Enclosure (1)

Examination Report No. 50-326/OL-89-01

Facility: University of California at Irvine, TRIGA

Examinations administered at the UCI Nuclear Reactor Facility, UC Irvine, Irvine, California.

Chief Examiner: Philip J. Morrill — 11-24-89
Philip J. Morrill, Operator Licensing Examiner — Date Signed

Approved: [signature] — 11-24-89
Lew Miller, Chief, Operations Section — Date Signed

Summary:

Examinations October 25 and 26, 1989, (Report No. 50-326/OL-89-01)

Operator Licensing examinations were administered to one Reactor Operator (RO) Candidate. The candidate passed the operating portion of the examination, but failed the written portion of test.

REPORT DETAILS

1. Examiners

   Philip J. Morrill, RV, Chief Examiner

2. Persons Attending the Exit Meeting on October 26, 1989

   Philip Morrill, RV Chief Examiner
   Dr. George Miller, Supervisor, UC Irvine Nuclear Reactor Facility

3. Written Examinations and Facility Review

   The written examination was administered on October 25, 1989 at the U.C. Irvine Nuclear Reactor Facility. On October 26, 1989 the Chief Examiner held a review of the written examination with the Reactor Supervisor, in accordance with NUREG 1021,"Operator Licensing Examiner Standards". The NRC resolution of these comments are documented in Enclosure (3) of this report, which includes the licensee's letter documenting this meeting [Attachment A to Enclosure (3)].

4. Operating Examinations

   The operating examination was administered on October 26, 1989. The examination was conducted, using walk-through scenarios that tested the operator candidates' integral system knowledge and ability to actually operate the reactor controls. Aspects of facility design and control, administration, security, and emergency plan were also thoroughly tested.

   The candidate passed the operating portion of the examinations.

   While conducting the operating examination, the examiner observed that the candidate did not use the linear power recorder scales below three watts while starting up the reactor. When questioned, the candidate explained that the lower ranges were not used due to noise in the circuit. The examiner later asked the Reactor Supervisor if this practice was consistent with the facility practice and procedures. The Reactor Supervisor stated that noise in the electrical circuit made the lower scales erratic and consequently they were not used by the operator. He went on to explain that the channel was operable and that its operation in this manner did not violate the facility procedures.

   Also during the operating examination, the examiner observed a reactor SCRAM when the candidate was switching between the steady state and the pulse mode of operation. The candidate was not sure of the cause of the SCRAM. When questioned, the Reactor Supervisor stated that the operator was too slow in switching and that one had to move the mode switch briskly to avoid a SCRAM.

Based on these events, the examiner pointed out to the Reactor Supervisor that the material condition of the facility appeared to be deteriorating (from the last examination) and that corrective maintenance was needed. The Supervisor explained that he had been given little time or budget for maintenance, but that he would try to get these items repaired as soon as he could. The examiner restated his concern that maintenance should not be delayed any further.

5. Exit Meeting

On October 26, 1989, the Chief Examiner met with the Reactor Supervisor of the licensee's staff to discuss the written examination key and the material condition of the facility. The Reactor Supervisor stated he would do his best to improve maintenance at the facility.

(ENCLOSURE 3)

U.C. IRVINE TRIGA
REACTOR OPERATOR EXAMINATION
RESOLUTION OF FACILITY COMMENTS

QUESTION: A.01

COMMENT: There is not a sufficient distinction to differentiate between "prompt" and "fast" neutrons. 99.7% of the fast neutrons are prompt. Consequently, there is little distinction between answers "b" and "d".

ANALYSIS: The facility is correct in that 99.7% of the "prompt" neutrons are "fast". However, the choices are clearly stated in the four distractors and there is a major difference between "prompt" (emitted essentially instantaneously with fission) and "fast" (having high kinetic energy) neutrons. Moderators are designed to decrease the energy of "fast" neutrons and have little or no effect on the promptness of "prompt" neutrons.

CONCLUSION: There is a substantial distinction between the meaning and use of the terms "prompt" and "fast" when discussing neutron flux. The question will remain unchanged.

QUESTION: A.08

COMMENT: The facility teaches the reactor period equation by using "tau" which is the reciprocal of "lambda" [which was given in the root of the question]. In addition the operators are taught that 25 cents of reactivity will cause a 25 second period in the reactor. This is supported by the "in-hour" curve which was supplied as part of the facility material.

ANALYSIS: The facility comments regarding the "in-hour" curve appear correct, but this curve was not included as part of the test nor was it referenced in the question. The formula for the calculation using "lambda-effective" and "beta-effective" was given on the NRC supplied Equation Sheet. The question stated the numerical values to use for "lambda-effective" and "beta-effective". The problem could not be solved correctly by making different assumptions than those stated in the question. The purpose of the question was to see if the candidate could use the period equation, not if he could use a "rule-of-thumb".

CONCLUSION: The facility comment is correct in-so-far as it goes, however the question and answer are clear and are not affected by the comment. The question and answer are not changed

QUESTION: A.15

COMMENT: The two parts of the answer given [provide accurate instrument readings and permit controlled start-ups] are not independent and may be stated as one item. The Technical Specifications [page 12] state that "proper operation of the start-up channel" is the reason the source is installed.

ANALYSIS: The facility comment is correct in that the distinction between source range operability and controlling a start-up are different ways of viewing the same requirement. The facility reference material states the requirement as a two step process [...give accurate instrument readings and thereby permit controlled startups.]

CONCLUSION: The exact wording of the candidate's answer is not essential. The concept sought is that the reactor is controllable during start-up by the indications of the source range instrument. No change to the answer or key are required.

QUESTION: B.03

COMMENT: This question appears to be too closely related to question C.06. This also appears to be SRO level of knowledge rather than RO level of knowledge.

ANALYSIS: The question is certainly similar to C.06 which asks for limiting safety system setting. Question B.03 asks for the safety limit itself. This facility only has one safety limit, and that is that fuel element temperature must not exceed 1000 degrees C. The question was asked as a feature of facility design limits, similar to maximum excess reactivity or to maximum pulse reactivity. To omit this type of question would be to say that the reactor operator need not recognize the only facility safety limit out of four choices. As a design feature it appears to meet the intent of Examiners Standards ES-404 Rev. 5 page 2.

CONCLUSION: The question is different from C.06 and is clear in it's statement and the correct answer. Although not clearly a "design feature" this is a very significant limit which should be known to operators. The question and answer are retained as-is.

QUESTION: B.04

COMMENT: "d" would be a correct answer for "shutdown margin" which is in the reference to this question. This may mislead the candidate. The question should have stressed that we were not looking for shutdown margin.

ANALYSIS: The facility comment has merit, however, the question is clear in stating that we are considering the reactor "SHUTDOWN" without any mention of "shutdown margin". Consequently, if one misreads the question or reads more into it than was asked one will not get the correct answer. The examiner's error in the reference [should have been Technical Specification 1.1] had no effect since the candidate was not given this information.

CONCLUSION: The question and answer will be left as-is.

QUESTION: B.10

COMMENT: The facility feels that "a" could also be a correct answer.

ANALYSIS: The facility reference material states that the double length poison section allows the fast transient rod [No. 4] to accelerate [up to speed] with no change in reactivity; thus the reactivity change for this rod occurs at a faster rate than for the other transient rod. No additional references were provided by the facility. The rod may have a more constant change of reactivity as it is moved in the core, but this is not documented in the reference material which does describe the faster reactivity rate.

CONCLUSION: The question and answer will be left as-is.

QUESTION: B.11

COMMENT: "Shock absorber" should be an acceptable substitute for "dash pot action".

ANALYSIS: The term "dash pot action" was taken out of the facility reference material. It appears equivalent to "shock absorber".

CONCLUSION: Change the key to add "shock absorber" for full credit.

QUESTION: B.12

COMMENT: The composition of the control rods doesn't seem like an important feature for an operator to know.

ANALYSIS: As a design feature for fabrication of control rods the type of poison used appears consistent with Examiners Standards ES-404 Rev. 5 page 2.

CONCLUSION: The question and answer will be left as-is.

QUESTION: B.13

COMMENT: The maintenance of low electrical conductivity is needed to minimize corrosion.

ANALYSIS: A review of the reference material indicates that the facility is correct.

CONCLUSION: The first answer will be modified to read "maintain low electrical conductivity OR minimize corrosion" for full credit [0.5].

QUESTION: C.02

COMMENT: This question has a high level of detail and the candidate should not be expected to know numbers which are this close together.

ANALYSIS: Knowledge of the reactivity worth of removing a fuel element from the "E" ring was included based on the Examiner's Standards ES-404 Rev. 5 page 2 which allows for the values of reactivity worths and for the effects of experiment insertion or other factors. In re-reading the standard it could be construed to cover only qualitative changes due to fuel element changes and quantitative values of normal parameters. A reading of the facility Standard Operating Procedures indicates that after any fuel movement a "core excess" reactivity must be measured, consequently, the core excess reactivity should always be known.

CONCLUSION: This question is deleted.

QUESTION: C.06

COMMENT: C.06 appears fair, but B.03 appears to be SRO level of knowledge rather than RO level of knowledge. B.03 appears to be too closely related to question C.06.

ANALYSIS: The resolution of B.03 has been previously stated. B.03 is similar to C.06 which asks for limiting safety system setting while question B.03 asked for the safety limit itself. This facility only has one safety limit and two limiting safety system settings which support that safety limit. C.06 required that the candidate identify one of the two limiting safety system settings out of a list of four possible settings. The question was asked to test knowledge of facility general operating characteristics, which in this case is an operational limit which must not be exceeded. Consequently, it appears to meet the intent of Examiners Standards ES-404 Rev. 5 page 2.

CONCLUSION: The question and answer will be left as-is.

QUESTION: C.07

COMMENT: The facility believes that "d" is also a correct answer since negative temperature coefficient affects rho and core temperature will change rho the same way.

