Department of Mechanical Engineering
THE UNIVERSITY OF TEXAS AT AUSTIN
Nuclear Engineering Teaching Laboratory • Austin, Texas 78758
512-232-5370 • FAX 512-471-4589 • http://www.me.utexas.edu/~netl/

08/21/2013

ATTN: Document Control Desk,
U.S. Nuclear Regulatory Commission,
Washington, DC 20555-0001

Patrick G. Boyle
Nuclear Engineer
NRR/DPR/PRLB

SUBJECT: Docket No. 50-602, Request for Renewal of Facility Operating License R-129

REF: UNIVERSITY OF TEXAS AT AUSTIN - REQUEST FOR ADDITIONAL INFORMATION REGARDING THE LICENSE RENEWAL REQUEST FOR THE NUCLEAR ENGINEERING TEACHING LABORATORY TRIGA MARK II NUCLEAR RESEARCH REACTOR (TAC NO. ME7694)

Sir:

Attached is a partial response to the Request for Additional Information referenced above, including:

- RAI 4
- RAI 5
- RAI 16.2
- RAI 17 (in 2 parts)
- RAI 25
- RAI 30
- RAI 32.1
- RAI 32.2
- RAI 35.7
- RAI 35.8
- RAI 36.2
- RAI 36.4
- RAI 40.1
- RAI 40.3
- RAI 40.5
- RAI 40.6
- RAI 40.7

A020
NRR

If there are any questions, please feel free to contact P. M. Whaley at 512 232 5373 or whaley@mail.utexas.edu.

Your attention in this matter is greatly appreciated,

P. M. Whaley

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

S. Biegalski

ATT: RAI RESPONSES

RAI 16.2

The coolant flow rates cited in UT SAR Table 5-1 for the tubes and shell side of the primary coolant heat exchanger appear to be in error. Please confirm and revise accordingly.

RESPONSE

The shell and tube flow rate values for Table 5-1 appear to have been inadvertently transposed, and will be changed to indicate:

Flow Rate (shell)	400 gpm (25.2 lps)
Flow Rate (tubes)	250 gpm (15.8 lps)

RAI 17 (a)

The guidance in NUREG-1537 Section 5.2, "Primary Coolant System," requests that the licensee 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 safety limits should be shown and discussed. UT SAR Section 5.3.4 provides a summary of the control system, but does not include information on the pool low-level scram setpoint referred to in UT SAR, Section 13.6.2 and the UT TRIGA TS 3.4, Table 2....

RESPONSE

Section 5.3.4 Control System will be revised to add information and structure as indicated:

a. Level gage

A metric scale is used to provide local indication of pool level. With the 23.5 cm mark secured to the tank equipment monitoring ring, 8 cm corresponds to 8.10 meters above the floor of the pool. Pool level is normally maintained at 8.10 ± 0.05 m, corresponding to an indicated 8 ± 5 cm.

b. Level Control Functions

Pool level is monitored by 5 float switches using sealed relays on two separate assemblies. Two level switches are adjusted to alarm if water level is 5 cm above or 10 cm below the nominal value (8.15 or 8.05 m above the pool floor, 8.8 or 7.5 cm gage level). Two level switches are adjusted to provide a reactor trip initiation if water level falls to 7.79 m above the pool floor, 30 cm below normal pool level. One level switch is adjusted below the reactor trip switches to alarm at a remote 24-hour response station.

c. Temperature Control

(Followed by the information currently in the draft Safety Analysis Report.)

RAI 17, Part 2: The guidance in NUREG-1537 Section 5.2, "Primary Coolant System," requests that the licensee 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 safety limits should be shown and discussed...In addition, it does not describe actions that are needed, or should be taken, should pressure at the chilled water outlet rise above the pressure at the pool inlet to the heat exchanger. Please confirm and revise accordingly.

RESPONSE:

Section 3.8.3 specifies:

D	The pressure difference between chilled water outlet from the pool heat exchanger and pool water inlet SHALL NOT be less than 7 kPa (1 psig)

Section 3.8.4 specifies:

D. The pressure difference between chilled water outlet from the pool heat exchanger and pool water inlet is less than 7 kPa (1 psig)	D.1 ENSURE the reactor is SHUTDOWN OR D.2 Verify pressure differential is greater than 7 kPa (1 psig) OR D.3 RESTORE pressure difference to greater than 7 kPa (1 psig) OR D.4 Isolate chill water	D.1 IMMEDIATE D.2 IMMEDIATE D.3 IMMEDIATE D.4 IMMEDIATE

"Actions that are needed, or should be taken, should pressure at the chilled water outlet rise above the pressure at the pool inlet to the heat exchanger" are to (1) ensure the reactor is shutdown or (2) one of the following (a) verify differential pressure is greater than 7 kPa (1 psig), (b) restore the pressure difference to greater than 7 kPa (1 psig), or (c) isolate the chill water.

The basis states, "The specified pressure difference assures that any postulated heat exchanger leakage will not release potentially contaminated water to the chill water system." If a limiting condition for operation cannot be met, the reactor should be shutdown. It is possible that the differential pressure channel is not operating properly, and actual differential pressure is adequate to me the specification. If it can be verified that actual pressure is adequate, operations may continue. If differential pressure does not meet the specification but can be restored, operation contingent on restoration is acceptable. If the pressure differential does not meet the specification and cannot be restored, isolation of the chill water system from the heat exchanger will prevent flow from the pool water system into the chill water system.

RAI 25:

The guidance in NUREG-1537 Section 11.1.5, "Radiation Exposure Control and Dosimetry," requests that the licensee consider of all groups (including embryos and fetuses, declared pregnant women, minors, and students) when establishing dose limits. The UT SAR does not mention these groups, or whether they were considered in establishing dose limits. Please confirm that these considerations are included in your radiation protection procedures or elsewhere.

RESPONSE:

While ALARA has always been applied to doses to all groups, an exposure limit for special categories of radiation workers (declared pregnant workers, minors, etc.) was not explicitly stated in the NETL ALARA program. A revised version of the NETL ALARA program has been drafted and will be submitted to the Reactor Oversight Committee for approval stating that for special categories of radiation workers (declared pregnant workers, minors, etc.), the dose limit will be established on a case-by-case basis by the NETL Director with concurrence from the HP.

RAI 30

The guidance in NUREG-1537 Section 13.1.6, "Experiment Malfunction," requests that the licensee provide analysis of an experiment malfunction event. UT SAR, Section 13.8.2.C includes an analysis of fueled experiment fission product inventory to estimate the allowable limit on production of iodine and strontium in an experiment based on a 2-hour DAC limit; the analysis uses fission yield data from uranium-235. Please clarify the source of the activation materials for producing iodine, and identify actions needed if it is not ^{235}U. In addition, please show that the limits for the iodine and strontium are less than the values that could be released in an MHA and the doses to the public from such releases are within the 10 CFR Part 20 limits.

RESPONSE

This RAI is addressed in 2 parts. Fission product isotopes of interest are first considered, then neutron activated materials. In both cases, the derived air concentrations of 10CFR20 appendix B is identified for each element of interest, then the activity that (if released into the reactor bay, volume of 4.12E9 ml) would result in 1000 DAC is calculated. Finally, the maximum potential exposure associated with a postulated release is calculated using CAP-88.

FISSION PRODUCT ISOTOPES OF INTEREST

Fission products of interest include radioactive strontium and iodine. The results of calculations for fueled experiments are provided in Table 1.

Table 1, Maximum Potential Dose Outside Reactor Bay from Fueled Experiments

Isotope	Fueled Exp. Limit µCi	Max. Dose mrem/yr	DAC µCi/ml	Bay Activity (1000 DAC) µCi	Max. Dose (1000 DAC) mrem/yr
Sr-90 (D)	93500	2.65	8E-09	32960	0.93416
Sr-90 (Y)	93500	2.65	2E-09	8240	0.23354
I-131	932000	0.414	2E-08	82400	0.036603
I-132	932000	0.00509	0.000003	12360000	0.067503
I-132m	932000	0.00142	0.000004	16480000	0.025109
I-133	932000	0.0452	1E-07	412000	0.019981
I-134	932000	0.00461	0.00002	82400000	0.407579
I-135	932000	0.0137	7E-07	2884000	0.042394

NEUTRON ACTIVATED MATERIALS

Neutron activation products with the potential to exist in a vapor form (e.g., noble gases, low vapor pressure, and sublimation potential at near atmospheric pressure) were identified. The maximum potential dose associated with potentially gaseous activation products is provided in Table 2, with the exception that materials with a half-life too short to be included in CAP-88 calculations are not included.

