Westinghouse Electric Corporation

ASTRONUCLEAR LABORATORY

NUCLEAR AND RADIATION AND SHIELDING

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No: RAFF No. 113 Rev. C
WANL-7 I-1309

Date: January 21, 1965

From: H. C. Woodsum - Radiation and Shielding

Subject: Additional Radiation and Shielding Experiments Needed at WANL

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WESTINGHOUSE ELECTRIC CORPORATION

ASTRONUCLEAR LABORATORY

PROJECT NERVA - REACTOR ANALYSIS TEST REQUEST

INFORMATION CATEGORY

RATR No. 118 Rev. 0

Unclassified
H.C. Woodsum 1/21/65
Authorized Classifier Date

WANL-TI I-1389

ADDITIONAL RADIATION AND SHIELDING EXPERIMENTS NEEDED AT WAMET

Prepared By: H.C. Woodsum Date: 1/21/65
H. C. Woodsum

Approved By: J.G. Gallagher Date: 1/21/65
J. G. Gallagher

NERVA TEST PROGRAM
REACTOR ANALYSIS TEST REQUEST

WANL-TTI-1349

RATR No. 118 Rev. 0

January 21, 1965

ADDITIONAL RADIATION AND SHIELDING EXPERIMENTS NEEDED AT WANTE

There are three types of PAX experiments which are still urgently needed by the Radiation and Shielding Analysis Group. Described generally these are:

1. Measurement of the scattered fast neutron flux and gamma ray dose from the clamshell shield mockup at the pressure vessel surface together with an investigation of gamma scalloping at the pressure vessel surface.
2. Measurement by means of collimators of the relative wall capture and direct reactor gamma radiation contributions at various locations in the test cell.
3. Measurement of streaming through the actuator in the privy roof.

The priorities of all three of these measurements are roughly the same and are urgently needed by Radiation and Shielding in order to:

1. Understand the contribution of test cell wall capture gamma dose to the radiation damage doses to critical items such as the actuators

below the privy roof.

2. Determine the effect of the NRX clamshell shield on reactor heating rates and fluxes.

3. Determine the effect of possible streaming in the control drum actuators.

DESCRIPTION OF EXPERIMENTAL MEASUREMENTS NEEDED

With the paraffin mockup of the NRX privy roof shield, measurements of the scattering of fast neutrons and gamma rays off the shield inner surface and returning to the pressure vessel should be made in order to assess the importance of these effects on increasing heating rates in the outer regions of the reactor. Measurements of the back scattered fluxes with shield in place should be made by placing sulfur pellets and gamma dosimeters on the surface of the pressure vessel in an axial and circumferential array. Axial dosimeters should be placed 4-6 inches apart starting from a position below the height of the mockup shield and extending to above the shield. Circumferential measurements should be made horizontally around the core midplane and should be spaced close enough that differences of gamma intensity between and behind control drums can be seen. This may require a circumferential separation of only 5° or about 2". The total subtended angle for these dosimeters should include the angle subtended by the shield and should extend slightly beyond.

Measurements of unshielded axial and circumferential variations could be made during the same run by duplicating these same dosimeter positions on the side of the reactor away from the shield, i.e., azimuthally located 180° from the previous positions.

All subsequent measurements can be made without the NRX privy roof shield mockup.

The second set of measurements needed are the measurements of wall capture and wall scatter gamma doses vs. direct gamma doses. This can best be accomplished by alternately shielding gamma dosimeters from the direct (reactor) and indirect(wall) contributions. It is estimated that in order to reduce the direct dose level to a point where it is a small fraction of the expected wall contribution (say $\sim 10\%$) would require a total lead thickness of about 4 inches. This could be accomplished by placing 2 lead bricks between gamma detector and reactor and allowing the gamma detector to "see" only the concrete wall perpendicular to the reactor detector axis. Measurements could be made at several radial positions approximately on the reactor core midplane extending from a radius of 5 feet to the wall surface such that one detector and shield does not appreciably interfere with another. This could best be accomplished by making 3 radial shielded measurements - at radii of 5, 7, and 9 feet (wall surface) in a direction perpendicular to one of the concrete walls. Unshielded measurements should also be made at adjacent nearby positions. Another set of measurements should be made with the lead bricks shielding the gamma detectors from the wall while viewing the reactor directly. In this case, care should be taken that the shadow area subtended by the lead bricks is sufficient to screen out most of the wall area. Finally, unshielded gamma dose measurements should also be made in a direction away from the wall at the same radii (5, 7, and 9 feet).

A vertical traverse measurement of thermal flux on the wall surface should also be made. These measurements would complement the horizontal measurements made previously on the wall source and would result in a complete description of thermal flux patterns on and in the concrete.

Measurements of streaming through the actuators will involve a mockup of the privy roof shield (a 19 inch thick shield involving Al, boral, steel balls, and water), an actual control drum hydraulic actuator, and suitable plugs for the hole where the privy roof is penetrated by the actuator for measurements with the actuator removed. Measurements should include gamma dose and fast neutron flux at the lower and upper actuator seals made by placing detectors within the actuator and similar measurements should be made immediately outside the actuator near the same axial positions. Measurements should be repeated at the same axial positions first with the actuator removed and second, with the actuator removed and the hole plugged.

SIGNED

H. C. Woodsum

H. C. Woodsum - Radiation & Shielding