ANALYSIS: The facility is correct that NTC will affect reactivity, however that is reflected in answer "c" as the PRINCIPAL reason for low power. Keeping the temperature constant for more accurate power readings is not the principal reason for low power; low power insures that both the fuel temperature and the bath temperature do not change, either of which could change reactivity. The distractor "provide more accurate power readings by keeping the core at the same temperature" implies that if the core temperature varied the power readings would

fluctuate. On the other hand, the correct answer "minimize the effects of negative temperature coefficient" can include both fuel temperature and bath temperature as well local temperature changes in the core. Keeping the core at the same temperature is one result of low power operation but low power is not necessary for more accurate power readings for control rod calibration.

CONCLUSION: The question and the answer will be left as-is.

QUESTION: C.08

COMMENT: The facility feels that this is a SRO level question when the BASES of the Technical Specifications are questioned. Also the facility temperature monitor is a thermocouple which does not have a "cold" reference junction, consequently the indicated temperature and the temperature increase are the same on the control console.

ANALYSIS: The facility is correct in that the Bases of the Technical Specifications are generally a SRO knowledge level while the Specifications themselves are an RO knowledge level. The question was intended to determine if the candidate was aware of the limits to fuel temperature which could occur during a maximum pulse. The instrumentation of the facility cannot differentiate between different initial fuel temperatures, consequently there is no way to differentiate between temperature of 500 C and an increase of 500 C.

CONCLUSION: Considering the limitations of instrumentation to monitor fuel temperature and the fact that the answer was extracted from the Technical Specification Bases the question will be deleted.

QUESTION: C.09

COMMENT: The facility initially stated that answers "b" and "d" were both correct since the grid plate was five to six feet above the tank bottom and that the reference material [page 5-20] was not necessarily for the UCI TRIGA. The facility personnel subsequently determined that the critical dimension [height of the grid plate above the tank bottom] was four feet and documented this in their November 3, 1989 letter. Consequently this comment is no longer valid and "d" is the only correct answer. The facility also commented that the setpoint of the pool level alarm at five feet below the normal level should be the item focused upon by the test question.

ANALYSIS: After facility confirmation the question is still valid and only has one correct answer. Due to the reference to Technical Specifications the question could have been placed in another part of the examination, such as Safety and Emergency Systems. The question is intended to see if the candidate could recognize the Technical Specification limit and differentiate it from the alarm limit. The facility comment has merit. However, the limits of the Technical Specifications are reasonable questions for a reactor operator.

CONCLUSION: The question is a valid question. The question and the answer will be left as-is.

QUESTION: C.14

COMMENT: The actual maximum rate of change of power [period] when in the automatic mode will vary from a period of five to eight seconds due to the variability of maintenance. Similarly the period SCRAM setpoint varies from three to three and one-half seconds.

ANALYSIS: The facility logs and records support the facilities' comment. The question asked for the maximum rate of change of power and the SCRAM period setpoint which are allowed to vary within limits of the maintenance procedures.

CONCLUSION: The answer key will be changed to reflect that the maximum period may be 5 to 8 seconds and that the period SCRAM is set at 3 to 3.5 seconds.

QUESTION: D.03

COMMENT: The coupling of the electromagnet to the armature is "magnetically" not "electro-magnetically".

ANALYSIS: The coupling of the electro-magnet to the armature is magnetic which is caused by an electric current in the electromagnet. The use of the term "electro-magnetically" was intended to minimize ambiguity by making it clear that a permanent magnet was not used. "Magnetically" would have been used if the coupling was through the use of a permanent magnet. In any case this does not change the correct answer or invalidate the question.

CONCLUSION: The question and answer will remain as-is.

QUESTION: D.04

COMMENT: Both "a" and "c" are correct in that "a" is correct in the steady state mode while "c" is correct in the pulse mode.

ANALYSIS: The facility is correct.

CONCLUSION: This question will be deleted.

QUESTION: D.05

COMMENT: Answer "d" is also correct. This use of a second magnetic pick-up on the fast transient rod to indicate when it is up is not in the reference material.

ANALYSIS: A visual examination are inspection of the facility showed that the facility comment is correct.

CONCLUSION: This question will be deleted.

QUESTION: D.10

COMMENT: Answer "d" is a normal condition right after a SCRAM.

ANALYSIS: The facility comment does not appear to be consistent with the reference material. The situation the facility is describing may occur for a very short time after a SCRAM when the control rod has reached bottom but the control rod drive has not started to move down. The candidate did not ask any questions regarding this situation.

CONCLUSION: The question and answer will remain as-is.

QUESTION: D.11

COMMENT: The use of a detector which uses the recoil of light element nuclei to detect neutrons was not emphasized in the training since the facility does not have this type of detector.

ANALYSIS: The facility comment is correct. The question was generated based on the reference material which included this detector principle. Since this detector type is not used the question does not appear applicable to this facility.

CONCLUSION: This part of the answer will be deleted. Points will not be deducted for not listing the third type of detector requested by the question.

QUESTION: D.15

COMMENT: The reference material is in error in that only the regulating rod can be driven by the servo controller. The regulation will occur both above and below 1 KW.

ANALYSIS: An examination of the facility showed that the facility is correct. This makes answer "d" at least partially correct, since the regulating rod will regulate above 1KW. However, the regulating rod will also regulate below 1 KW, so it cannot regulate "only above 1 KW".

CONCLUSION: This question will be deleted.

QUESTION: E.02

COMMENT: On page 4-13 of the reference material, the intent of the statement is that both exhaust and supply dampers will shut. Figure 4-5 shows the same thing. Consequently both "c" and "d" are correct.

ANALYSIS: The facility is correct. Both answers "c" and "d" are correct

CONCLUSION: This question will be dropped.

QUESTION: E.09

COMMENT: The facility feels that this is an SRO level question.

ANALYSIS: The question asks for the three Technical Specification safety system channels which must be operable in all modes of reactor operation. The candidate must select the correct combination from four choices. As a reactor operator an individual would be operating the facility without direct SRO supervision and should be knowledgeable of the three required safety system channels. Some channels are not required in different modes and the reactor operator is the only one who has immediate ability to act and/or get assistance.

CONCLUSION: The question and answer will remain as-is

QUESTION: E.10

COMMENT: The facility feels that this is an SRO level question.

ANALYSIS: The question asks for the Technical Specification measuring channels which must be operable in all modes of reactor operation. The candidate must select the correct combination from four choices. As a reactor operator an individual would be operating the facility without direct SRO supervision and should be knowledgeable of the required measuring channels. Some channels are not required in different modes and the reactor operator is the only one who has immediate ability to act and/or get assistance.

CONCLUSION: The question and answer will remain as-is

QUESTION: E.11

COMMENT: The actual setpoint is set between 105 and 110 % power.

ANALYSIS: The examiner verified the facility practice by observing that the trip was set at 108.5 % and that there was the stated variation of the trip setpoint recorded in the console log.

CONCLUSION: The answer will be changed to reflect that the setpoint can be between 105 and 110 % of full scale of the strip chart recorder.

QUESTION: E.15

COMMENT: The facility feel that this is an SRO level question.

ANALYSIS: The candidate is required to demonstrate thorough knowledge of design characteristics and operating methods of safety and emergency systems. This

question is based on one of the two Specifications for Design Features for fuel storage in the Technical Specifications. The only normal operator controllable characteristic of fuel storage is to eliminate inadvertent criticality. This is done by maintaining Keff less than 0.8 for all conditions of moderation.

CONCLUSION: The question and answer will remain as-is.

QUESTION: F.04

COMMENT: The facility expects the RO to bring this sort of situation to the SRO on call for resolution.

ANALYSIS: The question asks the candidate to select the kind of encapsulation he would expect to be used for a fissionable material which generates significant heat. If the candidate does not have the ability to verify the correct type of encapsulation for an experiment then he would not be able to detect situations which he needed to bring to the attention of the SRO on duty. The RO operates without supervision and should be able to independently identify encapsulation requirements.

CONCLUSION: The question and answer will remain as-is.

QUESTION: F.07

COMMENT: The SOP states that "b" is the correct answer while the new "Daily Start-up" checklist dated 9/5/89 would have "d" as the correct answer.

ANALYSIS: Based on which part of the procedure there are two possible correct answers. The Facility agreed to change the SOP to reflect the new form.

CONCLUSION: This question will be deleted.

QUESTION: F.11

COMMENT: The new "Daily Start-up" checklist dated 9/5/89 changed the maximum conductivity to 1.8 micro-mhos per square Cm. while the SOP still states 2.0 micro-mhos per square Cm.

ANALYSIS: Based on two different facility documents either 1.8 or 2.0 is the correct answer.

CONCLUSION: This question will be deleted.

QUESTION: F.13

COMMENT: The order of the emergency actions is not important, and consequently action "E" "obtain outside assistance [SRO, Reactor Supervisor, and Radiation Safety]" should be added. This is consistent with the training given to personnel and is a very important item.

ANALYSIS: The facility comment has merit. The facility principles of emergency procedures lists "summon outside professional assistance..." as the first item.

CONCLUSION: Action "E", obtain outside assistance, will be added as a possible correct answer.

QUESTION: G.05

COMMENT: The facility expects a portable meter to be present which is one of the distractors.

ANALYSIS: Based on the facility procedures the "localized monitoring" refers to localized on the person conduction an experiment. A portable monitor may be used, but this is not described in the requirements of the Radiological Safety Program. The question and answer are clear and are based on the reference material.

CONCLUSION: The question and answer will remain as-is.

QUESTION: G.06

COMMENT: The facility practice is to issue as many dosimeters as possible.

ANALYSIS: The question asks for the number of dosimeters which must be issued to a six person tour group. It would have been appropriate to ask for the minimum number of dosimeters to be issued to avoid ambiguity.

CONCLUSION: The question can have two correct answers since nothing precludes issuing more than the minimum number of dosimeters. This question will be deleted.

