how the staffing requirements of 10 CFR Section 50.54 are met. DTRR SAR, Section L.1.2, states that the staffing meets all requirements of 10 CFR Section 50.54 but does not show how this is accomplished. Please show how the staffing requirements of 10 CFR Section 50.54 are met.
50. NUREG–1537, Part 1, Section 12.3, “Procedures” requests the applicant to provide an overview of procedures used at their reactor. DTRR SAR, Section L.3.12, “Control Rod Inspection and Removal,” describes the rod drop time test but provides no information

- regarding control rod inspection and removal. Please describe the procedure used for control rod removal and inspection, including the applicable console settings and how shutdown margin is maintained.
51. NUREG–1537, Part 1, Section 12.11, “Startup Plan” requests the applicant to provide a description of the startup plan for license amendments authorizing modifications such as a request for increased power level. The DTRR SAR does not provide this information. Please provide a startup plan for the new requested power level.
 52. NUREG–1537, Part 1, Section 13.1.1, “Maximum Hypothetical Accident” requests the applicant to provide a maximum hypothetical accident (MHA) and demonstrate that it bounds all potential credible accidents at the facility. The MHA for TRIGA reactors is typically the failure of one fuel element in the air with the release of gaseous fission products. DTRR SAR, Section M.1.3, analyzes a fuel failure in the pool, but it does not meet the expectation of being a bounding accident analysis. Please provide an analysis of the MHA for the DTRR that bounds all other accident analyses. Please include all assumptions, sequence of events and the potential radiological consequences.
 53. NUREG–1537, Part 1, Section 13.1.2, “Insertion of Excess Reactivity” requests the applicant to provide an analysis of reactivity insertion events. Similarly, NUREG–1537, Part 1, Section 4.5.3, “Operating Limits,” requests that the applicant provide an analysis of the uncontrolled withdrawal of the highest reactivity control rod. DTRR SAR, Section M.1.2, does not provide sufficient information regarding reactivity insertion events.
 - 53.1 Please provide an analysis of possible reactivity insertion events for the DTRR.
 - 53.2 Please provide an analysis of the uncontrolled rod withdrawal event for DTRR using the highest reactivity control rod.
 54. NUREG–1537, Part 1, Section 13.1.3, “Loss of Coolant” requests the applicant to provide analysis that assures that doses to the public that could result from a loss of coolant accident do not exceed 10 CFR Part 20 limits. DTRR SAR, Section M.1.1, Table 7 presents exposures resulting from a loss of coolant accident. There is no statement regarding occupational or public dose limits and whether they are met. Please explain this accident analysis in further detail and in terms of meeting the regulatory limits.
 55. NUREG–1537, Part 1, Section 13.1.5, “Mishandling or Malfunction of Fuel” requests the applicant to provide analyses regarding the mishandling or malfunction of fuel. DTRR SAR, Section M.1.3, provides an analysis that assumes that a damaged fuel element is submerged in the reactor pool at the time of the event and only halogens and noble gases are released. The DTRR SAR does not discuss how the accident terminates and does not provide exposures to the staff or the public. Please provide additional information regarding this analysis indicating how the accident terminates and the dose consequences of this accident analysis.
 56. NUREG–1537, Part 1, Section 13.1.6, “Experiment Malfunction” requests the applicant to provide analysis of an experiment malfunction event. DTRR SAR, Section M.1.4, does not include analysis of an experiment failure with release of radioactivity. Please provide an analysis and consequences of an experiment malfunction for the experiment with the highest potential release of radioactivity.
 57. NUREG–1537, Part 1, Section 13.1.9, “Mishandling or Malfunction of Equipment” requests the applicant to provide analysis regarding equipment mishandling or

