U.S. NUCLEAR REGULATORY COMMISSION

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Examination Report No. 50-288/OL-84-01

Facility Licensee: Aerotest Operations, Inc.

3455 Fostoria Way

San Ramon, California 94583

Facility Docket Number: 50-288

Chief Examiner: [signature] 9-26-84

John Elin, Operator Licensing Examiner — Date

Approved: [signature] 9/26/84

Robert J. Pate, Chief — Date

Reactor Safety Branch

Summary:

Examinations on August 28, 1984.

Written and oral examination administered to one SRO-Instant candidate. Passed oral, failed one section of the written examination. License denied.

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REPORT DETAILS

1. Person Examined

   1-SRO instant candidate.

2. Examiner

   John O. Elin

3. Examination Review

   The written examination and answer key were reviewed on site by Mr. Irvin Lamb of Aerotest Operations, Inc., Mr. Lamb's comments are documented on the review copy of the answer key. These comments were incorporated into the key prior to grading the candidate's response.

4. At the conclusion of the examination the examiner met with Mr. Irvin Lamb and Mr. Richard Newacheck of the Aerotest Operations staff. The results of the examination were not discussed. The examiner noted, however, that the candidate appeared weak in knowledge of reactor theory.

KEY

U.S. NUCLEAR REGULATORY COMMISSION
SENIOR REACTOR OPERATOR LICENSE EXAMINATION

Facility: AEROTEST OPERATIONS, INC.
Reactor Type: ARRR
Date Administered: AUGUST 28, 1984
Examiner: John Elin
Candidate: ______________________

INSTRUCTIONS TO CANDIDATE

Use separate paper for the answers. Writer 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 and a final grade of at least 70%. Examination papers will be picked up six (6) hours after the examination starts.

Category Value	% of Total	Applicant's Score	% of Cat. Value	Category
20	20	____	____	H. Reactor Theory
20	20	____	____	I. Radioactive Materials Handling Disposal and Hazards
20	20	____	____	J. Specific Operating Characteristics
20	20	____	____	K. Fuel Handling and Core Parameters
20	20	____	____	L. Administrative Procedures, Conditions and Limitations
100	100	____	____	Totals

Final Grade ______ %

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

____
Candidate's Signature

Enclosures to Aerotest Rpt

PDR Copy

$f = ma$

$v = s/t$

Cycle efficiency = (Network out)/(Energy in)

$w = mg$

$s = V_o t + 1/2 \, at^2$

$E = mc^2$

$KE = 1/2 \, mv^2$

$a = (V_f - V_o)/t$

$A = \lambda N$

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

$PE = mgh$

$V_f = V_o + at$

$w = \theta/t$

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

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

$\Delta E = 931 \, \Delta m$

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

$\dot{Q} = \dot{m} Cp \Delta t$

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

$Pwr = W_f \Delta n$

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

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

$TVL = 1.3/\mu$

$HVL = -0.693/\mu$

$P = P_o 10^{sur(t)}$

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

$SUR = 26.06/T$

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

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

$SUR = 26\rho/\ell^* + (\beta - \rho)T$

$CR_1(1 - K_{eff1}) = CR_2(1 - K_{eff2})$

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

$T = \ell/(\rho - \beta)$

$T = (\beta - \rho)/(\lambda\rho)$

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

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

$M = (1 - K_{effo})/(1 - K_{eff1})$

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

$\ell^* = 10^{-4}$ seconds

$\bar{\lambda} = 0.1 \text{ seconds}^{-1}$

$\rho = [(\ell^*/(T \, K_{eff})] + [\bar{\beta}_{eff}/(1 + \bar{\lambda}T)]$

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

$\Sigma = \sigma N$

$I_1 d_1 = I_2 d_2$

$I_1 d_1^{\,2} = I_2 d_2^{\,2}$

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

<u>Water Parameters</u>

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.

<u>Miscellaneous Conversions</u>

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 in = 2.54 cm
°F = 9/5°C + 32
°C = 5/9 (°F-32)

H-1 (4.0)

A reactor is initially critical at a power level of 1 Kw. At t=0 the Keff of the reactor core was made to be 1.0020. (Assume β = .0072 ; amd λ = 0.1)

a. Calculate the reactivity insertion. (1.0)

b. What is the reactivity insertion in terms of Dollars and Cents? (1.0)

c. Calculate the resultant reactor period (T). (1.0)

d. At what time will the reactor power equal 100 kw ? (1.0)

a. $$\rho = \frac{(keff - 1)}{keff} = \frac{(1.0020 - 1.000)}{1.0020}$$

ρ = 0.0020

b. Dollars = ρ / β = .0020 /.0072 = \$ 0.28 or 28 cents

c. $$T = \frac{\beta - \rho}{\rho \lambda} \quad (\text{for } \rho \leq \beta)$$

$$T = \frac{(0.0072 - 0.002)}{(0.002)(0.1)} = 26 \text{ sec}$$

d. $$P = Po\ e^{(t/T)}$$

$$100 \text{ kw} = (1 \text{ kw})\ e^{(t/26 \text{ sec})}$$

t = (ln 100) (26 sec) = 119.7 sec or 2 minutes

Formula Sheet
Nuclear Reactor Engineering (Glasstone & Sesonski)

H-2 (4.0)

Refer to FIGURE H-1 which shows an instantaneous, negative, reactivity insertion into an already critical reactor core (at time t = 0), followed by a removal of this negative reactivity after a stable reactor period is reached (at time t = 1), thus rendering the reactor critical once again. Assuming no source neutrons:

a. Show the resulting reactor period as a function of time for this reactivity change. (1.0)

b. Show the reactor power level as a function of time for this reactivity change. (1.0)

c. Explain the shape of the reactor power response at a time IMMEDIATELY AFTER t=0. (1.0)

d. Explain the shape of the reactor power response at a time IMMEDIATELY PRIOR TO t=1 (1.0)

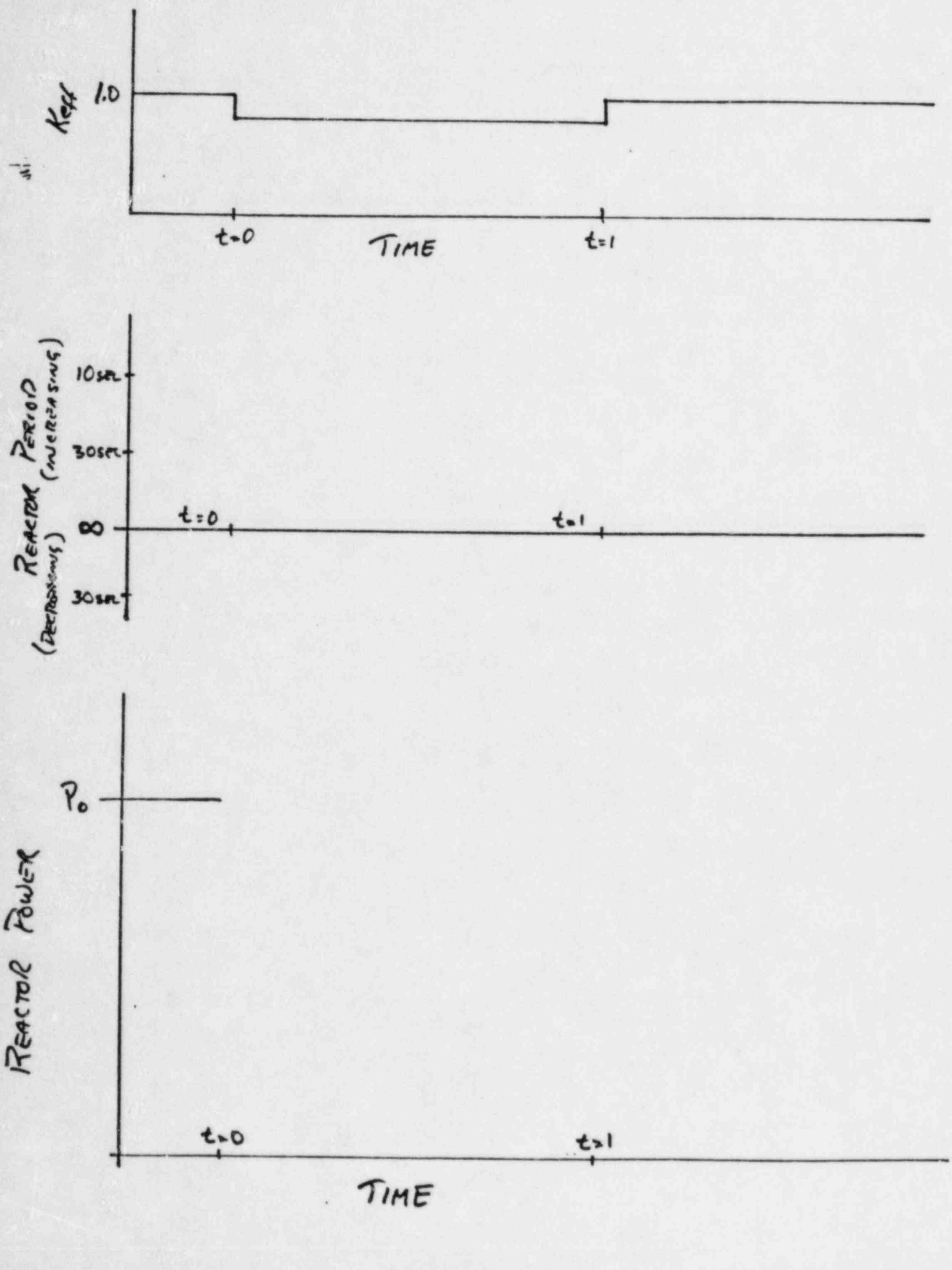
(a) & (b) ATTACHED

c. "PROMPT DROP" in total neutron flux due to a reduction in prompt neutron production.

d. "Negative Stable Period" due to the decay of delayed neutron precursors. The delayed neutron population is relatively large due to the over abundance of delayed neutron precursors.

Formula Sheet
Nuclear Reactor Engineering (Glasstone & Sesonski)

