August 28, 2001

Mr. Sean O'Kelly, Associate Director
University of Texas
Nuclear Engineering Teaching Laboratory
10100 Burnet Road
Austin, TX 78712

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-602/OL-01-02

Dear Mr. O'Kelly:

During the week of August 13, 2001, the NRC administered initial examinations to employees of your facility who had applied for a license to operate your University of Texas reactor. The examination was conducted in accordance with NUREG-1478, "Non-Power Reactor Operator Licensing Examiner Standards," Revision 1. At the conclusion of the examination, the examination questions and preliminary findings were discussed with those members of your staff identified in the enclosed report.

In accordance with 10 CFR 2.790 of the Commission's regulations, a copy of this letter and the enclosures will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's document system (ADAMS). ADAMS is accessible from the NRC Web site at (the Public Electronic Reading Room) http://www.nrc.gov/NRC/ADAMS/indesx.html. The NRC is forwarding the individual grades to you in a separate letter which will not be released publicly. Should you have any questions concerning this examination, please contact Warren Eresian at 301-415-1833 or Internet e-mail wje@nrc.gov.

Sincerely,

/RA/

Eugene V. Imbro, Acting Chief
Operational Experience and Non-Power Reactors Branch
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket No. 50-602

Enclosures:
1. Initial Examination Report No. 50-602/OL-01-02
2. Examination and answer key

cc w/encls:

Please see next page

cc:

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  Planning Office
P.O. Box 13561
Austin, TX 78711

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Docket No. 50-602

2. Examination Report

AREXB r/f

Office of Nuclear Reactor Regulation, Regulatory Improvement Programs, Research and Test Reactors Branch

August

Facility File (EBarnhill, O6-D17)

PMadden

C = COVER

E = COVER & ENCLOSURE

N = NO COPY

ADAMS ACCESSION #: ML012320326

TEMPLATE #:NRR-074

OFFICE	NAME	DATE
REXB:CE	WEresian	08/ 21 /2001
IOLB	EBarnhill	08/ 21 /2001
REXB:SC	PMadden	08/ 23 /2001
REXB:ABC	EImbro	08/ 28 /2001

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University of Texas - R-129 - 602

_/RA/_

Warren Eresian, Chief Examiner

Date

1.

2.

3.

Warren Eresian, Chief Examiner

REPORT DETAILS

RO PASS/FAIL	SRO PASS/FAIL	TOTAL PASS/FAIL
1/0	N/A	1/0
1/0	N/A	1/0
1/0	N/A	1/0

ENCLOSURE 1

All work done on this examination is my own. I have neither given

FINAL GRADE

CANDIDATE'S SCORE

6020 20 20 VALUE CATEGORY % OF CANDIDATE'S CATEGORY

33.3 33.3 33.3 TOTAL SCORE

NON-POWER REA

U. S. NUCLEAR

Candidate's Signature

CANDIDATE

REACTOR TYPE:

DATE ADMINISTERED:

FACILITY:

% OF VALUE

MONITORING, RADIOLOGICAL SAFETY, NORMAL AND EMERGENCY, THEORY,

CATEGORY 4

University of T

ENCLOSURE 2

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NRC RULES AN

QUESTION: 001 (1.00)

Which ONE of the following is the major source of energy released due to thermal fission of a U^{235} atom?

a. Kinetic energy of the fission neutrons.

b. Prompt gamma rays.

c. Fission product decay.

d. Kinetic energy of the fission fragments.

QUESTION: 002 (1.00)

Which ONE of the following elements will slow down fast neutrons least quickly, i.e. produces the smallest energy loss per collision?

a. Oxygen-16

b. Uranium-238

c. Hydrogen-1

d. Boron-10

QUESTION: 003 (1.00)

Which factor in the six-factor formula is represented by the ratio:

$$\frac{\text{number of neutrons that reach thermal energy}}{\text{number of neutrons that start to slow down}}$$

a. fast non-leakage probability

b. resonance escape probability

c. reproduction factor

d. thermal utilization factor

(***** CATEGORY A CONTINUED ON NEXT PAGE *****)

QUESTION: 004 (1.00)

Starting with a critical reactor at low power, a control rod is withdrawn from position X and reactor power starts to increase. Neglecting any temperature effects, in order to terminate the increase with the reactor again critical but at a higher power, the control rod must be:

a. inserted deeper than position X

b. inserted, but not as far as position X

c. inserted back to position X

d. inserted, but exact position depends on power level

QUESTION: 005 (1.00)

A 1/M curve is being generated as fuel is loaded into the core. After some fuel elements have been loaded, the count rate existing at that time is taken to be the new initial count rate, C_o. Additional elements are then loaded and the inverse count rate ratio continues to decrease. As a result of changing the initial count rate:

a. criticality will occur earlier (i.e., with fewer elements loaded.)

b. criticality will occur later (i.e., with more elements loaded.)

c. criticality will occur with the same number of elements loaded.

d. criticality will be completely unpredictable.

QUESTION: 006 (1.00)

A reactor is subcritical with a K_{eff} of 0.955. A positive reactivity of 3.5% delta k/k is inserted into the core. At this point, the reactor is:

a. supercritical.

b. exactly critical.

c. prompt critical.

d. subcritical.

