

U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Report No. 50-182/OL-90-01

Docket No. 50-182

License No. P-87

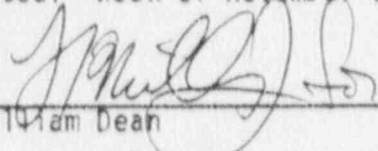
Licensee: Purdue University
 School of Nuclear Engineering
 West Lafayette, Indiana 47907

Facility Name: PUR-1

Examination Administered At: Purdue University


Examination Conducted: Week of November 12, 1990

Chief Examiner:


 William Dean

 12-4-90
 Date

Approved By:


 M. Jordan, Chief
 Operator Licensing Section 1

 12/10/90
 Date
Examination Summary

Examinations administered during the week of November 12, 1990 (Report No. 50-182/OL-90-01) to one reactor operator.

Results:

One reactor operator candidate took and passed the examinations.

REPORT DETAILS1. Examiners

William Dean, Chief Examiner
 James Canady, Licensed Examiner Trainee

2. Exit Meeting

An exit meeting was held with E. R. Stansberry (Reactor Supervisor), William Dean (Chief Examiner), and James Canady (Licensed Examiner Trainee) on November 14, 1990. No generic concerns were raised. The facility examination comments were discussed as noted in Enclosure 2.

Enclosure 2

Facility Comments and NRC Resolution

of Comments

QUESTION A.03 (1.00)

During a startup with an established stable period of 40 seconds, the source is raised to its upper limit when passing 5 watts. Which one of the following statements describes the effect the reactor operator should observe on the period meter?

- A. slight increase
- B. slight decrease
- C. large increase
- D. large decrease

ANSWER:

A.

FACILITY COMMENT:

Purdue uses the terms lengthen or shorten to describe the period instead of increase or decrease. Confusion often arises with the latter terms. Both LSO's would have answered it with choice B.

Do not concur. The term "lengthen" literally infers an "increase" in the length of the period (e. g. 30 seconds to 32 seconds). Similar arguments hold true for the term "shorter". No change to the answer key.

QUESTION A.08 (1.00)

Which one of the following statements describes characteristics of the PUR-1 reactor's moderator?

- A. LOW atomic number and HIGH neutron absorption cross section
- B. LOW atomic number and HIGH scattering cross section
- C. HIGH neutron absorption cross section and HIGH scattering cross section
- D. LOW neutron absorption cross section and LOW scattering cross section

ANSWER

A.

FACILITY COMMENT:

If you check the quoted reference choice, B will be found to be the correct answer.

NRC RESOLUTION:

Concur, typographical error in the answer key changed to reflect choice B as the correct answer.

QUESTION B.10 (1.00)

Select the statement below as specified in the Technical Specification for the PUR-1 reactor that describes the objective for the Safety Limit applicable to steady state power.

- A. Defines a power level below which it can be confidently predicted that no fuel element damage will occur.
- B. Provides an experimentally determined temperature below which there is assurance no fuel damage will occur.
- C. Defines an excess reactivity value which serves as the base for insuring the cladding temperature is maintained below 1100 degrees-F.
- D. Provides a safety margin that insures cladding integrity under all postulated emergency shutdown conditions.

ANSWER:

B.

FACILITY COMMENT:

The safety limit in Technical Specification 2.1 concerns power level instead of temperature.

NRC RESOLUTION:

Concur, typographical error in the answer key changed to reflect choice A as the correct answer.

QUESTION B.18 (1.00)

Assume the reactor has been shut down for LESS than four (4) hours. Which one of the following items is required to be checked prior to commencing the startup procedure, per PUR-1 Operating Manual?

- A. Magnet currents
- B. Position of source
- C. Setback switch lights
- D. Water conductivity

ANSWER:

C.

FACILITY COMMENT:

A change in the prestartup checklist changed item 11 to be item 12. Calibrating the Log N channel is a part of the short form of the prestartup instead of Annunciator Check. This was our error in not supplying you with latest information. We thank you for pointing out this error.

NRC RESOLUTION:

Due to the change in the prestartup checklist which was not reflected in the material provided to the NRC, none of the answers provided is correct. The question is deleted from the examination. The facility should update their reference material to ensure it is accurate.

U. S. NUCLEAR REGULATORY COMMISSION
NON-POWER REACTOR LICENSE EXAMINATION

FACILITY: Purdue Univ.
 REACTOR TYPE: PUR-1
 DATE ADMINISTERED: 90/11/14
 REGION: 3
 CANDIDATE: _____
 LICENSE APPLIED FOR: _____

INSTRUCTIONS TO CANDIDATE:

Use the answer sheets provided to document your answers. Staple this cover sheet on top of the answer sheets. Points for each question are indicated in parentheses for each question. A 70% in each section is required to pass the examination. Examinations will be picked up three (3) hours after the examination starts.