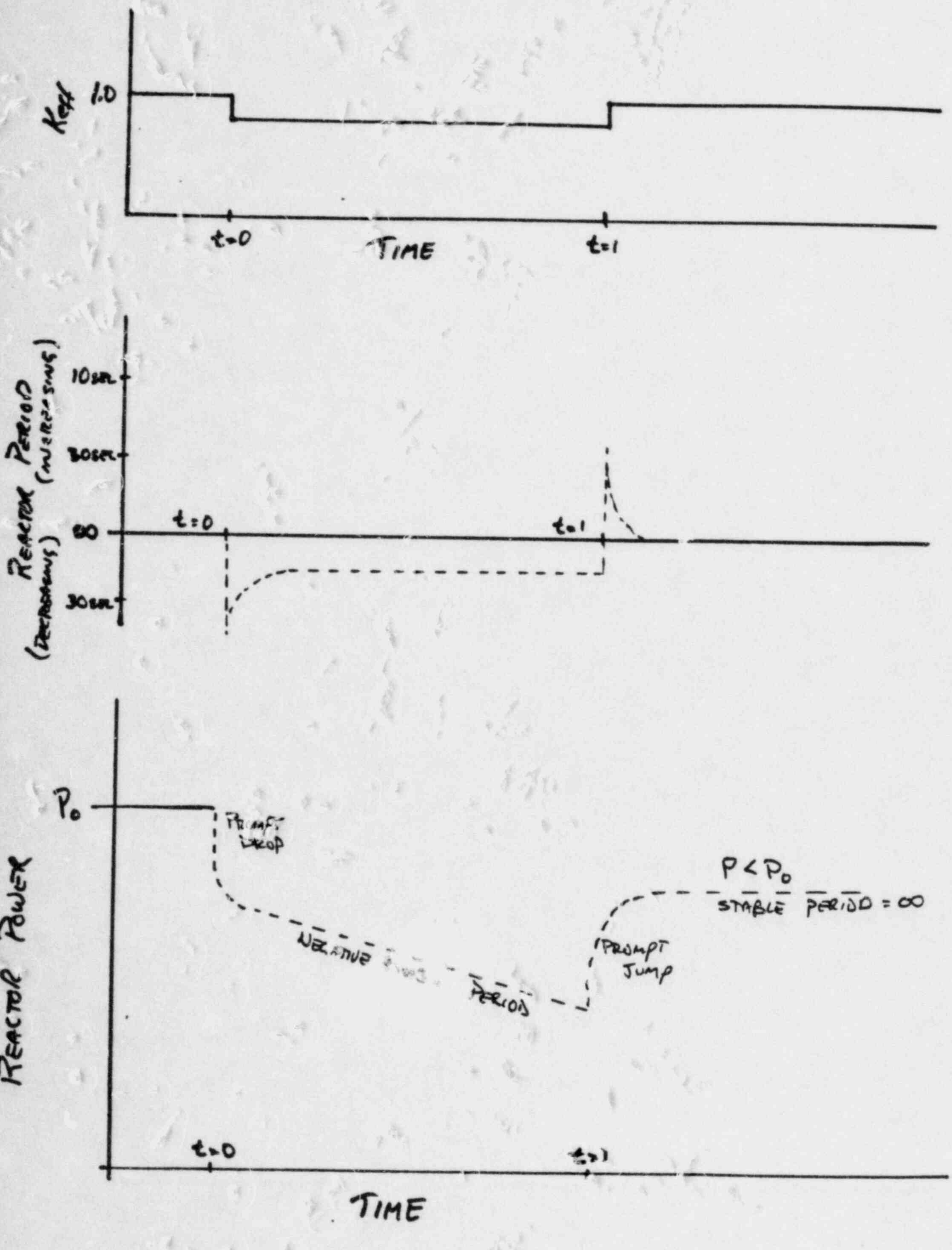
FIGURE H-1



Keff
1.0
t=0
TIME
t=1
REACTOR PERIOD
(INCREASING)
(DECREASING)
10sec
30sec
∞
30sec
t=0
t=1
P₀
REACTOR POWER
t=0
t=1
TIME

FIGURE A-1

KEY



H-3 (4.0)

FIGURE H-2 is a sketch of Reactor Power vs Time in hours. At t=0 hours reactor startup from Xenon free conditions to 100 % power occurs. At t=50 hours a reactor shutdown occurs followed by a reactor startup to 100 % power at t=65 hours.

a. Sketch the Xenon reactivity response in the core from this power transient. (Indicate approximate magnitude and duration of each transient.) (1.0)

b. Indicate the time in hours that the maximum negative reactivity will be inserted by Xenon. (1.0)

c. Indicate the time in hours that the maximun rate of rod insertion will have to occur in order to overcome the Xenon transient and remain just critical. (1.0)

d. What are the production and removal mechanisms for Xenon ? (1.0)

a,b,&c (ATTACHED)

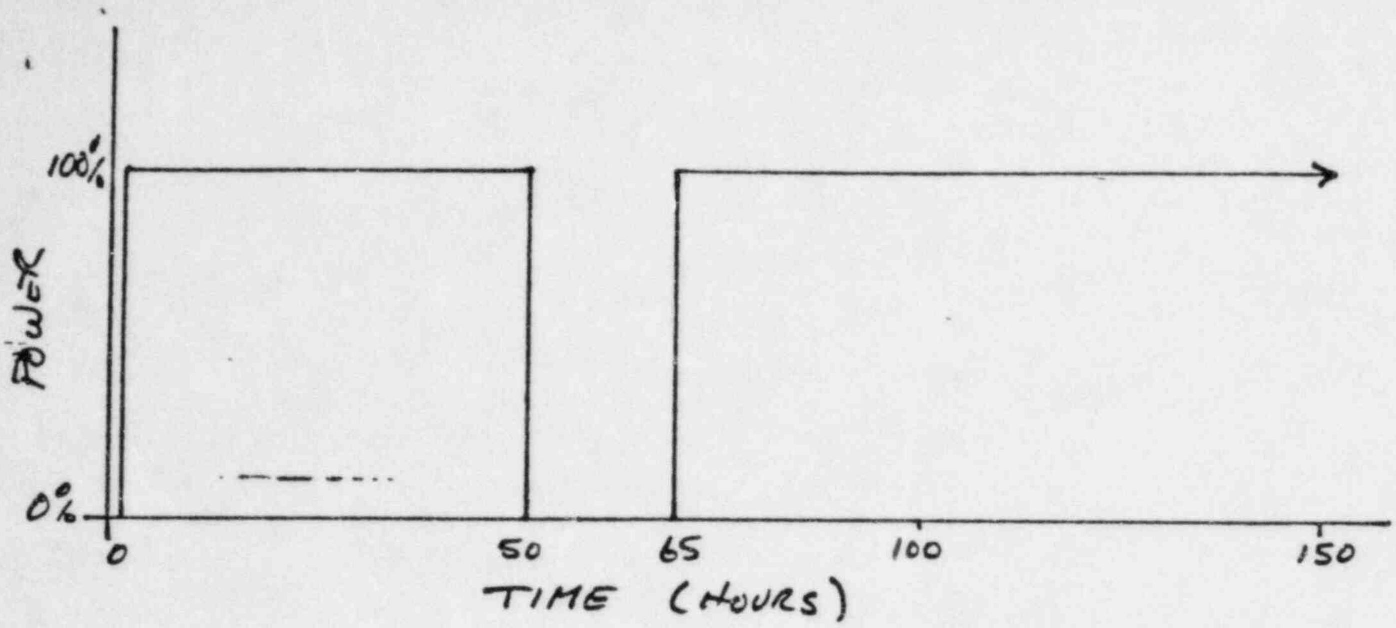
d. Xenon :

Production	(1) Iodine decay (fission daughter). (2) Direct yield from fission
Removal	(1) Burnout by neutron absorption. (2) Decay

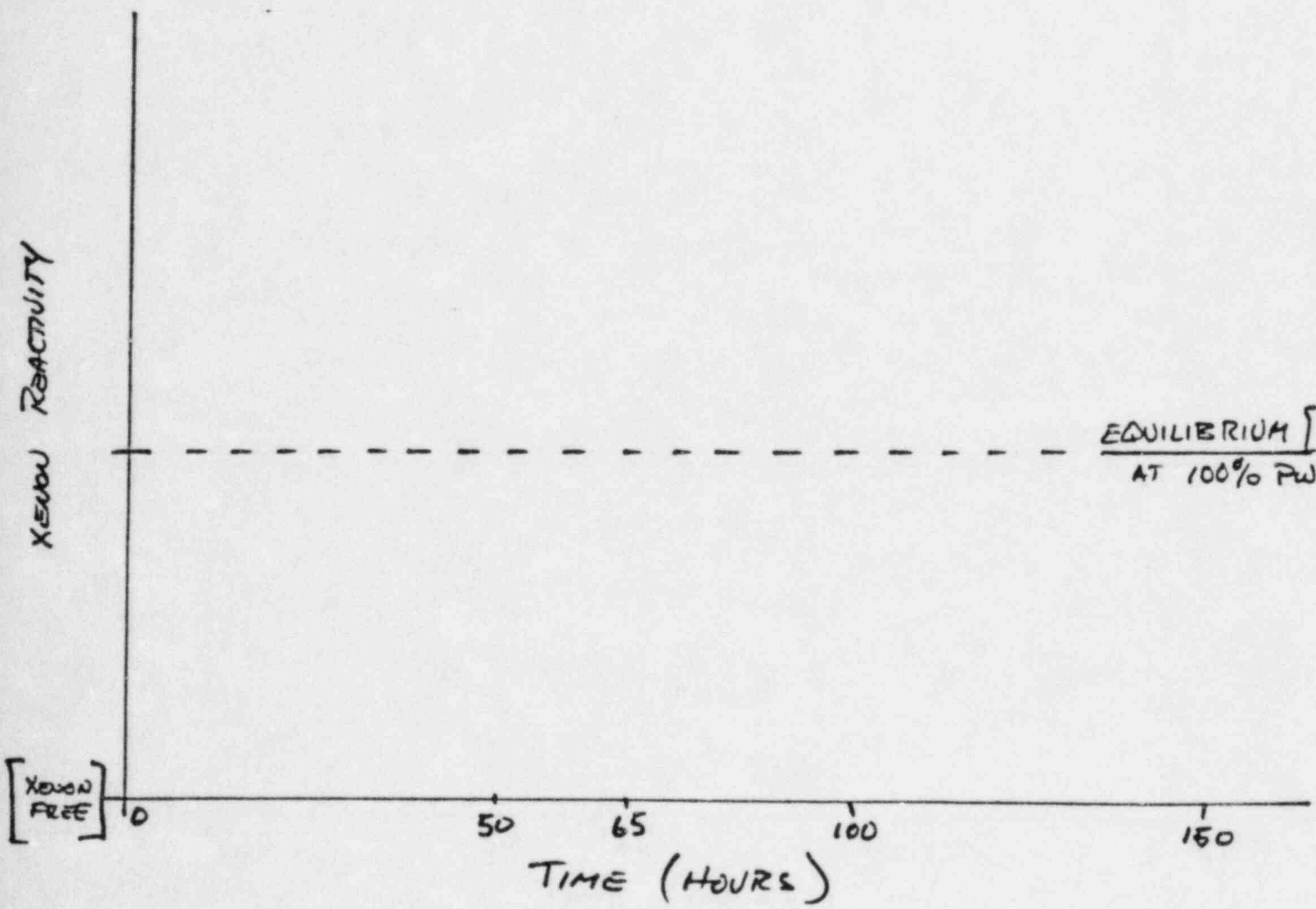
Nuclear Reactor Engineering (Glasstone & Sesonski)

AGNIR Reactor Physics Tests (figure 14)

FIGURE H-2

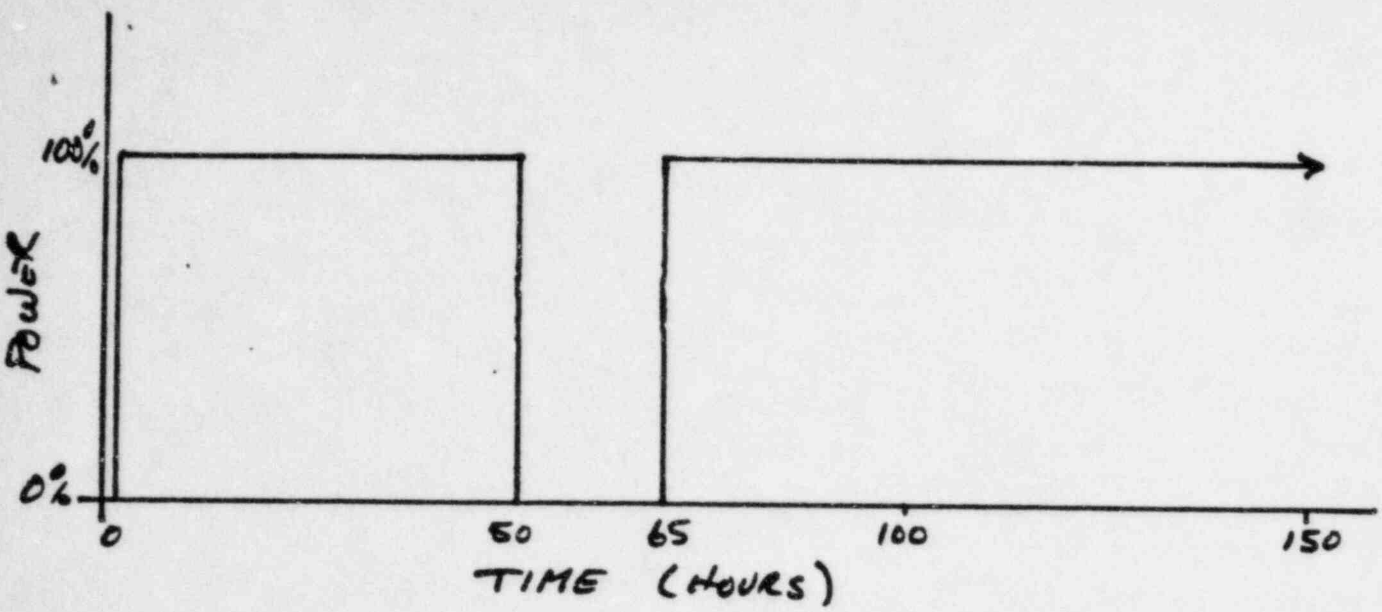


POWER
100%
0%
0
50
65
100
150
TIME (HOURS)