ENCLOSURE (3A)

UNIVERSITY OF CALIFORNIA, IRVINE

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DEPARTMENT OF CHEMISTRY
NUCLEAR REACTOR FACILITY
SUPERVISOR: DR. G.E. MILLER
TEL: (714) 856-6649 OR 714-856-6082

IRVINE, CALIFORNIA 92717

November 3rd, 1989

U.S. Nuclear Regulatory Commission, Region V,
1450 Maria Lane, Suite 210,
Walnut Creek, CA 94596

Attention: Phil Morrill

Docket 50-326

Re: Operator License Examination - October 25th, 1989

This is to acknowledge the opportunity provided for me to review the examination administered on October 25th at our reactor facility to Francis Anthony Nottke. A thorough discussion was held between myself and Mr Morrill at which a number of issues were resolved regarding test questions and correct responses. I appreciated the complete and open review that was held.

One generic issue that related to several questions was the appropriateness of emphasis in test items, at the Operator level, on recollection by the candidate of specific language/parameters in the facility Technical Specifications. In our training and requalification programs, we have been responding to a more recent emphasis on performance related assessment, which I have interpreted to imply, at the Operator level, a greater emphasis on facility practice rather than on license specifications. The latter are seen to be more the concern of the facility management including Senior Operators. As an example, I would argue that knowledge, by an operator, of the Fuel Temperature Safety Limit established by the Technical Specifications would seem of much less importance than knowledge of the operational limit established by the facility (for its scrams, etc), which allows not only the minimum margin of safety allowed by the Technical Specifications, but an additional factor deemed prudent and practical by the facility for daily set point use. No operator at a facility such as ours could ever be faced with a solo decision as to whether a Safety Limit should or was about to be exceeded! However, the operator should be aware of a situation when the set point is incorrect. A Senior Operator would be the decision maker as to what should be done, or how serious such a violation is. Focusing training and assessment on the Technical Specifications would almost seem to suggest either that facilities should not use local margins (so as not to confuse operators), or that Operators do have authority to extend parameters to the TS limits. Neither of these directions seems desirable.

I do not suggest that an operator could not know these items, but serious questions arise as to the need to know. I realize that this could restrict the range of questions to be asked Operators at a small TRIGA facility. This is entirely in keeping with arguments that our facility has made before: (a) it makes more sense to license "instant" seniors - a practice denied a few years ago, (b) it really doesn't take a great deal of knowledge to safely operate a 250 kw TRIGA reactor, and (c) a 250 kw TRIGA reactor operates so far below any potential safety limits as to make the actual existence of those limits trivial.

On one specific test item (C 09), I had questioned the ambiguity of possible answers. Unfortunately for my position, the facility drawings indicate that the top grid plate is only just over 4 feet above the tank bottom, not 5-6 feet as I had imagined. Thus there is a clear distinction between answers b. and d. However, the generic issue discussed above does apply here. At our facility we consider it more important that the water not fall more than 5 feet below normal level, which is where the alarm is actually set. This gives an additional margin of safety to the TS requirement in that the alarm will then be at 15 feet above the top grid plate. We certainly would not regard it as within the authority of a licensed reactor operator to adjust the alarm level down to the TS limit by setting it 2 feet lower!

I believe that all other items were fully dealt with in our discussions. I also am aware that you have to examine within strict examiner standards and so are not able to adjust the examination in every way a facility wishes. Please let me know if there is additional information that I should provide.

I should like to thank you for the proper, but friendly, way in which you conducted the examination and the review.

Sincerely yours,

George E Miller.

George E. Miller, Senior Lecturer in Chemistry
Reactor Supervisor

GEM/mm

ENCLOSURE (2)

ES-404
Rev 5 01/01/89

KEY - MASTER COPY

U.S. NUCLEAR REGULATORY COMMISSION
REACTOR OPERATOR LICENSE EXAMINATION

Facility: U.C. IRVINE - TRIGA
Reactor Type: TRIGA MK 1
Date Administered: 10/25/89
Examiner: P.J. MORRILL
Candidate: _____

INSTRUCTIONS TO CANDIDATE

Use separate paper for the answers. Write answers on one side only. Staple question sheet on top of the answer sheets. Points for each question are indicated in parentheses after the question. The passing grade requires at least 70% in each category. Examination papers will be picked up six (6) hours after the examination starts.

Category Value	% of Total	Candidate's Score	% of Cat. Value	
16.0	16.0	____	____	A. Principles of Reactor Operation
15.5	15.5	____	____	B. Features of Facility Design
13.5	13.5	____	____	C. General Operating Characteristics
12.0	12.0	____	____	D. Instruments and Controls
14.5	14.5	____	____	E. Safety and Emergency Systems
14.0	14.0	____	____	F. Standard and Emergency Operating Procedures
14.5	14.5	____	____	G. Radiation Control and Safety
100.0	100.0	____	____	Totals

Final Grade _____%

All work done on this examination is my own. I have neither given nor received aid.

_____
Candidate's Signature

Examiner Standards

ES-201
Rev. 5 01/01/89

PROCEDURES FOR THE ADMINISTRATION OF WRITTEN EXAMINATIONS

During the administration of this examination the following rules apply:

1. Cheating on the examination means an automatic denial of your application and could result in more severe penalties.

2. After the examination has been completed, you must sign the statement on the cover sheet indicating that the work is your own and you have not received or given assistance in completing the examination. This must be done after you complete the examination.

3. Restroom trips are to be limited and only one applicant at a time may leave. You must avoid all contacts with anyone outside the examination room to avoid even the appearance or possibility of cheating.

4. Use black ink or dark pencil only to facilitate legible reproductions.

5. Print your name in the blank provided in the upper right-hand corner of the examination cover sheet.

6. Fill in the date on the cover sheet of the examination (if necessary).

7. You may write your answers on the examination question page or on a separate sheet of paper. USE ONLY THE PAPER PROVIDED AND DO NOT WRITE ON THE BACK SIDE OF THE PAGE.

8. If you write your answers on the examination question page and you need more space to answer a specific question, use a separate sheet of the paper provided and insert it directly after the specific question. DO NOT WRITE ON THE BACK SIDE OF THE EXAMINATION QUESTION PAGE.

9. Print your name in the upper right hand corner of the first page of each section of your answer sheets whether you use the examination question pages or separate sheets of paper. Initial each page.

10. Before you turn in your examination, consecutively number each answer sheet, including any additional pages inserted when writing your answers on the examination question page.

11. If you are using separate sheets, number each answer as to category and number (i.e. 1.04, 6.10) and skip at least 3 lines between answers to allow space for grading.

12. Write "End of Category " at the end of your answers to a category.

13. Start each category on a new page.

14. Write "Last Page" on the last answer sheet.

15. Use abbreviations only if they are commonly used in facility literature. Avoid using symbols such as < or > signs to avoid a simple transposition error resulting in an incorrect answer. Write it out.

16. The point value for each question is indicated in parentheses after the question. The amount of blank space on an examination question page is NOT an indication of the depth of answer required.

17. Show all calculations, methods, or assumptions used to obtain an answer.

18. Partial credit may be given. Therefore, ANSWER ALL PARTS OF THE QUESTION AND DO NOT LEAVE ANY ANSWER BLANK. Partial credit will not be given on multiple choice questions.

19. Proportional grading will be applied. Any additional wrong information that is provided may count against you. For example, if a question is worth one point and asks for four responses, each of which is worth 0.25 points, and you give five responses, each of your responses will be worth 0.20 points. If one of your five responses is incorrect, 0.20 will be deducted and your total credit for that question will be 0.80 instead of 1.00 even though you got the four correct answers.

20. If the intent of a question is unclear, ask questions of the examiner only.

21. When turning in your examination, assemble the completed examination with examination questions, examination aids and answer sheets. In addition, turn in all scrap paper.

22. To pass the examination, you must achieve an overall grade of 80% or greater and at least 70% in each category.

23. There is a time limit of (6) hours for completion of the examination (or some other time if less than the full examination is taken).

24. When you are done and have turned in your examination, leave the examination area (DEFINE THE AREA). If you are found in this area while the examination is still in progress, your license may be denied or revoked.

25. Ensure that all information you wish to have evaluated as part of your answer is on your answer sheet, scrap paper will be disposed of without review immediately following the examination.

EQUATION SHEET

$f = ma$

$w = mg$

$E = mC^2$

$KE = \frac{1}{2}mv^2$

$PE = mgh$

$W = V\Delta P$

$\Delta E = 931\Delta m$

$\dot{Q} = \dot{m}C_p\Delta T$

$\dot{Q} = UA\Delta T$

$Pwr = W_f \dot{m}$

$P = P_o\ 10^{SUR(t)}$

$P = P_o\ e^{t/T}$

$SUR = 26.06/T$

$T = 1.44\ DT$

$SUR = 26\left(\frac{\lambda_{eff}\rho}{\bar{\beta} - \rho}\right)$

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

$T = \ell^*/(\rho - \bar{\beta})$

$\gamma = (\bar{\beta} - \rho)/\lambda_{eff}\rho$

$(K_{eff}-1)/K_{eff} = \Delta K_{eff}/K_{eff}$

$\rho = [\ell^*/TK_{eff}] + [\bar{\beta}/(1 + \lambda_{eff}T)]$

$P = \Sigma\phi V/(3 \times 10^{10})$

$\Sigma = N\sigma$

$v = s/t$

$s = v_o t + \frac{1}{2}at^2$

$a = (v_f - v_o)/t$

$v_f = v_o + at$

$\omega = \theta/t$

Cycle efficiency = $\frac{\text{Net Work (out)}}{\text{Energy (in)}}$

$A = \lambda N \qquad A = A_o e^{-\lambda t}$

$\lambda = \ln 2/t_{\frac{1}{2}} = 0.693/t_{\frac{1}{2}}$

$t_{\frac{1}{2}}(eff) = \frac{(t_{\frac{1}{2}})(t_b)}{(t_{\frac{1}{2}} + t_b)}$

$I = I_o e^{-\Sigma x}$

$I = I_o e^{-\mu x}$

$I = I_o\ 10^{-x/TVL}$

$TVL = 1.3/\mu$

$HVL = 0.693/\mu$

$SCR = S/(1 - K_{eff})$

$CR_x = S/(1 - K_{effx})$

$CR_1(1 - K_{eff})_1 = CR_2(1 - K_{eff})_2$

$M = 1/(1 - K_{eff}) = CR_1/CR_0$

$M = (1 - K_{eff})_0/(1 - K_{eff})_1$

$SDM = (1 - K_{eff})/K_{eff}$

$\ell^* = 1 \times 10^{-5}$ seconds

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

$I_1 d_1 = I_2 d_2$

$I_1 d_1^2 = I_2 d_2^2$

$R/hr = (0.5\ CE)/d^2$ (meters)

$R/hr = 6\ CE/d^2$ (feet)

WATER PARAMETERS

1 gal. = 8.345 lbm

1 gal. = 3.78 liters

1 ft^3 = 7.48 gal.