(***** CATEGORY A CONTINUED ON NEXT PAGE *****)

QUESTION: 007 (1.00)

Which ONE of the following is true concerning the differences between prompt and delayed neutrons?

a. Prompt neutrons account for less than one percent of the neutron population while delayed neutrons account for approximately ninety-nine percent of the neutron population.

b. Prompt neutrons are released during fast fissions while delayed neutrons are released during thermal fissions.

c. Prompt neutrons are released during the fission process while delayed neutrons are released during the decay of fission products.

d. Prompt neutrons are the dominating factor in determining the reactor period while delayed neutrons have little effect on the reactor period.

QUESTION: 008 (1.00)

Which ONE of the reactions below is an example of a <u>photoneutron</u> source?

a. ${}_{1}H^{2} + \gamma \rightarrow {}_{1}H^{1} + n$

b. ${}_{92}U^{238} \rightarrow {}_{35}Br^{87} + {}_{57}La^{148} + 3n + \gamma$

c. ${}_{51}Sb^{123} + n \rightarrow {}_{51}Sb^{124} + \gamma$

d. ${}_{4}Be^{9} + \alpha \rightarrow {}_{6}C^{12} + n$

QUESTION: 009 (1.00)

The <u>major</u> contributor to the production of Xenon-135 in a reactor operating at full power is:

a. directly from the fission of Uranium-235.

b. directly from the fission of Uranium-238.

c. from the radioactive decay of Promethium.

d. from the radioactive decay of Iodine.

(***** CATEGORY A CONTINUED ON NEXT PAGE *****)

QUESTION: 010 (1.00)

The effective neutron multiplication factor, K_{eff}, is defined as:

a. production/(absorption + leakage)

b. (production + leakage)/absorption

c. (absorption + leakage)/production

d. absorption/(production + leakage)

QUESTION: 011 (1.00)

For the same constant reactor period, which ONE of the following transients requires the SHORTEST time to occur? A power increase of:

a. 5% of rated power - going from 1% to 6% of rated power.

b. 15% of rated power - going from 10% to 25% of rated power.

c. 30% of rated power - going from 20% to 50% of rated power.

d. 50% of rated power - going from 50% to 100% of rated power.

QUESTION: 012 (1.00)

A reactor is slightly supercritical with the following values for each of the factors in the six-factor formula:

Fast fission factor =	1.03
Fast non-leakage probability =	0.84
Resonance escape probability =	0.96
Thermal non-leakage probability =	0.88
Thermal utilization factor =	0.70
Reproduction factor =	1.96

A control is inserted to bring the reactor back to critical. Assuming all other factors remain unchanged, the new value for the thermal utilization factor is:

a. 0.698

b. 0.702

c. 0.704

d. 0.708

(***** CATEGORY A CONTINUED ON NEXT PAGE *****)

QUESTION: 013 (1.00)

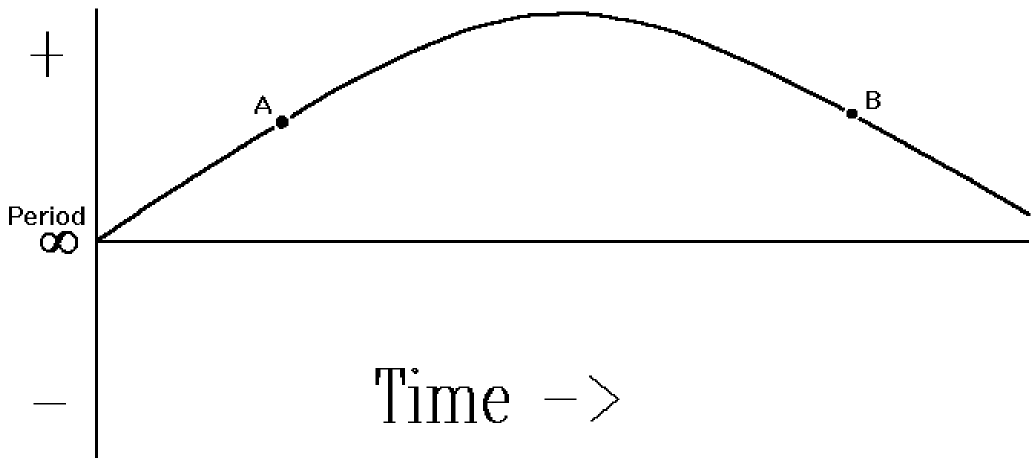
Shown below is a trace of reactor period as a function of time. Between points A and B, reactor power is:

a. continually increasing.

b. increasing, then decreasing.

c. continually decreasing.

d. constant.



QUESTION: 014 (1.00)

You enter the control room and observe that the neutron instrumentation indicates a steady neutron level with no rods in motion. Which ONE condition below CANNOT be true?

a. The reactor is critical.

b. The reactor is subcritical.

c. The reactor is supercritical.

d. The neutron source is in the core.

(***** CATEGORY A CONTINUED ON NEXT PAGE *****)

QUESTION: 015 (1.00)

Which ONE of the following describes the response of the reactor to EQUAL amounts of reactivity insertion as the reactor approaches critical (K_{eff} =1.0)?

a. The change in neutron population per reactivity insertion is smaller, and it requires a longer time to reach a new equilibrium count rate.

b. The change in neutron population per reactivity insertion is larger, and it requires a longer time to reach a new equilibrium count rate.

c. The change in neutron population per reactivity insertion is larger, and it takes an equal amount of time to reach a new equilibrium count rate.

d. The change in neutron population per reactivity insertion is smaller, and it requires a shorter time to reach a new equilibrium count rate.