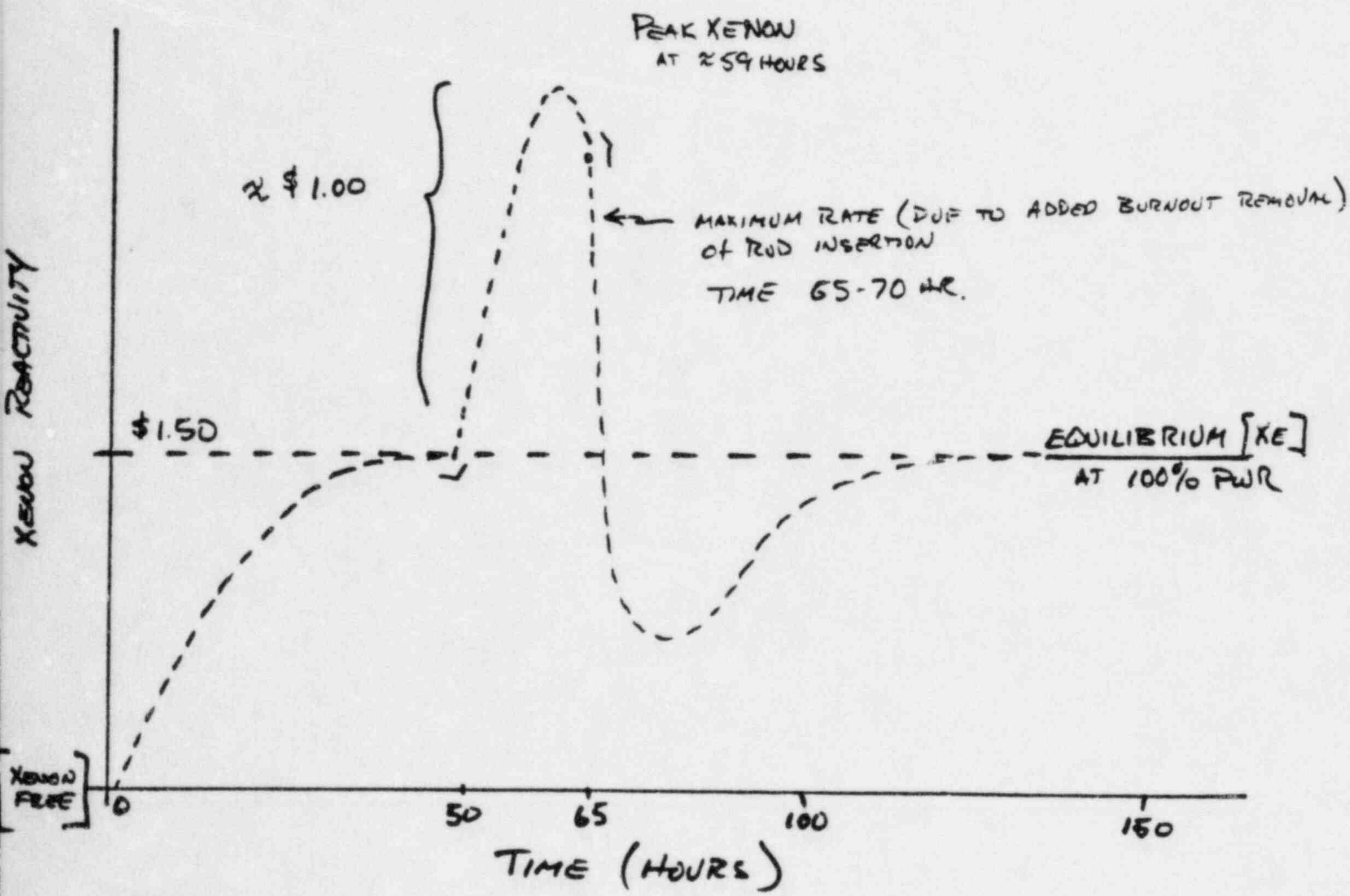


XENON REACTIVITY
EQUILIBRIUM [XE]
AT 100% PWR
[XENON FREE]
0
50
65
100
150
TIME (HOURS)

KEY



100%
0%
POWER
0
50
65
100
150
TIME (HOURS)



PEAK XENON
AT ≈ 59 HOURS
≈ $1.00
MAXIMUM RATE (DUE TO ADDED BURNOUT REMOVAL) of ROD INSERTION
TIME 65-70 HR.
$1.50
EQUILIBRIUM [XE]
AT 100% PWR
XENON REACTIVITY
[XENON FREE]
0
50
65
100
150
TIME (HOURS)

H-4 (4.0)

The reactor is shut down by 5% delta K/K with a count rate (CR) of 10.

(a) How much positive reactivity would have to be added to double the count rate? (Show work) (1.0)

(b) How much negative reactivity would have to be inserted to reduce the count rate by 1/2? (Show work). (1.0)

(c) Why is there a difference between values obtained for part (a) and Part (b)? (2.0)

(a)
$$\frac{CR_2}{CR_1} = \frac{1 - K_1}{1 - K_2} = \frac{2}{1}$$

$$K_1 = 1 - 0.05 = 0.95$$

$$K_2 = \frac{K_1 + 1}{2} = \frac{0.95 + 1}{2} = 0.975$$

Reactivity added = 0.975 - 0.95 = 2.5 % delta K/K

(b)
$$\frac{CR_2}{CR_1} = \frac{1 - K_1}{1 - K_2} = \frac{1}{2}$$

$$K_2 = 2K_1 - 1$$

$$K_1 = 0.95 \text{ (see above)}$$

$$K_2 = 1.90 - 1 = 0.90$$

Negative reactivity inserted = 0/95 - 0.90 = 5% delta K/K

(c) The count rate depends on the margin to criticality not K. The closer to criticality, th[illegible] ore pronounced an incremental change in delta K/K w[illegible] have.

Formula sheet

H-5 (2.0)

If the delayed neutron population is only about 0.5 % of the total neutron population in the core, why do the delayed neutrons have such a large effect on the operator's ability to control the plant?

Even though the percentage of delayed neutrons is small, their relative effect is great because their generation - to - generation time may be on the order of 13 seconds while this time for prompt neutrons is on the order of 4×10^{-5} seconds. Thus the long lifetimes for delayed neutrons slow the reactor's response times greatly.

Nuclear Reactor Engineering (Glasstone & Sesonski)

H-6 (2.0)

(1) A target nuclide is irradiated for several weeks, producing a radio-nuclide with a half-life of several hours. Doubling the time the target nuclide is irradiated at the same neutron dose rate will:

(a) Double the activity

(b) more than double the activity

(c) less than double the activity

(d) produce the same activity.

(2) If the half-life of the radio-nuclide is several years, how would your answer change?

(1.0 each)

(1) ANS (d) radio-nuclide probably in equilibrium

(2) ANS (a) little decay during irradiation

Nuclear Reactor Engineering (Glasstone & Sesonbski)

I-1 (2.0)

In accordance with 10 CFR 20, "Standards for Protection Against Radiation":

a. What is a RADIATION AREA ? (1.0)

b. What is a HIGH RADIATION AREA ? (1.0)

a. Area (accessible to personnel) where major part of the body could receive:

5 mRem in one hour (0.5)
or
100 mRem in 5 days (0.5)

b. Area (accessible to personnel) where major part of the body could receive :

100 mRem in 1 hour (1.0)

10 CFR 20

I-2 (3.0)

In accordance with 10 CFR 20, "Standards for Protection Against Radiation" ; What are the Radiation Dose Standards for individuals in restricted areas per Calendar Quarter:

(1.0 each)

1.25 Rem - Whole Body; head and trunk; active blood-forming organs; lens of eyes; or gonads.

18.75 Rem _ Hands and forearms; Feet and ankles

7.5 Rem - Skin of the whole body.

10 CFR 20

I-3 (3.0)

In accordance with 10 CFR 20, "Standards for Protection Against Radiation" ; What are three requirements that must be met if the Whole Body limits for a Calendar Quarter are to be exceeded:

(1.0 each)

3.0 Rem per calendar quarter maximum

5(N-18) total accumulated dose to the whole body where N is the individuals age in years at his last birthday.

Form NRC - 4 or equivalent.

10 CFR 20

I-4 (3.0)

(a) A technician performing radiography receives a dose of 15 Rem to his fingers (as determined by analysis of gold rings) and a dose of 1.1 Rem on the film badge. What reports, if any must be filed with the NRC relating to these doses? (1.0)

(b) If the technician's assistant received a dose of 10 Rem as measured by her film badge, What reports, if any must be filed with the NRC ? (1.0)

(c) If the first technician's film badge were reading 30 Rem instead of 1.1 Rem, would the reporting requirements change? If so what would they be? (1.0)

(a) No reports required

(b) Report to the NRC within 24 hours, of individual exposure in excess of 5 Rem whole body.

(c) Yes, Report to the NRC (Immediate Notification), of individual exposure in excess of 25 Rem whole body.

10 CFR 20.403

I-5 (3.0)

A source of Cobalt 60 (half-life = 5.3 years) is determined to read 10 Rem per hour at 1 foot.

(a) What would be the total dose from working at 1 foot from the source for 5 hours? (1.0)

(b) What would be the total dose from working at a distance of 3 feet from the source for 3 hours? (1.0)

(c) Would the exposure in part b (above) be more or less if the half-life of the source were 2 hours with the same initial dose rate? (1.0)

(a) (10 Rem / hr) (5 hr) = 50 Rem

(b) (10 Rem / hr) (3 hr) (1/3) (1/3) = 3.33 Rem

(c) Less as the source would decay during the exposure time reducing the dose rate.

I-6 (3.0)

A sample of Phosphorus (P) has an initial activity of 2.5 million curies and a half-life of 2.5 minutes.

(a) What is the disintegration constant (λ) in units of 1/ seconds of this sample? (1.0)

(b) What is the sample's activity in curies after 10 minutes ? (1.0)

(c) What is the sample's activity in curies after 2 hours ? (1.0)

(a) $\lambda = 0.693 / t_{1/2} = 0.693 / (2.5)(60)$

$= 0.00462 \text{ sec}^{-1}$

(b) $A = A_0 e^{-\lambda t}$

$= (2.5 \times 10^6) e^{-(0.00462)(10)(60)}$

= .157 million curies

(c) $A = A_0 e^{-\lambda t}$

$= (2.5 \times 10^6) e^{-.00462)(2)(60)(60)}$

$= 8.98 \times 10^{-9}$ cuires

Formula Sheet

I-7 (3.0)

What are the following Unrestricted Area whole body radiation limits in accordance with AeroTest Radiological Safety Procedures ?

(a) Exposure in 1 hour **(1.0)**

(b) Exposure over seven consecutive days **(1.0)**

(c) Exposure over 1 year **(1.0)**

(a) 2 mRem in 1 hour

(b) 100 mRem in seven consecutive days

(c) 0.5 Rem in 1 year

Radiological Safety Procedures

J-1 (2.0)

The ARRR has been operated for 4 hours in the morning and shut down for four hours when it is again operated. Would this be a good time to calibrate rods by the period method ? Explain.

No. Xenon poisoning will still be buildingnup from the I-135 decay and period measurements would therefore be affected.

Test No. 1

J-2 (2.0)

Why is the primary pump switched on at startup rather than allowing the water temperature switch to start it ?

When the primary pump is on the pool water is circulated within the tank. This produces a spiral movement that increases the time it takes for N-16 to reach the surface and allows it to decay thereby reducing the air activity.

