The Dow Chemical Company
Midland, Michigan 48667

Mr. Geoffrey Wertz
Research and Test Reactors Licensing Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Subject: Dow Chemical Company- Response to the Request for Additional Information for the renewed license of the TRIGA research reactor. License No. R-108; Docket No. 50-264

Enclosed the response to the request for additional information questions 8, 15, 17, and 28. In addition, I am requesting a 90 day extension for the following questions.

RAI 7,14,16,18,19,24,26,29,52,53,54,55,56,57.

Should you have any questions or need additional information, please contact the undersigned at 989-638-6932.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on May. 12, 2011

Melinda Krahenbuhl, Ph.D.
Director
Dow TRIGA Research Reactor

Subscribed and sworn to before me this 12 day of May, 2011

Kimberly A. Hartman
Notary Public
Gladwin County, Michigan
My Commission Expires:
December 15, 2016

KIMBERLY ANN HARTMAN
NOTARY PUBLIC - STATE OF MICHIGAN
COUNTY OF GLADWIN
My Commission Expires December 15, 2016
Acting in the County of Midland

cc: Wayde Konze, R&D Director - Analytical Sciences

A020
NRR

Response to request for additional information

The Dow Chemical Company

May 2011

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.

DTRR response:

The roof of building 1602 is poured gypsum with a 6-ft by 6ft dome skylight equipped with two one-piece domes centered over the reactor pool. Maintenance on the building infrastructure is completed on an as need basis. Instrumentation is protected by not storing it directly on the floor in case of flooding. If water damage is incurred by rod drives, the current to the magnet is interrupted the control rods drop by gravity into the core.

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 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 requested power level. Please provide a complete description of the LCC for the 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 requested power level.

DTRR response:

15.1 At 300 kW the excess reactivity is limited to $3.00, and shutdown margin is $1.00 based on a cold xenon negligible condition (<0.30$). The control rod worth for the safety and shim is approximately $3.00 each. The reg rod is worth ~$ 1.00.

The reactivity worth of the control rods are Shim1 $2.68, Shim 2 $2.73, Reg $1.01 as measured 1/11/11.

15.2 The core configuration is found in Figure 1. The core is loaded with 79 SS fuel elements, 1 Al fuel element and 5 graphite dummies.

15.3. The excess reactivity of the DTRR as currently configured is \$2.28 (1/11/11)

•F4-Rabbit Terminus
•S-AmBe Source
•D-Dummy element
•AL- Aluminum Fuel element
•Safe- Safety control rod
•Shim-Shim Control rod
•Reg-Regulating Control Rod