CATEGORY VALUE	% OF TOTAL	CANDIDATE'S SCORE	% OF CATEGORY VALUE	CATEGORY
20.00	32.26 ^{JAC} 32.79	_____	_____	A. REACTOR THEORY, THERMODYNAMICS AND FACILITY OPERATING CHARACTERISTICS
* 20.00	33.87 ^{JAC} 32.79	_____	_____	B. NORMAL AND EMERGENCY OPERATING PROCEDURES AND RADIOLOGICAL CONTROLS
JAC. 21.00 11-21-90	33.87 ^{JAC} 34.42	_____	_____	C. PLANT AND RADIATION MONITORING SYSTEMS
61.00	62.00	_____	_____ %	TOTALS
		FINAL GRADE		

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

Candidate's Signature

* Question #18 deleted

MASTER COPY

NRC RULES AND GUIDELINES FOR LICENSE 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 candidate 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. Print your name in the upper right-hand corner of each answer sheet.
7. Partial credit may be given. Therefore, ANSWER ALL PARTS OF THE QUESTION AND DO NOT LEAVE ANY ANSWER BLANK. NOTE: partial credit will NOT be given on multiple choice questions.
8. Proportional grading will NOT be given on multiple choice questions.
9. If the intent of a question is unclear, ask questions of the examiner only.
10. When turning in your examination, assemble the completed examination with examination questions, examination aids and answer sheets. In addition, turn in all scrap paper.
11. To pass the examination, you must achieve at least 70% in each category.
12. There is a time limit of (3) hours for completion of the examination.
13. When you are done and have turned in your examination, leave the examination area as defined by the examiner. If you are found in this area while the examination is still in progress, your license may be denied or revoked.

QUESTION: 001

The uranium fuel (U-235) used in the PUR-1 reactor is enriched to approximately:

- A. 3 %
- B. 7 %
- C. 20 %
- D. 93 %

QUESTION: 002

The clad of the PUR-1 fuel assemblies consists of which one of the following materials?

- A. stainless steel
- B. aluminum
- C. zircaloy
- D. beryllium

QUESTION: 003

During a startup with an established stable period of 40 seconds, the source is raised to its upper limit when passing 5 watts. Which one of the following statements describes the effect the reactor operator should observe on the period meter?

- A. slight increase
- B. slight decrease
- C. large increase
- D. large decrease

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

QUESTION: 004

According to Technical Specifications, which one of the following statements describes the importance of maintaining a high degree of water purity for the PUR-1 reactor?

- A. Eliminates need for using filter and demineralizer
- B. Reduces impurities through product activation
- C. Decreases resistivity for proper pH balance
- D. Minimizes corrosion rate of fuel element cladding

QUESTION: 005

The PUR-1 was designed with a negative moderator temperature coefficient so that an increase in moderator temperature would cause which of the following?

- A. decreased voids
- B. decreased power
- C. increased voids
- D. increased power

QUESTION: 006

Nitrogen-16 is not a radiological problem in the PUR-1 reactor because it:

- A. emits gammas which do not travel far in water.
- B. is contained within the fuel element.
- C. combines with free hydrogen to form a mild acid.
- D. decays before reaching the surface of the pool.

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

QUESTION: 007

Which one of the following statements describes the neutron production reaction for the PUR-1 reactor's startup source?

- A. Pu-239 beta decays, emitting gammas that produce a Be-9 (gamma, alpha), neutron reaction.
- B. Sb-124 alpha decays, producing a Be-9 (gamma, alpha) neutron reaction.
- C. Pu-239 alpha decays, producing a Be-9(alpha, neutron), Carbon-12 reaction.
- D. Sb-124 beta decays, emitting gammas that produce a Be-9 (gamma, alpha), neutron reaction.

QUESTION: 008

Which one of the following statements describes characteristics of the PUR-1 reactor's moderator?

- A. LOW atomic number and HIGH neutron absorption cross section
- B. LOW atomic number and HIGH scattering cross section
- C. HIGH neutron absorption cross section and HIGH scattering cross section
- D. LOW neutron absorption cross section and LOW scattering cross section

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

QUESTION: 009

Rank the following types of radiation in order from the MOST penetrating (1) to the LEAST penetrating (4); ie., travels the furthest in air.

- _____ A. alpha
- _____ B. beta
- _____ C. gamma
- _____ D. neutron

QUESTION: 010

As stated in Technical Specifications which one of the following statements describes a pool experiment?

- A. An experiment positioned more than six inches horizontally from the reflector.
- B. An experiment conducted in the pool directly above or below the core.
- C. An experiment whose nuclear characteristics have been determined within the pool.
- D. An experiment placed within the core or within the graphite reflector.

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

QUESTION: 011

Which one of the following conditions would provide the greatest rod worth for shutting down or reducing the power of the PUR-1 reactor?

- A. SS rod #2 and RR at lower limit with SS rod #1 upper limit
- B. SS rod #1 at lower limit with SS rod #2 and RR at upper limit
- C. SS rod #1 and RR at lower limit with SS rod #2 at upper limit
- D. SS rod #2 at lower limit with SS rod #1 and RR at upper limit

QUESTION: 012

Which one of the following PUR-1 reactor materials has the highest neutron absorption cross section?

- A. Uranium fuel
- B. Boron stainless steel
- C. Water filled stainless steel tube
- D. Graphite reflector

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

QUESTION: 013

Which one of the following conditions best describes the behavior of the reactor as it approaches criticality during a normal startup?

- A. Reactor period moves further away from infinity in the negative direction
- B. Reactor period moves further away from infinity in the positive direction
- C. Reactor period becomes more positively stable
- D. Reactor period approaches infinity

QUESTION: 014

Which one of the following is the reason there is a -80 second period soon after a reactor scram?