QUESTION: 016 (1.00)

Which ONE of the following conditions would INCREASE the shutdown margin of a reactor?

a. An experiment which adds positive reactivity.

b. Depletion of burnable poison added to the uranium fuel.

c. Depletion of uranium fuel.

d. Decreasing fuel temperature.

QUESTION: 017 (1.00)

The reactor is to be pulsed. The projected pulse will add TWICE as much reactivity as the last pulse performed. In relation to the last pulse, for the projected pulse:

a. peak power will be four times larger and the energy released will be four times larger.

b. peak power will be two times larger and the energy released will be four times larger.

c. peak power will be four times larger and the energy released will be two times larger.

d. peak power will be two times larger and the energy released will be two times larger.

(***** CATEGORY A CONTINUED ON NEXT PAGE *****)

QUESTION: 018 (1.00)

The reactor is operating in the automatic mode at 50% power. A problem in the secondary cooling system causes the primary coolant temperature to increase by 5 degrees F. Given that the primary coolant temperature coefficient is -7.0×10^{-5} Δ k/k/deg. F and the differential rod worth of the regulating rod is 8.87×10^{-5} Δk/k/inch, the change in the position of the regulating rod will be:

a. eight (8) inches in.

b. eight (8) inches out.

c. four (4) inches in.

d. four (4) inches out.

QUESTION: 019 (1.00)

Two critical reactors are identical except that Reactor 1 has a beta fraction of 0.0072 and Reactor 2 has a beta fraction of 0.0060. An equal amount of positive reactivity is inserted into both reactors. Which ONE of the following will be the response of Reactor 2 compared to Reactor 1?

a. The resulting power level will be lower.

b. The resulting power level will be higher.

c. The resulting period will be longer.

d. The resulting period will be shorter.

QUESTION: 020 (1.00)

During the minutes following a reactor scram, reactor power decreases on a negative 80 second period, corresponding to the half-life of the longest-lived delayed neutron precursors, which is approximately:

a. 20 seconds.

b. 40 seconds.

c. 55 seconds

d. 80 seconds.

(***** END OF CATEGORY A *****)

QUESTION: 001 (1.00)

Which ONE of the following would be an initiating condition for a Non-Reactor Specific Emergency?

a. Damage to building reactor systems or facility utilities.

b. > 20 mr/hr at operations boundary from unknown source.

c. Nearby, threatening, or impending natural disaster.

d. Discovery of forced entry or SNM theft.

QUESTION: 002 (1.00)

A radiation survey of an area reveals a general radiation reading of 1 mrem/hr. However, there is a small section of pipe which reads 10 mrem/hr at one (1) meter. Assuming that the pipe is a point source, which ONE of the following defines the posting requirements for the area in accordance with 10CFR Part 20?

a. Restricted Area.

b. Radiation Area.

c. High Radiation Area.

d. Grave Danger, Very High Radiation Area.

QUESTION: 003 (1.00)

The Safety System channels required to be operable in <u>all</u> modes of operation are:

a. fuel element temperature scram (550°C), reactor high power scram (1.1 MW), and manual scram.

b. fuel element temperature scram (550°C) and manual scram.

c. manual scram and reactor high power scram (1.1 MW).

d. reactor high power scram (1.1 MW), loss of high voltage scram, and fuel element temperature scram (550°C).

(***** CATEGORY B CONTINUED ON NEXT PAGE *****)

QUESTION: 004 (1.00)

Match the 10 CFR Part 55 requirements listed in Column A for an actively licensed operator with the correct time period from Column B. Column B answers may be used once, more than once, or not at all.

	Column A		Column B
a.	License Expiration	1.	1 year
b.	Medical Examination	2.	2 years
c.	Requalification Written Examination	3.	3 years
d.	Requalification Operating Test	4.	6 years

QUESTION: 005 (1.00)

Which ONE statement below describes the basis for the Safety Limit applicable to fuel temperature?

a. Excessive gas pressure between the fuel-moderator and cladding may result in loss of fuel element cladding integrity.

b. High fuel temperature combined with lack of adequate cooling could result in fuel melt.

c. Excessive hydrogen produced as a result of the zirconium-water reaction is potentially explosive.

d. Pulsing the reactor at high fuel temperatures could result in loss of fuel element cladding integrity.

QUESTION: 006 (1.00)

With regard to Radiation Work Permits (RWPs), which ONE of the following statements is NOT TRUE?

a. An RWP is issued for a specific time period, and may expire prior to the completion of work.

b. All personnel who work under an RWP must read and sign it.

c. If the potential for personnel exposure exceeds 100 mrem, the RWP must be approved by the ALARA committee.

d. The RWP is closed out by the person (or persons) who actually perform the work.

(***** CATEGORY B CONTINUED ON NEXT PAGE *****)

QUESTION: 007 (1.00)

Two point sources have the same Curie strength. Source A's gammas have an energy of 1 Mev, while Source B's gammas have an energy of 2 Mev. You obtain a measurement from the same GM tube 10 feet from each source. Concerning the two measurements, which ONE of the following statements is true?

a. The measured dose rate from Source B is four times that of Source A.

b. The measured dose rate from Source B is twice that of Source A.

c. Both measurements are the same.

d. The measured dose rate from Source B. is half that of Source A.