Density = 62.4 lbm/ft^3

Density = 1 gm/cm^3

Heat of vaporization = 970 Btu/lbm

Heat of fusion = 144 Btu/lbm

1 Atm = 14.7 psi = 29.9 in. Hg

1 ft. H_2O = 0.4335 lbf/in^2

MISCELLANEOUS CONVERSIONS

1 Curie = 3.7×10^{10} dps

1 kg = 2.21 lbm

1 hp = 2.54×10^3 BTU/hr

1 Mw = 3.41×10^6 Btu/hr

1 Btu = 778 ft-lbf

1 inch = 2.54 cm

$^oF = 9/5\,^oC + 32$

$^oC = 5/9\ (^oF - 32)$

CATEGORY A
PRINCIPLES OF REACTOR OPERATION

*QUESTION A.01 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

Which one of the following correctly describes the function of a GOOD MODERATOR?

a. The function of a moderator is to slow down prompt neutrons to thermal energy with a large number of collisions.

b. The function of a moderator is to slow down prompt neutrons to thermal energy with a small number of collisions.

c. The function of a moderator is to slow down fast neutrons to thermal energy with a large number of collisions.

d. The function of a moderator is to slow down fast neutrons to thermal energy with a small number of collisions.

*ANSWER

d.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 3-8, 3-9

*QUESTION A.02 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

Which one of the following statements correctly states how NEUTRON FLUX is affected by the addition of a reflector around a reactor core?

a. With a reflector in place thermal flux is higher at the edge of the core.

b. With a reflector in place thermal flux is lower at the edge of the core.

c. With a reflector in place fast flux is higher at the edge of the core.

d. With a reflector in place fast flux is lower at the edge of the core.

*ANSWER

a.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 3-9, 3-10

$QUESTION A.03 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

Which one of the following lists the TWO PRINCIPAL REFLECTORS used in TRIGA reactors?

a. water and graphite

b. graphite and aluminum

c. aluminum and zirconium hydride

d. zirconium hydride and water

*ANSWER

a.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 3-9, 3-10, 3-27

*QUESTION A.04 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

In a TRIGA type reactor, Keff is affected by a change in water temperature. This is often called the "bath" coefficient of reactivity.

How will Keff be affected by an INCREASE in temperature in an OVER-MODERATED reactor?

a. Keff will increase due to an increase in average energy loss per collision.

b. Keff will decrease due to a increase in average energy loss per collision.

c. Keff will increase due to a decrease in moderator density.

d. Keff will decrease due to a decrease in moderator density.

*ANSWER

c.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 3-12

*QUESTION A.05 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

Which one of the following statements correctly explains the meaning of the TERM "DOLLAR" when referring to reactivity?

a. One dollar [$1.00] is equivalent to Keff = 1.00 % delta K/K

b. One dollar [$1.00] is equivalent to Beff = 0.70 % delta K/K

c. One dollar [$1.00] is equivalent to Keff = 0.70 % delta K/K

d. One dollar [$1.00] is equivalent to Beff = 1.00 % delta K/K

*ANSWER

b.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 2-1

*QUESTION A.06 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

Which one of the following sentences correctly defines the "REACTOR PERIOD"?

a. The time in seconds for the neutron population to change by a factor of 1.333.

b. The time in seconds for the neutron population to change by a factor of 1.500.

c. The time in seconds for the neutron population to change by a factor of 2.000.

d. The time in seconds for the neutron population to change by a factor of 2.718.

*ANSWER

d.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 3-19

*QUESTION A.07 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

How long AFTER SHUTDOWN from high power will it take for the MAXIMUM xenon POISON effect to occur?

a. Immediately

b. 1 to 3 hours

c. 5 to 7 hours

d. 20 to 40 hours

*ANSWER

c.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 3-36

*QUESTION A.08 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

With the reactor at 0.1 watt, 25 cents of reactivity is inserted. [Use Lambda-eff = 0.08 and Beff = 0.007] What is the resulting reactor period in seconds?

a. 22 seconds

b. 28 seconds

c. 36 seconds

d. 48 seconds

*ANSWER

c.

T = [1 + [Beff - delta-roe] x tau-avg]/delta-roe

T = [0.007 - 0.0018]/[0.0018 x 0.08] "1" can be neglected

T = 0.0052/[0.0018 x 0.08]

T = 36 seconds

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 3-21

*QUESTION A.09 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

With the reactor at a power of 1 watt and a period of 30 seconds, how long will it take for power to reach 500 watts?

a. 81 seconds

b. 124 seconds

c. 140 seconds

d. 186 seconds

*ANSWER

d.

p/po = exp[t/T]

500 = exp[t/30]

ln 500 = t/30

t = 6.21 x 30 = 186 seconds

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 3-18, 3-20

***QUESTION A.10 [1.00]**

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

The reactor is subcritical with a Keff of 0.96 and 30 counts per second indicated. After a fuel element is removed the count rate drops to 10 counts per second. No other changes have occurred.

What is the Keff of the core with the fuel element removed?

a. 0.9733

b. 0.8800

c. 0.8400

d. 0.6666

*ANSWER

b.

CR1/CR2 = [1 - Keff2]/[1 - Keff1]

30/10 = [1-Keff]/[1-0.96]

1 - Keff = 3 x .04 = .12

Keff = 0.88

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 3-24, 3-58

$QUESTION A.11 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

Why is the reactor pulsed from low steady state power levels?

a. to prevent saturation of the compensated ion chamber

b. to prevent fission product poisons from building up

c. to prevent a large inventory of neutron precursors

d. to prevent overheating the fuel

$ANSWER

d.

$REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 3-40

*QUESTION A.12 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

How is PEAK POWER related to REACTIVITY during a pulse?

a. Peak power will vary linearly with the excess reactivity.

b. Peak power will vary as the square of the excess reactivity.

c. Peak power will vary linearly as the prompt excess reactivity.

d. Peak power will vary as the square of the prompt excess reactivity.

*ANSWER

d.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 3-41

$QUESTION A.13 [1.00]

SHORT ANSWER.

The "cell and inhomogenities effect" is one of three effects which give the TRIGA its' large prompt negative temperature coefficient.

What are the OTHER TWO effects which have been used to give the TRIGA reactors a large PROMPT NEGATIVE TEMPERATURE COEFFICIENT?

*ANSWER

Doppler Effects [0.50]

Core Leakage [0.50]

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 3-30

*QUESTION A.14 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

Experiments were performed by General Atomic personnel at Brookhaven National Laboratory to examine the properties of zirconium hydride for moderating slow neutrons.

Which of the following statements properly describes one of the experimental results?

a. Zirconium hydride alone is very effective in slowing down neutrons below 0.14 electron volts.

b. For neutrons of energy above 0.14 electron volts, zirconium hydride's ability to slow down neutrons is about one tenth that of free hydrogen.

c. "Cold" neutrons can gain energy in passing through hot zirconium hydride in multiples of 0.14 electron volts.

d. The neutron slowing down ability and prompt negative temperature coefficient of zirconium hydride are strongly dependent on the zirconium to hydrogen ratio.

*ANSWER

c.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 3-27

#QUESTION A.15 [1.00]

SHORT ANSWER

What are the TWO operational [disregarding the source interlock] reasons for installing a neutron source in the core?

#ANSWER

A source of neutrons is needed to provide accurate instrument readings [0.50] and to permit controlled start-ups [0.50].

#REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 3-24
Technical Specifications, page 12

$QUESTION A.16 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

How is reactivity affected if a void, such as an empty container, is placed in the core?

a. negative reactivity of about 10-4 % delta-K/K for a 1% water void

b. negative reactivity of about 10-3 % delta-K/K for a 1% water void

c. positive reactivity of about 10-4 % delta-K/K for a 1% water void

d. positive reactivity of about 10-3 % delta-K/K for a 1% water void

*ANSWER

a.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 3-42

END OF CATEGORY A
GO ON TO CATAGORY B

CATEGORY B
FEATURES OF FACILITY DESIGN

*QUESTION B.01 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

Why have portions of the first floor above the U.C.I. reactor room been THICKENED to seventeen inches of CONCRETE?

a. The thicker floor is needed to prevent debris from falling into the core during an earthquake.

b. The thicker floor is to mitigate the effects of a rod ejection accident.

c. The thicker floor is needed to shield from the reactor following a worst case accident.

d. The thicker floor provides shielding for the first floor for possible operation at higher power levels.

*ANSWER

d.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 4-1

*QUESTION B.02 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

What is the PRIMARY RADIOACTIVE substance of concern that could be released if the U.C.I. NEUTRON GENERATOR [sealed tube accelerator] were broken?

a. helium-3

b. deuterium

c. nitrogen-16

d. tritium

*ANSWER

d.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 4-6

*QUESTION B.03 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

Based on the U.C.I. TECHNICAL SPECIFICATIONS what is the SAFETY LIMIT for fuel element temperature?

a. 1000 degrees F

b. 1000 degrees C

c. 800 degrees F

d. 800 degrees C

*ANSWER

b.

*REFERENCE $

Technical Specification 2.1

$QUESTION B.04 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

Based on the TECHNICAL SPECIFICATIONS, the U.C.I. REACTOR is considered SHUTDOWN when the reactor is subcritical and which of the following conditions is satisfied?

a. The reactor is shutdown by at least $1.00 with all control rods inserted.

b. The reactor is shutdown by at least $0.50 with all control rods inserted.

c. The reactor is shutdown by at least $1.00 with the highest worth rod withdrawn.

d. The reactor is shutdown by at least $0.50 with the highest worth rod withdrawn.