Table 2: Maximum Potential Dose from Release of Volatile Material (at 1000 DAC in the Reactor Bay)

Isotope	DAC µCi/ml	Bay Activity µCi	Max. Dose mrem/yr
H-3	0.00002	82400000	0.0498
F-18	1E-07	412000	0.000984
Cl-36	0.000001	4120000	323
Cl-38	0.00002	82400000	0.259
Ar-37	1	4.12E+12	0
Ar-39	0.0002	8.24E+08	0.00399
Ar-41	0.000003	12360000	3.04E-05
Ga-70	0.00008	3.3E+08	0.0513
Ga-72	0.000001	4120000	0.143
As-74	3E-07	1236000	0.732
As-76	6E-07	2472000	0.0289
As-77	0.000002	8240000	0.036
Se-75	3E-07	1236000	2.58
Se-77m	1E-07	412000	0
Se-81	0.0001	4.12E+08	0.037
Se-81m	0.00003	1.24E+08	0.0261
Se-83	0.00005	2.06E+08	0.799
Br-80	0.00009	3.71E+08	0.0701
Br-80m	0.000007	28840000	0.0279
Br-82	0.000002	8240000	0.00101
Kr-85m	0.00002	82400000	0.0234
Kr-87	0.000005	20600000	0.032
Kr-88	0.000002	8240000	0.0365
Rb-86	3E-07	1236000	0.341
Rb-88	0.00003	1.24E+08	0.151
Xe-125	0.00002	82400000	2.81
Xe-127	0.00001	41200000	0.0196
Xe-129m	0.0002	8.24E+08	0.0318
Xe-131m	0.0004	1.65E+09	0.0243
Xe-133	0.0001	4.12E+08	0.0232
Xe-133m	0.0001	4.12E+08	0.0224
Xe-135	0.00001	41200000	0.0191
Xe-135m	0.000009	37080000	0.0205
Xe-138	0.000004	16480000	0.0366
Hg-197	0.000006	24720000	1.15
Hg-197m	0.000004	16480000	1.03
Hg-199m	0.00007	2.88E+08	0.559
Hg-203	5E-07	2060000	0.156

Of the materials analyzed, only chlorine 36 has the potential to exceed the 100 mrem/yr exposure limit for routine non-occupational exposure or the 10 mrem/yr limit on routine effluents. Neutron activation is calculated by:

$$A = \phi \cdot N \cdot \sigma \cdot (1 - e^{-\lambda \cdot t})$$

Where A is the specific activity, ϕ is the neutron flux, N is the number density of the target material, σ is the cross section, and λ is the decay constant. Defining κ as total activity, V_{Cl35} as the volume of the target material, and using the standard mass/atomic weight relationship:

$$\frac{\frac{m \cdot N_A}{AMU}}{V_{Cl35}} = \frac{\left[\kappa / V_{Cl35}\right]}{\phi \cdot \sigma \cdot (1 - e^{-\lambda \cdot t})}$$

or

$$m = \frac{\kappa}{\phi \cdot \sigma \cdot (1 - e^{-\lambda \cdot t})} \cdot \frac{AMU}{N_A}$$

For an activity that would result in 1000 times the Cl36 DAC (4.12E6 μCi), neutron flux approximately 1E13 n/cm^2-s, cross section of approximately 60 barns, the number of target chlorine 35 atoms required to achieve the 1000 DAC value (where *t* is the irradiation interval) is:

$$m = \frac{(4.12\ Ci)(3.7x10^{10}\ Bq)(cm^2\ s)(AMU)}{(Ci)(10^{13}\ n)(60x10^{-24}\ cm^2)(1-e^{-\lambda t})(6.023x10^{23})} = 4.22x10^{-4}/(1 - e^{-\lambda t})$$

The decay constant (λ) is 0.693/$t_{½}$; the denominator of the equation is on the order of 1E-8 for values less than about 100 hours. Therefore the mass of Cl35 required to achieve 1000 DAC is on the order of 42 kg. The 100 mrem/yr exposure limit for routine operations can be met if the target mass is reduced to 31%, on the order of 13 kg. The annual limit of 10 mrem/yr from routine effluents can be met if the target mass is reduced to 3.1%, or 1.3 kg. The chemical reactivity, physical form, and half-life of chlorine 36 (3E5 years) render generation of Cl36 quantities that are capable of challenging exposure limits virtually impossible.

Since there is no realistic mechanism to generate a quantity of Cl36 that could challenge limits, a single specified value of 1000 DAC is preferred (rather than noting the exception) to provide simple and clear guidance.

TRIGA fuel elements are specifically exempted from consideration in experimental limits, and this analysis does not rely on or impact the maximum hypothetical accident (TRIGA fuel element failure).

RAI 32.1

32. The "Interim Staff Guidance for the Streamlined Research Reactor License Renewal Process," (ISG) identifies ANSI/ANS-15.1-2007 and the corresponding regulatory positions in NUREG-1537, Appendix 14.1 are the guidance documents for the review of technical specifications. The guidance in ANSI/ANS-15.1-2007 Section 1.3, "Definitions," recommends definitions commonly used in Research and Test Reactor TS. The TS definitions noted below were either missing, were not consistent with guidance, or were lacking recommended details. (Note: capitalization for this sequence of RAIs follows the style of the proposed UT TRIGA TS.)

32.1 The proposed UT TRIGA TS definitions section 1.0 does not describe definitions for: core configuration; license; licensee; protective action; reactivity worth of an experiment; reactor operator; reactor operating; responsible authority; safety limit; scram time; senior reactor operator; shall/should/may definitions (only the definition for "shall" is provided); true value; unscheduled shutdown. Please provide definitions for the above or provide justification for not using them.

RESPONSE

The following terms are not used at all: Responsible Authority, Scram time, Should, True Value, and Unscheduled Shutdown. In the absence of the term "Should," May is unambiguous.

The following terms are not used in specification statements, but are unambiguous and understood In context: Core Configuration, Reactor Operating, and Protective Action. In addition, protective action is used in a generic sense, and includes reactor safety system response as well as actions for protection of personnel.

License and licensee have more than one 10CFR20 definition, and are understood in context.

Reactivity worth of an experiment is unambiguous and understood in context.

Safety Limit is an explicit section of the Technical Specifications, and has specific statements and requirements related to the section.

As per a recent proposed Technical Speciation change, reactor operator and senior reactor operator are currently being changed to the terminology of 10CFR55. Since operators are trained to 10CFR55 the terms should be well understood, and "certified" is not a correct term.

RAI 32.2

32. The "Interim Staff Guidance for the Streamlined Research Reactor License Renewal Process," (ISG) identifies ANSI/ANS-15.1-2007 and the corresponding regulatory positions in NUREG-1537, Appendix 14.1 are the guidance documents for the review of technical specifications. The guidance in ANSI/ANS-15.1-2007 Section 1.3, "Definitions," recommends definitions commonly used in Research and Test Reactor TS. The TS definitions noted below were either missing, were not consistent with guidance, or were lacking recommended details. (Note: capitalization for this sequence of RAIs follows the style of the proposed UT TRIGA TS.)

32.2 The following definitions are not consistent with the guidance: channel calibration, excess reactivity; experiment; confinement; movable experiment; secured experiment. Please revise accordingly or provide justification for the deviations.

RESPONSE

1. channel calibration

ANSI/ANS-15.1-2007 defines:

channel calibration: A channel calibration is an adjustment of the channel such that its output corresponds with acceptable accuracy to known values of the parameter that the channel measures. Calibration shall encompass the entire channel, including equipment actuations, alarm, or trip, and shall be deemed to include a channel test.

The original proposed definition is:

Channel Calibration

Channel calibration is an adjustment of the channel such that its output corresponds with acceptable accuracy to known values of the parameter which the channel measures. Calibration shall encompass the entire channel, including equipment actuation, alarm, or trip and shall be deemed to include a channel test.