- A. This is due to the sustained fission rate of U-235 with source neutrons.
- B. This is the decay constant of the longest lived group of delayed neutron precursors.
- C. The fuel temperature coefficient adds positive reactivity due to the fuel temperature decrease following a scram counteracting some of the negative reactivity injected by the scram.
- D. The amount of excess negative reactivity added on a scram is beyond the required shutdown margin.

QUESTION: 015

Select the word below that describes how the conductivity of the water in the pool of the PUR-1 reactor varies with its resistivity.

- A. logarithmically
- B. exponentially
- C. linearly
- D. inversely

QUESTION: 016

Select the statement below that describes the purpose of the graphite reflector surrounding the PUR-1 reactor.

- A. thermalizes neutrons
- B. reduces neutron leakage
- C. enhances fast neutron leakage
- D. minimizes number of delayed neutrons

QUESTION: 017

Select the statement below that describes the PUR-1 reactor when it is exactly critical.

- A. $K_{eff} = 1$; $\Delta K/K = 1$
- B. $K_{eff} = 1$; $\Delta K/K = 0$
- C. $K_{eff} = 0$; $\Delta K/K = 1$
- D. $K_{eff} = 0$; $\Delta K/K = 0$

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

QUESTION: 018

Which one of the following terms defines the ratio of the number of thermal neutrons absorbed in the fuel to the number of thermal neutrons absorbed in all materials?

- A. thermal non-leakage factor
- B. fast fission factor
- C. thermal utilization factor
- D. neutron reproduction factor

QUESTION: 019

Which one of the following statements describes the beta decay of nuclides?

- A. The atomic mass number decreases by 1, and the number of protons remains constant.
- B. The atomic mass number remains constant, and the number of protons increases by 1.
- C. The atomic mass number remains constant, and the number of protons remains constant.
- D. The atomic mass number decreases by 1, and the number of protons decreases by 1.

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

QUESTION: 020

Select the statement which accurately describes a difference between prompt and delayed neutrons.

- A. Prompt neutrons account for less than one percent of the neutron population while delayed neutrons account for approximately ninety-nine percent of the neutron population.
- B. Prompt neutrons are released during fast fissions while delayed neutrons are released during thermal fissions.
- C. Prompt neutrons are released during the fission process while delayed neutrons are released during the decay process.
- D. Prompt neutrons are the dominating factor in determining the reactor period while delayed neutrons have little effect on the reactor period.

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

QUESTION: 001

If you are working in a radiation zone where the general background is 25 mrem/hr gamma radiation, how long can you work in that zone before you would exceed the 10 CFR 20 whole body quarterly limit? Assume your total accumulated occupational dose to the whole body cannot be determined.

- A. 30 hours
- B. 50 hours
- C. 75 hours
- D. 120 hours

QUESTION: 002

Which one of the following is the definition of a Rem?

- A. A measure of the sum of the products of the dose equivalent to the organ or tissue and the weighing factors applicable to each of the body organs or tissues that are irradiated.
- B. A quantity of radiation absorbed, per unit of mass, by the body or by any portion of the body.
- C. A measure of the dose of any ionizing radiation to body tissue in terms of the energy absorbed per unit mass of the tissue.
- D. A measure of dose of any ionizing radiation to the body tissue in terms of its estimated biological effect relative to a dose of 1 R of x-rays.

QUESTION: 003

In accordance with the procedure for Irradiation Outside Reflector Core, which of the following statements accurately describes the removal of an irradiated sample and fuel assembly when the monitored dose rate is GREATER than 1.0 Rem/hour at one meter?

- A. Remove sample from fuel assembly and immediately place in pool for shielding.
- B. Place the fuel assembly with sample in a shielded container and take to the counting room for detailed monitoring.
- C. Return fuel assembly to reactor core and place irradiated sample in storage rack for radiation decay.
- D. Place the fuel assembly with sample back into the pool until safe to handle.

QUESTION: 004

The ALARA principle involves:

- A. making every reasonable effort to minimize stay time and maximize distance and shielding to keep occupational exposures low.
- B. maintaining exposures less than federal requirements to insure there is no undue risk to public health and safety.
- C. adhering to the philosophy that low levels of radiation is occupationally acceptable since there is no evidence of increased health risks.
- D. selecting individuals with reasonably low exposures to perform high radiation duties since they can accomplish more prior to exceeding limits.

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

QUESTION: 005

When is the regulating rod typically raised to about 30 cm during an approach to critical for a normal startup?

- A. After one shim-safety rod has been raised to its upper limit
- B. After a positive reactor period greater than 30 seconds has been established
- C. After the installed neutron source has been raised to its upper limit
- D. After both shim-safety rods have been raised to the shim range

QUESTION: 006

In accordance with PUR-1 procedure for the Removal and Installation of Fuel Assemblies, who MUST be present in the reactor room during ALL fuel changes?

- A. Radiological Control Officer
- B. Health Physics Technician
- C. Licensed Senior Operator
- D. Assistant Laboratory Director

QUESTION: 007

Which one of the following actions would the reactor operator take during a pre-startup check if it is discovered that the magnet indicating lights are NOT on and the magnet current meters do NOT indicate a magnet current?