*ANSWER

a.

*REFERENCE $

Technical Specification 3.1

*QUESTION B.05 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

What is the PRIMARY cooling mode of the U.C.I. reactor core?

a. natural convection

b. natural conduction

c. forced convection

d. radiation

*ANSWER

a.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 5-6

*QUESTION B.06 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

The U.C.I. reactor room, laboratory, and counting room are designed to act as a confinement area for contaminated air.

How is this CONFINEMENT MAINTAINED during NORMAL operation?

a. The access doors have weather seals and the ventilation system maintains at least 0.15 inch of water positive pressure in this area.

b. The access doors have spring closure devices and the ventilation system maintains at least 0.15 inch of water positive pressure in this area.

c. The access doors have weather seals and the ventilation system maintains at least 0.15 inch of water negative pressure in this area.

d. The access doors have spring closure devices and the ventilation system maintains at least 0.15 inch of water negative pressure in this area.

*ANSWER

c.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 4-8

*QUESTION B.07 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

What design features of the TRIGA reactor cause the reactor to be much more nearly linear than exponential in its response to reactivity changes?

a. the short delay time for transferring heat to the cooling water and the large prompt negative temperature coefficient

b. the short delay time for transferring heat to the cooling water and the large prompt positive temperature coefficient

c. the long delay time for transferring heat to the cooling water and the large prompt negative temperature coefficient

d. the long delay time for transferring heat to the cooling water and the large prompt positive temperature coefficient

*ANSWER

c.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 3-31

*QUESTION B.08 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

The rotary rack facility can be used to irradiate up to forty samples at one time. Specimen containers are inserted and removed through a tube from the rack housing to the bridge.

What design feature prevents streaming of radiation through the loading and removal tube?

a. the tube, which is straight, is not in line with the core

b. the tube is lined with cadmium to absorb any neutrons which might leak out

c. after samples are inserted a plastic rod is inserted into the top of the tube

d. the tube is offset with large radius bends to avoid direct line streaming

*ANSWER

d.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 5-26

*QUESTION B.09 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

Which one of the following statements proeerly DESCRIBES the U.C.I TRIGA FUEL elements?

a. a homogenous mixture of 70% enriched uranium and zirconium hydride with stainless steel clad

b. a homogenous mixture of 20% enriched uranium and zirconium hydride with stainless steel clad

c. a homogenous mixture of 70% enriched uranium and zirconium hydride with aluminum clad

d. a homogenous mixture of 20% enriched uranium and zirconium hydride with aluminum clad

*ANSWER

b.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 5-1

$QUESTION B.10 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

The U.C.I. TRIGA has four control rods. one of the control rods [No. 4] has a double length poison section.

Why does this rod have a double length poison section?

a. This provides a more constant change of reactivity as the rod is inserted or withdrawn from the core.

b. This provides a faster insertion of negative reactivity during a SCRAM.

c. This provides for a faster reactivity change during pulsing operations.

d. This provides more negative reactivity to allow pulses of up to $3.00.

$ANSWER

c.

$REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 5-5

***QUESTION B.11 [1.00]**

SHORT ANSWER.

Following a reactor SCRAM what DESIGN FEATURE of the STANDARD CONTROL ROD assembly DECELERATES the control rod near the end of its' travel?

*ANSWER

A piston [inside the ventilated housing barrel] provides dash-pot action [near the end of rod travel]. "Shock absorber" is an acceptable substitute for "Dash-pot action".

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 5-15

$QUESTION 8.12 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

What material is used as the NEUTRON ABSORBER in the U.C.I. TRIGA reactor CONTROL RODS?

a. compacted and sintered boron carbide

b. graphite impregnated with boron carbide

c. boron-aluminum alloy [Boral]

d. boron carbide mixed with zirconium hydride

$ANSWER

b.

$REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 5-12

#QUESTION B.13 [1.50]

SHORT ANSWER.

What are the THREE functions of the U.C.I. TRIGA primary water purification system?

#ANSWER

[0.50 each]

maintain low electrical conductivity OR Minimize corrosion.

reduces radioactivity

maintains optical transparency

#REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 5-32b

$QUESTION B.14 [1.00]

SHORT ANSWER

What DESIGN FEATURE slows down nitrogen-16 from reaching the surface of the reactor pool during full power [250 KW] operation?

$ANSWER

Water is discharged through a diffuser nozzle across the top of the core which interrupts the vertical convection currents.

$REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 8-23

*QUESTION B.15 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

How does the pneumatic transfer system blower function to insert and remove samples from the terminus in the core?

a. The blower exhausts through a filter into the reactor room exhaust duct and pressurizes the system to move the sample into and out of the terminus.

b. The blower exhausts through a filter into the reactor room exhaust duct and draws a vacuum on the system to move the sample into and out of the terminus.

c. The blower draws air through a filter from the reactor room exhaust duct and pressurizes the system to move the sample into and out of the terminus.

d. The blower draws air through a filter from the reactor room exhaust duct and draws a vacuum on the system to move the sample into and out of the terminus.

*ANSWER

b.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 5-30

END OF CATEGORY B
GO ON TO CATEGORY C

CATEGORY C
GENERAL OPERATING CHARACTERISTICS

*QUESTION C.01 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

What is approximate reactivity due to equilibrium xenon at 250 KW?

a. + 1.0 % delta-K/K

b. + 0.1 % delta-K/K

c. - 1.0 % delta-K/K

d. - 0.1 % delta-K/K

*ANSWER

c.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 3-37

0.0

*QUESTION C.02 [~~1.00~~]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

Approximately how much reactivity change would occur by removing a fuel element from the E RING and leaving the position filled with water?

a. 0.59 delta-K/K

b. 0.41 delta-K/K

c. 0.31 delta-K/K

d. 0.22 delta-K/K

deleted

*ANSWER

b.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 3-34

*QUESTION C.03 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

Following a pulse, approximately how long will it take for fuel temperature to return to equilibrium with the surrounding pool water?

a. 0.5 second

b. 5.0 seconds

c. 30 seconds

d. 5.0 minutes

*ANSWER

d.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 3-54
Facility comments on 4/86 examination

*QUESTION C.04 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

What TWO parameters are measured by the fuel element inspection tool?

a. bulging and elongation

b. bowing and elongation

c. bulging and out of roundness

d. bowing and out of roundness

*ANSWER

b.

*REFERENCE $

Technical Specification 4.1

*QUESTION C.05 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

A startup was stopped with the count rate channel reading 1000 counts/sec. After 10 minutes you observe that the COUNT RATE is increasing LINEARLY with time.

Which of the following properly characterizes the status of the reactor?

a. The reactor is subcritical and the count rate increase is due to build-up of delayed neutron precursors.

b. The reactor is critical and the count rate increase is due to Am-Be source neutrons.

c. The reactor is subcritical and the count rate increase is due to Am-Be source neutrons.

d. The reactor is critical and the count rate increase is due to build-up of delayed neutron precursors.

*ANSWER

b.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 3-24

$QUESTION C.06 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

Which of the following is a MAXIMUM U.C.I Technical Specification LIMITING SAFETY SYSTEM SETTING for the fuel element temperature channel?

a. 800 degrees F in the B-ring

b. 800 degrees C in the B-ring

c. 755 degrees F in the C-ring

d. 500 degrees C in the C-ring

*ANSWER

b.

*REFERENCE $

Technical Specification 2.2

*QUESTION C.07 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

What is the PRINCIPAL reason for limiting power to LESS than 1 KW when control rod reactivity worth calibrations are being conducted?

a. minimize the effects of fission product poisons

b. provide more accurate start-up rate indication

c. minimize the effects of negative temperature coefficient

d. provide more accurate power readings by keeping the core at the same temperature

*ANSWER

c.

*REFERENCE *

Normal Operating Procedures for the U.C.I. TRIGA Reactor, Pg. 4-7-4

0.0

*QUESTION C.08 [~~1.00~~]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

The Technical Specification TRANSIENT ROD reactivity insertion limit [3.2.a] for pulse operations is based on the Safety Analysis Report.

Which of the following statements regarding the BASES of the pulse mode reactivity insertion limit is correct?

a. For a pulse insertion of $3.00 the temperature increase of the fuel is NOT expected to exceed 500 degrees C.

b. For a pulse insertion of $3.00 the temperature of the fuel is NOT expected to exceed 500 degrees C.

c. For a pulse insertion of $3.00 the temperature increase of the fuel is NOT expected to exceed 800 degrees C.

d. For a pulse insertion of $3.00 the temperature of the fuel is NOT expected to exceed 800 degrees C.

*ANSWER

a.

Deleted

*REFERENCE $

Technical Specifications 3.2

*QUESTION C.09 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

What is the TECHNICAL SPECIFICATION water level channel alarm LIMIT for the reactor tank?

a. five feet below the top of the reactor tank

b. five feet below the normal water level

c. thirteen feet above the bottom of the reactor tank

d. thirteen feet above the reactor top grid plate

*ANSWER

d.

*REFERENCE $

Technical Specification 3.7

*QUESTION C.10 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

What is the approximate steady state B-ring fuel element temperature when the reactor is operating at 250 KW?

a. 60 degrees C

b. 125 degrees C

c. 270 degrees C

d. 350 degrees C

*ANSWER

c.

*REFERENCE *

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 3-39

$QUESTION C.11 [1.00]

SHORT ANSWER.

What is the RANGE of the Period Channel? [State the UPPER and LOWER end of the scale. 0.50 each]

$ANSWER

-30 seconds [to infinity] [0.50]

and

+3 seconds [to infinity] [0.50]

$REFERENCE *

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. C-2 & 6-17

$QUESTION C.12 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

Which of the following statements correctly describes the limits associated with INDIVIDUAL experiments?

a. An experiment worth more than $1.00 must be secured and a single experiment may not be worth more than $3.00.

b. An experiment worth more than $0.50 must be secured and a single experiment may not be worth more than $3.00.

c. An experiment worth more than $1.00 must be secured and a single experiment may not be worth more than $1.00.

d. An experiment worth more than $0.50 must be secured and a single experiment may not be worth more than $1.00.