The defined term is taken verbatim from the current approved Technical Specifications. Since this was acceptable in the current (approved) Technical Specifications, it remains unchanged.

Differences between the approved definition and ANSI standard include (1) avoiding multiple uses of the word "that", deletion of "s" for parallel construction, and deletion of a comma. This is an editorial difference, and does not change the meaning of the definition in any way.

On further consideration, the second sentence will be split into two sentences for clarity in a second editorial change that does not change the meaning of the definition in any way, so that the definition will be:

Channel Calibration

Channel calibration is an adjustment of the channel such that its output corresponds with acceptable accuracy to known values of the parameter which the channel measures. Calibration shall encompass the *entire channel, including equipment actuation, alarm, or trip. Calibration shall be deemed to include a channel test.*

1. excess reactivity

ANSI/ANS-15.1-2007 defines:

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

The original proposed definition is:

Reactivity, Excess

Excess reactivity is that amount of reactivity that would exist if all the control rods were moved to the maximum reactive condition from the point where the reactor is exactly critical.

The defined term is taken verbatim from the current approved Technical Specifications. Since this was acceptable in the current (approved) Technical Specifications, it remains unchanged.

The last phrase of the ANSI definition ("or at a specified set of conditions") requires additional information to have an unambiguous meaning. Since "reactivity control devices" at the UT TRIGA are "control rods," and since "exactly critical" does not need amplification, the equivalent and unambiguous definition is less ambiguous than, but otherwise explicitly agrees with, the ANSI definition.

2. experiment:

ANSI/ANS-15.1-2007 defines:

experiment: any operation, hardware, or target (excluding devices such as detectors, foils, etc.) that is designed to investigate nonroutine reactor characteristics or that is intended for irradiation within the pool, or on or in a beam port or irradiation facility. Hardware rigidly secured to the core or shield structure so as to be part of its design to carry out experiments is not normally considered an experiment.

The original proposed definition is:

Experiment

Any operation, component, or target (excluding devices such as detectors, foils, etc.), which is designed to investigate non-routine reactor characteristics or which is intended for irradiation within the pool, on or in a beam tube or irradiation facility and which is not rigidly secured to a core or shield structure so as to be part of their design.

The defined term is taken verbatim from the current approved Technical Specifications. Since this was acceptable in the current (approved) Technical Specifications, it remains unchanged.

The meaning of the word "hardware" in the ANSI standard definition is not as well defined as when the standard was developed; "component" as used in the approved definition is more descriptive. However, the definition is still difficult to read; after further consideration, the definition will be edited in a way that does not alter the meaning to:

Experiment

Any operation, component, or target (excluding devices such as detectors, foils, etc) that is:

> *(1) designed to investigate non-routine reactor characteristics, or intended for irradiation within the pool, on or in a beam tube or irradiation facility; and*
>
> *(3) not rigidly secured to a core or shield structure so as to be part of the core or shield structure design.*

3. confinement:

ANSI/ANS-15.1-2007 defines:

confinement: Confinement is an enclosure of the overall facility that is designed to limit the release of effluents between the enclosure and its external environment through controlled or defined pathways

The proposed definition is equivalent:

Confinement

Confinement means an enclosure on the overall facility which controls the movement of air into it and out through a controlled path.

The defined term is taken verbatim from the current approved Technical Specifications. Since this was acceptable in the current (approved) Technical Specifications, it remains unchanged.

4. moveable experiment:

ANSI/ANS-15.1-2007 defines:

moveable experiment: A moveable experiment is one where it is intended that all or part of the experiment may be moved in or near the core or into and out of the reactor while the reactor is operating

The proposed definition:

Experiment, Moveable

A moveable experiment is one where it is intended that all or part of the experiment may be moved in or near the core or into and out of the reactor while the reactor is operating.

The defined term is taken verbatim from the current approved Technical Specifications. Since this was acceptable in the current (approved) Technical Specifications, it remains unchanged.

In comparison to the ANSI standard, the defined term is changed from "moveable experiment" to "experiment, moveable" in the current approved Technical Specifications in order to place the definition alphabetically near the definition of "experiment." Since this was acceptable in the current (approved) Technical Specifications, it remains unchanged.

5. secured experiment

ANSI/ANS-15.1-2007 defines:

secured experiment: A secured experiment is any experiment, experimental apparatus, or component of an experiment that is held in a stationary position relative to the reactor by mechanical means. The restraining force must be substantially greater than those to which the experiment might be subjected by hydraulic, pneumatic, buoyant, or other forces that are normal to the operating environment of the experiment, or by forces which can arise as a result of credible malfunctions.

The proposed definition:

Experiment, Secured

A secured experiment is any experiment, experiment facility, or component of an experiment that is held in a stationary position relative to the reactor by mechanical means. The restraining force must be substantially greater than those to which the experiment might be subjected by hydraulic, pneumatic, buoyant, or other forces which are normal to the operating environment of the experiment, or by forces which can arise as a result of credible conditions.

The defined term is taken verbatim from the current approved Technical Specifications. Since this was acceptable in the current (approved) Technical Specifications, it remains unchanged.

In comparison to the ANSI standard, the defined term was changed from "secured experiment" to "experiment, secured" for the currently approved Technical Specifications in order to place the definition alphabetically near the definition of "experiment." Since this was acceptable in the current (approved) Technical Specifications, it remains unchanged.

RAI 35.7 Section 3.3 of the guidance describes specifications for leak or loss of coolant detection and a secondary coolant activity limit. No such specifications are found in the proposed UT TRIGA TS.

RESPONSE:

The chill water subsystem for the pool cooling system as described in the Safety analysis Report is protected from radioactive contamination by:

1. System design, which maintains chill water pressure greater than pool water pressure so that any potential leakage will be from chill water to pool water, and

2. Automatic closure of a pneumatic valve if differential pressure drops to 2 psid, and

3. Control room alarms if differential pressure falls to 5 psid

The alarm and valve actuation are functionally tested prior to each startup. A pool- to chill- water leak would require multiple failures of the heat exchanger, heat exchanger design, and associated automatic controls as well as personnel failure to respond to an abnormal condition. A primary to secondary leak is not credible for the UT reactor.

RAI 35.8 Section 3.8.2 of the regulatory interpretations states that containers for experiments containing known explosive materials shall be designed such that the design pressure of the container is twice the pressure the experiment can potentially produce. Proposed UT TRIGA TS 3.6 "Limitations on Experiments," does not include such a specification.

RESPONSE:

The 13.8.2, D provides analysis for over pressure from explosives in a standard capsule used at the UT TRIGA reactor. Experiment design specification (5.4.3, part 9) will be revised to:

9. Use of explosive solid or liquid material with a National Fire Protection Association Reactivity (Stability) index of 2, 3, or 4 in the reactor pool or biological shielding

   a. SHALL NOT exceed the equivalent of 25 milligrams of TNT without prior NRC approval.

   b. SHALL be irradiated in a container capable of withstanding twice the pressure the experiment can potentially produce.

RAI 36: ANSI/ANS-15.1-2007 Section 3, "Limiting conditions for operations," requests that the licensee provide LCOs for constraints and operational characteristics that shall be adhered to during operation. The ISG states that the applicable TSs should explain why the TSs, including their bases, are acceptable. The following deficiencies and differences are noted with the proposed UT TRIGA LCOs: Please confirm and revise accordingly, or explain why such changes are not necessary.

36.2 The setpoint stated for condition B for Specification B in proposed UT TRIGA TS 3.3, "Measuring Channels," is stated as 2mW. However, the neutron count rate should be stated in terms of neutrons per unit time.

RESPONSE

3.3.3 Specifications will be revised to state:

A	The MEASURING CHANNELS specified in TABLE 1 SHALL be OPERATING
B	The startup channel indicates greater than 2 mW

And the basis will be revised to include:

Experience has shown that subcritical multiplication with the neutron source used in the reactor does not provide enough neutron flux to correspond to an indicated power level of $2x10^{-7}$ %. Therefore an indicated power of $2x10^{-7}$ % (or 2 mW) or more indicates operating in a potential critical condition, and at least one neutron channel is required with sensitivity at a neutron flux level corresponding to reactor power levels less than $2x10^{-7}$ % ("Startup Channel"). If the indicated neutron level is less than the minimum sensitivity for the channel, a neutron source will be used to determine that the channels is responding to neutrons to ensure that the channel is functioning prior to startup.