QUESTION: 008 (1.00)

Following an abnormal shutdown, the reactor may be restarted only with the approval of:

a. a Senior Reactor Operator.

b. the Reactor Operator on duty at the time of the shutdown.

c. the Reactor Supervisor.

d. the NETL Director.

QUESTION: 009 (1.00)

Prior to the movement of fuel out of the reactor, movement of any control rod drive is prevented by:

a. removing power from the drive motor.

b. de-energizing the magnets.

c. mechanically blocking the rod from moving.

d. removing the neutron source.

(***** CATEGORY B CONTINUED ON NEXT PAGE *****)

QUESTION: 010 (1.00)

In the event of an area evacuation, personnel should proceed to the emergency assembly area, located in:

a. the health physics room.

b. the reception office.

c. the control room.

d. the library/conference room.

QUESTION: 011 (1.00)

“The total worth of the transient rod shall be limited to 2.8% $\Delta K/K$, and the total withdrawal time for the rod shall not exceed 15 seconds.” This is an example of a:

a. safety limit.

b. limiting safety system setting.

c. limiting condition for operation.

d. surveillance requirement.

QUESTION: 012 (1.00)

Which ONE of the following statements define the Technical Specifications term "Channel Test?"

a. The adjustment of a channel such that its output corresponds with acceptable accuracy to known values of the parameter which the channel measures

b. The qualitative verification of acceptable performance by observation of channel behavior

c. The introduction of a signal into a channel for verification of the operability of the channel

d. The combination of sensors, electronic circuits and output devices connected to measure and display the value of a parameter

(***** CATEGORY B CONTINUED ON NEXT PAGE *****)

QUESTION: 013 (1.00)

Which ONE of the following is the 10 CFR 20 definition of TOTAL EFFECTIVE DOSE EQUIVALENT (TEDE)?

a. The sum of the deep dose equivalent and the committed effective dose equivalent.

b. The dose that your whole body receives from sources outside the body.

c. The sum of the external deep dose and the organ dose.

d. The dose to a specific organ or tissue resulting from an intake of radioactive material.

QUESTION: 014 (1.00)

Two inches of shielding reduce the gamma exposure in a beam of radiation from 400 mR/hr to 200 mR/hr. If you add an additional four inches of shielding what will be the new radiation level? (Assume all reading are the same distance from the source.)

a. 25 mR/hr

b. 50 mR/hr

c. 75 mr/hr

d. 100 mr/hr

QUESTION: 015 (1.00)

In order to comply with Tech. Specs, a power calibration is required on a regular interval. Which ONE of the below statements is correct for this condition?

a. The coolant pumps shall be on during the performance of the power calibration to assure proper mixing of pool water.

b. The pool constant is a function of the pool volume. A 10 centimeters change in pool volume is acceptable but requires the approval of the SRO.

c. Adjustments to the power instrumentation cannot be performed under any circumstances, if the difference is greater than 5%.

d. Differences between indicated and measured power greater than 10% are suspect and will be verified by a follow-up calorimetric.

(***** CATEGORY B CONTINUED ON NEXT PAGE *****)

QUESTION: 016 (1.00)

Which one of the following statements concerning the Fuel Temperature Limiting Safety System Setting is FALSE?

a. The trip level provides a margin of 400 °C for in any condition of operation.

b. The LSSS prevents the safety limit from being reached.

c. The LSSS is not applicable in the pulse mode because of the relatively long time constant of the fuel temperature channel.

d. Two redundant temperature thermocouple sensors monitor the fuel temperature LSSS.

QUESTION: 017 (1.00)

Which ONE of the following statements is applicable when moving experiments in the reactor pool?

a. Explosive materials in quantities greater than 25 milligrams shall be encapsulated in specially designed container.

b. The reactivity worth of any moveable experiment shall be less than $2.50.

c. The reactor must be subcritical by at least $0.25.

d. A licensed operator shall supervise all experiment movements in the reactor pool.

QUESTION: 018 (1.00)

Which ONE of the following requires the direct supervision (i.e., presence) of a Senior Reactor Operator?

a. Relocation of a $0.75 experiment.

b. Reactor Pool Power Calibration.

c. Pulsing the reactor.

d. Movements of fuel within the reactor bay.

(***** CATEGORY B CONTINUED ON NEXT PAGE *****)

QUESTION: 019 (1.00)

In accordance with the Technical Specifications, which ONE situation below is permissible when the reactor is operating?

a. One control rod inoperable but is in its fully withdrawn position.

b. The reactor power trip setpoint is set at 1.010 kW.

c. The Transient Rod withdrawal time is 18 seconds.

d. One fuel temperature measuring channel is inoperable.

QUESTION: 020 (1.00)
]
While the reactor is operating and with experiments in Beam Port 3, which one of the following is a violation of Tech. Specs?

a. The Ar-41 continuous air monitor has been out of service for the past seven (7) days for maintenance. The auxiliary air purge system is operating.

b. The HEPA filter of the auxiliary air purge system is out of service and a replacement cannot be found. The continuous air monitor (particulate) is operating.

c. The particulate air monitor has been out of service for the past five (5) days for maintenance. The continuous air monitor (Ar-41) is in service.

d. The air confinement system exhaust fan is out of service. Exhaust of pool areas is via the auxiliary air purge system.