Test No 1

J-3 (3.0)

With respect to SCRAM insertion times;

(a) How is the Scram insertion time measured ? (1.0)

(b) What are typical values of Scram insertion time ? (1.0)

(c) What are the Technical Specification Limits for Scram Insertion time ? (1.0)

(a) Measures with an oscilloscope; the trace is triggered by the Scram button for the rod being measured, and the voltage trace changes by a microswitch at the end of drop.

(b) Typical Values are approximately 450 msec.

(c) Tec Spec limits are 600 msec.

Technical Specification

J-4 (3.0)

One of the most important safety features of the ARRR reactor is the fuel design. Discuss how this is accomplished.

A Large negative temperature coefficient insures that even in the event of a complete scram system failure, no dangerious power levels would be reached. (1.0)

The Fuel is a crystalline matrix of Uranium and Zirconium hydride. The Hydrogen in the Zirconium hydride provides the moderation for fast neutrons. (1.0)

As power increases the fuel element temperature increases. The hydrogen atoms gain energy so that neutrons are not slowed down to thermal energies as rapidly for interaction with U-235. (1.0)

Test no 2 ; Reactor Physics Tests.

J-5 (4.0)

With respect to the Reactor Pool;

(a) What is the minimum depth of water above the top of the reactor core ? (1.0)

(b) What is the maximum bulk water temperature permitted by Technical Specification ? (1.0)

(c) At what temperature does the water temperature alarm annunciator operate ? (1.0)

(d) Why is the maximum bulk water temperature limited? (1.0)

(a) 16 feet

(b) 130 degrees F

(c) 120 degrees F

(d) Ion chambers may be damaged.

Technical Specification 4.0 ; Test no. 2

J-6 (4.0)

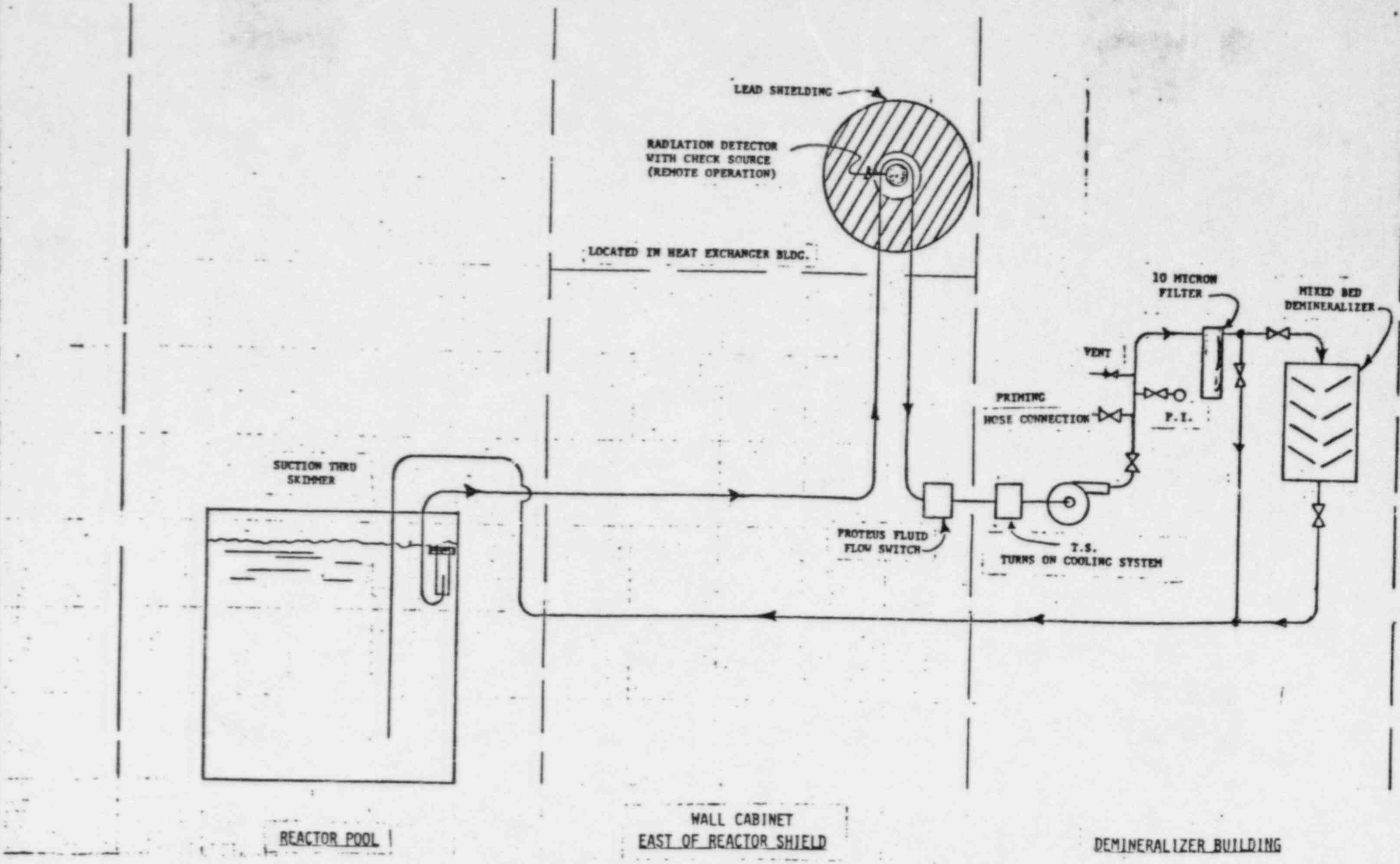
Sketch the ARRR Demineralizer system indicating the major components and their location.

See Attached Sketch

Major components (0.5 each)

1. Skimmer Suction (reactor pool)
2. Radiation Detector (heat exchanger building)
3. Proteus Fluid Switch (wall cabnet east of reactor shield)
4. Temperature switch (demineralizer building)
5. Pump (demineralizer building)
6. 10 micron filter (demineralizer building)
7. Mixed bed demineralizer (demineralizer building)
8. pool return (reactor pool)

ARRR demineralizer system.



ARRR DEMINERALIZER SYSTEM

J-6 KEY

J-7 (2.0)

Explain the action of the rods in the following situations;

(a) The shim rod down switch is operated and the Reg rod up switch is also operated. (1.0)

(b) The shim rod up switch is operated and the Reg rod up switch is also operated. (1.0)

(a) The shim rod will run downward and the reg rod will run upward.

(b) The shim rod will run upward and the reg rod will not move.

Test no 3 ; Tech spec 5.3

K-1 (4.0)

In accordance with the Technical Specification Section 6.0, Reactor Safety Systems, what four interlocks or conditions must exist before safety rod withdrawal?

(1) The master switch is in the ON position

(2) The safety system has been reset

(3) All four nuclear instrument channels are in the OPERATE mode

(4) The startup channel count rate is greater than 2 cps.

Technical Specification 6.5

K-2 (4.0)

With respect to the fuel storage pits located in the floor of the reactor room, the Technical Specification Section 11.0, Fuel Storage and Transfer, allows;

(a) How many fuel elements in the storage racks? (1.0)

(b) What weight of U-235 in each of the above fuel elements? (1.0)

(c) Does the maximum storage capacity change if the fuel storage racks are dry or flooded with water? (1.0)

(d) When may the lock and chain be removed from the fuel storage pit? (1.0)

(a) 19 fuel elements

(b) 700 gm U-235

(c) no

(d) only during fuel transfer operations.

Technical Specification 11.0

K-3 (1.0)

What conditions (Designed Basis) are placed on fuel storage racks located in the reactor tank.

They shall be designed so that for all conditions of moderation, Keff shall not exceed 0.8.

Technical Specification 11.2

K-4 (4.0)

(a) What minimum staff are required for fuel transfers in the reactor tank ? (1.0)

(b) What restrictions are placed on the number of fuel elements not in storage or in the core lattice ? (1.0)

(c) What devise is used to transfer highly radioactive fuel elements ? (1.0)

(d) Where is the Fuel handling tool kept when not in use? (1.0)

(a) Three staff members as follows:
a licensed Senior Operator
a Licensed Operator
one additional staff member

(b) Not more than one fuel element at a time

(c) A shielded fuel transfer cask

(d) In a locked cabinet under the cognizance of the Reactor Supervisor.

Technical Specification section 11.0

K-5 (3.0)

Describe the control rod drive mechanism and explain rod position indication and it's function during a reactor Scram.

The rod drive mechanism is a rack and pinion type drive running vertically. Attachment of the control portion of the rod to the drive protion is via an electromagnet. (1.0)

Connected to the motor is a potentiometer which is wired to the rod position indiicator on the control panel. (1.0)

All Scram systems interrupt power to the electromagnets holding the control portion to the drive portion and gravety drives the rod into the core lattice. (1.0)

Test no 1

K-6 (2.0)

(a) **What is the minimum shutdown margin allowed for ARRR with the strongest rod withdrawn ?** **(1.0)**

(b) **How does this effect the maximum reactivity allowed in the ARRR ?** **(1.0)**

(a) $ 0.50

(b) This limits the maximum reactivity allowed to a value equal to or less than the safety rod worth minus $0.50

Test no 1

K-7 (2.0)

What are the two instrumentation requirements specified by the Critical Assembly and Power Calibration Procedures for reactor fuel handling during fuel inspection.

(1.0 each)

(a) Reactor Instrumentation Channels 1,2,3,& 4 shall be operating.

(b) At least two radiation monitoring instruments with ranges sufficient to properly indicate any dose rates which might be encountered shall be made available.

Critical Assembly and Power Calibration Procedures.

L-1 (3.0)

In accordance with the Technical Specifications for the Aerotest Radiography and Research Reactor;

(a) What is the maximum excess reactivity above cold, clean critical with experiments in place ? (1.0)

(b) What is the maximum excess reactivity above cold, clean critical without experiments in place ? (1.0)

(c) What is the maxumum weight of U-235 allowed in the reactor core ? (1.0)

(a) $ 3.00

(b) $ 3.00

(c) 3.30 kg of U-235

Technical Specification section 5.0

L-2 (3.0)

According to the Technical Specifications, what three conditions must be met in order to consider the reactor, with fixed experiments in place, shutdown ?

(1.0 each)

(a) The console key is in the "off" position and the key is removed from the console and under the control of a licensed operator (or stored in a locked storage area).

(b) Sufficient control rods are inserted so as to assure the reactor is subcritical by a margin greater that 0.7 % delta K/K cold, clean critical condition.

(c) No work is in progress involving refueling operations or maintenance of its control rod mechanisms.

Technical Specification 1.0

L-3 (3.0)

In accordance with the Technical Specifications;

(a) When may Temporary Procedures be utilized ? (1.0)

(b) Who must approve a Temporary Procedure prior to utilization ? (1.0)

(c) Who must subsequently review a Temporary Procedure? (1.0)

(a) Temporary Procedures may NOT change the intent of the previously approved procedures.

(b) A licensed Senior Reactor Operator and one other qualified individual.

(c) Temporary Proceedures are reviewed by the Reactor Safeguards Committee.

Technical Specification 12.2.2

L-4 (2.0)

In Accordance with ARRR Administrative Procedures,

(a) When may a Senior Licensed Operator deviate from procedures ? (1.0)

(b) Deviations to procedures shall be reported to what person? (1.0)

(a) As required during an emergency to assure the health and safety of the staff and general public as required to assure plant safety.

(b) Reactor Supervisor

Administrative Procedures

L-5 (3.0)

In Accordance with 10 CFR 55, " Operators' Licenses" :

(a) The " Exemptions from License " provisions of the Code of Federal Regulations (10 CFR 55), allow what individuals to operate the reactor controls without a license ? (1.0)

(b) As defined in 10 CFR 55, when is an individual deemed to be operating the controls of a nuclear facility? (1.0)

(c) What are the "controls" as defined in 10 CFR 55 ? (1.0)

(a) An individual may manipulate the controls as a part of his training to qualify for an operator license under the direction and in the presence of a licensed operator or senior operator.

(b) An individual is deemed to operate the controls of a nuclear facility if he directly manipulates the controls or directs another to manipulate the controls

(c) "controls" - apparatus and mechanisms the manipulation of which directly affect the reactivity or power level of the reactor.

