Westinghouse

MASTER

WANL-TME-104

Date: August 22, 1962

From: Reactor Analysis

Subject: Review of Vitro's Preliminary
E-MAD Facility Nuclear Shielding
Report (Report No. KLX-1842)

The shielding for the E-MAD facility as proposed by Vitro Engineering Company⁽¹⁾ has been reviewed from a shielding point of view and found to be adequate for a NERVA or Phoebus engine under normal operating conditions with the possible exceptions of radiation

1. Penetrating the upper main bay walls and scattering to the main bay operation galleries.
2. Penetrating the low density section of the main door (122/1) and scattering to the ground outside the building.
3. Scattering on the main bay floor and streaming through the 1/2" slot below the main door.

The design analysis does not appear to cover special circumstances such as the core or activated engine components in elevated positions.

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This review which considered basic criteria, assumptions, methods and spot check of results, was made to assure the adequacy of the shielding for the engine maintenance and disassembly work to be performed under the NERVA development program.

The design criteria is consistent with the agreement reached between AGC; WANL; SNPO, Cleveland and Vitro Engineering Corporation in January, 1962⁽²⁾.

The assumptions used to fulfill the design criteria were found to be compatible with the expected normal operation procedure. However, it must be taken into consideration that the assumed "40 hr. week" may be closer to 70 hrs. (based on 7 days per week and 10 hrs per day). It does not appear that overtime, including a 7-day week or even 2 - 12 hr shifts per day, should be considered an irregular occurrence in a development program such as NERVA.

It is agreed that a fresh engine each week is conservative (present plans will provide one engine each two weeks) and that a technician cannot stand at a window in the gallery for eight continuous hours; however, the consumption of these two major safety factors in the original design leaves little margin of flexibility, as normally provided, for future modifications of operation. In other words, the present MAD shielding design tends to limit the growth of the development program without modifications to the facility.

Several discrepancies were noted in reviewing the report, they are given below. With the exception of the question on the dose rate in the main bay

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operating galleries and outside the main door due to radiations scattered through the upper stepped and low density walls and streaming beneath the door, the comments do not adversely effect the dose rates.

1. Pg. 4 Engine Sources. The references to "thermal shield" should be "vessel internals" or "reflector".
2. Pg. 4 WANL's best estimates of the ratio of core to engine dose rates, via program 14-0⁽³⁾, are 5.5 unshielded^(4,5), and 7.3 through five ft. of ordinary concrete rather than 3.8 and 2.9 as used in the report.
3. Pg. 10 (a) Units of volumetric source strength should be mev/cc rather than mev/sq cm.
(b) Plus sign is omitted in the brackets of the first flux equation.
4. Pg. 23 Scattered Dose Rate. No allowance has been made for the dose rate in the gallery or outside the main door due to radiations penetrating the upper wall sections diagonally and scattering to the detector from the outer one or two relaxation lengths of the concrete. The concrete has an electron density almost 2000 times that of air.
5. Pg. 44 Ducts and Penetrations. In the paragraph continued from page 43 reference is made to a 4 foot pipe penetration, should this be 4 inch?

The methods used in determining the shielding requirements were generally standard acceptable methods. The results appear compatible with similar WANL calculations.

SIGNED

L. O. Ricks

REFERENCES

1. "E-MAD Nuclear Shielding Report, NERVA and Future Nuclear Engines" KLX-1842, Vitro Engineering Company, - Preliminary.
2. Minutes of Meetings - AGC Ltr. 740:LC02 n.m. dtd. 1-6-62, L. E. White to R. Brookshire, Vitro's Ltr, dtd. 1-19-62, G. Kligfield to W. Esselman.
3. XDC-59-2-16, "Shielding Computer Programs 14-0 and 14-1, Reactor Shield Analysis", by J. T. Martin, J. P. Yalch and W. E. Edwards, dtd. 1-23-59.
4. WANL-TME-017, "Dose Rate From an Unshielded Core", dtd. 2-14-62, by L. O. Ricks.
5. WANL-TME-020, "Dose Rate From an Unshielded Engine", dtd. 3-6-62, by L. O. Ricks.