RAI 36: The guidance in ANSI/ANS-15.1-2007 Section 3, "Limiting conditions for operations," provides guidance and recommendations for the specifications pertaining to the limiting conditions for operation (LCO). This guidance is supplemented by NUREG-1537 Appendix 14.1. Some deficiencies and differences with the proposed UT TRIGA TS are described below. Please discuss these deficiencies and differences and revise accordingly.

36.4: Proposed UT TRIGA TS 3.4 Table 2 does not provided the scram setpoints for the Reactor Power Level, Fuel Temperature, and Pool Water Level SAFETY SYSTEM CHANNELS.

RESPONSE

Table 2 will be revised as:

TABLE 2: REQUIRED SAFETY SYSTEM CHANNELS				
Safety System Channel or Interlock	Minimum Number Operable	Function	OPERATING Mode Setpoint/Applicability	
			STEADY STATE MODE	PULSE MODE
Reactor power level	2	Scram	1.1 MW	NA
Manual scram bar	1	Scram	YES	YES
Fuel Temperature	1	Scram	550°C	550°C
Pool water level	1	Scram	YES	YES
CONTROL ROD (STANDARD) position interlock	1	Prevent withdrawal of standard rods in the PULSE MODE	NA	YES
Pulse rod interlock[1]	1	Prevent inadvertent pulsing while in STEADY STATE MODE	YES	NA

RAI 4

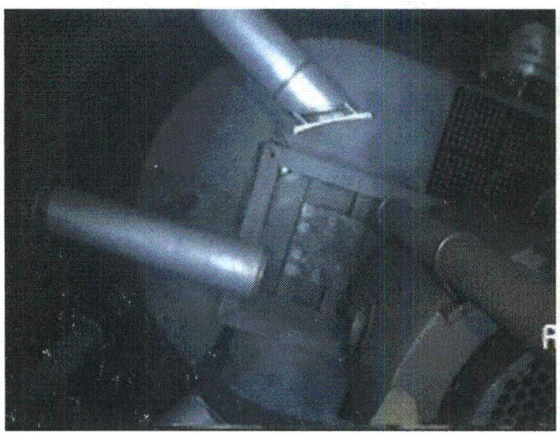
The guidance in NUREG-1537 Section 4.2.5, "Core Support Structure," requests that the licensee provide design information pertaining to the core support structure. UT SAR Section 4.2.5 provides some information, but does not address suitability for continued use. Please confirm whether there is any visual evidence of cracking, corrosion, or deformation of the core support structure, and state whether the structure is appropriate for continued use for the operating period being requested.

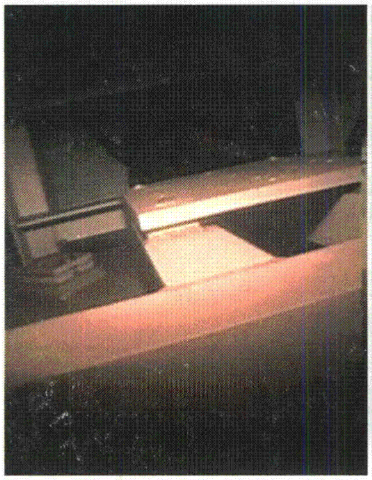
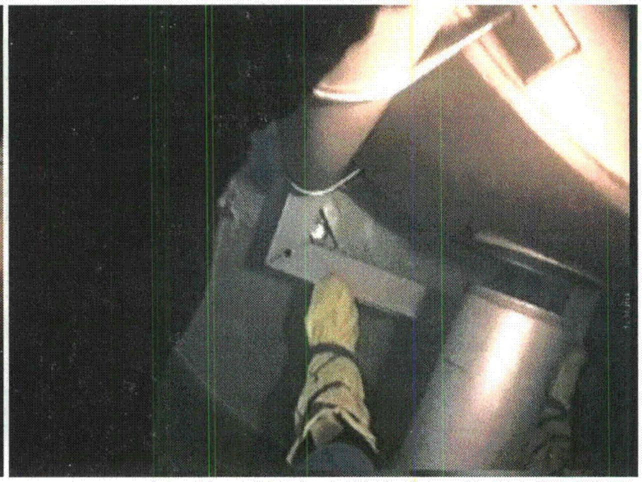
RAI 5

The guidance in NUREG-1537 Section 4.3, "Reactor Tank or Pool," requests that the licensee 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 UT SAR does not provide sufficient information. Please confirm whether there is any visual evidence of cracking, corrosion, or deformation of the reactor pool liner, connected pipes or beam ports and provide a discussion of preventative measures employed to monitor and maintain the integrity of the connected primary coolant system over the life of the facility.

RESPONSE

(1) In 2004 the reactor reflector was replaced, using support by in-pool divers with helmet mounted cameras. Although not specifically acquired to inspect the pool and reflector stand, the extensive video provides evidence that there is no detectable degradation in the reflector stand or the pool. Four snapshots taken from the video are provided, strictly as a sample of available graphic information.



(2) There is no current visible evidence of cracking, corrosion or deformation of the core support structure or the reactor pool, connected pipes or beam ports.

(3) Maintenance of conductivity minimizes potential corrosion (RAI 18).

(4) Monitoring pool level provides a means to detect pool and pool cooling system leakage.

RAI 40.1

ANSI/ANS-15.1-2007 Section 6.1 "Organization," recommends organizational structures including levels and reporting authority. UT TRIGA TS 6.1.1 "Structure," Figure 6.1, does not describe the organizational structure as described in ANSI/ANS-15.1-2007, Section 6.1 "Organization."

RESPONSE

Levels and reporting authority are represented on the organizational charts. A correlation between ANSI standard and UT structure will be incorporated in the basis.

RAI 40.3 Although the guidance of ANSI/ANS-15.1-2007 Section 6.1.3 "Staffing," have been included in proposed UT TRIGA TS 6.1.3 "Staffing," the following items are not consistent with the guidance:

- A designated senior reactor operator shall be readily available on call. "Readily Available on Call" means an individual who has been specifically designated and the designation known to the operator on duty, can be rapidly contacted by phone, by the operator on duty.

- A list of reactor facility personnel by name and telephone number shall be readily available in the control room for use by the operator. The list shall include (a) management personnel, (b) radiation safety personnel, (c) other operations personnel.

- Events requiring the presence at the facility of the senior reactor operator are (a) initial startup and approach to power, (b) all fuel or control-rod relocations within the reactor core region, (c) relocation of any experiment with reactivity worth greater than one dollar; (d) recovery from unplanned or unscheduled shutdown or significant power reduction.

RESPONSE

The proposed Technical Specifications includes a definition for INITIAL STARTUP:

INITIAL STARTUP — *A reactor startup and approach to power following:*

1. *Modifications to reactor safety or control rod drive systems,*
2. *Fuel element or control rod relocations or installations within the reactor core region,*
3. *Relocation or installation of any experiment in the core region with a reactivity worth of greater than one dollar, or*
4. *Recovery from an unscheduled (a) shutdown or (b) significant power reductions.*

The proposed specification for staffing (section 6.1.3) includes:

> *Whenever the reactor is not secured, the reactor shall be (1) under the direction of or (2) directly operated by a (USNRC licensed) Senior Operator, designated as Reactor Supervisor. The Supervisor may be on call if cognizant of reactor operations and capable of arriving at the facility within thirty minutes.*

The specification statement from section 6.1.3 referenced above will be revised to:

1. Replace *"on call"* with *"capable of being rapidly contacted by phone by the operator on duty,"* and

2. Add *"The Supervisor will be present at the facility for any INITIAL STARTUP."*

The statement *"Names and telephone numbers of reactor facility management personnel, radiation safety personnel, other operations personnel shall be listed in the control room for use by the operator"* will be added to section 6.1.3.