10 CFR 55

L-6 (3.0)

What three requirements are imposed by Technical Specification on solid explosive materials brought into the facility?

(1.0 each)

(a) Individule explosive devices shall be limited to 1000 grains equivalent TNT encased in metallic sheathing.

(b) The maximum quantity of explosive material that may be possesed at one time shall be limited to 50 pounds equivalent TNT

(c) Explosive material shall be stored in designated areas within the reactor facility.

Technical Specification 9.11.3

L-7 (3.0)

In accordance with the ARRR Emergency Plan;

(a) In the absence of the President, Aerotest Operations with no designated alternate, who shall act as the Emergency Cordinator (EC) in the case of a radiological emergency ? (1.0)

(b) A radiologocal emergency is indicated by what levels of activity for the following samples:

(1) Smearable Surface Contamination (0.5)

(2) Radiation Level in the Control Room (0.5)

(3) Water Activity (0.5)

(4) Air activity (0.5)

(a) Radiation Safety Officer

(b) (1) 10mR/hr per 100 square cm.

(2) > 100 mR/hr

(3) > 200 mR/hr as seen on the control room monitor.

(4) > 20 mR/hr as seen on the control room indicator.

Emergency Plan

FACILITY REVIEW COPY

KEY

U.S. NUCLEAR REGULATORY COMMISSION
SENIOR REACTOR OPERATOR LICENSE EXAMINATION

Facility: AEROTEST OPERATIONS, INC.
Reactor Type: ARRR
Date Administered: AUGUST 28, 1984
Examiner: John Elin
Candidate: ____________

INSTRUCTIONS TO CANDIDATE

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

Category Value	% of Total	Applicant's Score	% of Cat. Value	Category
20	20	____	____	H. Reactor Theory
20	20	____	____	I. Radioactive Materials Handling Disposal and Hazards
20	20	____	____	J. Specific Operating Characteristics
20	20	____	____	K. Fuel Handling and Core Parameters
20	20	____	____	L. Administrative Procedures, Conditions and Limitations
100	100	____	____	Totals

Final Grade ______%

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

____
Candidate's Signature

Facility Reviewed [signature] Aerotest

$f = ma$

$v = s/t$

Cycle efficiency = (Network out)/(Energy in)

$w = mg$

$s = V_o t + 1/2\ at^2$

$E = mc^2$

$KE = 1/2\ mv^2$

$a = (V_f - V_o)/t$

$A = \lambda N$

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

$PE = mgh$

$V_f = V_o + at$

$w = \theta/t$

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

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

$\Delta E = 931\ \Delta m$

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

$\dot{Q} = \dot{m} Cp \Delta t$

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

$Pwr = W_f \Delta n$

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

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

$TVL = 1.3/\mu$

$HVL = -0.693/\mu$

$P = P_o 10^{sur(t)}$

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

$SUR = 26.06/T$

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

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

$SUR = 26\rho/\ell^* + (\beta - \rho)T$

$CR_1(1 - K_{eff1}) = CR_2(1 - K_{eff2})$

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

$T = \ell/(\rho - \beta)$

$T = (\beta - \rho)/(\lambda\rho)$

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

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

$M = (1 - K_{effo})/(1 - K_{eff1})$

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

$\ell^* = 10^{-4}$ seconds

$\bar{\lambda} = 0.1\ \text{seconds}^{-1}$

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

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

$\Sigma = \sigma N$

$I_1 d_1 = I_2 d_2$

$I_1 d_1{}^2 = I_2 d_2{}^2$

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

<u>Water Parameters</u>

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.

<u>Miscellaneous Conversions</u>

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 in = 2.54 cm
°F = 9/5°C + 32
°C = 5/9 (°F-32)

H-1 (4.0)

A reactor is initially critical at a power level of 1 kw. At t=0 the Keff of the reactor core was made to be 1.0020. (Assume β = .0072 ; amd λ = 0.1)

a. Calculate the reactivity insertion. (1.0)

b. What is the reactivity insertion in terms of Dollars and Cents? (1.0)

c. Calculate the resultant reactor period (T). (1.0)

d. At what time will the reactor power equal 100 kw ? (1.0)

a. $$\rho = \frac{(Keff - 1)}{Keff} = \frac{(1.0020 - 1.000)}{1.0020}$$

$\rho = 0.0020$

b. Dollars = ρ/β = .0020 /.0072 = $ 0.28 or 28 cents

c. $$T = \frac{\beta - \rho}{\rho \lambda} \quad (\text{for } \rho \leq \beta)$$

$$T = \frac{(0.0072 - 0.002)}{(0.002)(0.1)} = 26 \text{ sec}$$

d. $P = Po\ e^{(t/T)}$

$100\ kw = (1\ kw)\ e^{(t/26\ sec)}$

t = (ln 100) (26 sec) = 119.7 sec or 2 minutes

Formula Sheet
Nuclear Reactor Engineering (Glasstone & Sesonski)

H-2 (4.0)

Refer to FIGURE H-1 which shows an instantaneous, negative, reactivity insertion into an already critical reactor core (at time t = 0), followed by a removal of this negative reactivity after a stable reactor period is reached (at time t = 1), thus rendering the reactor critical once again. Assuming no source neutrons:

a. Show the resulting reactor period as a function of time for this reactivity change. (1.0)

b. Show the reactor power level as a function of time for this reactivity change. (1.0)

c. Explain the shape of the reactor power response at a time IMMEDIATELY AFTER t=0. (1.0)

d. Explain the shape of the reactor power response at a time IMMEDIATELY PRIOR TO t=1 (1.0)

(a) & (b) ATTACHED

c. "PROMPT DROP" in total neutron flux due to a reduction in prompt neutron production.

d. "Negative Stable Period" due to the decay of delayed neutron precursors. The delayed neutron population is relatively large due to the over abundance of delayed neutron precursors.

Formula Sheet
Nuclear Reactor Engineering (Glasstone & Sesonski)

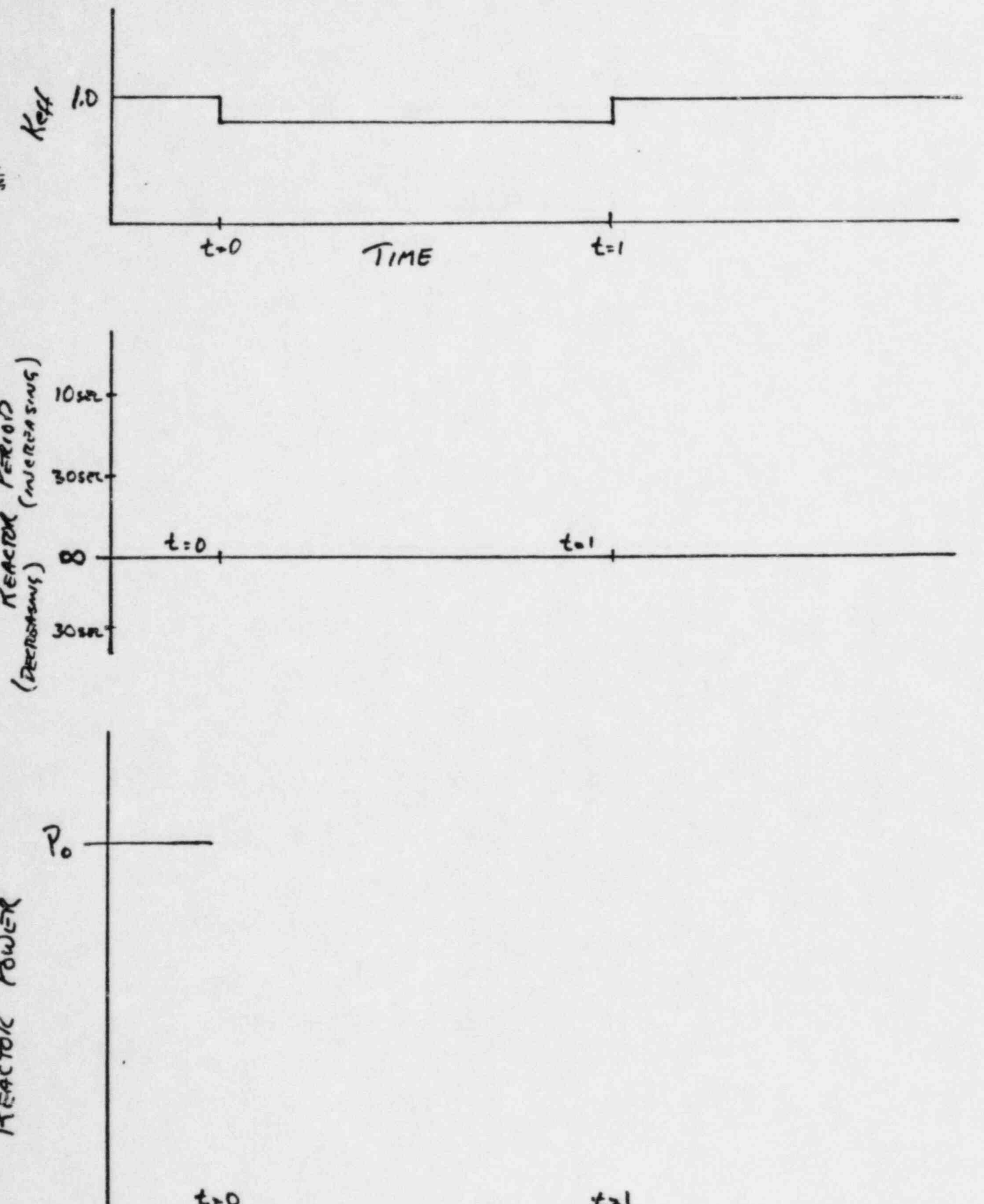
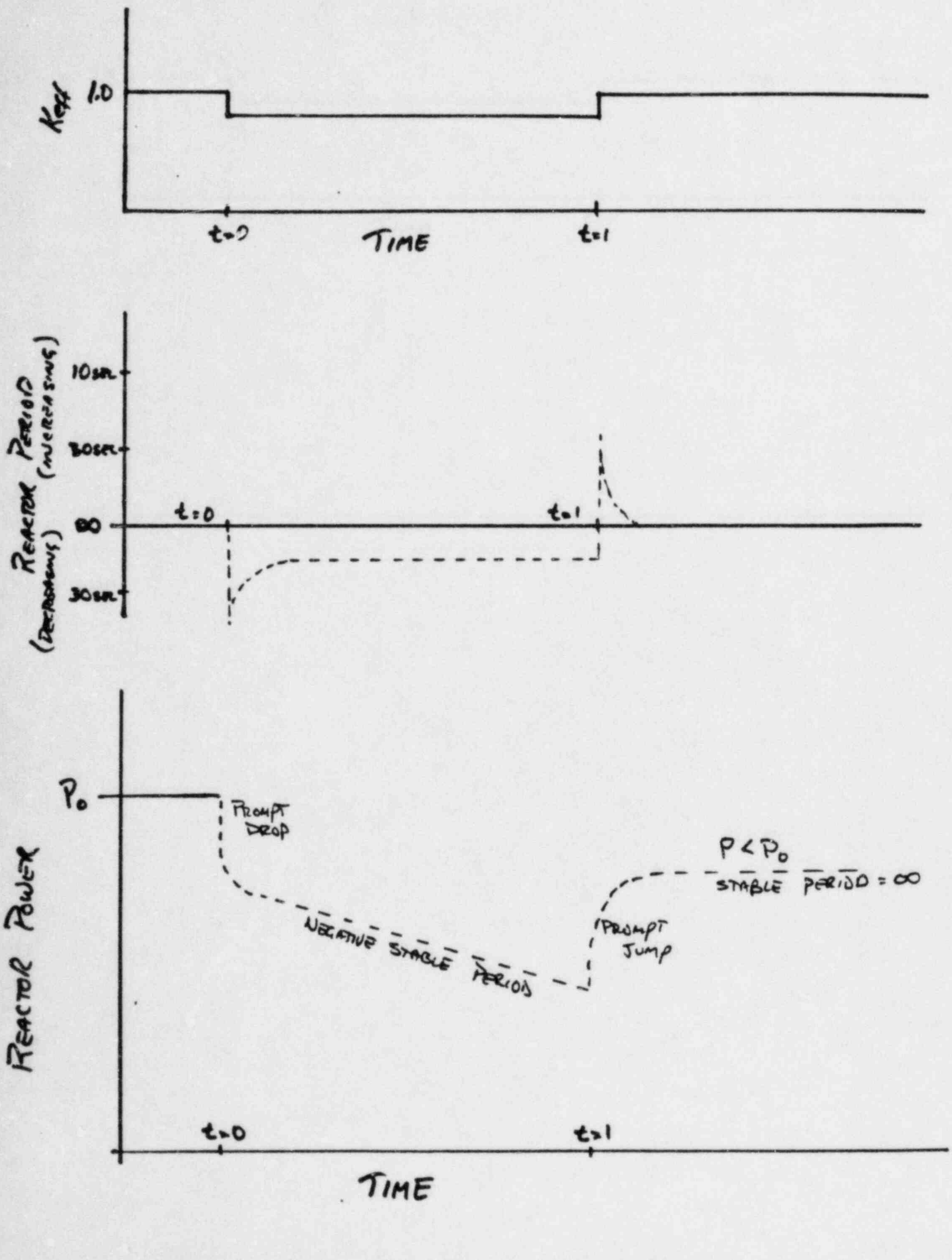