(***** END OF CATEGORY B *****)

QUESTION: 001 (1.00)

A three-way solenoid valve controls the air supplied to the pneumatic cylinder of the transient rod. De-energizing the solenoid causes the valve to shift to:

a. open, admitting air to the cylinder.

b. close, admitting air to the cylinder.

c. open, removing air from the cylinder.

d. close, removing air from the cylinder.

QUESTION: 002 (1.00)

The fuel-moderator elements are:

a. 20% enriched uranium clad with zirconium.

b. 8.5% enriched uranium clad with stainless steel.

c. 20% enriched uranium clad with stainless steel.

d. 8.5% enriched uranium clad with zirconium.

QUESTION: 003 (1.00)

Pool water conductivity is measured at the:

a. outlet of the coolant system heat exchanger.

b. outlet of the purification system filter.

c. discharge of the purification system pump.

d. discharge of the coolant system pump.

(***** CATEGORY C CONTINUED ON NEXT PAGE *****)

QUESTION: 004 (1.00)

Which ONE of the following design features prevents water from being siphoned out of the reactor pool and uncovering the core in the event of a primary coolant pipe rupture?

a. The capacity of the primary water makeup system.

b. All primary coolant pipes and components are located above core height.

c. The suction and discharge lines penetrate the reactor tank approximately 8 feet below pool surface.

d. The small holes that are drilled in the suction and return lines approximately ½ meter below pool surface.

QUESTION: 005 (1.00)

When the reactor is in the AUTOMATIC mode, the controlling signal is:

a. reactor power as measured by the ion chamber in the NPP-1000 system.

b. reactor period as measured by the ion chamber in the NM-1000 system.

c. reactor power as measured by the fission chamber in the NM-1000 system.

d. reactor power as measured by the fission chamber in the NP-1000 system.

QUESTION: 006 (1.00)

Which ONE of the following describes the action of the rod control system to drive the magnet draw tube down after a dropped rod?

a. Deenergizing the rod magnet initiates the rod down motion of the draw tube.

b. Actuation of the MAGNET DOWN limit switch initiates the rod down motion of the draw tube.

c. Actuation of the ROD DOWN limit switch initiates the rod down motion if the rod drive is withdrawn.

d. Resetting the scram signal initiates the rod down motion of the draw tube.

(***** CATEGORY C CONTINUED ON NEXT PAGE *****)

QUESTION: 007 (1.00)

A diffuser nozzle is located a short distance above the top grid plate and directs water downward over the core. The purpose of this diffuser is to:

a. enhance heat transfer across all fuel elements in the core.

b. ensure consistent water chemistry in the core.

c. better distribute heat throughout the pool.

d. reduce the dose rate at the pool surface from N-16.

QUESTION: 008 (1.00)

Carbon Dioxide is used in the pneumatic transfer system because:

a. it is more compressible than compressed air, which minimizes the pressure required to move samples.

b. it does not retain moisture.

c. it minimizes the production of Argon-41.

d. it is a better neutron absorber than compressed air, thus inserting negative reactivity in the event of a leak.

QUESTION: 009 (1.00)

Half-way through a 6 hour reactor operation you discover that the normal ventilation exhaust damper has been blocked open by a student performing experiments. You cannot move the damper because it is damaged. Which one of the following actions should you take?

a. Immediately secure reactor operations and comply with the requirements for reportable events.

b. Continue with reactor operations. Up to one week is allowed to repair the damper.

c. Continue with reactor operations. The CAM will offer adequate protection.

d. Immediately secure reactor. This event is not reportable if the damper is repaired within 48 hours.

(***** CATEGORY C CONTINUED ON NEXT PAGE *****)

QUESTION: 010 (1.00)

Which ONE of the following is the purpose of the ½-inch aluminum safety plate suspended beneath the lower grid plate?

a. Prevents the control rods from dropping out of the core if the mechanical connections fail.

b. Provides structural support for the lower grid plate and the suspended core.

c. Provides a catch plate for small tools and hardware dropped while working on the core.

d. Prevents fuel rods from dropping out of the core.

QUESTION: 011 (1.00)

With reference to the heat exchanger in the coolant system, differential pressure is measured between the cooling system inlet and secondary outlet. The purpose of this measurement is:

a. alarm when the secondary outlet pressure exceeds the cooling system inlet pressure.

b. alarm when the cooling system inlet pressure exceeds the secondary outlet pressure.

c. provide an alarm if the secondary system pump discharge pressure exceeds the cooling system pump suction pressure.

d. to measure the difference in flow rate of the primary and secondary loops.

QUESTION: 012 (1.00)

Which ONE of the following statements correctly describes the purpose of the potentiometer in the control rod drive assembly?

a. Provides rod position indication when the electromagnet engages the connecting rod armature.

b. Provides a variable voltage to the rod drive motor for regulating control rod speed.

c. Provides potential voltage as required for resetting the electromagnet current.

d. Provides the potential voltage to relatch the connecting rod to the electromagnet.

(*****CATEGORY C CONTINUED ON NEXT PAGE *****)

QUESTION: 013 (1.00)

Which ONE of the following conditions will prevent rod withdrawal?

a. Compensating voltage is 20% lower than normal.

b. The reactor operator selects pulse mode and attempts to withdraw the shim rod.

c. Rods are being pulled for a reactor startup. Source count 1.4 cps.

d. The demineralizer inlet temperature is 40°C.