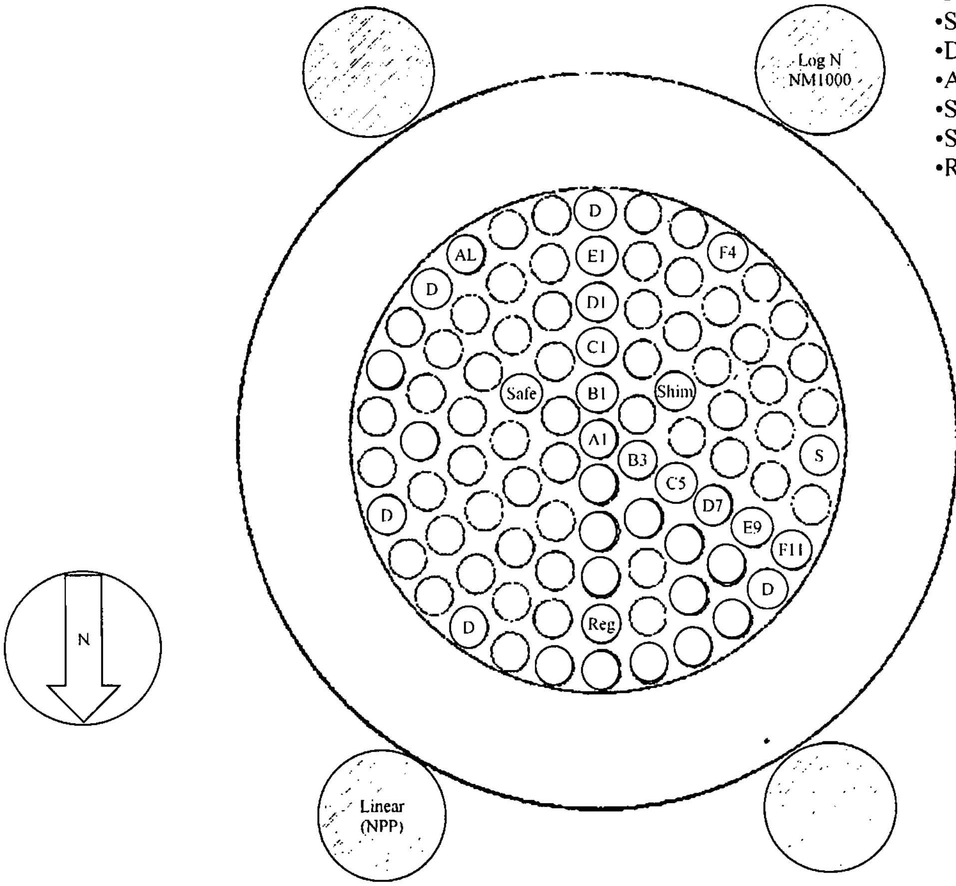

Figure 1. Upper grid plate

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.

DTRR response:

17.1 Excess reactivity is experimentally determined using the data collected during the control rod worth determinations at reference core condition. This excess reactivity analysis is completed twice a year. The reference core condition is defined as - the core is at ambient temperature (cold) and the reactivity worth of xenon in the fuel is negligible (less than $.30). Additionally, excess reactivity is determined hourly when the reactor is operational. Algebraically the core excess =both shim rod worths + reg rod worth at any given power level.

17.2 Shut down margin is experimentally determined using the data collected during the control rod worth determinations which are done twice a year. The core is at the reference core condition. Algebraically the Shutdown margin = total reactivity worth of the reg rod + the total reactivity of the smaller worth shim rod – the excess reactivity at reference core conditions. Shutdown margin is $1.33 (1/11/11). Uncertainties in the measurements of control rod worth are dependent on individual time measurements of reactor power change due to stepwise withdrawal of each individual control rod. Multiple measurements are taken at each step withdrawal for each control rod to minimize uncertainty. Total rod worth is determined by curve fitting data. Uncertainty for the value of the shutdown margin using in this approach is estimated to be 5%.

17.3 Using introductory nuclear physics (Lamarsh and Baratta 2001): fission produces energy. Some of this energy is deposited in the fuel and the cladding. The result of this energy deposition is a change in the fuel temperature. The change in the temperature is therefore dependent on the fission rate or power and the heat capacity of the fuel and clad. Limiting the power output (i.e. the rate of fission), limits the fuel temperature. The DTRR is not equipped with instrumented fuel elements. The maximum and average fuel temperature at 300 kW were calculated as 260 °C and 140°C, respectively assuming that the maximum and power density is twice the average power density. The model is an iterative process using estimated flux, water temperature (60°C) and correlations for natural convection. These estimates were confirmed based on measurements in similar facilities (Whittemore W.L. 1994).

Lamarsh J.R. and Barratta A.J., "Introduction to Nuclear Engineering 3rd edition", Prentice Hall Upper Saddle River, New Jersey, 1991

Whittemore W.L., "The General Atomics TRIGA MARK 1 Reactor: Past and Present" General Atomics, July 1994.

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.

DTRR response:

Reference: "Operation and maintenance manual microprocessor based instrumentation and control for the ICI TRACERCO TRIGA reactor", General Atomics 1990.

28.1 The I&C system has an interlock on the start-up count rate, reactor drive control and period. When the start-up channel is less than 2 cps, control rod movement is prevented. The reactor drive control prohibits the withdrawal of two or greater control rods by the control rod drives. The third interlock prohibits rod withdrawal when the reactor period is less than 3 seconds. Bypassing of the channels and interlocks in table 3.3 is permitted for checks, calibrations, maintenance or measurement with written approval from the Reactor Operations Committee.