- malfunction. DTRR SAR, Section M.1.7, describes an accident that involves dropping a lead transfer cask in the pool but does not discuss the accident results and dose consequences. Please provide information pertaining to the results and consequences of the accident scenario with the dropped lead cask.
58. American National Standards Institute/American National Standards (ANSI/ANS)-15.1-2007, Section 1.3, provides definitions commonly used in Research and Test Reactor TSs. The DTRR TS definitions noted below did not conform or lacked recommended detail. Please explain and justify the differences noted below or consider revising these definitions.
- 58.1 "Reportable Occurrence" as defined in the DTRR TSs 1.29c and 1.29f do not conform to ANSI-15.1-2007 Sections 6.7.2(1)(c)(iii) and 6.7.2(1)(c)(vi).
- 59.2 "Reactor Shutdown" does not include reference core condition in the definition as recommended by ANSI/ANS-15.1-2007.
- 59.3 "Shutdown Margin" does not conform to the definition in ANSI-15.1-2007.
- 59.4 "Excess Reactivity" does not include reference core condition in the definition as recommended by ANSI/ANS-15.1-2007.
- 59.5 "Limiting Safety System Settings" does not conform to the description of the LSSS in ANSI/ANS-15.1-2007, Section 2.2, "Limiting Safety System Settings."
59. ANSI/ANS-15.1-2007, Section 2.2, "Limiting Safety System Settings" requests that Technical Specifications establish setpoints for protective actions. DTRR TS 2.2 does not define the LSSS setpoint for the new requested power level. Please provide a TS that establishes the LSSS setpoint for the new requested power level.
60. The license renewal application for License R-108 requested an increase in the steady state power level for the DTRR. However, the proposed TSs do not provide Limiting Conditions for Operations (LCO) for the requested increase in steady state power. Please provide a LCO for the new requested power level.
61. ANSI/ANS-15.1-2007, Section 3, "Limiting Conditions for Operations" and NUREG-1537, Part 1, Appendix 14.1, Section 3.8.2, "Materials," provide recommended LCOs. Some differences were noted with the DTRR TS LCOs. Please explain and justify why the DTRR TS LCOs differ from these guidance documents or consider revising the LCOs.
- 61.1 ANSI/ANS-15.1-2007, Section 3.1, "Reactor Core Parameters" recommends an LCO for fuel inspection not found in the DTRR TS LCOs.
- 61.2 ANSI/ANS-15.1-2007, Section 3.2, "Reactor Control and Safety Systems" recommends a specification for permitted bypassing of channels for checks, calibrations, maintenance, or measurements. DTRR TS 3.3, "Reactor Control and Safety Systems" does not specify when it is permitted to bypass channels for checks, calibrations, maintenance or measurements.
- 61.3 ANSI/ANS-15.1-2007, Section 3.3, "Coolant Systems" recommends an LCO for monitoring pool leaks, loss-of-coolant, and isolation valve positions which were not found in the DTRR TS 3.4, Coolant System.