- A. Check the Log Count Rate meter to insure it is in the "CALIBRATE" position.
- B. Check the position of the Safety-Shim rods to insure they are at their lower limit.
- C. Check the setback and scram initiation meter setpoints to insure they are set to proper values.
- D. Check Log-N amplifier selector switch to insure it is in the "OPERATE" position.

QUESTION: 008

Which one of the following statements is an action specified in the PUR-1 Emergency Procedure that the operator would take in the event the reactor fails to scram upon depressing the scram buttons?

- A. Depress the "Gang Lower" switch to lower the control rods to their lower limit.
- B. Evacuate the reactor room since the inherent safety feature of the reactor will cause it to shutdown on its own.
- C. Empty the contents of the two containers of boric acid into the pool to absorb the thermal neutrons.
- D. Turn the magnet key to the "off" position to de-energize the scram circuit associated with the regulating rod.

QUESTION: 009

In accordance to the guidelines provided in the PUR-1 Radiological Control and Health Physics Handbook which one of the following statements describes the correct action to be taken IMMEDIATELY following a major spill involving radiological hazards to personnel?

- A. Clean up the spill to prevent the spread of contamination.
- B. Notify the Licensed Senior Operator and provide a brief summary of spill to Radiation Control Officer.
- C. Turn on ventilation devices for the removal of radioactive mists, fumes, or vapors.
- D. Vacate the room and prohibit entrance to contaminated area.

QUESTION: 010

Select the statement below as specified in the Technical Specification for the PUR-1 reactor that describes the objective for the Safety Limit applicable to steady state power.

- A. Defines a power level below which it can be confidently predicted that no fuel element damage will occur.
- B. Provides an experimentally determined temperature below which there is assurance no fuel damage will occur.
- C. Defines an excess reactivity value which serves as the base for insuring the cladding temperature is maintained below 110° degrees-F.
- D. Provides a safety margin that insures cladding integrity under all postulated emergency shutdown conditions.

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

QUESTION: 011

Which one of the following values specified in the PUR-1 Technical Specification describes the minimum height of water required above the core to furnish adequate personnel shielding?

- A. 11 feet
- B. 13 feet
- C. 15 feet
- D. 17 feet

QUESTION: 012

According to Technical Specifications when the reactor is in operation, a channel check of each reactor safety system measuring channels in use or on scale must be performed as a minimum approximately every:

- A. one hour.
- B. two hours.
- C. three hours.
- D. four hours.

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

QUESTION: 013

What is the MINIMUM crew for operating the PUR-1 reactor per Technical Specifications?

- A. Two licensed operators, one of which is in the control room and the other licensed crew member must be at the reactor facility.
- B. Two persons, both in reactor room, one of which is a licensed member and another crew member instructed in methods to shutdown the reactor
- C. Two persons, one of which is a licensed operator and the other a licensed senior operator who is readily available or on call
- D. Two persons, one of which can be an unlicensed crew member in the control room as long as the Reactor Supervisor is readily available or on call

QUESTION: 014

Which one of the following Technical Specification actions is required in the event a safety limit of the PUR-1 reactor is violated?

- A. Reduce power immediately to a level below that of the limiting safety setting and investigate causes.
- B. Determine cause of exceeding safety limit and shut down the reactor if damage is imminent.
- C. Shut down the reactor immediately and report the violation to the NRC.
- D. Notify the Reactor Supervisor and let him make the decision whether it is necessary to shut down.

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

QUESTION: 015

How would an accessible area at the PUR-1 reactor facility be posted if the radiation level is 65 mRem/hour?

- A. CAUTION - HIGH RADIATION AREA
- B. CAUTION - RADIATION AREA
- C. CAUTION - AIRBORNE RADIOACTIVITY AREA
- D. CAUTION - RADIOACTIVE MATERIAL(S)

QUESTION: 016

As specified in the PUR-1 Technical Specifications, which of the following channels is used SOLELY to provide a trip signal at the measured value ?

- A. 1
- B. 2
- C. 3
- D. 4

QUESTION: 017

What is the Technical Specification criteria for shim-safety rod drop time?

- A. < 0.5 second
- B. < 1.0 second
- C. < 1.5 seconds
- D. < 2.0 seconds

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

Question Deleted
J.A.C.
11-21-90

~~QUESTION: 010~~

~~Assume the reactor has been shut down for LESS than four (4) hours. Which one of the following items is required to be checked prior to commencing the startup procedure, per PUR-1 Operating Manual?~~

- ~~A. Magnet currents~~
- ~~B. Position of source~~
- ~~C. Setback switch lights~~
- ~~D. Water conductivity~~

QUESTION: 019

Any accidental releases of radioactivity into the environment must be reported by the operator IMMEDIATELY to the:

- A. Reactor Supervisor
- B. US Nuclear Regulatory Commission
- C. Emergency Director
- D. Radiological Control Officer

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

QUESTION: 020

The dose rate at a distance six inches from a point source is 5000 mrem/hour. At what approximate distance from the source is a "High Radiation Area" sign required to be posted, per 10 CFR 20 regulations?

- A. 1.5 feet
- B. 3.5 feet
- C. 4.0 feet
- D. 6.0 feet

QUESTION: 021

In the event of an emergency who will serve as the Emergency Director?