28.2 Parameters that are monitored and displayed are Linear Power, Percent Power and Log power, pool water temperature, pool water activity, control rod position, and period. The following table indicates the scrammable channels and the channels monitoring the parameter and the actuating set point. In the case of the loss of high voltage there is no display. Pool water activity, control rod position, pool water temperature are not scrammable channels. Additionally, the readings from the area radiation monitor and the continuous air monitor can be viewed from the console.

Scram Channel	Minimum Operable	Scram Setpoint
Reactor Power Level NM1000 & NPP1000	2	Not to exceed maximum licensed power
NPP1000 Detector High-Voltage Power Supply	1	Failure of the detector high-voltage power supply
NM1000 Detector High-Voltage Power Supply	1	Failure of the detector high-voltage power supply
Manual Scram	1	Not applicable
Watchdog (DAC to CSC)	1	Not applicable

28.3 The power monitoring channels, pool water temperature, and control rod position are displayed at the console at either the graphic display, status monitor or both. The water activity (Geiger tube) is displayed on top of the console. The area radiation monitor reading is displayed on a shelf to the right of the console. Rod drives movement is controlled by buttons located on the console. Figure 2 is a block diagram of the console.

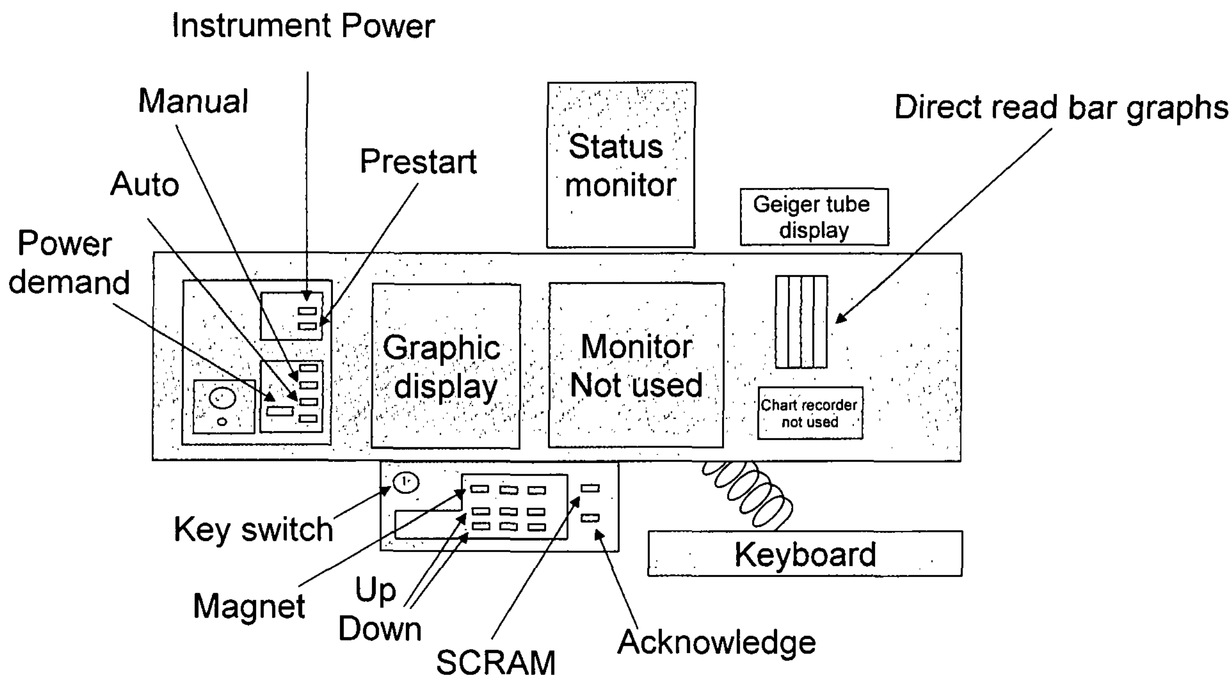

Figure 2. Block Diagram of the console