$ANSWER

a.

$REFERENCE $

Normal Operating Procedures for the U.C.I. TRIGA Reactor, Pg. 4-1-4 and Technical Specification 3.1

$QUESTION C.13 [1.50]

SHORT ANSWER.

In automatic operation what are the THREE sources of information used by the servo amplifier? [0.50 each]

*ANSWER

[0.50 each]

power demand/power demand potentiometer

reactor power/linear power channel

reactor period/period circuit

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 6-17

$QUESTION C.14 [1.00]

SHORT ANSWER

During normal ~~steady-state~~ automatic operation the period channel provides an input signal into the servo-amplifier [automatic reactor control system].

a. What is the maximum rate of change of reactor power when in the automatic mode? [0.50]

b. What is period SCRAM setpoint? [0.50]

$ANSWER

[0.50 each]

a. period of 7 seconds [5 to 8 seconds is Satisfactory]

b. period exceeds 3 seconds [3 to 3.5 Seconds is Satisfactory]

$REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 6-17

$QUESTION C.15 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

When the count-rate channel is indicating 10+4 counts/Sec. approximately what power level would you expect to see on the linear recorder?

a. 300 watts

b. 100 watts

c. 50 watts

d. 5 watts

*ANSWER

d.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 6-3

END OF CATEGORY C
GO ON TO CATEGORY D

CATEGORY D
INSTRUMENTS AND CONTROLS

*QUESTION D.01 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

What is the stroke [length of travel] for the control rods?

a. fifteen inches for all the rods except for the fast transient rod which can move thirty inches

b. fifteen inches for all the rods except for the adjustable transient rod which can move thirty inches

c. fifteen inches for the regulating and shim rods and thirty inches for the fast transient and adjustable transient rods

d. fifteen inches for the shim and fast transient rods and thirty inches for the adjustable transient and regulating rods

*ANSWER

a.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 5-12

*QUESTION D.02 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

How is the electrical position indication signal developed for the regulating control rod?

a. a magnetic pick-up counts the number of revolutions of the drive motor which are summed to give position indication

b. a tachometer, set-up as an integrator, is connected to the drive motor which raises and lowers the rod

c. a slide potentiometer is connected above the rod's electromagnet to sense rod position

d. a helipot is connected to the pinion gear which raises and lowers the rod

*ANSWER

d.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 5-15

*QUESTION D.03 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

What component is electro-magnetically coupled to the electro-magnet when a standard control rod is being raised out of the core?

a. the pull rod

b. the piston

c. the armature

d. the draw tube

*ANSWER

c.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 5-14

0.0

*QUESTION D.04 [~~1.00~~]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

How is the adjustable transient rod adjusted to vary the amount of reactivity inserted into the core?

a. the air cylinder and rod are raised or lowered by an electric motor driving a worm gear and ball nut

b. the air cylinder and rod are raised or lowered by an electric motor driving a rack and pinion gear

c. the air cylinder is raised or lowered by an electric motor driving a worm gear and ball nut

d. the air cylinder is raised or lowered by an electric motor driving a rack and pinion gear

*ANSWER

c.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 5-17

deleted

0.0

*QUESTION D.05 [~~1.00~~]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

What is the purpose of the MAGNETIC PICK-UP on the outside of the pneumatic cylinder of the fast transient rod?

a. the pick-up sends a signal to switch on the "NV" circuits

b. the pick-up provides a rod up signal to the "FIRE" push-button when the rod is used as a safety rod

c. the pick-up is used to coordinate the simultaneous firing of both transient rods

d. the pick-up provides a rod up signal to the "ARM" push-button when the rod is used as a safety rod

*ANSWER

c.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 5-20, 6-15

deleted

*QUESTION D.06 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

What TWO power indications are recorded on the dual pen strip chart recorder of the control console during steady state power operation?

a. uncompensated ion chamber linear power and fission chamber log n power

b. uncompensated ion chamber linear power and compensated ion chamber log n power

c. compensated ion chamber linear power and fission chamber log n power

d. compensated ion chamber linear power and compensated ion chamber log n power

*ANSWER

d.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 6-3, 6-5.

*QUESTION D.07 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

What TWO indications are recorded on the dual pen strip chart recorder of the control console during "PULSE" mode operation?

a. uncompensated ion chamber neutron flux pulse height and integrated neutron flux

b. uncompensated ion chamber neutron flux pulse height and fuel element temperature

c. compensated ion chamber neutron flux pulse height and integrated neutron flux

d. compensated ion chamber neutron flux pulse height and fuel element temperature

*ANSWER

b.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 6-16

*QUESTION D.08 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

What type of radiation does a compensated ion chamber compensate for?

a. fast neutron

b. gamma

c. beta

d. alpha

*ANSWER

b.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 7-15

*QUESTION 1.09 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

The two standard control rods have three push-button switches associated with each control rod drive; a red "UP" switch, a white "DOWN" switch, and a yellow and blue "CONT/ON" push-button.

Both the UP and DOWN lights are OFF and BOTH SIDES of the CONT/ON lights are ON. ALL light bulbs are good.

What is the status of the control rod and the control rod drive?

a. the rod is on the bottom and the control rod drive is driving in just after a SCRAM

b. rod and drive making contact, both at their upper limit

c. rod and drive not making contact, both at their lower limits

d. rod and drive making contact, between upper and lower limits

*ANSWER

d.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 6-13

*QUESTION D.10 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

The two standard control rods have three push-button switches associated with each control rod drive; a red "UP" switch, a white "DOWN" switch, and a yellow and blue "CONT/ON" push-button.

The UP light is on, the DOWN light is OFF, and the CONT/ON light is OFF. All light bulbs are good.

What is the status of the control rod and the control rod drive?

a. abnormal condition, rod and drive not making contact, drive is full up and rod is full down

b. abnormal condition, drive and rod are both completely up, rod is stuck in the full up position

c. normal condition, rod and drive not making contact, rod is complete' up, drive is down

d. normal condi[illegible] rod and drive not making contact, drive is comp[illegible].y up, rod is down

*ANSWER

a.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 6-13

1.00

*QUESTION D.11 [1.50]

SHORT ANSWER.

Neutrons are uncharged particles and do not cause significant ionization of orbital electrons, consequently neutrons cannot be detected by ordinary alpha, beta, or gamma detectors.

What are the THREE principal methods by which NEUTRON radiation is detected in neutron detectors?

*ANSWER

[0.50 each]

neutron absorption to produce alpha or beta radioactive isotopes

~~recoil of light element nuclei after being struck by neutrons~~ deleted

fission induced by neutrons

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 7-14

*QUESTION D.12 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

The fast transient rod can be with-drawn and used as a safety rod.

How does one re-insert the fast transient rod without affecting the position of the other rods?

a. depress the "DOWN" push-button

b. depress the "FIRE" push-button a second time

c. depress the "ARM" push button a second time

d. depress the "CONT/ON" push-button

*ANSWER

c.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 6-14

*QUESTION D.13 [1.00]

SHORT ANSWER.

What does illumination of each half of the adjustable transient rod "ARM" button indicate? [TWO responses are required.]

*ANSWER

one half when the FIRE button is armed [0.50]

and

one half when the control rod is NOT in the full down position [0.50]

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 6-10

*QUESTION D.14 [1.00]

SHORT ANSWER

The reactor power range switch has positions which are used for switching scales used, and indications recorded on, the dual pen strip chart recorder.

What are the TWO modes of operation that can be selected on the reactor power RANGE switch?

*ANSWER

steady state [14 positions 0.1 watt to 250 KW] [0.50]

and

pulse [2 positions 250 - 2000 MW] [0.50]

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 6-5

0.0

*QUESTION D.15 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

When the reactor is being automatically controlled, which control rod(s) are used?

a. either the shim rod or the regulating rod move one at a time

b. the shim rod only above 1KW

c. both the shim rod and the regulating rod move together to stay banked

d. the regulating rod only above 1KW

*ANSWER

a.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 6-21

deleted

END OF CATEGORY D
GO ON TO CATEGORY E

CATEGORY E
SAFETY AND EMERGENCY SYSTEMS

*QUESTION E.01 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

What signal will ACTUATE the Emergency Purge System?

a. reactor SCRAM on high temperature

b. low reactor pool level

c. area radiation monitor high alarm

d. continuous air monitor high alarm

*ANSWER

d.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 4-13, 9-2

*QUESTION E.02 [~~1.00~~ 0.0]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

An RELEASE of fission products from a damaged fuel element into the U.C.I. reactor room has occurred.

How does the VENTILATION SYSTEM FUNCTION to minimize the release?

a. The emergency purge fan starts at 4325 CFM, normal exhaust dampers shut, and the room air is filtered before release.

b. The emergency purge fan starts at 4325 CFM, normal supply dampers shut, and the room air is filtered before release.

c. The emergency purge fan starts at 250 CFM, normal exhaust dampers shut, and the room air is filtered before release.

d. The emergency purge fan starts at 250 CFM, normal supply dampers shut, and the room air is filtered before release.

*ANSWER

c.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 4-9 to 4-13

deleted

*QUESTION E.03 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

What is the PRINCIPAL REASON for LOCATING the continuous air monitor [CAM] alongside the U.C.I. reactor pool rather than at the reactor room exhaust stack.

a. The monitor is located centrally for all personnel to see and hear any alarms which might occur.

b. The CAM was placed in the reactor room to provide post accident monitoring of the reactor room as well as detection of a release.

c. The CAM could not be placed at the exhaust stack since the radiation level there is very low and some background radiation needs to keep the indicator above zero.

d. The CAM was located next to the reactor pool since experiments indicated that it would detect the leakage of fission products from a fuel element fastest in that location.

*ANSWER

d.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 4-13

*QUESTION E.04 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

A Tracerlab area radiation system is installed in the U.C.I. reactor facility.

In what location can read-outs from the local monitor be read?

a. ceiling over the fuel pit storage area

b. north wall of laboratory B54A

c. east wall of the reactor room below window

d. north wall of the reactor room below window

*ANSWER

c.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 4-14

*QUESTION E.05 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

A main power failure has occured.