RAI 40.5 ANSI/ANS-15.1-2007 Section 6.4 "Procedures," recommends that procedures be written for surveillance checks, calibrations, and inspections required by the TS or those that may have an effect on reactor safety.

RESPONSE

The proposed Technical Specifications section 6.3 requires written procedures for:

- *a.* *Startup, operation, and shutdown of the reactor*
- *b.* *Fuel loading, unloading, and movement within the reactor.*
- *c.* *Control rod removal or replacement.*
- *d.* *Routine maintenance, testing, and calibration of control rod drives and other systems that could have an effect on reactor safety.*
- *e.* *Administrative controls for operations, maintenance, conduct of experiments, and conduct of tours of the Reactor Facility.*
- *f.* *Implementing procedures for the Emergency Plan or Physical Security Plan.*

and:

- *a.* *Personnel radiation protection, in accordance with the Radiation Protection Program as indicated in Chapter 11*
- *b.* *Administrative controls for operations and maintenance*
- *c.* *Administrative controls for the conduct of irradiations and experiments that could affect core safety or reactivity*

The currently approved proposed Technical Specifications section 6.3 explicitly incorporates the ANSI recommendations for written procedures, and the proposed specifications will be revised to:

- *a.* *Startup, operation, and shutdown of the reactor.*
- *b.* *Fuel loading, unloading and movement in the reactor.*
- *c.* *Routine maintenance of major components of systems that could have an effect on reactor safety.*
- *d.* *Surveillance calibrations and tests required by the technical specifications or those that could have an effect on reactor safety.*
- *e.* *Administrative controls for operation, maintenance and the conduct of experiments or irradiations that could have an effect on reactor safety.*
- *f.* *Personnel radiation protection, consistent with applicable regulations or guidelines, and shall include a management commitment and programs to maintain exposures and releases as low as reasonably achievable.*
- *g.* *Implementation of required plans such as the emergency plan or physical security plan.*

RAI 40.6 ANSI/ANS-15.1-2007 Section 6.7.2(1) "Special reports," specifies facsimile or similar conveyance of the special report. Proposed UT TRIGA TS 6.8(c) specifies telegraph of similar conveyance.

RESPONSE

The referenced part is:

The SAFETY LIMIT violation shall be reported to the Nuclear Regulatory Commission within 24 hours by telephone, confirmed via written statement by email, fax or telegraph

The Merriam-Webster online dictionary defines FAX as synonymous with FACSIMILE.

RAI 40.7 ANSI/ANS-15.1-2007 Section 6.8 "Records," provides recommendations for record retention. 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. The proposed UT TRIGA TS 6.10 is not consistent with this guidance

RESPONSE

10CFR55(a)5 states:

Records. The requalification program documentation must include the following:

(i) The facility licensee shall maintain records documenting the participation of each licensed operator and senior operator in the requalification program. The records must contain copies of written examinations administered, the answers given by the licensee, and the results of evaluations and documentation of operating tests and of any additional training administered in areas in which an operator or senior operator has exhibited deficiencies. The facility licensee shall retain these records until the operator's or senior operator's license is renewed.

The regulation explicitly addresses licenses that will be renewed, and does not address record retention following termination of licenses. Paragraph § 55.55 (Expiration) states:

(a) Each operator license and senior operator license expires six years after the date of issuance, upon termination of employment with the facility licensee, or upon determination by the facility licensee that the licensed individual no longer needs to maintain a license.

Therefore the proposed Technical Specification will be revised to:

One License Cycle

The facility licensee shall maintain records documenting the participation of each licensed operator and senior operator in the requalification program. The records must contain copies of written examinations administered, the answers given by the licensee, and the results of evaluations and documentation of operating tests and of any additional training administered in areas in which an operator or senior operator has exhibited deficiencies. The facility licensee shall retain these records until the operator's or senior operator's license is renewed, expired, or terminated.

RAI #	Question	Reply Date	ADAMS	Accept	Comment
1	Please provide a list of all changes to the facility accomplished under 10 CFR Section 50.59 since the issuance of your current license.	9/17/2012	ML12307A071	Y	
2.1	Clarify what fuel element types are allowed in the design features of the technical specifications (TS), and identify the geometries that are applicable.	9/17/2012	ML12307A071	Y	
2.2	Please confirm that the UT SAR statements and conclusions are either based upon NUREG-1282 or provide a basis, methodology, and analysis for any differences.	9/17/2012	ML12307A071	Y	
2.3	Please provide a discussion that confirms this potential does not exist for the UT TRIGA reactor under normal operations or accident conditions.	9/17/2012	ML12307A071	Y	
2.4	Please demonstrate the applicability of these figures to the UT TRIGA.	9/17/2012	ML12307A071	Y	
3.1	Please confirm the type of absorber material used in the UT TRIGA control rods.	9/17/2012	ML12307A071	Y	
3.2	Please clarify what control rod types are allowed in the design features section of the technical specifications, and identify the geometries applicable to each of the four control rods in UT TRIGA.	9/17/2012	ML12307A071	Y	
4	Please confirm whether there is any visual evidence of cracking, corrosion, or deformation of the core support structure, and state whether the structure is appropriate for continued use for the operating period being requested.			Y	Not submitted when planned
5	Please confirm whether there is any visual evidence of cracking, corrosion, or deformation of the reactor pool liner, connected pipes or beam ports and provide a discussion of preventative measures employed to monitor and maintain the integrity of the connected primary coolant system over the life of the facility.			Y	Not submitted when planned
6	Please describe methods used to demonstrate acceptable radiological exposure.	9/17/2012	ML12307A071	Y	
7	Please describe the methods used for steady state neutronic (steady-state and kinetics) and thermal-hydraulic analysis and include comparisons with UT TRIGA measurements that demonstrate that those methods are appropriate to analyze the limits imposed by the UT TRIGA TS.	12/19/2012	ML13002A015	P	partial response
8.1	Please provide schematic drawings showing the location of fuel elements, control rods, and other components installed in the lettered-and-numbered lattice positions. For fuel elements provide a cross reference to fuel element serial numbers and their accumulated burnup. Please provide all technical parameters and conclusions supplied for normal operation, accident analysis, and dose estimates using the LCC.	12/19/2012	ML13002A015	Y	
8.2	Please provide analyses that quantify the effects of fuel burnup, plutonium buildup, and the effect of fission products on the UT TRIGA LCC.	12/19/2012	ML13002A015	Y	
8.3	Please provide the technical parameters including analysis of "reactor kinetic behavior, basis reactor criticality, control rod worth, definition of the limiting core configuration (LCC), [etc.]" (NUREG-1537, Section 4.5.1). State whether the comparison of calculated and measured values demonstrates acceptable model development.	12/19/2012	ML13002A015	P	partial response
9	The GA-4361 unit cell parameters are displayed and compared with UT TRIGA core parameters. Please provide the technical parameters that are applicable to UT TRIGA.	12/19/2012	ML13002A015	P	Partially acceptable for the 1992 and LCC, but OC is missing
10	Given the difference between the "Reference" and "Current" values of excess reactivity and shutdown margin, which values are being used in the UT TRIGA TS.	12/19/2012	ML13002A015	P	Partially acceptable for the 1992 and LCC, but OC is missing
11.1	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 provide calculations of full power reactivity defects for power, xenon, and samarium.				
11.2	Please provide calculations for excess reactivity and control rod worths, and evaluate whether they are in agreement with the analytical model and with UT TRIGA performance. Provide a discussion that describes the evaluation of these calculations to demonstrate acceptable reactor shutdown and shutdown margin. Include consideration of experiment reactivity				
11.3	Please provide "a transient analysis assuming that an instrumentation malfunction drives the most reactive control rod out in a continuous ramp mode," (NUREG-1537, Section 4.5.3) of the reactor using a rate of withdrawal consistent with proposed UT TRIGA TS values of the maximum control rod withdrawal speed, reactivity rate, and the control rod scram time including uncertainties.			N	Not submitted when planned
11.4	Please provide all other applicable technical parameters, "excess reactivity, control rod worth, temperature coefficients, [etc.]" (NUREG-1537, Section 4.5.3).				
12	The NRC staff notes that the power distribution in the figure continues to the center of the fuel element indicating that this curve is not applicable to stainless steelclad fuel that has a zirc rod in the center. Please confirm and revise accordingly.	12/19/2012	ML13002A015	Y	