Keff
1.0
t=0
TIME
t=1
REACTOR PERIOD
(INCREASING)
(DECREASING)
10sec
30sec
∞
30sec
t=0
t=1
REACTOR POWER
P0
t=0
t=1
TIME

FIGURE A-1

FIGURE H-1

KEY



H-3 (4.0)

FIGURE H-2 is a sketch of Reactor Power vs Time in hours. At t=0 hours reactor startup from Xenon free conditions to 100 % power occurs. At t=50 hours a reactor shutdown occurs followed by a reactor startup to 100 % power at t=65 hours.

a. Sketch the Xenon reactivity response in the core from this power transient. (Indicate approximate magnitude and duration of each transient.) (1.0)

b. Indicate the time in hours that the maximum negative reactivity will be inserted by Xenon. (1.0)

c. Indicate the time in hours that the maximun rate of rod insertion will have to occur in order to overcome the Xenon transient and remain just critical. (1.0)

d. What are the production and removal mechanisms for Xenon ? (1.0)

a,b,&c (ATTACHED)

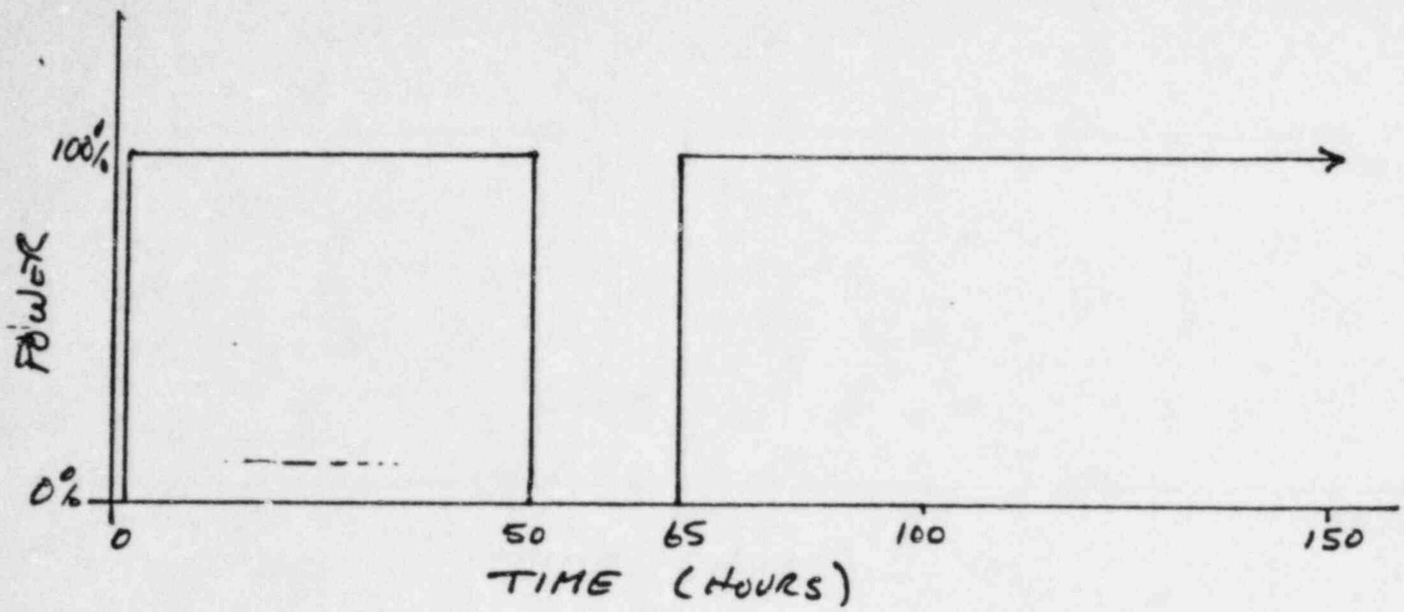
d. Xenon :

Production	(1) Iodine decay (fission daughter).
	(2) Direct yield from fission
Removal	(1) Burnout by neutron absorption.
	(2) Decay

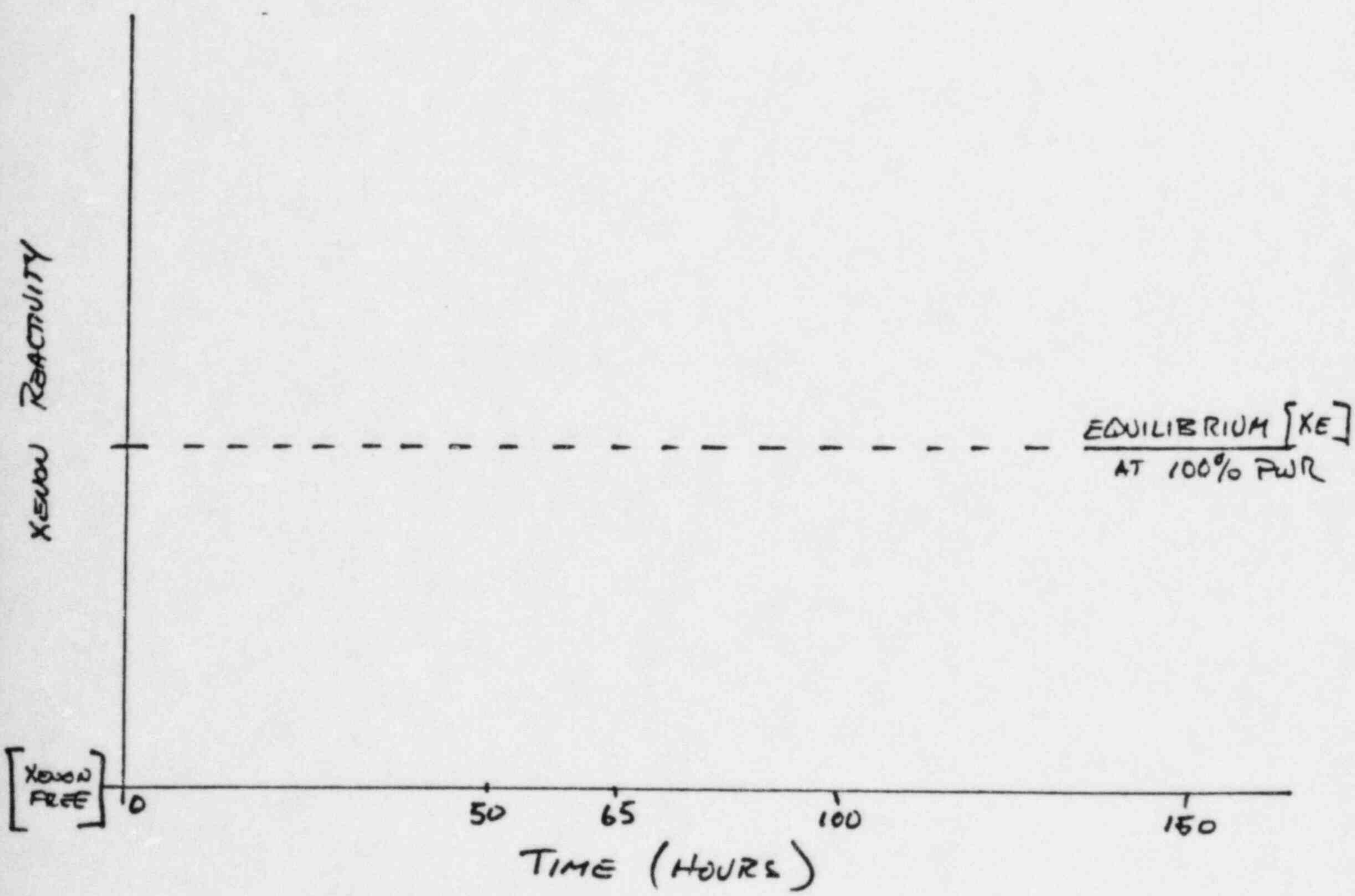
Nuclear Reactor Engineering (Glasstone & Sesonski)

AGNIR Reactor Physics Tests (figure 14)

FIGURE [illegible]

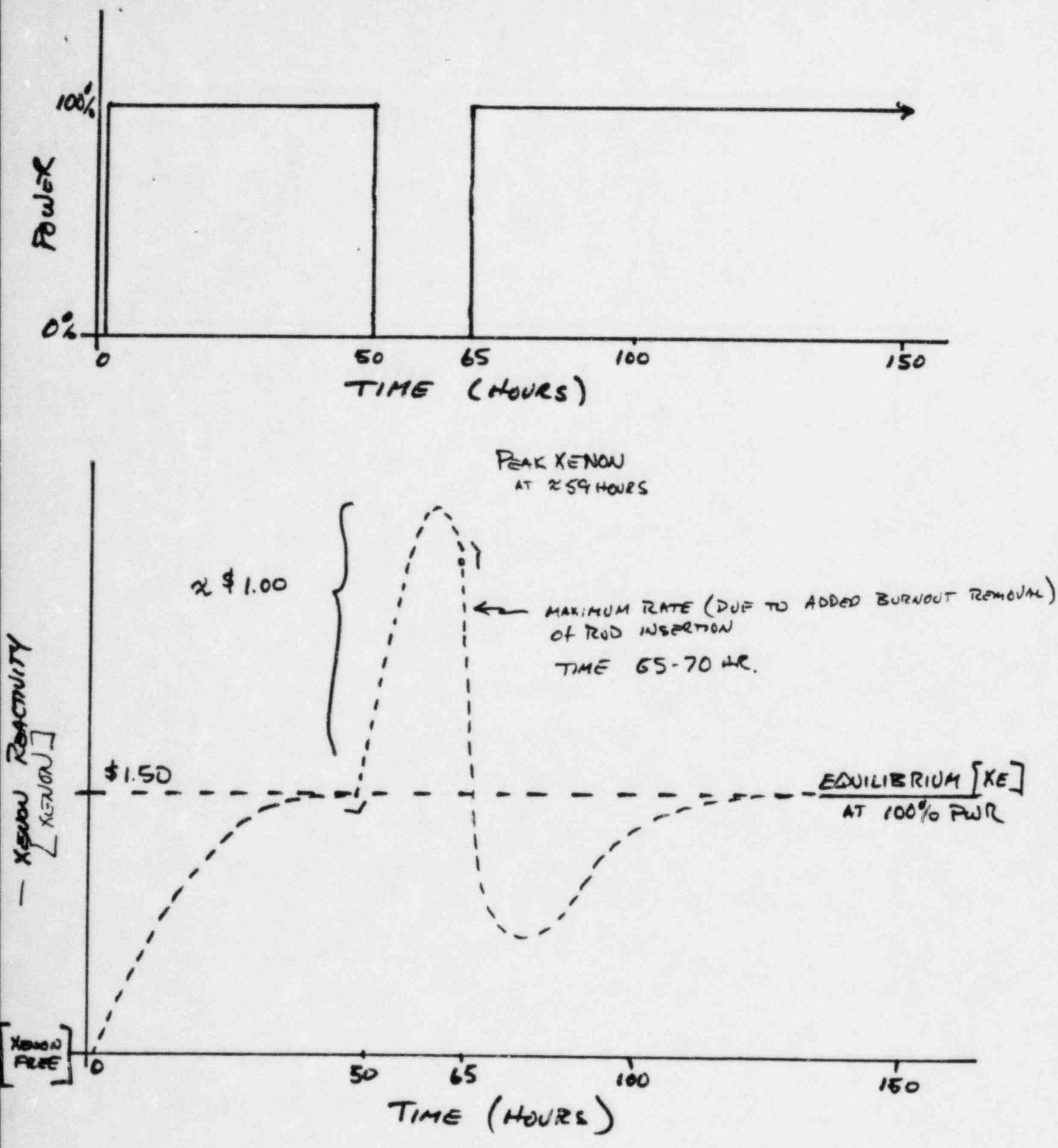


POWER
100%
0%
0
50
65
100
150
TIME (HOURS)



XENON REACTIVITY
EQUILIBRIUM [XE]
AT 100% PWR
[XENON FREE]
0
50
65
100
150
TIME (HOURS)

FIGURE H-2 KEY



H-4 (4.0)

The reactor is shut down by 5% delta K/K with a count rate (CR) of 10.