QUESTION: 014 (1.00)

In order to prevent radiation streaming through a beam port, each beam port contains:

a. an inner shield plug and an outer shield plug.

b. a lead-filled shutter and a lead-lined door.

c. a step (or steps) to provide for divergence of the radiation beam.

d. a removable cover plate.

QUESTION: 015 (1.00)

Which ONE of the following types of detector is used in the Area Radiation Monitor system?

a. Proportional Counter.

b. Scintillation Detector.

c. Ionization Chamber.

d. Geiger-Mueller Tube.

(*****CATEGORY C CONTINUED ON NEXT PAGE *****)

QUESTION: 016 (1.00)

How does the ventilation system respond to a high radiation alarm from the air particulate monitor?

a. The supply fan continues to operate, while the return fan stops. Supply and return dampers remain open.

b. Both the supply and return fans stop, and supply and return dampers close.

c. If the ventilation system was not running prior to the high radiation alarm, it automatically starts. If running, continues to operate.

d. The return fan continues to operate, while the supply fan stops.

QUESTION: 017 (1.00)

The reactor is in the AUTOMATIC mode at a power level of 500 kW. The neutron detector from which the control system receives its input signal fails low (signal suddenly goes to zero). As a result:

a. the control system inserts the regulating rod to reduce power, to try to match the power of the failed detector.

b. the control system withdraws the regulating rod to increase power.

c. the control system drops out of the AUTOMATIC mode into the MANUAL mode.

d. the reactor scrams.

QUESTION: 018 (1.00)

For the measurements listed in Column I, select the appropriate neutron monitoring system from Column II. Items in Column II may be used once, more than once, or not at all.

Column I	Column II
a. Reactor period.	1. NM-1000
b. Pulse energy.	2. NP-1000
c. Safety Channel #2.	3. NPP-1000
d. Log power.	

(*****CATEGORY C CONTINUED ON NEXT PAGE *****)

QUESTION: 019 (1.00)

Which ONE of the following statements is TRUE regarding the Square-Wave mode?

a. Reactor power can be increased from 50 kW to 500 kW.

b. Reactor power must be steady (i.e. infinite period) in order to enter the Square-Wave mode.

c. The shim rods, regulating rod, and transient rod must all be above the down limit.

d. If the demand power is not reached within 10 seconds, system transfers back to Steady-State (Manual) mode.

QUESTION: 020 (1.00)

Bulk pool water temperature is limited to 48 degrees C in order to ensure that:

a. nucleate boiling does not occur on fuel element surfaces.

b. the expansion of pool water at high temperatures does not reduce the moderating capability of the coolant.

c. demineralizer resins are not damaged.

d. activation of pool water impurities is limited.

(*****END OF CATEGORY C*****)
(*****END OF EXAMINATION*****)

A. REACTOR THEORY, THERMODYNAMICS & FACILITY OPERATING CHARACTERISTICS

ANSWER: 001 (1.00)
D.
REFERENCE:
UT-TRIGA Training Manual, Vol. IV, Nuclear Physics and Reactor Theory, Module 1, pg. 61.

ANSWER: 002 (1.00)
B.
REFERENCE:
UT-TRIGA Training Manual, Vol. IV, Nuclear Physics and Reactor Theory, Module 2, pp. 24-27.

ANSWER: 003 (1.00)
B.
REFERENCE:
UT-TRIGA Training Manual, Vol. IV, Nuclear Physics and Reactor Theory, Module 3, pg. 3.

ANSWER: 004 (1.00)
C.
REFERENCE:
UT-TRIGA Training Manual, Vol. IV, Nuclear Physics and Reactor Theory, Module 4, pg. 24.

ANSWER: 005 (1.00)
C.
REFERENCE:
UT-TRIGA Training Manual, Vol. IV, Nuclear Physics and Reactor Theory, Module 4, pg. 6.

ANSWER: 006 (1.00)
D.
REFERENCE:
UT-TRIGA Training Manual, Vol. IV, Nuclear Physics and Reactor Theory, Module 3, pg. 19.
For K = 0.955, reactivity = (K-1)/K = -0.045/0.955 = -4.71% $\Delta K/K$.
-4.71% + 3.50% = -1.21%, i.e. subcritical.

ANSWER: 007 (1.00)
C.
REFERENCE:
UT-TRIGA Training Manual, Vol. IV, Nuclear Physics and Reactor Theory, Module 2, pg. 29.

ANSWER: 008 (1.00)
A.
REFERENCE:
UT-TRIGA Training Manual, Vol. IV, Nuclear Physics and Reactor Theory, Module 2, pg. 2.

ANSWER: 009 (1.00)
D.
REFERENCE:
UT-TRIGA Training Manual, Vol. IV, Nuclear Physics and Reactor Theory, Module 3, pg. 35.

ANSWER: 010 (1.00)
A.
REFERENCE:
UT-TRIGA Training Manual, Vol. IV, Nuclear Physics and Reactor Theory, Module 3, pg. 8.

ANSWER: 011 (1.00)
D.
REFERENCE:
UT-TRIGA Training Manual, Vol. IV, Nuclear Physics and Reactor Theory, Module 4, pg.11.