RAI #	Question	Reply Date	ADAMS	Accept	Comment
13	Please confirm that the Bernath correlation is used to characterize DNBR for UT TRIGA, or demonstrate the applicability of Biasi correlation to UT TRIGA analysis.				
14.1	Please provide clarification as to the relationship of the reactivity coefficient with the analysis provided in UT SAR Section 4.6.				
14.2	The basis for TS 3.2 "Pulsed Mode Operation," states that the reactivity limits are established so as to meet fuel temperature limits. However, this is inconsistent with the statements in UT SAR Section 4.6 as described above. Please revise the discussion in UT SAR Section 4.6 to support the UT TRIGA TS.				
14.3	UT SAR, Section 4.6 (p. 4-46) provides a series of statements regarding pulse reactivities and responses that are not supported by analyses. Please provide analysis supporting these statements in sufficient detail so that a confirmatory analysis can be performed.				
15.1	Please describe the analytical methods used to determine the DNBR, including the core inlet and exit conditions assumed and other assumptions and correlations employed. This [TRACE DNBR] analysis should describe the parameters determined from the LCC such as peaking factors and limiting coolant inlet temperature and that the inlet temperature used for DNBR is a limiting value by showing how it corresponds to the primary pool water temperature measuring channel value.				
15.2	Please provide a comprehensive description of the calculational methods and the results that demonstrate the acceptability of design assumptions and TS for pulsing at UT TRIGA (e.g., the LCC, the approved power level, the pulse of reactivity inserted by the transient rod as allowed by TS, the value of the fuel temperature coefficient, the effective delayed neutron fraction, the prompt neutron lifetime.				
16.1	The pool dimensions of a "tall tank formed by the union of two half-cylinders with a radius of 6½ ft. (1.9812 m) with 6½ feet separating the half-cylinders," appears to be inconsistent with the stated tank nominal water volume of 40.57 cubic meters. Please confirm and revise accordingly.	9/17/2012	ML12307A071	Y	
16.2	The coolant flow rates cited in UT SAR Table 5-1 for the tubes and shell side of the primary coolant heat exchanger appear to be in error. Please confirm and revise accordingly.				
17	UT SAR Section 5.3.4 provides a summary of the control system, but does not include information on the pool low-level scram setpoint referred to in UT SAR, Section 13.6.2 and the UT TRIGA TS 3.4, Table 2. In addition, it does not describe actions that are needed, or should be taken, should pressure at the chilled water outlet rise above the pressure at the pool inlet to the heat exchanger. Please confirm and revise accordingly				
18	Please provide a pH testing TS or provide a justification for not doing so.			N	Not submitted when planned
19.1	The licensee cites a correlation that determines effective release height above the building exhaust stack due to effluent momentum from the purged air system or the ventilation system. Please confirm that the correct form of the correlation is ΔH = D (Vs/μ)1.4 and not as it is stated in the UT SAR.				
19.2	The licensee uses two different stack exit diameter values for the stack (0.4012 m2 on UT SAR, p. 9-6 and 45.72 cm on UT SAR p. 9-2). Please explain this discrepancy.				
19.3	Ensure the impact of the above changes on offsite doses for both normal operation and accident conditions are considered and revised accordingly.				
20.1	Please identify all locations covered by the license where fuel elements are stored, identify the types and numbers of fuel elements that are stored, provide details concerning the storage rack or bin geometry, and analysis that demonstrates that such racks or bins provide adequate conditions for storage.				
20.2	Describe any measuring systems used to confirm that acceptable reactivity levels are maintained in storage locations, how those systems are controlled by procedures or UT TRIGA TS, and how they are calibrated.	9/17/2012	ML12307A071	Y	
20.3	UT SAR Section 9.4.5 states that fuel elements are required to be stored in a configuration with keff less than 0.8. This is inconsistent with the statement in UT SAR Section 5.2.3 of the proposed UT TRIGA TS, which states, "The keff of all fuel elements or fueled devices in storage is less than 0.9." Please explain this discrepancy.	9/17/2012	ML12307A071	Y	
21.1	UT SAR Section 9.4.3 states that a top loading fuel transfer cask is used and that there is "no potential for failure or mishandling as exists in a bottom loading cask." Please describe how the use of such a cask eliminates the potential for such accidents.	9/17/2012	ML12307A071	Y	
21.2	UT SAR Section 9.4.2 states, "A 5-tonne crane is used in conjunction with fuel handling tool and the transfer cask to allow remote handling of irradiated fuel." Please describe the physical or administrative precautions employed to minimize the potential for fuel or core damage due to malfunction, such as loss of electrical power, or dropped loads.	9/17/2012	ML12307A071	Y	

RAI #	Question	Reply Date	ADAMS	Accept	Comment
22.1	In the process of confirming the dose calculations in UT SAR Section 11.1.1.1.1 the NRC staff finds that the beam tube volume cited should be in units of cm3. Please confirm.	9/17/2012	ML12307A071	Y	
22.2	Please provide the 41Ar occupational exposure including stay times and the effect of ventilation, and how these compare to the limits of 10 CFR Part 20 and the commitments of the UT TRIGA ALARA program.				
22.3	Please provide a discussion of facility worker doses, and whether these doses are ALARA.	9/17/2012	ML12307A071	Y	
22.4	UT SAR Section 11.1.1.1.2 provides a conservative estimate of offsite 41Ar air concentrations using an equation for ground level concentration at the building center. Please provide a reference for the equation cited, and a discussion of its suitability for providing dose calculations for members of the public and their location.				
22.5	Please provide a complete description of the maximally exposed individual calculation, including how the estimates compare to the limits in 10 CFR Part 20 and the commitments of the UT TRIGA ALARA program.				
22.6	UT SAR Section 11.1.1.1.2 provides conservative dose estimates for the maximally exposed individual of 66 mrem per year using the CAP88-PC computer code. UT TRIGA TS 3.5.3(D) indicates that releases of 41Ar from the reactor bay to an unrestricted environment SHALL NOT exceed 100 Ci per year, and provides CAP88-PC model results indicating that 100 Ci per year release of 41Ar would result in a maximally exposed individual dose of 0.142 mrem per year. Please resolve this discrepancy between the maximally exposed individual doses in the UT SAR and those provided in the TS.				
22.7	UT SAR Section 11.1.1.1.2 provides a discussion of the maximally exposed offsite individual, but does not provide doses to members of the public. Please provide a discussion of potential public doses.				
23	Please describe the liquid effluents providing this detail [primary coolant point of discharge].	9/17/2012	ML12307A071	Y	
24	The UT SAR does not provide a description of exposure limits to visitors, or the dosimetry provided to determine compliance with those limits. Please provide a description of how UT meets NUREG- 1537 Section 11.1.5.	9/17/2012	ML12307A071	Y	
25	The UT SAR does not mention these groups [pregnant women, minors, students, etc] , or whether they were considered in establishing dose limits. Please confirm that these considerations are included in your radiation protection procedures or elsewhere.				
26	UT SAR Section 11.2.2.3 provides an estimate of the annual average generation of solid waste of 25 cubic feet, while Table 13.1 in UT SAR Section 11.1.1.3 states that annual solid waste volume is typically less than 2 cubic feet. Please discuss this discrepancy.	9/17/2012	ML12307A071	Y	
27.1	Please provide an analysis of the MHA for the UT TRIGA including doses to the workers and to the individuals in the non-restricted areas that bounds all other accident analyses. Please describe all assumptions, the operating conditions of the HVAC system, and the sequence of events used in calculating the potential radiological consequences and discuss how those consequences are less than the applicable limits in 10 CFR Part 20. Please provide sufficient detail to allow independent confirmation of these results				
27.2.1	The [atmospheric dispersion] calculations are then performed for distances from 10 to 100 meters from the building. Because, the reactor building is both tall and wide, any release from the stack could be accumulated in the building wake. Therefore, the applicability of the assumption of elevated release is appears inaccurate. Please justify the use of the elevated release values for dose estimates at nearby distances from the facility.				
27.2.2	if there is an error in the correlation used for the plume rise (see RAI 19.1), the estimated plume rise above the stack height may be inaccurate. Please confirm and revise accordingly.				
27.3	For the determination of effluent leakage around doors and HVAC duct vents the licensee employs complicated discussions and assumptions that are not supported or justified. Please revise the discussion and calculations using applicable assumptions for building overpressure.				
27.4	UT SAR page 3-7 states that the reactor bay is about 18.3 m on each side, with a total of 4575 m3 of volume. This leads to a wall cross section area of about 250 m2, which is in-line with the value of 234 m2 given in the original application for licensing safety analysis report in 1991 (1991 SAR). Please confirm the building wall cross section area and revise accordingly.				
27.5	For the offsite public dose calculations, in the UT SAR it does not appear consistent with the potential for ground release of the reactor bay air content, similar to that evaluated in the 1991 SAR				
27.6	UT SAR Appendix 13.1, SCALE 6.1 input file, cites an input value 1.6 for the weight fraction of the ZrH1.6U fuel. Is this input value for the weight fraction of hydrogen in the fuel? Please confirm and revise accordingly.				
28.1	It appears that the UT SAR does not provide sufficient information on the peaking factors and other assumptions used to estimate the maximum fuel temperature rise as listed in UT SAR Tables 13.20 and 13.21. Please provide sufficient additional information to allow confirmatory analysis.				

