UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION IV
611 RYAN PLAZA DRIVE SUITE 400
ARLINGTON, TEXAS 76011-8064

NOV 7 1996

William T. Cottle, Group Vice
  President, Nuclear
Houston Lighting & Power Company
P.O. Box 289
Wadsworth, Texas 77483

SUBJECT: GENERIC FUNDAMENTALS EXAMINATION RESULTS

This letter forwards the results of the Generic Fundamentals Examination Section (GFES) of the written operator licensing examination that was administered on October 9, 1996, to nominated employees of your facility. We are forwarding the following items:

- the examinations, including answer keys;
- the results for your nominated employees; and
- copies of the individual answer sheets completed by your nominated employees.

We request that your training department forward the individual answer sheets and results to the appropriate individuals. It should be noted that the examination was administered in two forms, which were identical except for the sequence of questions.

In accordance with the Commission's regulations, 10 CFR 2.790, a copy of this letter and the examination and answer key will be placed in the NRC's Public Document Room (PDR). The individual results and answer sheets are exempt from public disclosure and, therefore, will not be placed in the PDR.

Questions concerning this examination should be directed to Dr. George Usova at (301) 415-1064.

Sincerely,

Kenneth E. Brockman, Acting Director
Division of Reactor Safety

Dockets: 50-498
50-499
Licenses: NPF-76
NPF-80

Enclosures: As stated

cc: (see next page)

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PDR ADOCK 05000498
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FACILITY COMMENTS AND NRC RESPONSES FOR THE OCTOBER 1996 GFE

FACILITY -- SOUTH TEXAS PROJECT

EXAM -- PWR FORM A/B

QUESTION: 14/42

Refer to the drawing of a gas-filled detector characteristic curve (see figure below).

What is the effect of operating a proportional neutron detector at a voltage near the high end of the proportional region?

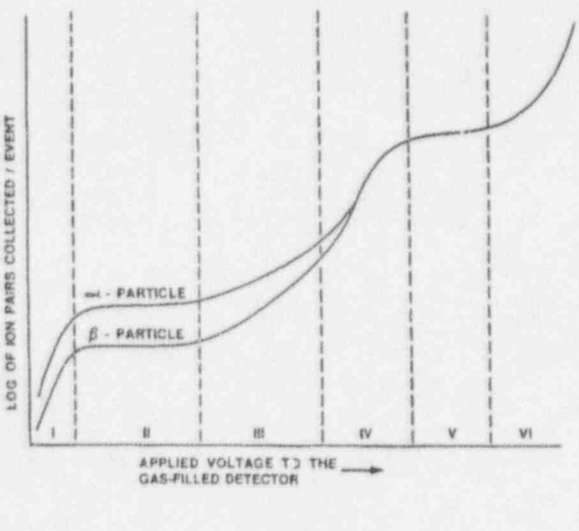
A. Gamma pulses will increase in size while neutron pulses remain essentially the same, causing some gamma pulses to be counted as neutron pulses and yielding a less accurate neutron count rate.

B. A high gamma radiation field will result in multiple small gamma pulses that combine to form larger pulses, which will be counted as neutron pulses, yielding a less accurate neutron count rate.

C. Neutron pulses will become so large that gamma pulse discrimination is no longer needed, yielding a more accurate neutron count rate.

D. The positive space charge effect will increase and prevent collection of both gamma and neutron pulses, causing a less accurate neutron count rate.

ANSWER: B.



GAS-FILLED DETECTOR CHARACTERISTIC CURVE

FACILITY COMMENTS AND NRC RESPONSES FOR THE OCTOBER 1996 GFE

COMMENT:

The figure provided with the question does not accurately represent a Gas Filled Detector Characteristic Curve in that it shows a disproportionality in Region III, the Proportional Region. The detector response in Region III should show a direct proportion for each of the two characteristic curves shown and they should parallel one another throughout this region. These attributes are shown in the Sourcebook on Atomic Energy, Third Edition (Glasstone), page 200 and Nuclear Reactor Engineering, Third Edition (Glasstone & Sesonske), page 311. The figure provided with the question depicts the curves as being disproportionate with respect to each other.

Because a more direct proportionality actually exists than was depicted on the exam question, operation of a detector near the high end of the proportional region would be no different than one operating at a lower point, thus we feel the question has no correct answer.

RESPONSE:

Do not concur. According to Westinghouse (Radiation, Chemistry, and Corrosion Considerations for Nuclear Power Plant Application, 1983, p. 5-29), "In a high gamma field with high operating voltage, gamma pulse pile-up results in instrument output indicating a neutron flux much higher than actually exists." This makes option B the correct answer.

Based on the interim answer key, this question was answered correctly by 23/124 examinees and yielded a very small positive discrimination index of +0.02. <u>No answer key change is required.</u>

FACILITY COMMENTS AND NRC RESPONSES FOR THE OCTOBER 1996 GFE

FACILITY -- SOUTH TEXAS PROJECT

EXAM -- PWR FORM A/B

QUESTION: 56/84

Neutron flux shaping in a reactor core reduces radial power peaking:

A. in the center of the core caused by the high number density of fuel assemblies.

B. at the periphery of the core caused by moderator reflection of thermal leakage neutrons.

C. throughout the core caused by uneven burnout of control rod poison material.

D. throughout the core caused by uneven burnout of fuel assemblies.

ANSWER: A.