NSWER: 012 (1.00)
A.
REFERENCE:
UT-TRIGA Training Manual, Vol. IV, Nuclear Physics and Reactor Theory, Module 3, pg. 2.
Since K_{eff} is being reduced, the thermal utilization factor must be less than its original value.

ANSWER: 013 (1.00)
A.
REFERENCE:
UT-TRIGA Training Manual, Vol. IV, Nuclear Physics and Reactor Theory, Module 4, pg. 11.
Since the period is always positive, power must be increasing.

ANSWER: 014 (1.00)
C.
REFERENCE:
UT-TRIGA Training Manual, Vol. IV, Nuclear Physics and Reactor Theory, Module 4, pg. 24.

ANSWER: 015 (1.00)
B.
REFERENCE:
UT-TRIGA Training Manual, Vol. IV, Nuclear Physics and Reactor Theory, Module 4, pg. 7.

ANSWER: 016 (1.00)
C.
REFERENCE:
UT-TRIGA Technical Specifications, 1.26. Any process which adds negative reactivity increases the shutdown margin.

ANSWER: 017 (1.00)
C.
REFERENCE:
UT-TRIGA Training Manual, Vol. IV, Pulsed Reactors.

ANSWER: 018 (1.00)
D.
REFERENCE:
UT-TRIGA Training Manual, Vol. IV, Nuclear Physics and Reactor Theory, Module 3, pg. 21.
Since the coolant temperature increased, negative reactivity was added. Therefore, the rod must add positive reactivity, i.e. withdrawn out. $7x5x10^{-5}/8.75x10^{-5} = 4$ inches.

ANSWER: 019 (1.00)
D.
REFERENCE:
UT-TRIGA Training Manual, Vol. IV, Nuclear Physics and Reactor Theory, Module 4, pg. 11.

ANSWER: 020 (1.00)
C.
REFERENCE:
UT-TRIGA Training Manual, Vol. IV, Nuclear Physics and Reactor Theory, Module 4, pp. 17.

B. NORMAL/EMERGENCY PROCEDURES & RADIOLOGICAL CONTROLS

ANSWER: 001 (1.00)
C.
REFERENCE:
Procedure Plan-E, Emergency Classification.

ANSWER: 002 (1.00)
C.
REFERENCE:
10 mrem/hr at 1 meter (100 cm.) = 111.1 mrem/hr. at 30 cm.

ANSWER: 003 (1.00)
B.
REFERENCE:
UT-TRIGA Reactor Technical Specifications, Section 3.2.3.

ANSWER: 004 (1.00)
A,4; B,2; C,2; D,1
REFERENCE:
10 CFR 55

ANSWER: 005 (1.00)
A.
REFERENCE:
SAR, Section 4-1.

ANSWER: 006 (1.00)
D.
REFERENCE:
HP-7, Radiation Work Permits.

ANSWER: 007 (1.00)
C.
REFERENCE:
GM tubes cannot distinguish between energies.

ANSWER: 008 (1.00)
A.
REFERENCE:
OPER-2, Reactor Startup and Shutdown.

ANSWER: 009 (1.00)
D.
REFERENCE:
FUEL-1, Movement of Fuel.

ANSWER: 010 (1.00)
A.
REFERENCE:
Procedure Plan-E, Emergency Response.

ANSWER: 011 (1.00)
C.
REFERENCE:
UT-TRIGA Reactor Technical Specifications, Section 3.1.3.

NSWER: 012 (1.00)
C.
REFERENCE:
UT-TRIGA Reactor Technical Specifications, Section 1.0

ANSWER: 013 (1.00)
A.
REFERENCE:
10 CFR 20.1003 *Definititions*

ANSWER: 014 (1.00)
B.
REFERENCE:
Nuclear Power Plant Health Physics and Radiation Protection

ANSWER: 015 (1.00)
D.
REFERENCE:
SURV-2 “Reactor Pool Calibration”

ANSWER: 016 (1.00)
C.
REFERENCE:
SOP II, REACTOR OPERATIONS, C.6, and 10 CFR 50.36

ANSWER: 017 (1.00)
D.
REFERENCE:
FUEL-2; T.S.3.4

ANSWER: 018 (1.00)
D.
REFERENCE:
FUEL-1

ANSWER: 019 (1.00
B.
REFERENCE:
UT-TRIGA Reactor Technical Specifications, Section 3.2

ANSWER: 020 (1.00)
B.
REFERENCE:
UT-TRIGA Reactor Technical Specifications 3.3.2 & 3.3.3

C. FACILITY AND RADIATION MONITORING SYSTEMS

ANSWER: 001 (1.00)
D.
REFERENCE:
University of Texas SAR, page 4-69.

ANSWER: 002 (1.00)
C.
REFERENCE:
University of Texas SAR, page 4-59.

ANSWER: 003 (1.00)
B.
REFERENCE:
University of Texas SAR, page 5-8.

ANSWER: 004 (1.00)
D.
REFERENCE:
SAR 5.2.1

ANSWER: 005 (1.00)
C.
REFERENCE:
UT-TRIGA Training Manual, Vol. II, Reactor Instrumentation and Control Systems, page 34.

ANSWER: 006 (1.00)
C.
REFERENCE:
GA Maintenance Manual

ANSWER: 007 (1.00)
D.
REFERENCE:
UT-TRIGA Training Manual, Vol. II, Operation Support Systems, page 6.