RAI #	Question	Reply Date	ADAMS	Accept	Comment
29.1	Please provide a LOCA analysis that represents the current licensed power level for the UT TRIGA in sufficient detail to allow confirmatory analysis.				
29.2	Please confirm that the LOCA analysis uses peaking factors that are consistent with the LCC and revise the analysis accordingly.				
29.3	UT SAR Section 13.5.8, "Results and Conclusion," states that the maximum fuel temperature in a LOCA event after "long-term operation at full power of 2000 kW is 750°C." Please provide the analysis that supports this temperature.				
30	Please clarify the source of the activation materials for producing iodine, and identify actions needed if it is not 235U. In addition, please show that the limits for the iodine and strontium are less than the values that could be released in an MHA and the doses to the public from such releases are within the 10 CFR Part 20 limits.			N	Not submitted when planned
31	Please identify potential incidents, including loss of power or dropped loads, related to the operation of the crane and discuss the consequences.	9/17/2012	ML12307A071	Y	
32.1	The proposed UT TRIGA TS definitions section 1.0 does not describe definitions for: core configuration; license; licensee; protective action; reactivity worth of an experiment; reactor operator; reactor operating; responsible authority; safety limit; scram time; senior reactor operator; shall/should/may definitions (only the definition for "shall" is provided); true value; unscheduled shutdown. Please provide definitions for the above or provide justification for not using them.				
32.2	The following definitions are not consistent with the guidance: channel calibration, excess reactivity; experiment, confinement; movable experiment; secured experiment. Please revise accordingly or provide justification for the deviations.				
32.3	Please revise to the following: when IMMEDIATELY is used as a COMPLETION TIME, The REQUIRED ACTION should be pursued without delay and in a controlled manner.				
32.4	The proposed UT TRIGA TS definition of REACTOR SHUTDOWN only requires the reactor to be subcritical by $0.29. Please explain the discrepancy in using the value of an abnormal condition (shutdown margin) for a normal condition, i.e., the definition of Reactor Shutdown.				
32.5	The proposed UT TRIGA TS definition of REACTOR SECURED MODE requires that 3 of the 4 control rods be fully inserted. Please either provide analysis demonstrating the acceptability of the insertion of 3 out of 4 rods or revise the definition to require insertion of all 4 control rods in order to satisfy the requirements of this mode.				
33	The basis provided in support of the TS 2.1 references Chapter 4, Section 4.2.1 Z which does not exist. Please discuss this error and/or revise accordingly.				
34.1	The basis provided in support of the UT TRIGA TS 2.2 references Chapter 4 Section 4.6 B which does not exist. Please provide a basis for the LSSS.				
34.2	UT TRIGA TS 2.2.The REQUIRED ACTION, B.1 and B.2, which support condition B seem to be reversed and the completion times are both labeled B.2. Please discuss this error and/or revise accordingly.	9/17/2012	ML12307A071	Y	
34.3	UT TRIGA TS 2.2, B.2 refers to the statement "verify the measurement value is not correct." Please describe how this is verified.				
35.1	Section 3.1 of the guidance describes having specifications for fuel burnup, core configurations, and reactivity coefficients (if such coefficients establish required conditions). Such specifications are not present in the proposed UT TRIGA TS. Please discuss.				
35.2	Proposed UT TRIGA TS 3.1 "Core Reactivity," Specification A excludes consideration of experiments having positive reactivity. This is not standard, please explain.	9/17/2012	ML12307A071	Y	
35.3	Please provide an analysis and evaluation that demonstrates the ability to repeatedly measure core reactivity with sufficient accuracy to justify this small value of the shutdown margin.				
35.4	Section 3.2 of the guidance describes that a limit be established for the maximum control rod reactivity insertion rate for non-pulsed operation. The proposed UT TRIGA TS do not provide such a specification. This rate, and the control rod scram times, are typically justified through the analysis of an uncontrolled, control rod withdrawal transient.				
35.5	Section 3.2 of the guidance describes a specification for permitted bypassing of channels for checks, calibrations, maintenance, or measurements. Proposed UT TRIGA TS 3.3, "Measuring Channels," does not specify when it is permitted to bypass channels for checks, calibrations, maintenance or measurements				
35.6	Proposed UT TRIGA TS 4.3 "Measuring Channels," contain Surveillance Requirements for the Fuel Temperature Channel and the Upper Level Radiation Monitor. However, there are no associated LCO specifications.				

RAI #	Question	Reply Date	ADAMS	Accept	Comment
35.7	Section 3.3 of the guidance describes specifications for leak or loss of coolant detection and a secondary coolant activity limit. No such specifications are found in the proposed UT TRIGA TS.				
35.8	Section 3.8.2 of the regulatory interpretations states that containers for experiments containing known explosive materials shall be designed such that the design pressure of the container is twice the pressure the experiment can potentially produce. The proposed UT TRIGA TS 3.6 "Limitations on Experiments," does not include such a specification, please explain or revise.				
36.1	The list of measuring channels presented in Table 1 of proposed UT TRIGA TS 3.3 "Measuring Channels," does not include the data acquisition and control (DAC) and control system computer (CSC) [watchdog] which are [is] listed as [a] SCRAM channels in UT SAR Table 4.6. Please revise or justify				
36.2	The setpoint stated for condition B for Specification B in proposed UT TRIGA TS 3.3, "Measuring Channels," is stated as 2mW. However, the neutron count rate should be stated in terms of neutrons per unit time. [bad ERI question, 2x10-7 of full power is acceptable for log power channel indication - equivalent to some low count rate]				
36.3	The basis for propose UT TRIGA TS 3.3 contains a statement "According to General Atomics, detector voltages less than 80% of required operating value do not provide reliable ..." Please explain how this statement applies to UT TRIGA and how the required conditions for safe operation are ensured by your TS. Such information should be discussed in the SAR and then utilized in the TS basis.				
36.4	Proposed UT TRIGA TS 3.4 Table 2 does not provided the scram setpoints for the Reactor Power Level, Fuel Temperature, and Pool Water Level SAFETY SYSTEM CHANNELS. Please explain or revise.				
36.5	Proposed UT TRIGA TS 3.5 "Gaseous Effluent Control," Specification A does not establish the conditions that determine HVAC OPERABILITY (e.g., conditions or positions for the fans/louvers/doors); a basis statement is not provided for the stated value of 10,000 cpm; such information should be discussed in the SAR and then utilized in the TS basis. Also, there are more COMPLETION TIMEs for Specification A than there are REQUIRED ACTIONs. Please explain or revise.				
36.6	Proposed UT TRIGA TS 3.5 "Gaseous Effluent Control," Specification B does not provide a basis statement for the stated limit of 10,000 cpm; such information should be discussed in the SAR and then utilized in the TS basis. Also, there is a missing COMPLETION TIME for REQUIRED ACTION B.3.				
36.7	Proposed UT TRIGA TS 3.5, "Gaseous Effluent Control," Specification D does not provide a basis statement for the stated limit of 100 Ci/yr; such information should be discussed in the SAR and then utilized in the TS basis.				
36.8	The basis for the proposed UT TRIGA TS 3.7 "Fuel Integrity," does not provide an appropriate basis statement to support the limits in Specification C. Specification B is missing the word "not" in the REQUIRED ACTION. The second occurrence of CONDITION B should be CONDITION C.				
36.9	TS 3.8, "Reactor Pool Water" has no specification for maintaining an acceptable pH level.				
Question 37 series require review against ANS/ANSI 15.1-2007 section 3 to explain deviation or revise TS.					
37.1	Proposed UT TRIGA TS 3.2 "Pulsed Mode Operation," the COMPLETION TIME listed for the REQUIRED ACTION is "immediate." Please consider the COMPLETION TIME to be "prior to commencement of pulsing operation."				
37.2.1	CONDITION A.2 the lumping together of COMPLETION TIME(S) under A.2 is confusing as to which REQUIRED ACTION must be completed first.				
37.2.2	The REQUIRED ACTION(S) A.1.1 and A.1.2 are, "Restore channel to operation OR ENSURE the reactor is SHUTDOWN." The COMPLETION TIME is stated as Immediate for both REQUIRED ACTION(S). Please consider a sequence of events (e.g., either restore the channel to operation within an acceptable COMPLETION TIME, OR shutdown).				
37.2.3	The COMPLETION TIME(S) for the REQUIRED ACTION(S) A.3.1 through A.3.3 are confusing in that no action is identified to take precedence over another, potentially leaving the operator to make their own assumptions as to the priority of events within one hour of any specified CONDITION.				
37.2.4	CONDITION(S) A.4 through A.7 state a series of REQUIRED ACTION(S) that are not sequentially linked. Use of the same COMPLETION TIME for each action is contradictory.				
37.2.5	The REQUIRED ACTION(S) A.4.3 and A.4.4 seem to contradict each other.				
37.3	Proposed UT TRIGA TS 3.4 "Safety Channel and Control Rod Operability," Specification B has no associated REQUIRED ACTION(S) or COMPLETION TIME(S).				
37.4	Proposed UT TRIGA TS 3.5 "Gaseous Effluent Control," logical "AND/OR" connectors are missing between REQUIRED ACTION(S) C.2.a-C.2.b and C.2.b-C.2.c. COMPLETION TIME(S) are all listed as IMMEDIATE which is contradictory. Please revise providing a clear sequence of the expected steps.				