- A. Reactor operator
- B. Assistant Laboratory Director
- C. Senior licensed operator, on call
- D. Laboratory Director

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

QUESTION: 001

Select the Channel number below which the Servo Control System utilizes to maintain the reactor at a constant power level.

- A. 1
- B. 2
- C. 3
- D. 4

QUESTION: 002

Assume the Licensed Senior Operator (LSO) instructs you during a startup that you will be increasing power to 75% of licensed power and then placing the reactor in servo control to automatically maintain this power level. You have just completed the startup step of placing the shim-safety rods in the shim range. Given that servo operation is desired, which one of the following actions is required to be performed next per startup procedure?

- A. Leave the regulating rod at its lower limit.
- B. Withdraw the regulating rod about half its length.
- C. Withdraw the regulating rod to its upper limit.
- D. Withdraw the regulating rod to the point of going critical.

QUESTION: 003 (3.00)

Match the PUR-1 safety channel with setpoint condition in Column I with the type of trip response/interlock expected to occur in column II. Items in Column I have only one correct answer and items in Column II may be used more than once (0.50 points per correct response).

Column I (Safety Channel with Setpoint)	Column II Trip Response/Interlock
_____ 1. Log-N and period, 12 sec. period	a. Slow scram
_____ 2. Linear level, 120% range	b. Fast scram
_____ 3. Manual scram, console and hallway	c. Setback
_____ 4. Log count rate and period, 7 sec. period	d. Rod withdraw interlock
_____ 5. Safety, 120% power	
_____ 6. Log count rate and period, 2 counts per sec (cps)	

QUESTION: 004

Which of the following statements describes the setpoint and trip action expected to occur if the setpoint is exceeded for the fixed radiation monitors associated with the PUR-1 water process and operator console?

- A. 50 mR/hour - Fast Scram
- B. 7.5 mR/hour - Setback
- C. 50 mR/hour - Setback
- D. 7.5 mR/hour - Slow Scram

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

QUESTION: 005

What type of detector is used in the source range of the Startup Channel (Channel No.1)?

- A. Compensated ion chamber
- B. proportional boron counter
- C. fission chamber
- D. non-compensated ion chamber

QUESTION: 006

Select the statement below that characterizes a fast scram condition only.

- A. All rods simultaneously insert to their lower limit faster than that for a slow scram.
- B. Facility 110 volt power to the power supply circuit for the magnets is interrupted.
- C. Both shim safety rods insert to their lower limit faster than the regulating rod.
- D. Current from the power supply circuit to the magnets is interrupted.

QUESTION: 007

Which one of the following types of personnel monitoring devices is NORMALLY required unless otherwise specified by the Radiological Control Officer, per the Radiological Control and Health Physics Handbook?

- A. Thermoluminescent dosimeter (TLD)
- B. Ring badge
- C. Film badge
- D. Pocket dosimeter

QUESTION: 008

How often must the operation of the radiation monitoring equipment be verified during periods when the PUR-1 reactor is in operation?

- A. hourly
- B. daily
- C. weekly
- D. monthly

QUESTION: 009

Which one of the following statements describes the purpose of the rod withdrawal interlock associated with the Log Count Rate Channel (safety channel #1)?

- A. It prevents regulating rod withdrawal until after the shim safety rods have been raised to their shim range.
- B. It ensures the shim safety rods remain at their lower limit until the Log-N comes on scale.
- C. It limits the rate of shim rod withdrawal during approach to critical with a period less than 30 seconds.
- D. It inhibits rod withdrawal unless the startup channel is operating properly and the neutron source is in core.

QUESTION: 010

Which of the following statements describes a "setback" condition for the PUR-1 reactor?

- A. Shim safety rods drive in
- B. Shim safety and regulating rods drive in
- C. Regulating rod drives in
- D. regulating rod drives in and shim rods scram

QUESTION: 011

Which of the following statements describes a feature of the PUR-1 reactor facility that makes it highly unlikely that any reactor water would be lost during any severe seismic activity?

- A. Reinforcing bars connect the reactor pool to the original building structure to provide additional rigidity.
- B. The free standing construction of the reactor pool with its steel barriers is expected to limit any vibrational damage.
- C. The steel cylinders containing compacted magnetite sand is designed to cushion the tremors caused by an earthquake.
- D. The reactor pool is imbedded in a reinforced concrete platform that rests upon the bedrock found beneath the reactor room.

QUESTION: 012

What type of detector is used in the Radiation Area Monitors (RAM)?

- A. Ion chamber
- B. Proportional counter
- C. Geiger-Muller (G.M.) tube
- D. Scintillation counter

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

QUESTION: 013

According to the accident analysis for a loss of coolant accident (LOCA) which one of the following conditions would occur if the PUR-1 reactor pool were instantaneously drained while operating at licensed power.

- A. The decay heat would produce a core meltdown.
- B. The loss of water would shut the reactor down.
- C. The fuel cladding would melt releasing fission products.
- D. The molten uranium fuel would shut the reactor down.

QUESTION: 014

Which of the following elements listed below is an easily detected fission product whose detection in the PUR-1 water process system is an indication of a fuel cladding leak?

- A. Cesium
- B. Argon
- C. Barium
- D. Xenon

QUESTION: 015

Which one of the following conditions will result in a PUR-1 reactor "setback"?

