Westinghouse

No: WANL-TMI-430
Date: December 21, 1962

From: Reactor Analysis

Subject: Dose Rate from PTX Experiments
in the WREC Facility

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PROBLEM

Determine the radiation levels through 4.5' concrete shield wall between the high bay and counting room facilities at WREC for the NRX experiments conducted at 1 KW.

CONCLUSION

MASTER

The total gamma dose rate outside the 4.5' concrete wall is expected to be less than 10 mr/hr with a low energy neutron flux less than $60 \text{ n/cm}^2\text{-sec}$. These values are based on calculated NRX values normalized to previous measurements¹ made for a Yankee critical assembly. The unnormalized dose rate was calculated to be less than 1 mr/hr for both neutrons and gammas. Base on the normalized values, which are the higher, the present wall is adequate.

ANALYSIS

The dose rates for the PTX were calculated by shielding program 14-0 for an NRX core with the inner and outer reflectors and operating at 1 KW. The calculations

1. Private communication with D. Halen, WREC.

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showed that an additional 6" of concrete would reduce the gamma dose rate by 2 factor or 0.33 and the neutron dose rate by a factor of 0.2. The distance between the reactor and the wall was 9'.

A calculation was made of the gamma and neutron dosage due to the Yankee core mockup at the CRX test facility for comparison with measured values. This comparison was used to evaluate the calculated radiation level for an NRX core in the same facility.

The analytical model consisted of 5000 stainless steel clad UO₂ fueled rods immersed in 40 cm of water. The operating power level of the assembly was 2 KW.

Aim-5, a 4 group diffusion theory code, was used to obtain the neutron flux and power distribution of the core configuration. Fast constants were obtained from MUFT and thermal cross sections, including capture cross section, were obtained from TEMPEST. The 14-0 Reactor Shield Analysis code was used to obtain the gamma and neutron dose at several locations. It was assumed that all the power was generated in that portion of the fuel rods immersed in water. The secondary gammas generated in the water reflector steel tank wall and the concrete wall were neglected since their source term is less than 5% of the secondary source term in the core. Experimentally a gamma dose of 10 mr/hr and a neutron flux of 200 n/cm²-sec were detected for the Yankee assembly.

Since the same method was used to calculate the dose rates for the NRX and Yankee assemblies, the NRX calculated values were normalized to the Yankee

measurements as follows:

$$\frac{\text{NRX}_M}{\text{NRX}_C} = \frac{\text{Yankee}_M}{\text{Yankee}_C}$$

$$\text{The normalized NRX measurement} = \frac{\text{NRX}_C}{\text{Yankee}_C} \times \text{Yankee}_M$$

$$\text{Gamma dose rate} = \frac{2.84 (-4)}{4.29 (-4)} \times 10 \doteq 7 \text{ mr/hr}$$

$$\text{Neutron flux} = \frac{2.67 (-5)}{1.00 (-4)} \times 200 \doteq 60 \text{ n/cc-sec}$$

C - Calculation

M - Measurement

SIGNED: _____

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for (R)
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From WNL Dwg 975 DG32