Mathematics - Course 221

APPENDIX 2: QUESTIONS BEARING DIRECTLY ON COURSE 221 CONTENT FROM RECENT AECB NUCLEAR GENERAL EXAMINATIONS

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1. Question #6, October, 1978

Neutron power (linear N), logarithm of neutron power (log N), rate of change of neutron power (linear rate) and rate of change of logarithm of neutron power (rate log) are four types of neutron power signals used for CANDU reactor control.

(a) Which of these signals are used for reactor regulation:

i) at low power?

ii) at high power?

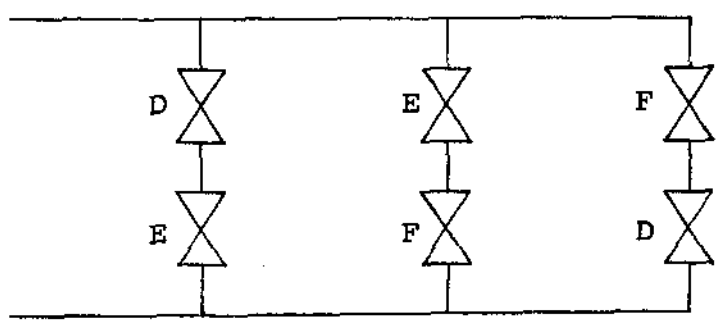
In each case, explain why the signals you selected are required in order to provide adequate reactor regulation.

(b) Of the four signals listed previously, linear N, linear rate and rate log are used for CANDU reactor protection. Which one(s) of these signals is (are) more likely to respond to dangerous conditions and to activate the protective system(s) when the reactor is:

i) at low power? Explain.

ii) at high power? Explain.

2. Question #7, October, 1978



The above diagram is a schematic representation of the typical dump valve arrangement for a reactor with moderator dump. The opening and closing of valves D, E and F are controlled by channels D, E and F respectively. During five years of reactor operation, the electronics of channels D, E and F were tested three times a week and four unsafe failures of individual channels were found.

(Cont'd)

2. Question #7, October, 1978 (Cont'd)

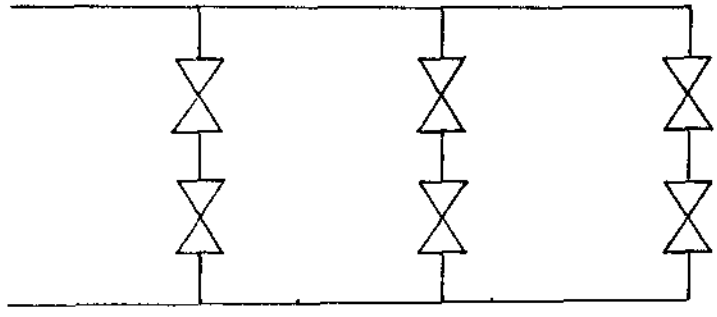
(a) Calculate the unreliability of a dump channel.

(b) If the correct operation of one dump line is sufficient to achieve an efficient dump,

i) list the various combinations of channel failures that will cause dump system to fail;

ii) calculate the unreliability of the dump system due to dump channel failures.

3. Question #5, June, 1978



The above diagram is a schematic representation of the typical dump valve arrangement for a reactor with moderator dump. In five years of operation of this reactor, six failures (to open) of individual valves were found. The dump valves are tested twice a week.

(a) Calculate the unreliability of:

i) a dump valve,

ii) a dump line.

(b) Suppose that you have a dump system consisting of a single dump line. Give and briefly discuss one advantage and one disadvantage of using two dump valves in that line instead of one.

4. Question #7, June, 1977

Give and explain four advantages that result from using triplicated instruments arranged in two-out-of-three tripping circuit instead of a simple circuit actuated by a single instrument.

5. Question #11, June, 1977

In a control room we usually find meters which indicate neutron power on a linear and logarithmic scale.

(a) Draw two simple instrument dials, one showing a linear scale with values of neutron power from 0 to 100% and the other a logarithmic scale with values of neutron power from 10^{-5}% to 100%.

(b) Given that 200 megawatts is 100% power, mark and identify the positions on each scale which correspond to the following power levels:

i) 50% power

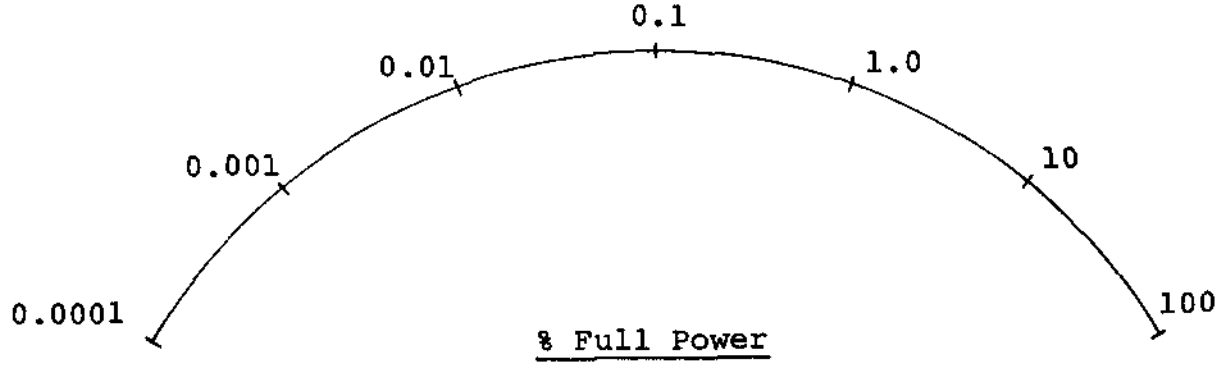
ii) 400 watts

iii) 10 kilowatts

6. Question #8, October, 1976

Give and explain three reasons why reactor safety systems should be tested routinely.

7. Question #1, June, 1975



The above diagram represents the face of an instrument which indicates neutron power on a logarithmic scale. Given that 100 megawatts is 100% power, mark the positions on the scale which correspond to the following power levels:

(a) 50% power

(b) 0.005 megawatts

(c) 500 watts

NOTE: Mark the positions on the above diagram.

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NOTE: Recent AECB nuclear general examinations have contained many more questions impinging on course 221 content - questions regarding nuclear decay rates, rate of fission product buildup, variation of reactor power with time following reactivity changes, etc. No doubt such topics can be discussed qualitatively without any use of calculus (and qualitative discussion is all the AECB requires), but a quantitative treatment of such topics certainly does involve the use of calculus. Thus a background knowledge of calculus concepts can hardly fail to quicken one's insight into such topics, and to aid one's ability to discuss them definitively, even at the descriptive level.

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