- A. 50 mR/hr on pool top radiation monitor
- B. 110% range on channel #3
- C. 7 second period on channel #1
- D. 120% power on channel #4

QUESTION: 016

Which one of the following events will result if a complete power outage occurs at the main campus of Purdue University (Duncan Annex) while the PUR-1 reactor is operating at full licensed power?

- A. Regulating rod and shim safety rod blocks initiate immediately.
- B. Regulating rod and shim safety rod setback circuitry initiates immediately.
- C. Regulating rod and shim safety rod positions remain as-is.
- D. Regulating rod and shim safety rod scram circuits initiate immediately.

QUESTION: 017

The solenoid operated drain valve located on the piping between the condensate hold-up tank and the sewer drain has an emergency interlock with the PUR-1 reactor room ventilation system. Which one of the following will occur when the console switch for the ventilation exhaust system is turned to the OFF position?

- A. The solenoid valve OPENS and the air conditioner STOPS.
- B. The solenoid valve OPENS and the air conditioner continues to RUN.
- C. The solenoid valve CLOSES and the air conditioner STOPS.
- D. The solenoid valve CLOSES and the air conditioner continues to RUN.

QUESTION: 018

Assume the PUR-1 reactor is in servo control at 100% of licensed power and the water process system chiller is erroneously placed into operation resulting in a lowering of the pool temperature. Which one of the following statements describes the expected control system response with no operator action?

- A. The setback circuitry will activate a yellow light and buzzer as a warning and drive rods toward lower limit.
- B. The regulating rod will drive in to compensate for any power changes up to a 5% deviation from original power.
- C. The reactor will immediately shift back into manual control and the "SERVO PERMIT" light goes out.
- D. The scram circuitry will activate a red warning light with a scram within 30 seconds with no operator action.

QUESTION: 019

A "GENERAL PRACTICE" of operation for the PUR-1 reactor is to operate with a period NO shorter than:

- A. 15 seconds
- B. 20 seconds
- C. 25 seconds
- D. 30 seconds

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

ANSWER: 001 D.

REFERENCE:

Technical Specifications, Section 5.2, page 25

ANSWER: 002 B.

REFERENCE:

Technical Specification, Section 5.2 page 25

ANSWER: 003 A.

REFERENCE:

REACTOR REQUALIFICATION TEST, Dec 1976, General Operating Characteristics, Question C1 Answer Key, Purdue University.

ANSWER: 004 D.

REFERENCE:

Technical Specification, section 3.3, bases

ANSWER: 005 B.

REFERENCE:

Safety Analysis Report, Section 3.5.1, page 3-6

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

ANSWER: 006 D.

REFERENCE:

REACTOR REQUALIFICATION EXAM, Dec 1976, Principles of Reactor Operation, Question #5 answer key, Purdue University

ANSWER: 007 C.

REFERENCE:

REACTOR REQUALIFICATION EXAM, Dec 1977, General Operating Characteristics, Question 3a answer key, Purdue University

ANSWER: 008 ⁱⁿ A.

REFERENCE:

REACTOR REQUALIFICATION TESTS, Dec 1978, Principles of Reactor Operation, Questions 3 answer key, Purdue University

ANSWER: 009 A-4, B-3, C-1, D-2

REFERENCE:

Safety Analysis Report, Section 5.2.3, Training, page 5-2

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

ANSWER: 010 A.

REFERENCE:

Technical Specifications, Section 1.18, page 4

ANSWER: 011 C.

REFERENCE:

Safety Analysis Report, Section 3.4, page 3.4

ANSWER: 012 B.

REFERENCE:

Safety Analysis Report, Section 3.3, page 3-4, and PUR-1 Specification, Sections IIIA and B.

ANSWER: 013 C.

REFERENCE:

PUR-1 Procedure No. 65, Reactor Startup, Operation and Shutdown, Part A, Approach to Critical, Step 7, front page

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

ANSWER: 014 B.

REFERENCE:

REACTOR REQUALIFICATION TEST,

ANSWER: 015 D.

REFERENCE:

PUR-1 Operating Manual, May 1965, Pre-Startup Procedure, step 5, page 2 and Technical Specifications, Section 3.3, Primary Coolant Conditions, part b, page 14 and Section 4.3, part b, page 22

ANSWER: 016 B.

REFERENCE:

REACTOR REQUALIFICATION TESTS, Dec 1976, Principles of Reactor Operation, question 1b answer key, Purdue University

ANSWER: 017 B.

REFERENCE:

Reactor Requalification Test, Dec 1976, Section A, Principles of Reactor Operation, Question A1c answer key

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

ANSWER: 018 C.

REFERENCE:

Nuclear Reactor Engineering, 3rd Edition, Samuel Glasstone and Alexander Sesonske, Section 3.156, Diffusion and Slowing Down of Neutrons, page 189

ANSWER: 019 B.

REFERENCE:

Nuclear Reactor Engineering, 3rd Edition, Samuel Glasstone and Alexander Sesonske, Section 1.34, Radioactivity, Page 11

ANSWER: 020 C.

REFERENCE:

REACTOR REQUALIFICATION EXAM, Dec 1980, Section A, Question 1
answer key, Purdue University

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

ANSWER: 001 B.