- 61.4 ANSI/ANS-15.1-2007, Section 3.7, "Radiation Monitoring Systems and Effluents" recommends an LCO for monitoring environmental conditions which is not found in DTRR TS 3.6, Radiation Monitoring Systems.
- 61.5 ANSI/ANS-15.1-2007, Section 3.8.1 recommends a limit for the sum of the absolute values of the reactivity worth of all experiments. DTRR TS 3.7, "Experiments" provides a limit for the total absolute reactivity worth of in-core experiments that is inconsistent with this recommendation.
- 61.6 ANSI/ANS-15.1-2007, Section 3.8.1 recommends a specification for the absolute reactivity worth of individual experiments. DTRR TS 3.7, "Experiments," does not provide reactivity worth limits for individual unsecured, secured or movable experiments.
- 61.7 NUREG-1537, Part 1, Appendix 14.1, Section 3.8.2, "Materials," recommends that containers for experiments containing known explosive materials be designed such that the design pressure of the container is twice the pressure the experiment can potentially produce. DTRR TS 3.7, "Experiments" Specification 5 does not include this guidance for known explosive material containers.
- 62. ANSI/ANS-15.1-2007, Section 4, "Surveillance Requirements," identifies recommended Surveillance Requirements (SRs). The following differences were noted in comparison to DTRR TS surveillance requirements. Please provide justification regarding the differences noted or consider revising the surveillance requirements noted below.
 - 62.1 DTRR TS 4.0, "Surveillance Requirements" does not specify which surveillances, if any, are required for safety while the reactor is shutdown and thus should not be deferred during a period when the reactor is shutdown.
 - 62.2 DTRR TS 4.0, "Surveillance Requirements" does not specify which surveillances are required prior to, or following maintenance, inspection, and fuel movement activities.
 - 62.3 DTRR TS 4.2, "Reactor Control and Safety Systems" Specification 2 accomplishes calibration of NM1000, however, no equivalent specification applies to NPP1000.
 - 62.4 ANSI/ANS-15.1-2007, Section 4.3(4) recommends that reactor coolant be analyzed for radioactivity annually. This specification was not found in DTRR TS 4.3, "Coolant Systems."
 - 62.5 DTRR TS 3.5, "Confinement" has no corresponding SR.
 - 62.6 DTRR TS 3.8, "Experiments" has no corresponding SR.
 - 62.7 DTRR TS 4.4, "Radiation Monitoring Systems" does not specify the frequency of evaluation of environmental monitors.
- 63. ANSI/ANS-15.1-2007, Section 1.2.2, "Format" recommends that the Basis "provides the background or reason for the choice of specification(s) or references a particular portion of the Safety Analysis Report." The Bases listed below lack specific reference and need additional information:
 - 63.1 In DTRR TS 2.2, "Limiting Safety System Settings" an updated basis should be provided based on the LSSS determined for the new requested power level.

- 63.2 In DTRR TS 3.1, "Reactivity Limits" the Bases for this LCO do not have an explanation or DTRR SAR reference for the reactivity limits stated. The Bases do not include data for all components of the excess reactivity and shutdown margin evaluations and how the components are used.
64. ANSI/ANS-15.1-2007, Section 5.0, "Design Features" provides information, identified below, regarding content and format that was not found in the DTRR TS. Please provide additional information for each of the following:
- 64.1 ANSI/ANS-15.1-2007, Section 5.1, "Site and Facility Description" recommends a description of the site and the facility expressly identifying the extent of the reactor license coverage.
- 64.2 ANSI/ANS-15.1-2007, Section 5.2, "Reactor Coolant System" requests a description of the reactor coolant system including materials and applicable temperatures.
- 64.3 ANSI/ANS-15.1-2007, Section 5.3, "Reactor Core and Fuel" recommends providing a description of: 1) core parameters including fuel enrichment; 2) conditions for operation of the reactor with damaged or leaking fuel elements; and 3) fuel burn-up limits.
65. ANSI/ANS-15.1-2007, Section 6, "Administrative Controls" provides recommendations regarding content and format. DTRR TSs differences from these recommendations were noted. Please provide additional information for the following:
- 65.1 ANSI/ANS-15.1-2007, Section 6.1, "Organization" recommends organizational structures including levels and reporting authority. DTRR TS Figure 6.1, the DTRR organization structure, includes no level 3 or 4 staff and differs from Figure 8.0 of the DTRR SAR.
- 65.2 ANSI/ANS-15.1-2007, Section 6.1.2, "Responsibility" describes responsibilities for the operation and safeguarding of the public which was not fully described in DTRR TS 6.1.2. Please describe the Facility Director's responsibilities and clarify what is meant by "management sense."
- 65.3 ANSI/ANS-15.1-2007, Section 6.1.3(3), "Staffing" lists those events requiring the senior reactor operator to be present at the facility. DTRR TS 6.1.3 does not include initial startup and approach to power recommended by ANSI/ANS-15.1, Section 6.1.3(3)(a) and required by 10 CFR Section 50.54(m)(1).
- 65.4 ANSI/ANS -15.1-2007, Section 6.1.4, "Selection and Training of Personnel" recommends meeting or exceeding the criteria in ANSI/ANS-15.4-1988 (R1999). DTRR TS 6.1.4 states that the implementation shall be consistent with all current regulations but does not indicate what regulations or guidance is being met.
- 65.5 ANSI/ANS-15.1-2007, Section 6.2.2, "Charter and Rules" provides recommendations that are incorporated into DTRR TS 6.2.1 except for the provision for "quick action" in DTRR TS 6.2.1. Please explain what this means and when this would be necessary.
- 65.6 ANSI/ANS-15.1-2007, Section 6.2.4, "Audit Function" recommends an audit of the facility emergency plan and implementing procedures and the operator requalification program that is performed by an individual not immediately responsible for the audited area. DTRR TS 6.2.3.b states that these audits may