RAI #	Question	Reply Date	ADAMS	Accept	Comment
37.5	Proposed UT TRIGA TS 3.7 "Fuel Integrity," the COMPLETION TIME listed for all REQUIRED ACTION(S) is IMMEDIATE. Please consider revising the REQUIRED ACTION(S) for Specification A and B to state, "Discharge fuel elements prior to reactor operation."				
37.6.1	REQUIRED ACTION(S) A.1 through A.3 are in reverse order. The COMPLETION TIME(S) are all IMMEDIATE which is contradictory.				
37.6.2	REQUIRED ACTION(S) B.1 and B.2 are in reverse order.				
37.6.3	REQUIRED ACTION(S) C.1 and C.2 are in reverse order. The COMPLETION TIME(S) are all IMMEDIATE which is contradictory. Also, and the CONDITION seems to be improperly stated.				
37.6.4	REQUIRED ACTION(S) D.2 and D.3 are in reverse order. The COMPLETION TIME(S) are all IMMEDIATE which is contradictory. A basis to support the established limits in Specification D is not provided. Such information should be discussed in the SAR and then utilized in the TS basis.				
38.1	There are no SRs for the DAC or CSC that are listed as SCRAM channels in UT SAR Table 4.6.				
38.2	There are no SRs for the reactor bay differential pressure for CONDITION A.3 in proposed UT TRIGA TS 3.3 "Measuring Channels."				
38.3	Proposed UT TRIGA TS 3.3 "Measuring Channels," contains Surveillance Requirements for the Fuel Temperature Channel and the Upper Level Radiation Monitor but there are no associated LCO specifications				
38.4	There are no SRs for the Reactor Power Level scram, the Manual scram, or Fuel Temperature scram to support proposed UT TRIGA TS 3.4 "Safety Channel and Control Rod Operability."				
38.5	There are no SRs to support proposed UT TRIGA TS 3.7 "Fuel Integrity," CONDITION C.				
39.1	Proposed UT TRIGA TS 5.1.3(1) allows fuel having a stoichiometry of 1.55 to 1.80 in hydrogen to be used in UT TRIGA.				
39.2	1) core parameters; 2) conditions for operation of the reactor with damaged or leaking fuel elements; 3) parameters such as maximum core loading, thermal characteristics, physics parameters, etc; and 4) fuel burn-up limits. These design features are not stated in the proposed UT TRIGA TS.				
39.3	Please provide a basis for meeting UT TRIGA TS 5.2 "Reactor Fuel and Fueled Devises in Storage," in recommended by ANS Standard 15.1, Section 5.4.				
39.4	Proposed UT TRIGA TS 5.4 incorporates considerations for experiments into the design features section. These considerations do not meet the regulations of the definition for design features from 10 CFR 50.36.				
40.1	ANSI/ANS-15.1-2007 Section 6.1 "Organization," recommends organizational structures including levels and reporting authority. UT TRIGA TS 6.1.1 "Structure," Figure 6.1, does not describe the organizational structure as described in ANSI/ANS-15.1-2007, Section 6.1 "Organization."				
40.2	individual or group that shall be assigned responsibility for implementing the radiation protection program using the guidelines of "Radiation Protection at Research Reactor Facilities," ANSI/ANS-15.11-1993 (R2004). This individual or group shall report to Level 1 or Level 2. The proposed UT TRIGA TS contains no such section.				
40.3	UT TRIGA TS 6.1.3 "Staffing," the following items are not consistent with the guidance:				
40.4	ANSI/ANS-15.1-2007 Section 6.1.4 "Selection and training of personnel," recommends a section for ensuring that the selection and training of UT TRIGA staff is consistent with ANSI/ANS-15.4-1988. No such section is provided in the UT TRIGA TS.				
40.5	ANSI/ANS-15.1-2007 Section 6.4 "Procedures," recommends that procedures be written for surveillance checks, calibrations, and inspections required by the TS or those that may have an effect on reactor safety.				
40.6	ANSI/ANS-15.1-2007 Section 6.7.2(1) "Special reports," specifies facsimile or similar conveyance of the special report. Proposed UT TRIGA TS 6.8(c) specifies telegraph of similar conveyance.				
40.7	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. The proposed UT TRIGA TS 6.10 is not consistent with this guidance				
41	UT SAR does not provide a written statement whether UT is "owned, controlled, or dominated, by an alien, foreign corporation, or foreign government." Please provide a written statement that confirms or denies this status.				
42	UT's latest annual financial statements were not included in the UT SAR. Please provide a copy of UT's latest annual financial statements.				
43	Assuming review of this application is completed on schedule, and a renewed license granted in FY 2013, please provide the estimated operating costs for each of the FYs 2013 through FY2017.				

RAI #	Question	Reply Date	ADAMS	Accept	Comment
44.1	A comparison of the UT TRIGA decommissioning cost estimate to more recently decommissioned research reactors of similar licensed power limit as the UT TRIGA.				
44.2	decommissioning cost estimate for the UT TRIGA to meet the NRC's radiological release criteria for decommissioning the facility, which should also include a contingency factor of at least 25 percent. A contingency factor provides reasonable assurance for unforeseen circumstances that could increase decommissioning costs				
44.3	Provide a calculation detailing how the rates in Table 15.3 "Escalation Costs," were derived.				
44.4	Provide a calculation showing how the escalation factors in Table 15.4 "Calculation Summary," were derived.				
45.1	Provide the following information: An updated SOI containing the decommissioning cost estimate in 2013 dollars, and the name of the document(s) governing control of funds				
45.2	Provide the following information: Written documentation verifying that the signator of the SOI, Kevin P. Hegarty, Vice President and Chief Financial Officer, is authorized to execute the SOI that binds UT financially.				