ANSWER: 008 (1.00)
C.
REFERENCE:
UT-TRIGA Training Manual, Vol. II, Operation Support Systems, page 21.

ANSWER: 009 (1.00)
A.
REFERENCE:
Technical Specifications, Section 3.3.2.a

ANSWER: 010 (1.00)
A.
REFERENCE:
UT-TRIGA Training Manual, Vol. II, Description of TRIGA Mark II Reactor, page 14.

ANSWER: 011 (1.00)
B.
REFERENCE:
UT-TRIGA Training Manual, Vol. II, Reactor Instrumentation and Control Systems, page 36.

ANSWER: 012 (1.00)
A.
REFERENCE:
UT-TRIGA Training Manual, Vol. II, Description of TRIGA Mark II Reactor, page 20.

ANSWER: 013 (1.00)
B.
REFERENCE:
Reactor Description,. Section 2.1.7

ANSWER: 014 (1.00)
C.
REFERENCE:
UT-TRIGA Training Manual, Vol. II, Operation Support Systems, page 24.

ANSWER: 015 (1.00)
D.
REFERENCE:
UT-TRIGA Training Manual, Vol. II, Reactor Instrumentation and Control Systems, page 36.

ANSWER: 016 (1.00)
B.
REFERENCE:
UT-TRIGA Training Manual, Vol. V, Air Confinement System Surveillance.

ANSWER: 017 (1.00)
B.
REFERENCE:
UT-TRIGA Training Manual, Vol. II, Control Console Operator's Manual, page 5-3.

ANSWER: 018 (1.00)
A,1; B,3; C,2; D,1.
REFERENCE:
UT-TRIGA Training Manual, Vol. II, Reactor Instrumentation and Control Systems, figure 2-1.

ANSWER: 019 (1.00)
D.
REFERENCE:
UT-TRIGA Training Manual, Vol. II, Control Console Operator's Manual, pages 5-3, 5-4.

ANSWER: 020 (1.00)
C.
REFERENCE:
UT-TRIGA Reactor Technical Specifications, Appendix A.3.3.3.1.

A. REACTOR THEORY, THERMODYNAMICS & FACILITY OPERATING CHARACTERISTICS

ANSWER SHEET

MULTIPLE CHOICE (Circle or X your choice)
If you change your answer, write your selection in the blank.

001	a	b	c	d _____
002	a	b	c	d _____
003	a	b	c	d _____
004	a	b	c	d _____
005	a	b	c	d _____
006	a	b	c	d _____
007	a	b	c	d _____
008	a	b	c	d _____
009	a	b	c	d _____
010	a	b	c	d _____
011	a	b	c	d _____
012	a	b	c	d _____
013	a	b	c	d _____
014	a	b	c	d _____
015	a	b	c	d _____
016	a	b	c	d _____
017	a	b	c	d _____
018	a	b	c	d _____
019	a	b	c	d _____
020	a	b	c	d _____

(***** END OF CATEGORY A *****)

B. NORMAL/EMERGENCY PROCEDURES AND RADIOLOGICAL CONTROLS

ANSWER SHEET

MULTIPLE CHOICE (Circle or X your choice)
If you change your answer, write your selection in the blank.

001 a b c d ____

002 a b c d ____

003 a b c d ____

004 a____b____ c____ d ____

005 a b c d ____

006 a b c d ____

007 a b c d ____

008 a b c d ____

009 a b c d ____

010 a b c d ____

011 a b c d ____

012 a b c d ____

013 a b c d ____

014 a b c d ____

015 a b c d ____

016 a b c d ____

017 a b c d ____

018 a b c d ____

019 a b c d ____

020 a b c d ____

(***** END OF CATEGORY B *****)

C. FACILITY AND RADIATION MONITORING SYSTEMS

ANSWER SHEET

MULTIPLE CHOICE (Circle or X your choice)
If you change your answer, write your selection in the blank.

001	a	b	c	d ______
002	a	b	c	d ______
003	a	b	c	d ______
004	a	b	c	d ______
005	a	b	c	d ______
006	a	b	c	d ______
007	a	b	c	d ______
008	a	b	c	d ______
009	a	b	c	d ______
010	a	b	c	d ______
011	a	b	c	d ______
012	a	b	c	d ______
013	a	b	c	d ______
014	a	b	c	d ______
015	a	b	c	d ______
016	a	b	c	d ______
017	a	b	c	d ______
018	a______	b______	c______	d______
019	a	b	c	d ______
020	a	b	c	d ______

(***** END OF CATEGORY C *****)

EQUATION SHEET

$Q = m\ c_p\ \Delta T$

$CR_1\ (1\text{-}Keff)_1 = CR_2\ (1\text{-}Keff)_2$

$P = P_0\ e^{(t/\tau)}$

$\tau = (\ell^*/\rho) + [(\beta-\rho)/\lambda_{eff}\rho]$

$\lambda_{eff} = 0.1\ \text{seconds}^{-1}$

$DR_1D_1^{\ 2} = DR_2D_2^{\ 2}$

$DR = DR_o e^{-\lambda t}$

$DR = 6CiE/D^2$

$\rho = (Keff-1)/Keff$

$1\ ft^3$ (water) = 7.48 gallons

1 kW = 3413 Btu/hour

1 gallon (water) = 8.34 pounds

$°F = 9/5°C + 32$

$°C = 5/9\ (°F - 32)$