be satisfied by the annual review of these plans for the requalification program. Please explain how this audit process meets the recommendation that the audit be performed by an individual not immediately responsible for the area audited.

- 65.7 ANSI/ANS-15.1-2007, Section 6.4, "Procedures," recommends procedures for several categories of activities. DTRR TS 6.3 does not apply this recommendation to emergency and security plans, surveillances, and experiments.
- 65.8 ANSI/ANS-15.1-2007, Section 6.5, "Experiment Review and Approval" recommends that experiments be carried out in accordance with approved procedures. DTRR TS 6.4 does not describe the process of experiment review and approval for new experiments.
- 65.9 ANSI/ANS-15.1-2007, Section 6.7, "Reports" provides recommendations for reporting activities. The DTRR TS Section 6.6.1 (c) uses the outdated terminology "unreviewed safety question."
- 65.10 ANSI/ANS-15.1-2007, Section 6.7.2(1), "Special Reports" specifies facsimile or similar conveyance of the special report. DTRR TS 6.6.2.a specifies telegraph of similar conveyance.
- 65.11 ANSI/ANS-15.1-2007, Section 6.8, "Records" provides recommendations for record retention. ANSI/ANS-15.1-2007, Section 6.8.2 recommends an administrative control that retraining and requalification records for operators be retained for at least one certification cycle (per 10 CFR 55.55(a) this period is 6 years) and be maintained at all times the individual is employed or until the certification is renewed. DTRR TS 6.7.2 is not consistent with this ANSI/ANS Section 6.8.2 guidance.
- 65.12 ANSI/ANS-15.1-2007, Section 6.8.3, "Records to be retained for the lifetime of the reactor facility" recommends certain records be maintained for the lifetime of the facility. DTRR TS 6.7.3 does not implement the full extent of those recommendations (e.g. it does not include records of violations of safety limits, LSSS, LCOs; environmental monitoring; or approved changes in operating procedures).
- 66. NUREG-1537, Part 1, Appendix 14.1, Section 6.6.2 "Action To Be Taken in the Event of an Occurrence of the Type Identified in Sections 6.7.2(1)(b) and 6.7.2(1)(c)" states that in cases where the applicant chooses to employ alternative actions (shut down or return to normal) specific criteria should be established. DTRR TS 6.5.2 does not establish criteria for determining when the reactor must be shut down or when it can be returned to normal operation. Please describe and justify the need for the alternative action "reactor conditions shall be returned to normal" by providing examples of when this alternative action would be used in the event of a reportable occurrence as defined by DTRR TS 1.29
- 67. NUREG-1537, Part 1, Section 16.1, "Prior Use of Reactor Components" requests the applicant to provide information on prior use of items significant to safety, such as fuel cladding, reactivity control system, engineered safety features, and radiation monitoring systems. This means evaluating the continued serviceability of originally supplied components (e.g., for aging and wear); and also to consider the suitability of items supplied by other facilities. DTRR SAR Chapter P.1 does not provide sufficient detail regarding the prior use and continued use of items significant to safety. Please provide

additional detail to the information provided in DTRR SAR Chapter P.1 and provide information to support the acceptability of the ion and fission chambers at the new requested power level.