(a) How much positive reactivity would have to be added to double the count rate? (Show work) (1.0)

(b) How much negative reactivity would have to be inserted to reduce the count rate by 1/2? (Show work). (1.0)

(c) Why is there a difference between values obtained for part (a) and Part (b)? (2.0)

(a)

$$\frac{CR_2}{CR_1} = \frac{1 - K_1}{1 - K_2} = \frac{2}{1}$$

$$K_1 = 1 - 0.05 = 0.95$$

$$K_2 = \frac{K_1 + 1}{2} = \frac{0.95 + 1}{2} = 0.975$$

Reactivity added = 0.975 - 0.95 = 2.5 % delta K/K

(b)

$$\frac{CR_2}{CR_1} = \frac{1 - K_1}{1 - K_2} = \frac{1}{2}$$

$$K_2 = 2K_1 - 1$$

$$K_1 = 0.95 \quad \text{(see above)}$$

$$K_2 = 1.90 - 1 = 0.90$$

Negative reactivity inserted = 0/95 - 0.90 = 5% delta K/K

(c) The count rate depends on the margin to criticality not K. The closer to criticality, the more pronounced an incremental change in delta K/K will have.

Formula sheet

H-5 (2.0)

If the delayed neutron population is only about 0.5 % of the total neutron population in the core, why do the delayed neutrons have such a large effect on the operator's ability to control the plant?

Even though the percentage of delayed neutrons is small, their relative effect is great because their generation - to - generation time may be on the order of 13 seconds while this time for prompt neutrons is on the order of 4 X 10 -5 seconds. Thus the long lifetimes for delayed neutrons slow the reactor's response times greatly.

Nuclear Reactor Engineering (Glasstone & Sesonski)

H-6 (2.0)

(1) A target nuclide is irradiated for several weeks, producing a radio-nuclide with a half-life of several hours. Doubling the time the target nuclide is irradiated at the same neutron dose rate will:

(a) Double the activity

(b) more than double the activity

(c) less than double the activity

(d) produce the same activity.

(2) If the half-life of the radio-nuclide is several years, how would your answer change?

(1.0 each)

(1) ANS (d) radio-nuclide probably in equilibrium

(2) ANS (a) little decay during irradiation

Nuclear Reactor Engineering (Glasstone & Seconbski)

I-1 (2.0)

In accordance with 10 CFR 20, "Standards for Protection Against Radiation":

a. What is a RADIATION AREA ? (1.0)

b. What is a HIGH RADIATION AREA ? (1.0)

a. Area (accessible to personnel) where major part of the body could receive:

5 mRem in one hour (0.5)
or
100 mRem in 5 days (0.5)

b. Area (accessible to personnel) where major part of the body could receive :

100 mRem in 1 hour (1.0)

10 CFR 20

I-2 (3.0)

In accordance with 10 CFR 20, "Standards for Protection Against Radiation" ; What are the Radiation Dose Standards for individuals in restricted areas per Calendar Quarter:

(1.0 each)

1.25 Rem - Whole Body; head and trunk; active blood-forming organs; lens of eyes; or gonads.

18.75 Rem _ Hands and forearms; Feet and ankles

7.5 Rem - Skin of the whole body.

10 CFR 20

I-3 (3.0)

In accordance with 10 CFR 20, "Standards for Protection Against Radiation" ; What are three requirements that must be met if the Whole Body limits for a Calendar Quarter are to be exceeded:

(1.0 each)

3.0 Rem per calendar quarter maximum

5(N-18) total accumulated dose to the whole body where N is the individuals age in years at his last birthday.

Form NRC - 4 or equivalent.

10 CFR 20

I-4 (3.0)

(a) A technician performing radiography receives a dose of 15 Rem to his fingers (as determined by analysis of gold rings) and a dose of 1.1 Rem on the film badge. What reports, if any must be filed with the NRC relating to these doses? (1.0)

(b) If the technician's assistant received a dose of 10 Rem as measured by her film badge, What reports, if any must be filed with the NRC ? (1.0)

(c) If the first technician's film badge were reading 30 Rem instead of 1.1 Rem, would the reporting requirements change? If so what would they be? (1.0)

(a) No reports required

(b) Report to the NRC within 24 hours, of individual exposure in excess of 5 Rem whole body.

(c) Yes, Report to the NRC (Immediate Notification), of individual exposure in excess of 25 Rem whole body.

10 CFR 20.403

I-5 (3.0)

A source of Cobalt 60 (half-life = 5.3 years) is determined to read 10 Rem per hour at 1 foot.

(a) What would be the total dose from working at 1 foot from the source for 5 hours? (1.0)

(b) What would be the total dose from working at a distance of 3 feet from the source for 3 hours? (1.0)

(c) Would the exposure in part b (above) be more or less if the half-life of the source were 2 hours with the same initial dose rate? (1.0)

(a) (10 Rem / hr) (5 hr) = 50 Rem

(b) (10 Rem / hr) (3 hr) (1/3) (1/3) = 3.33 Rem

(c) Less as the source would decay during the exposure time reducing the dose rate.

Academic Program For Nuclear Power Plant Personnel
General Physics Corporation

I-6 (3.0)

A sample of Phosphorus (P) has an initial activity of 2.5 million curies and a half-life of 2.5 minutes.

(a) What is the disintegration constant (λ) in units of 1/ seconds of this sample? (1.0)

(b) What is the sample's activity in curies after 10 minutes ? (1.0)

(c) What is the sample's activity in curies after 2 hours ? (1.0)

(a) $\lambda = 0.693 / t_{1/2} = 0.693 / (2.5)(60)$

$= 0.00462 \text{ sec}^{-1}$

(b) $A = A_0 e^{-\lambda t}$

$= (2.5 \times 10^6) e^{-(0.00462)(10)(60)}$

= .157 million curies

(c) $A = A_0 e^{-\lambda t}$

$= (2.5 \times 10^6) e^{-(0.00462)(2)(60)(60)}$

$= 8.98 \times 10^{-9}$ curies

Formula Sheet

I-7 (3.0)

What are the following Unrestricted Area whole body radiation limits in accordance with AeroTest Radiological Safety Procedures ?

(a) Exposure in 1 hour **(1.0)**

(b) Exposure over seven consecutive days **(1.0)**

(c) Exposure over 1 year **(1.0)**

(a) 2 mRem in 1 hour

(b) 100 mRem in seven consecutive days

(c) 0.5 Rem in 1 year

Radiological Safety Procedures

J-1 (2.0)

The ARRR has been operated for 4 hours in the morning and shut down for four hours when it is again operated. Would this be a good time to calibrate rods by the period method ? Explain.

No. Xenon poisoning will still be buildingnup from the I-135 decay and period measurements would therefore be affected.

Test No. 1

J-2 (2.0)

Why is the primary pump switched on at startup rather than allowing the water temperature switch to start it ?

When the primary pump is on the pool water is circulated within the tank. This produces a spiral movement that increases the time it takes for N-16 to reach the surface and allows it to decay thereby reducing the air activity.

Test No 1

J-3 (3.0)

With respect to SCRAM insertion times;

(a) How is the Scram insertion time measured ? (1.0)

(b) What are typical values of Scram insertion time ? (1.0)

(c) What are the Technical Specification Limits for Scram Insertion time ? (1.0)

(a) Measures with an oscilloscope; the trace is triggered by the Scram button for the rod being measured, and the voltage trace changes by a microswitch at the end of drop.

(b) Typical Values are approximately 450 msec.

(c) Tec Spec limits are 600 msec.

Technical Specification

J-4 (3.0)

One of the most important safety features of the ARRR reactor is the fuel design. Discuss how this is accomplished.

A Large negative temperature coefficient insures that even in the event of a complete scram system failure, no dangerious power levels would be reached. (1.0)

The Fuel is a crystalline matrix of Uranium and Zirconium hydride. The Hydrogen in the Zirconium hydride provides the moderation for fast neutrons. (1.0)

As power increases the fuel element temperature increases. The hydrogen atoms gain energy so that neutrons are not slowed down to thermal energies as rapidly for interaction with U-235. (1.0)

Test no 2 ; Reactor Physics Tests.

J-5 (4.0)

With respect to the Reactor Pool;

(a) What is the minimum depth of water above the top of the reactor core ? (1.0)

(b) What is the maximum bulk water temperature permitted by Technical Specification ? (1.0)

(c) At what temperature does the water temperature alarm annunciator operate ? (1.0)

(d) Why is the maximum bulk water temperature limited? (1.0)

(a) 16 feet

(b) 130 degrees F

(c) 120 degrees F [NOMINAL] (116°F - 120°F)

(d) Ion chambers may be damaged.

Technical Specification 4.0 ; Test no. 2

J-6 (4.0)

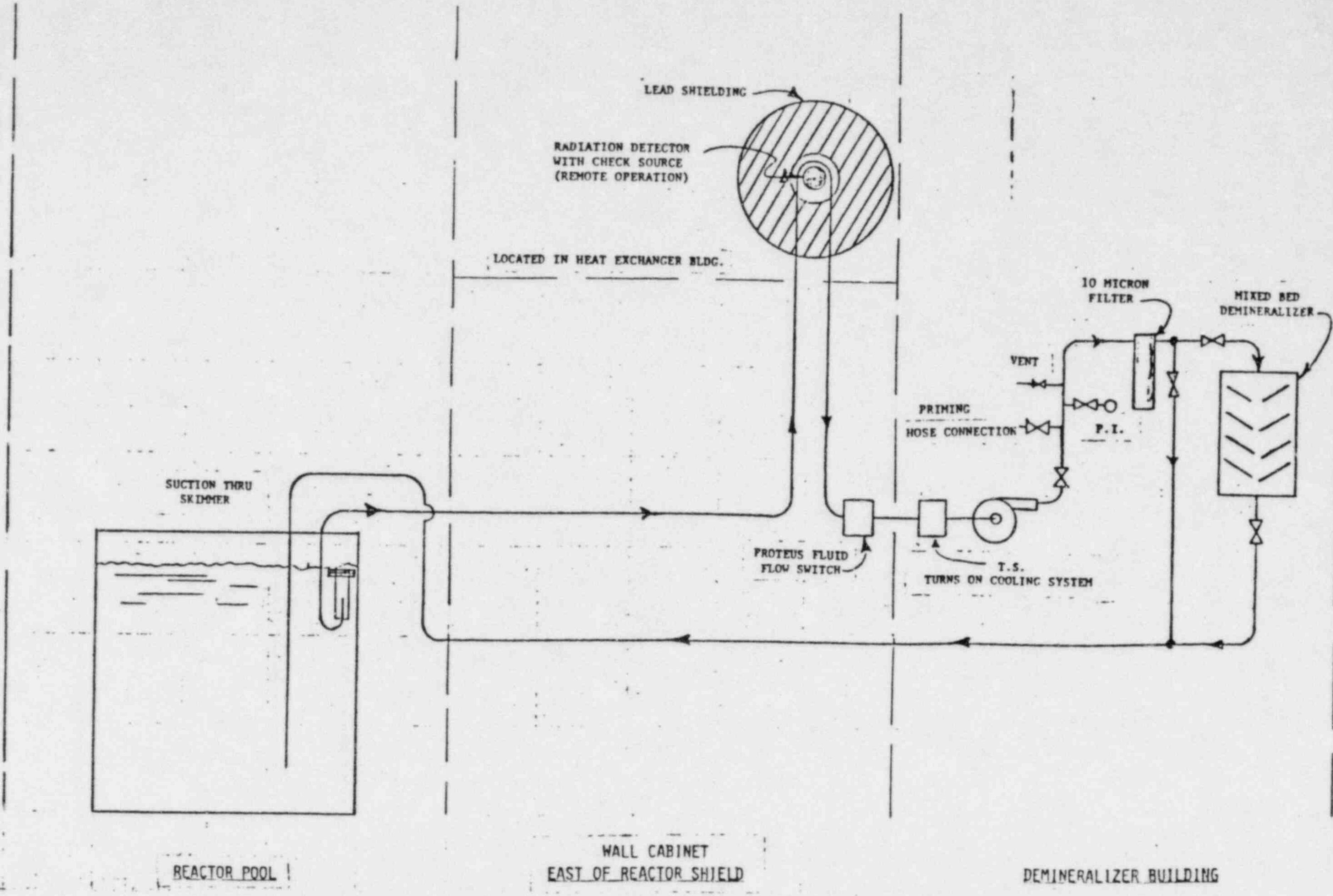
Sketch the ARRR Demineralizer system indicating the major components and their location.