COMMENT:

The answer key cited choice "A" as the correct answer: "in the center of the core caused by the high number density of fuel assemblies." However, the "number density" of fuel assemblies is a somewhat ambiguous term depending on the area of the core or the number of fuel assemblies being evaluated. The "number density" could be viewed as a constant for the core providing only the area actually occupied by fuel assemblies is taken into account. This was essentially the interpretation used at our facility which was the basis for rejecting choice "A".

We feel an equally correct answer is choice "D": "throughout the core caused by uneven burnout of fuel assemblies." Following the initial core load, subsequent refuelings involve replacement of approximately one third of the core. In recognition of the difference on fuel inventory between new fuel assemblies and those remaining in the core from the previous cycle, placement within the core is chosen to promote optimum flux shaping so as to reduce radial power peaking. Thus, the fuel content (i.e., uneven burnout of fuel assemblies) is in fact, a consideration for optimizing core power distribution.

RESPONSE:

Do not concur. If all fuel assemblies contained the same fuel enrichment, the center of a refueled core would have the highest neutron flux of any location in the core. This is because fission rate would increase geometrically from the perimeter of the core toward the center due to the cylindrical geometry of the core. This geometry would cause the center fuel assemblies to receive fission neutrons from the greatest <u>number</u> of fuel assemblies, and thereby generate the highest power and produce the highest radial peak. Neutron flux shaping using fuel loading patterns prevent this high peak in the center of the core.

Westinghouse (Reactor Core Control for Large PWRs, 1983, p. 8-13) also states "It should be noted that one of the major effects of burnup is to establish a flatter radial profile." This indicates that fuel burnup does not <u>cause</u> increased radial peaking. In fact, burnup actually flattens the radial neutron flux distribution and reduces radial power peaking. Therefore, option D cannot be correct.

Based on the interim answer key, this question was answered correctly by 67/124 examinees and yielded a moderate positive discrimination index of +0.20. <u>No answer key change is required.</u>

FACILITY -- SOUTH TEXAS PROJECT

EXAM -- PWR FORM A/B

QUESTION: 88/16

Which one of the following must be present to prevent departure from nucleate boiling from occurring in a reactor core following a pressurizer vapor space instrument line rupture if the leak rate is less than normal makeup capability?

A. Reactor coolant pump flow capability

B. Pressurizer level in the indicating range

C. Emergency core cooling injection capability

D. Steam generator steaming capability

ANSWER: D.

COMMENT:

We feel this question is beyond the scope of the generic fundamentals area. This question deals with Small Break Loss of Coolant Accident (SBLOCA) analysis and is very specific in its application within that analysis. We address SBLOCA analysis in the Transient Accident Analysis and Mitigating Core Damage Courses which are presented much later in our Initial Licensed Operator Training Program.

RESPONSE:

Partially concur. Although the conditions in the question provide an accident situation, an examinee knowledgeable in heat transfer and thermal hydraulics should be able to readily eliminate options B and C. Option B can be eliminated because it does not directly affect heat transfer conditions in the core. Option C can be eliminated because the leak rate is less than the normal makeup capability. Option D is the correct answer. Option A is the only remaining option that directly affects heat transfer in the core. Therefore, options A and D will be accepted.

Based on the interim answer key, this question was answered correctly by 48/124 examinees and yielded a small positive discrimination index of +0.09. The answer key has been changed to accept either A or D for full credit.

FACILITY -- SOUTH TEXAS PROJECT

EXAM -- PWR FORM A/B

QUESTION: 96/24

Which one of the following will prevent brittle fracture failure of a reactor vessel?

A. Manufacturing the reactor vessel from low carbon steel

B. Maintaining reactor vessel heatup/cooldown rates within limits

C. Maintaining the number of reactor vessel heatup/cooldown cycles within limits

D. Operating above the reference temperature for nil-ductility transition (RT_{NDT})

ANSWER: D.

COMMENT:

The answer key cited choice "D" as the correct answer: "Operating above the reference temperature for nil-ductility transition (RT_{NDT}).

We feel choice "B" is equally correct: "Maintaining reactor vessel heatup/cooldown rates within limits." The limits of heatup/cooldown rates and their accompanying operating curves are also based on the prevention of brittle fracture. These limits are derived through Fracture Mechanics analysis which uses the RT_{NDT} as the basis for determining allowable operating regions of pressure and temperature. Although remaining above RT_{NDT} will certainly prevent brittle failure, it is not operationally feasible. In order to enable operation of the plant over the entire spectrum of temperature, a method must be employed to ensure brittle failure does not occur when below the RT_{NDT}. This method is the Fracture Analysis mentioned earlier and is an extension of the original analysis and testing that yielded the RT_{NDT} results. Thus, staying within the heatup/cooldown limits is the operational method employed to ensure brittle fracture does not occur.

RESPONSE:

Do not concur. Option B does not refer to pressure-temperature curves for heatup and cooldown. It refers to heatup and cooldown rates (°F/hr). Simply maintaining heatup and cooldown rates within limits will not prevent brittle fracture. That is why the pressure-temperature curves and overpressure protection systems were developed.

Based on the interim answer key, this question was answered correctly by 92/124 examinees and yielded a small positive discrimination index of +0.13. No answer key change is required.