

January 13, 2004

To: Virginia Electric and Power Company

FROM: Stephen Monarque, Project Manager /RA/
Project Directorate II, Section 1
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

SUBJECT: NORTH ANNA POWER STATION, UNITS 1 AND 2 - FACSIMILE
TRANSMISSION OF QUESTION FOR PROPOSED TECHNICAL
SPECIFICATIONS CHANGES, USE OF FRAMATOME ANP ADVANCED
MARK-BW FUEL (TACS MB4714, AND MB4715)

A facsimile of the attached question on Rod-to-Rod Radiation was transmitted on January 13, 2004 to Mr. Tom Shaub of Virginia Electric and Power Company (VEPCO). This question was transmitted in order to allow VEPCO to determine the response time needed to address this request for additional information.

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NORTH ANNA POWER STATION, UNITS 1 AND 2

ROD-TO-ROD RADIATION QUESTION

The NRC staff has developed an example of a thermal radiation problem that could be used to justify the use of the RELAP 5 radiation model presented in Topical Report 2103(P), Revision 0, "Realistic Large Break LOCA Methodology for Pressurized Water Reactors."

A. In this example, a 6x6 array of rods in the hot bundle are selected, with the following bounding conditions presented below.

- 1) The limiting rod is located in position # 16 roughly in the center of the array.
- 2) The limiting rod peak cladding temperature (PCT) is 2032 F.
- 3) All remaining rods in the array are at a temperature of 1975 F.
- 4) The fence is at a temperature of 1975 F.
- 5) No guide tubes were modeled in this array.

Using these bounding conditions in this example, the minimum equivalent heat transfer coefficient for rod no. 16 is calculated to be 2.6 Btu/hr-ft²-F. This value bounds the FLECHT test data equivalent heat transfer coefficients of 1.87, 2.22, and 1.90 Btu/hr-ft²-F for FLECHT Tests 31504, 13609, and 13914, respectively. The temperature value of 1975 F for all of the rods surrounding the hot rod bounds the power distribution in the vicinity of the PCT rod. Specifically, a pin census would show that the difference in peaking factors between the hot rod and the rods surrounding the hot rod (nearest neighbors) is bounded by the 1975 F temperature assumed for the neighboring rods. If the hot rod temperature is 2032 F and the average hot bundle temperature is 1838 F, then the use of the actual peaking factors for the hot rod and the rods surrounding the hot rod would result in rod temperatures lower than 1975 F. This demonstrates that rod temperatures, in the intermediate range between the highest temperature rod and the average hot bundle temperature, can be obtained by interpolating both the peaking factors and the associated temperatures from the highest temperature rod and the average hot bundle temperature along with their associated peaking factors.

Note, in the above example, the highest temperature rod is rod # 16 with a temperature of 2032 F and peaking factor of F_{hr} . The temperature of the average bundle rod is 1838 F with a peaking factor of F_{ave} . If the actual peaking factors for the rods surrounding the hot rods are used to generate their temperatures (something in the intermediate range between F_{hr} and F_{ave}), this cause temperatures to be lower than the assumed neighboring temperatures of 1975 F. Thus, the chosen power distribution (or temperatures of neighboring rods) bounds the PDQ pin census distributions during the fuel cycle.

B. Regarding its proposed license amendment to implement Framatome Advanced Mark-BW Fuel at North Anna Power Station, Units 1 and 2, Virginia Electric and Power Company is requested to confirm that the separation in power between the highest temperature rod and the surrounding rods bounds the power distribution for potential peak temperature rod locations in the core (i.e all rods in the hot bundle within the physics uncertainty on peaking factor) during the entire fuel cycle.