See Attached Sketch

Major components (0.5 each)

1. Skimmer Suction (reactor pool)
2. Radiation Detector (heat exchanger building)
3. Proteus Fluid Switch (wall cabnet east of reactor shield)
4. Temperature switch (demineralizer building)
5. Pump (demineralizer building)
6. 10 micron filter (demineralizer building)
7. Mixed bed demineralizer (demineralizer building)
8. pool return (reactor pool)

ARRR demineralizer system.



ARRR DEMINERALIZER SYSTEM

J-6 KEY

J-7 (2.0)

Explain the action of the rods in the following situations;

(a) The shim rod down switch is operated and the Reg rod up switch is also operated. **(1.0)**

(b) The shim rod up switch is operated and the Reg rod up switch is also operated. **(1.0)**

(a) The shim rod will run downward and the reg rod will run upward.

(b) The shim rod will run upward and the reg rod will not move.

Test no 3 ; Tech spec 5.3

K-1 (4.0)

In accordance with the Technical Specification Section 6.0, Reactor Safety Systems, what four interlocks or conditions must exist before safety rod withdrawal?

(1) The master switch is in the ON position

(2) The safety system has been reset

(3) All four nuclear instrument channels are in the OPERATE mode

(4) The startup channel count rate is greater than 2 cps.

Technical Specification 6.5

K-2 (4.0)

With respect to the fuel storage pits located in the floor of the reactor room, the Technical Specification Section 11.0, Fuel Storage and Transfer, allows;

(a) How many fuel elements in the storage racks? (1.0)

(b) What weight of U-235 in each of the above fuel elements? (1.0)

(c) Does the maximum storage capacity change if the fuel storage racks are dry or flooded with water? (1.0)

(d) When may the lock and chain be removed from the fuel storage pit? (1.0)

(a) 19 fuel elements

(b) 700 gm U-235

(c) no

(d) only during fuel transfer operations.

Technical Specification 11.0

K-3 (1.0)

What conditions (Designed Basis) are placed on fuel storage racks located in the reactor tank.

They shall be designed so that for all conditions of moderation, Keff shall not exceed 0.8.

Technical Specification 11.2

K-4 (4.0)

(a) What minimum staff are required for fuel transfers in the reactor tank ? (1.0)

(b) What restrictions are placed on the number of fuel elements not in storage or in the core lattice ? (1.0)

(c) What device is used to transfer highly radioactive fuel elements ? (1.0)

(d) Where is the Fuel handling tool kept when not in use? (1.0)

(a) Three staff members as follows:
- a licensed Senior Operator
- a Licensed Operator
- one additional staff member

(b) Not more than one fuel element at a time

(c) A shielded fuel transfer cask

(d) In a locked cabinet under the cognizance of the Reactor Supervisor.

Technical Specification section 11.0

K-5 (3.0)

Describe the control rod drive mechanism and explain rod position indication and it's function during a reactor Scram.

The rod drive mechanism is a rack and pinion type drive running vertically. Attachment of the control portion of the rod to the drive protion is via an electromagnet. (1.0)

Connected to the motor is a potentiometer which is wired to the rod position indiicator on the control panel. (1.0)

All Scram systems interrupt power to the electromagnets holding the control portion to the drive portion and gravety drives the rod into the core lattice. (1.0)

Test no 1

K-6 (2.0)

(a) What is the minimum shutdown margin allowed for ARRR with the strongest rod withdrawn ? (1.0)

(b) How does this effect the maximum reactivity allowed in the ARRR ? (1.0)

(a) $ 0.50

(b) This limits the maximum reactivity allowed to a value equal to or less than the safety rod worth minus $0.50

Test no 1

K-7 (2.0)

What are the two instrumentation requirements specified by the Critical Assembly and Power Calibration Procedures for reactor fuel handling during fuel inspection.

(1.0 each)

(a) Reactor Instrumentation Channels 1,2,3,& 4 shall be operating.

(b) At least two radiation monitoring instruments with ranges sufficient to properly indicate any dose rates which might be encountered shall be made available.

Critical Assembly and Power Calibration Procedures.

L-1 (3.0)

In accordance with the Technical Specifications for the Aerotest Radiography and Research Reactor;

(a) What is the maximum excess reactivity above cold, clean critical with experiments in place ? (1.0)

(b) What is the maximum excess reactivity above cold, clean critical without experiments in place ? (1.0)

(c) What is the maxumum weight of U-235 allowed in the reactor core ? (1.0)

(a) $ 3.00

(b) $ 3.00

(c) 3.30 kg of U-235

Technical Specification section 5.0

L-2 (3.0)

According to the Technical Specifications, what three conditions must be met in order to consider the reactor, with fixed experiments in place, shutdown ?

(1.0 each)

(a) The console key is in the "off" position and the key is removed from the console and under the control of a licensed operator (or stored in a locked storage area).

(b) Sufficient control rods are inserted so as to assure the reactor is subcritical by a margin greater that 0.7 % delta K/K cold clean critical condition.

(c) No work is in progress involving refueling operations or maintenance of its control rod mechanisms.

Technical Specification 1.0

L-3 (3.0)

In accordance with the Technical Specifications;

(a) When may Temporary Procedures be utilized ? (1.0)

(b) Who must approve a Temporary Procedure prior to utilization ? (1.0)

(c) Who must subsequently review a Temporary Procedure? (1.0)

(a) Temporary Procedures may NOT change the intent of the previously approved procedures.

(b) A licensed Senior Reactor Operator and one other qualified indivi ual.

(c) Temporary Proceedures are reviewed by the Reactor Safeguards Committee.

Technical Specification 12.2.2

L-4 (2.0)

In Accordance with ARRR Administrative Procedures,

(a) When may a Senior Licensed Operator deviate from procedures ? (1.0)

(b) Deviations to procedures shall be reported to what person? (1.0)

(a) As required during an emergency to assure the health and safety of the staff and general public as required to assure plant safety.

(b) Reactor Supervisor

Administrative Procedures

L-5 (3.0)

In Accordance with 10 CFR 55, " Operators' Licenses" :

(a) The " Exemptions from License " provisions of the Code of Federal Regulations (10 CFR 55), allow what individuals to operate the reactor controls without a license ? (1.0)

(b) As defined in 10 CFR 55, when is an individual deemed to be operating the controls of a nuclear facility? (1.0)

(c) What are the "controls" as defined in 10 CFR 55 ? (1.0)

(a) An individual may manipulate the controls as a part of his training to qualify for an operator license under the direction and in the presence of a licensed operator or senior operator.

(b) An individual is deemed to operate the controls of a nuclear facility if he directly manipulates the controls or directs another to manipulate the controls

(c) "controls" - apparatus and mechanisms the manipulation of which directly affect the reactivity or power level of the reactor.

10 CFR 55

L-6 (3.0)

What three requirements are imposed by Technical Specification on solid explosive materials brought into the facility?

(1.0 each)

(a) Individidule explosive devices shall be limited to 1000 grains equivalent TNT encased in metallic sheathing.

(b) The maximum quantity of explosive material that may be possesed at one time shall be limited to 50 pounds equivalent TNT

(c) Explosive material shall be stored in designated areas within the reactor facility.

Technical Specification 9.11.3

L-7 (3.0)

In accordance with the ARRR Emergency Plan;

(a) In the absents OF of the President, Aerotest Operations with no designated alternate, who shall act as the Emergency Cordinator (EC) in the case of a radiological emergency ? (1.0)

(b) A radiologocal emergency is indicated by what levels of activity for the following samples:

(1) Smearable Surface Contamination (0.5)

(2) Radiation Level in the Control Room (0.5)

(3) Water Activity (0.5)

(4) Air activity (0.5)

(a) Radiation Safety Officer

(b) (1) ~~1R/hr per square foot~~ 10 mR/HR PER 100 cm^2 EMERGENCY PLAN REVISION. 7-16-84

(2) > 100 mR/hr

(3) > 200 mR/hr as seen on the control room monitor.

(4) > 20 mR/hr as seen on the control room indicator.

Emergency Plan

Rita
State of CA

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION V
1450 MARIA LANE, SUITE 210
WALNUT CREEK, CALIFORNIA 94596

SEP 27 [illegible]

Docket No. 50-288

Aerotest Operations, Inc.
3455 Fostoria Way
San Ramon, California 94583

Attention: Mr. Richard Newacheck
President

Gentlemen:

Subject: NRC Examinations

On August 28, 1984, the NRC administered examinations to an employee of your company who had applied for licenses to operate your Aerotest Radiography and Research Reactor.

As a result of this examination the Candidate was found to not meet the minimum qualification requirements for licensing.

At the conclusion of the examinations on August 28, 1984, the examination and preliminary findings were discussed with members of your staff as detailed in the enclosed report.

Sincerely,

Robert J. Pate

Robert J. Pate, Chief
Reactor Safety Branch

Enclosures:
1. Examination Report
No. 50-288-OL/84-01
2. Written Examination and Answer Key (SRO)
3. Plant Review of Key

cc w/o enclosures:
John Elin, Operator Licensing Examiner

U.S. NUCLEAR REGULATORY COMMISSION

REGION V

Examination Report No. 50-288/OL-84-01

Facility Licensee: Aerotest Operations, Inc.

3455 Fostoria Way

San Ramon, California 94583

Facility Docket Number: 50-288

Chief Examiner: [signature] 9-26-84
John Elin, Operator Licensing Examiner — Date

Approved: [signature] 9/26/84
Robert J. Pate, Chief — Date
Reactor Safety Branch

Summary:

Examinations on August 28, 1984.

Written and oral examination administered to one SRO-Instant candidate. Passed oral, failed one section of the written examination. License denied.

REPORT DETAILS

1. **Person Examined**

   1-SRO instant candidate.

2. **Examiner**

   John O. Elin

3. **Examination Review**

   The written examination and answer key were reviewed on site by Mr. Irvin Lamb of Aerotest Operations, Inc., Mr. Lamb's comments are documented on the review copy of the answer key. These comments were incorporated into the key prior to grading the candidate's response.

4. At the conclusion of the examination the examiner met with Mr. Irvin Lamb and Mr. Richard Newacheck of the Aerotest Operations staff. The results of the examination were not discussed. The examiner noted, however, that the candidate appeared weak in knowledge of reactor theory.