REFERENCE:

REACTOR REQUALIFICATION TEST, Dec 1976, Radiation Control and Safety, Question G3 answer key, Purdue University

ANSWER: 002 D.

REFERENCE:

OPERATOR REQUALIFICATION EXAM, Dec 1980, Section G, Radiation Control and Safety, question 2a and 2b answer key, Purdue University

ANSWER: 003 D.

REFERENCE:

PUR-1 Procedure No. 25a, Irradiation Outside Reflector Core, Section 3.

ANSWER: 004 A.

REFERENCE:

Safety Analysis Report, Section 5.1, page 5-1, Purdue University

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

ANSWER: 005 D.

REFERENCE:

PUR-1 Procedure No. 65, Reactor Startup, Operation and Shutdown,
Part A, Step 4, May 1977

ANSWER: 006 C.

REFERENCE:

PUR-1 Procedure No. 68, Removal and Installation of Fuel
Assemblies, page 1

ANSWER: 007 D.

REFERENCE:

PUR-1 Operating Manual, May 1965, Pre-startup Procedure, section
14, page 4

ANSWER: 008 C.

REFERENCE:

PUR-1 Operating Manual, Emergency Procedure, Emergency Shutdown,
page 13

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

ANSWER: 009 D.

REFERENCE:

PUR-1 Radiological Control and Health Physics Handbook, Section 4.2, Major Spills, page 32

ANSWER: 010 B.

REFERENCE:

Technical Specification 2.1, Safety Limit, page 7

ANSWER: 011 B.

REFERENCE:

PUR-1 Technical Specification, section 3.3, primary coolant conditions, page 14

ANSWER: 012 D.

REFERENCE:

PUR-1 Technical Specification, section 4.2b, Reactor Safety System, page 20

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

ANSWER: 013 B.

REFERENCE:

PUR-1 Technical Specification, Section 6.1.11, page 30

ANSWER: 014 C.

REFERENCE:

PUR-1 Technical Specification, Section 6.3a & b, page 34

ANSWER: 015 B.

REFERENCE:

REACTOR REQUALIFICATION TEST, Dec 1978, Section G, Radiation Control and Safety, question 3 answer key

ANSWER: 016 D.

REFERENCE:

PUR-1 Safety Analysis Report, Section 3.7.5, Channel #4-Safety Channel, page 3-11

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

ANSWER: 017 B.

REFERENCE:

PUR-1 Technical Specification, Section 3.2c, page 11

*Question Deleted
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11-21-90*

~~ANSWER: 018 C.~~

~~REFERENCE:~~

~~PUR-1 Operating Manual, Operation Procedure, Page 1~~

ANSWER: 019 D.

REFERENCE:

Radiological Control and Health Physics Handbook, May 1980, Section 3.5.1.2, page 22

ANSWER: 020 B.

REFERENCE:

OPERATOR REQUALIFICATION EXAM, Section G, Radiation Control and Safety, Question 4 answer key

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

ANSWER: 021 D.

REFERENCE:

Emergency Plan for the Purdue University Reactor, section 3.1.1,
page 12

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

C. PLANT AND RAD MONITORING SYSTEMS

Page 44

ANSWER: 001 C.

REFERENCE:

Safety Analysis Report, Section 3.7.6.1.2, page 3-12

ANSWER: 002 B.

REFERENCE:

PUR-1 Operating Manual, Startup Procedure, step 10, page 8

ANSWER: 003 (3.00)

1c, 2a, 3a, 4a, 5b, 6d

REFERENCE:

PUR-1 Technical Specification, 3.2, Table 1, page 12

ANSWER: 004 D.

REFERENCE:

PUR-1 Technical Specification, 3.2, Table 1, page 12

ANSWER: 005 C.

REFERENCE:

REACTOR REQUALIFICATION TEST, Dec 1978, Section D, Instruments and Control, Question D1 answer key

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

ANSWER: 006 D.

REFERENCE:

REACTOR REQUALIFICATION TEST, Dec 1977, Section E, Safety and
Emergency Systems, Question E3 answer key

ANSWER: 007 C.

REFERENCE:

Radiological Control and Health Physics Handbook, Purdue
University, Paragraph 3.6.1.4, page 26.

ANSWER: 008 B.

REFERENCE:

PUR-1 Technical Specifications, section 4.2d, Reactor Safety
System, page 20

ANSWER: 009 D.

REFERENCE:

PUR-1 Technical Specification, Section 3.2 base, page 13; and
Reactor Requalification Test, Dec 1977, Section D, Instrument and
Control, Question D1a answer key

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

ANSWER: 010 B.

REFERENCE:

Operator Requalification Exam, Section E, Safety and Emergency Systems, E3 answer key

ANSWER: 011 B.

REFERENCE:

Safety Analysis Report, PUR-1, Section 2.3, paragraph 2.3.2, page 2-3

ANSWER: 012 D.

REFERENCE:

Safety Analysis Report, PUR-1, Section 3.7.7, page 3-13

ANSWER: 013 B.

REFERENCE:

Safety Analysis Report, Section 7.3, Loss of Coolant Accident, page 7.3

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

ANSWER: 014 A.

REFERENCE:

PUR-1 Specifications, Section VII, Miscellaneous Facts and Figures,
part VIIu

ANSWER: 015 B.