What power is available to operate the area radiation and continuous air monitors?

a. building emergency batteries and inverter

b. building emergency diesel generator

c. portable gasoline powered generator

d. batteries and inverter in the control cabinet

*ANSWER

b.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 4-14

*QUESTION E.06 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

What detector is used by the percent-power channel?

a. uncompensated ion chamber

b. compensated ion chamber

c. core thermocouple

d. fission chamber

*ANSWER

a.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 6-17

*QUESTION E.07 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

The Technical Specifications state that the reactor shall not be operated unless fueled experiments are limited so that the isotopes iodine 131-135 and strontium-90 in the experiment are restricted.

What are the fueled experiment limits for iodine 131-135 and strontium 90?

a. 0.3 curies of iodine and 1 millicurie of strontium

b. 0.3 millicuries of iodine and 1 microcurie of strontium

c. 0.3 curies of iodine and 1 microcurie of strontium

d. 0.3 millicuries of iodine and 1 millicurie of strontium

*ANSWER

c.

*REFERENCE ¶

Technical Specification 3.8

*QUESTION E.08 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

The Technical Specifications state that the reactor shall not be operated for an experiment irradiating an explosive unless the amount of known explosive materials to be irradiated is limited and the experiment container is specially designed.

What are these TWO experiment limits for irradiating explosives?

a. 0.25 grams of known explosive and encapsulation in aluminum

b. 0.25 grams of known explosive and detonation of the explosive would not exceed design pressure of the container

c. 0.025 grams of known explosive and encapsulation in aluminum

d. 0.025 grams of known explosive and detonation of the explosive would not exceed design pressure of the container

*ANSWER

d.

*REFERENCE $

Technical Specifications 3.8

*QUESTION E.09 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

Based on the Technical Specifications, what are the THREE Safety System Channels which are required to be operable IN ALL MODES when operating the reactor?

a. fuel element temperature SCRAM, reactor power level SCRAM, and manual SCRAM

b. fuel element temperature SCRAM, manual SCRAM, and seismic switch SCRAM

c. manual SCRAM, start-up count rate rod withdrawal interlock, and reactor power level SCRAM

d. manual SCRAM, start-up count rate rod withdrawal interlock, seismic switch SCRAM

*ANSWER

b.

*REFERENCE $

Technical Specification 3.4

*QUESTION E.10 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

Based on the Technical Specifications, what Measuring Channels are required to be operable IN ALL MODES when operating the reactor?

a. 1 fuel element temperature, 1 reactor power level, 1 area radiation monitor

b. 2 reactor power levels, 1 fuel element temperature, 1 continuous air monitor

c. 1 reactor power level, 1 continuous air monitor, 2 area radiation monitors

d. 2 area radiation monitors, 1 fuel element temperature, and 1 continuous air monitor

*ANSWER

d.

*REFERENCE $

Technical Specification 3.3

*QUESTION E.11 [1.00]

SHORT ANSWER.

What is the SETPOINT of the REACTOR SCRAM associated with the linear power channel? [TWO responses are required. State the setpoint itself, and what indication or read-out the setpoint is taken from.]

*ANSWER

110% [0.50] of full scale of the strip chart recorder [0.50]
[105 to 110% is satisfactory for 110% limit]
*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 6-16

*QUESTION E.12 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

Interlocks are provided to prevent improper operation of the U.C.I. TRIGA reactor control rods and to meet TECHNICAL SPECIFICATION requirements.

Which of the following CORRECTLY STATES one of the U.C.I. TRIGA control rod drive interlocks?

a. the transient rods cannot be fired in the pulse mode with reactor power above 1KW

b. only one standard rod can be moved at a time in the pulse mode

c. control rods cannot be withdrawn unless the neutron count rate is above 1 count/Sec. in the steady state mode

d. two control rods cannot be moved at the same time when power is below 1 KW in the steady state mode

*ANSWER

a.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 6-11, 6-14, 6-25
Technical Specifications Page A-11

*QUESTION E.13 [1.50]

SHORT ANSWER.

The continuous air monitor and the Area Monitoring System alert the operator to a release of radioactive material.

a. What is the high alarm setpoint of the continuous air monitor? [0.50]

b. What is the high alarm setpoint of the area radiation monitor located at the rotating rack unload tube? [0.50]

c. In what TWO locations is a failure of the continuous air monitor alarmed? [0.50]

*ANSWER

a. 5,000 CPM

b. 1.0 R/Hr.

c. [Yellow light] on the unit [0.25] and in the control room [0.25]

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 9-2 to 9-4

***QUESTION E.14 [1.00]**

SHORT ANSWER.

What is the purpose of the "safety plate" beneath the reactor bottom grid plate?

*ANSWER

The safety plate precludes the possibility of a control rod dropping out the bottom of the core.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 5-24

*QUESTION E.15 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

Based on the Technical Specifications what is the reactivity [Keff] limit for storage of spent fuel?

a. Keff must be less than 0.90 for all conditions of moderation

b. Keff must be less than 0.80 for all conditions of moderation

c. Keff must be less than 0.70 for all conditions of moderation

d. Keff must be less than 0.60 for all conditions of moderation

*ANSWER

b.

*REFERENCE $

Technical Specification 5.3

END OF CATEGORY E
GO ON TO CATEGORY F

CATEGORY F
STANDARD AND EMERGENCY OPERATING PROCEDURES

*QUESTION F.01 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

Based on the Code of Federal Regulations, which of the following requires DIRECT supervision of a licensed SENIOR reactor operator?

a. an individual operating the U.C.I. reactor who is licensed at another TRIGA facility

b. a student who is operating operating the reactor for training as part of one of his/her courses

c. a reactor operator trainee during start-up operation

d. an unlicensed individual unloading fuel from the core

*ANSWER

d.

*REFERENCE $

10CFR55.13
SOP 1-1, 4.1.1.g

*QUESTION F.02 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

The Technical Specifications and the U.C.I. Operating Procedures allow temporary changes to the Standard Operating Procedures (SOPs) provided that the original intent is not changed.

Assuming that the original intent is not changed, whhich ONE of the the following individuals has the PRINCIPAL AUTHORITY to make temporary changes to the SOPs?

a. the Operator in Charge

b. the Senior operator on call

c. the Reactor Administrator

d. the Reactor Supervisor

*ANSWER

d.

*REFERENCE $

SOP 1.3, Technical Specification 6.3

*QUESTION F.03 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

Which TWO individuals must review a proposed experiment to determine whether it is a CLASS I "tried" experiment or a CLASS II "untried" experiment?

a. a member of the Radiological Safety Staff and the Reactor Supervisor

b. a member of the Radiological Safety Staff and the Reactor Operations Committee

c. the Experimenter and the Reactor Operations Committee

d. the Experimenter and the Reactor Supervisor

*ANSWER

a.

*REFERENCE $

SOP 2.1, 2.2

*QUESTION F.04 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

An experiment entails irradiating samples [redacted] of thorium. It is expected that significant heat will be generated in the samples.

As Operator in Charge, what kind of encapsulation would you expect the experimenter to use?

a. single polyethylene capsules

b. double polyethylene capsules

c. double metal capsules

d. single metal capsule

*ANSWER

c.

*REFERENCE $

SOP 2.4.2

*QUESTION F.05 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

Due to a failure of instrumentation [ion chamber] in the percent power channel, an unscheduled shutdown has occurred.

Based on the Standard Operating Procedures, who has the principal authority to authorize resumption of operations?

a. the Operator in Charge

b. any Senior Reactor Operator

c. the Senior Reactor Operator on call

d. the Reactor Supervisor

*ANSWER

d.

*REFERENCE $

SOP 2.6 page 2-7
SOP 4.1.6.a

*QUESTION F.06 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

Both the Technical Specifications and the Operating Procedures require that a licensed operator be present at the controls during reactor operation.

What are the other manning requirements during operation of the reactor?

a. a Senior Reactor Operator must be on call on the U.C.I. campus and a second person capable of initiating emergency action must be present in the facility

b. a Senior Reactor Operator must be on call on the U.C.I. campus and a second person capable of initiating emergency action must be present in the Physical Sciences building

c. a Senior Reactor Operator must be immediately on call in the physical sciences building and a second person capable of initiating emergency action must be present in the facility

d. a Senior Reactor Operator must be immediately on call and available within fifteen minutes with a second reactor operator capable of initiating emergency action present in the facility

*ANSWER

c.

*REFERENCE $

SOP 4.1.1.e

0.0

*QUESTION F.07 [~~1.00~~]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

The "Start-Up" procedure ,SOP 4.1.2, is being followed during a routine start-up in the morning.

What is the proper sequence of steps for start-up?

a. sign reactor log [enter date & serial No. of checklist]
complete all items on the start-up check-list
date and sign start-up check-list
bring the reactor critical to check core excess

b. date and sign start-up check-list
complete all items on the start-up check-list
sign reactor log [enter date & serial No. of checklist]
bring the reactor critical to check core excess

c. complete all items on the start-up check-list
bring the reactor critical to check core excess
sign reactor log [enter date & serial No. of checklist]
date and sign start-up check-list

d. sign reactor log [enter date & serial No. of checklist]
complete all items on the start-up check-list
bring the reactor critical to check core excess
date and sign start-up check-list

*ANSWER

b.

*REFERENCE $

SOP 4.1.2. c through g

deleted

*QUESTION F.08 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

In the reactor log book how are entries related tc fuel changes indicated?

a. they are written in red ink

b. they are flagged with a red sticker

c. they are written in green ink

d. they are flagged with a green sticker

*ANSWER

a.

*REFERENCE $

SOP 4.2.8

*QUESTION F.09 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

In the reactor log book how is resolution of an unusual event indicated?

a. they are underlined in red

b. they are underlined in green

c. they are flagged with a red sticker

d. they are flagged with a green sticker

*ANSWER

d.

*REFERENCE $

SOP 4.2.6

*QUESTION F.10 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

Based on SOP 4.3 a reactor power calibration is being conducted.

Besides elapsed time, what other TWO parameters are needed to complete the calibration?

a. pool temperature and pool level

b. pool temperature and primary system flow rate

c. secondary system cooling water flow and pool level

d. secondary and primary system flow rates

*ANSWER

a.

*REFERENCE $

SOP 4.3.2

[0.50]

*QUESTION F.11 [1.00]

SHORT ANSWER.

a. Based on Standard Operating Procedures, what is the pool water purification system minimum adequate flow rate? [0.50]

b. Based on Standard Operating Procedures, what is the maximum conductivity of the reactor pool water that is allowed for continued operation of the reactor? [0.50]

*ANSWER

a. 10 GPM

b. 2.0 micromhos/cm < deleted >

*REFERENCE $

SOP 4.7.7.a through c

*QUESTION F.12 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

Access to the U.C.I. TRIGA facility is restricted for reasons of radiation safety, radiation control, and physical security.

What areas comprise the CONTROLLED ACCESS area?

a. the control room (B64), and the reactor room (B54)

b. the control room (B64), the reactor room (B54), and laboratory (B54A)

c. the control room (B64), the reactor room (B54), laboratory room B54A, and laboratory room B54B

d. the control room (B64), the reactor room (B54), laboratory room B54A, laboratory room B54B, and office B62

*ANSWER

c.

*REFERENCE $

SOP 4.9

*QUESTION F.13 [1.50]

SHORT ANSWER.

During normal working hours you are operating the reactor as the Operator in Charge. The breakage of a large experiment has caused several area radiation alarms to alarm. As Operator in Charge, you are in charge until additional help arrives.

What THREE immediate actions should you take or make sure are being taken? [0.50 each]

*ANSWER

[0.50 each / for any 3 of the following]

personnel evacuate [to the control room as soon as possible]

SCRAM the reactor

conduct an immediate assessment of the radiation level in the control room [using portable instruments]

*REFERENCE $

SOP EP 6.3.1

{add "Obtain outside assistance"}

*QUESTION F.14 [1.00]

SHORT ANSWER.

The decision to emergency evacuate the Physical Sciences Building has been made due the breakage of a large experiment and associated high radiation levels.

a. During an emergency, how is building evacuation accomplished? [0.50]

b. Who [what office or desk] should be called in order to provide an explanation? [0.50] [note: these are NOT U.C.I. TRIGA related personnel]

*ANSWER

a. actuation of the fire alarm system [0.50]

b. the Police Dispatch Desk [0.50]

*REFERENCE $

SOP EP 6.5

*QUESTION F.15 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

Where are the emergency supplies for marking off a large controlled area [poles and special rope] stored?

a. in the Reactor Supervisor's office

b. in the research lab office across from the Reactor Supervisor's office

c. in the materials storage room adjacent to the loading dock

d. in the storeroom under the stairwell across the hall from the control room

*ANSWER

d.

*REFERENCE

SOP 6.A.1, 5.B, Inst. Man. page 4-4

END OF CATEGORY F
GO ON TO CATEGORY G

CATEGORY G
RADIATION CONTROL AND SAFETY

*QUESTION G.01 [1.00]

MULTIPLE CHOICE. SELECT THE CORRECT ANSWER.

A large spill of radioactive liquid has occurred which has leaked out onto the loading dock.

What is the color of the rope used to demark the contamination control line around the spill?

a. yellow and black

b. yellow and magenta

c. red and black

d. red and white

*ANSWER

b.

*REFERENCE $

SOP EP 6.9.3.1 and page 6-A-1

*QUESTION G.02 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

Following radiation alarms and an evacuation from the facility a radiation area around the facility is being demarked with poles and ropes in accordance with emergency procedures.

What is the radiation level used to establish this demarcation line?

a. 100 Mr/Hr.

b. 5 Mr/Hr.

c. 2 Mr/Hr.

d. 0.5 Mr/Hr.

*ANSWER

c.

*REFERENCE $

SOP EP 6.3.F

*QUESTION G.03 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

Following an experiment, who has the PRINCIPAL responsibility for properly disposing of radioactive waste?

a. the Operator in Charge

b. the senior operator on call

c. the Reactor Administrator

d. the Experimenter

*ANSWER

d.

*REFERENCE $

RSP 5.7.2

*QUESTION 6.04 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

Routine personnel monitoring is required for individuals visiting the U.C.I. TRIGA facility.

What PRINCIPAL type of radiation would be ACCURATELY monitored by the standard film badge monitor?

a. high energy alpha

b. low energy beta

c. low energy gamma

d. high energy neutrons

*ANSWER

c.

*REFERENCE $

RSP 5.1.2.1
Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 9-17

*QUESTION G.05 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

As reactor operator, you are checking INDIVIDUAL PERSONNEL monitoring requirements based on the LOCALIZED MONITORING REQUIREMENTS of the RADIOLOGICAL SAFETY PROGRAM are met prior to starting up the reactor. The experimenter you are checking will be using the "fast transfer facility" to irradiate sodium fluoride samples. He will probably have to handle some of the samples.

What is the MINIMUM localized monitoring that you expect the experimenter to use?

a. a neutron sensitive TLD

b. a finger ring TLD

c. a portable alarming beta-gamma meter

d. a high range self-reading dosimeter

*ANSWER

b.

*REFERENCE $

RSP 5.1.2.2

0.0

*QUESTION G.06 [~~1.00~~]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

A tour group of six persons escorted by a reactor operator is about to enter the facility.

How many self-reading dosimeters must be issued to individuals in the TOUR group?

a. 0

b. 1

c. 2

d. 3

*ANSWER

c.

*REFERENCE ¶

SOP 4.9.3 and RSP 5.1.2.1.[]

deleted

*QUESTION G.07 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

Which of the following would be the BEST absorber for high energy [> 1 Mev.] gamma radiation?

a. lead bricks

b. water

c. polyethylene blocks

d. aluminum

*ANSWER

a.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Pg. 8-5

*QUESTION 6.08 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

Which of the following terms describes the number of nuclear transformations occurring per unit time?

a. Ergs

b. Coulombs

c. Roentgens

d. Curies

*ANSWER

d.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Pg. 8-6

*QUESTION G.09 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

The quality factor [QF] relates absorbed dose to dose equivalent for persons exposed to ionizing radiation.

What is the QF for BETA radiation?

a. 1/10

b. 1/3

c. 1

d. 10

*ANSWER

c.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Pg. 8-7

*QUESTION G.10 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

Which of the following radiation detectors is BEST used to measure LOW LEVEL surface contamination?

a. G-M Survey Meter, Wm. Johnson GSM-5

b. "JUNO Meter, Technical Associates Model B

c. "CUTIE PIE" Monitor, Technical Associates Model CP-5

d. Self-Reading Dosimeter, Landsverk Model L-50

*ANSWER

a.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Pg. 9-6 through 9-17

*QUESTION G.11 [1.00]

SHORT ANSWER.

A radioactive sample [0.70 Mev gamma radiation] from an experiment causes a dose rate of 100 Mr/Hr. at a distance of 1 foot. Lead shielding is ONLY available in sheets which are one-half [1/2] inch thick.

What is the minimum amount of lead shielding [in inches] required to lower the dose rate to 1 Mr/Hr. or less at a distance of 1 foot?

SHOW ALL WORK AND ASSUMPTIONS MADE!

*ANSWER

$I/Io = 1/2^{[n]}$ [0.25]

$1/100 = 1/2^{[n]}$ [0.25]

$100 < 2^{[n]}$ [0.25]

$2^{[7]} = 128$ so $7 \times 1/2 = \underline{3.5 \text{ inches of lead}}$ [0.25]

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 8-13

*QUESTION G.12 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

An area has a general radiation of 40 Mr/Hr. due to storage of sealed irradiated samples.

What MARKING or POSTING is required for this area by the Code of Federal Regulations and by the Facility procedures?

a. CAUTION, HIGH CONTAMINATION AREA

b. CAUTION, HIGH RADIATION AREA

c. CAUTION, CONTROLLED AREA

d. CAUTION, RADIATION AREA

*ANSWER

d.

*REFERENCE *

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 8-11

*QUESTION G.13 [1.50]

SHORT ANSWER.

The Code of Federal Regulations establishes limits of maximum occupational exposures for individuals.

a. What is the limit for exposure of the skin of the whole body? [0.50]

b. What is the limit for exposure of the hands or feet? [0.50]

c. What is the whole body cumulative dose limit? [0.50]

*ANSWER

a. 7.5 Rem/Qtr. [0.50]

b. 18.75 Rem/Qtr. [0.50]

c. [N-18] x 5 [where N = age] [0.50]

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 8-9

*QUESTION G.14 [1.00]

SHORT ANSWER.

A sealed experiment which is more radioactive than expected has been dropped on the floor next to the pool. The resulting dose due to the experiment sample at ten [10] feet is 25 Mr/Hr.

What would be the dose at a distance of one [1] foot from this sample? [Assume the detector efficiency does not change and that background is negligible.]

SHOW ALL WORK AND ASSUMPTIONS MADE!

*ANSWER

$D2 = D1 \times [d1/d2]^{[2]}$ [0.25]

$D2 = 25 \times 10^{[2]}$ [0.50]

D2 = 2500 Mr/Hr. or 2.5 Rem/Hr. [0.25]

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Reactor, Pg. 8-12

*QUESTION G.15 [1.00]

MULTIPLE CHOICE, SELECT THE CORRECT ANSWER.

Based on the U.C.I. TRIGA Instruction Manual, calculation have been made which indicate that there would be about ten thousand curies of activity in a fuel element following several hours of operation at full power.

What would be the approximate dose rate IN AIR, if one one of the fuel elements were REMOVED from the core?

a. 10000 Rem/Hr. at six feet

b. 1000 Rem/Hr. at six feet

c. 10000 Mr/Hr. at six feet

d. 1000 Mr/Hr. at six feet

*ANSWER

b.

*REFERENCE $

Instruction Manual for the U.C.I. TRIGA Pg. 8-15

END OF CATEGORY G
END OF EXAMINATION