REFERENCE:

PUR-1 Technical Specifications, section 3.2, Reactor Safety
Systems, Table 1, page 12

ANSWER: 016 D.

REFERENCE:

REACTOR QUALIFICATION TEST, Dec 1976, Section E, Safety and
Emergency Systems, Question E1 answer key

ANSWER: 017 C.

REFERENCE:

Safety Analysis Report, PUR-1, Section 3.2.4, Emergency, page
3-2

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

ANSWER: 018 B.

REFERENCE:

Safety Analysis Report, PUR-1, Section 3.7.6.1.2, Servo Control System, page 3-12

ANSWER: 019 D.

REFERENCE:

REACTOR REQUALIFICATION TEST, PUR-1, Dec 1976, Section F, Standard and Emergency Procedures, Question F3 answer key

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

A N S W E R S H E E T

Multiple Choice (Circle or X your choice)

If you change your answer, write your selection in the blank.

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

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

A N S W E R S H E E T

Multiple Choice (Circle or X your choice)

If you change your answer, write your selection in the blank.

- | | | | | | |
|-----|---|---|---|---|-------|
| 001 | a | b | c | d | _____ |
| 002 | a | b | c | d | _____ |
| 003 | a | b | c | d | _____ |
| 004 | a | b | c | d | _____ |
| 005 | a | b | c | d | _____ |
| 006 | a | b | c | d | _____ |
| 007 | a | b | c | d | _____ |
| 008 | a | b | c | d | _____ |
| 009 | a | b | c | d | _____ |
| 010 | a | b | c | d | _____ |
| 011 | a | b | c | d | _____ |
| 012 | a | b | c | d | _____ |
| 013 | a | b | c | d | _____ |
| 014 | a | b | c | d | _____ |
| 015 | a | b | c | d | _____ |
| 016 | a | b | c | d | _____ |
| 017 | a | b | c | d | _____ |
| 019 | a | b | c | d | _____ |
| 020 | a | b | c | d | _____ |
| 021 | a | b | c | d | _____ |

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

ANSWER SHEET

Multiple Choice (Circle or X your choice)

If you change your answer, write your selection in the blank.

- | | | | | | | |
|-----|---|---|---|---|-------|-------|
| 001 | a | b | c | d | _____ | |
| 002 | a | b | c | d | _____ | |
| 003 | 1 | a | b | c | d | _____ |
| | 2 | a | b | c | d | _____ |
| | 3 | a | b | c | d | _____ |
| | 4 | a | b | c | d | _____ |
| | 5 | a | b | c | d | _____ |
| | 6 | a | b | c | d | _____ |
| 004 | a | b | c | d | _____ | |
| 005 | a | b | c | d | _____ | |
| 006 | a | b | c | d | _____ | |
| 007 | a | b | c | d | _____ | |
| 008 | a | b | c | d | _____ | |
| 009 | a | b | c | d | _____ | |
| 010 | a | b | c | d | _____ | |
| 011 | a | b | c | d | _____ | |
| 012 | a | b | c | d | _____ | |
| 013 | a | b | c | d | _____ | |
| 014 | a | b | c | d | _____ | |
| 015 | a | b | c | d | _____ | |
| 016 | a | b | c | d | _____ | |
| 017 | a | b | c | d | _____ | |
| 018 | a | b | c | d | _____ | |
| 019 | a | b | c | d | _____ | |

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

A N S W E R K E Y

- | | |
|-----|--------------------------------|
| 001 | D |
| 002 | B |
| 003 | A |
| 004 | D |
| 005 | B |
| 006 | D |
| 007 | C |
| 008 | <i>A B L.A.C.
11-21-90</i> |
| 009 | a-4 b-3 c-1 d-2 |
| 010 | A |
| 011 | C |
| 012 | B |
| 013 | C |
| 014 | B |
| 015 | D |
| 016 | B |
| 017 | B |
| 018 | C |
| 019 | B |
| 020 | C |

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

A N S W E R K E Y

- 001 B
- 002 D
- 003 D
- 004 A
- 005 D
- 006 C
- 007 D
- 008 C
- 009 D
- 010 ~~B~~ A
- 011 B
- 012 D
- 013 B
- 014 C
- 015 B
- 016 D
- 017 B
- ~~018~~ ~~C~~
- 019 D
- 020 B
- 021 D

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11-21-90

Question Deleted J.A.C.
11-21-90

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

A N S W E R K E Y

001	C
002	B
003	1 c
	2 a
	3 a
	4 a
	5 b
	6 d
004	D
005	C
006	D
007	C
008	B
009	D
010	B
011	B
012	D
013	B
014	A
015	B
016	D
017	C
018	B
019	D

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

TEST CROSS REFERENCE

Page 1

<u>QUESTION</u>	<u>VALUE</u>	<u>REFERENCE</u>
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007	1.00	9
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010	1.00	12
011	1.00	13
012	1.00	14
013	1.00	15
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016	1.00	19
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018	1.00	21
019	1.00	22
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013	1.00	37
014	1.00	38
015	1.00	39
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018	1.00	42
019	1.00	44
020	1.00	45
021	1.00	46

	21.00	

TEST CROSS REFERENCE

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016	1.00	61
017	1.00	62
018	1.00	63
019	1.00	64
	<u>21.00</u>	
TOTAL:	62.00	