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DESIGN AND EFFECTIVENESS OF WALL RETURN SHIELD FOR USE IN ZPPR-5 LOW LEVEL FLUX MONITOR EXPERIMENTS†

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In order to verify the adequacy of the Clinch River Low Level Flux Monitor design, a series of experiments have been performed on the Engineering Mockup Critical Assembly (ZPPR-5) at Idaho Falls. The detectors for this experiment must be placed 50 cm outside the edge of the radial blanket in order to allow for a spectral modifier to be placed between the blanket and the detector.[1] Hence, the detector must be protected from room return by an adequate shield within the limitations imposed by the edge of the matrix. A schematic of the reactor cell room is shown in Fig. 1.

The ZPPR-5 wall return calculations were done in the following manner:

a.) The ZPPR-5 core assembly was mocked up in an R-Z configuration, and the outward directed fluxes were found for the external boundaries,

b.) The reactor cell room was then mocked up in an R-Z configuration with the core region voided and the outward directed fluxes calculated in part (a) used as an interior boundary source,

c.) Using the fluxes calculated in this mockup, the resulting U-235 reaction rate at the Low Level Flux Monitor (LLFM), located 50 cm outside the edge of the radial blanket, was found for the configurations shown in Table 1.

The following three comparisons were made and summarized in Table 1:

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DISCLAIMER

1.) Bare detector U-235 reaction rate with walls, floor, and ceiling replaced by low density nitrogen vs. bare detector U-235 reaction rate with walls, floor, and ceiling in position;

2.) Bare detector U-235 reaction rates with walls, floor, and ceiling replaced by low density nitrogen vs. bare detector U-235 reaction rate with borated polyethylene room return shield and the walls, floor, and ceiling in position; and

3.) Bare detector U-235 reaction rate with stainless steel wall return shield and walls, floor, and ceiling replaced by low density nitrogen vs. bare detector U-235 reaction rate with stainless steel wall return shield and walls, floor, and ceiling in position.

Comparison 1 indicates that with the walls, floor, and ceiling in position, the LLFM detector reaction rate doubles.

Comparison 2 illustrates that a borated polyethylene room return shield completely removes any room return effects. However, at the same time, the borated polyethylene shields the detector from sections of the active core and also removes return from the empty matrix region. Hence, the detector reaction rate is ∿47% lower for this case than when the external surfaces are removed.

Comparison 3 shows that for a stainless steel room return shield the LLFM detector reaction rate as well as being constant with or without external surfaces is also essentially the value calculated for the bare detector with no room return.

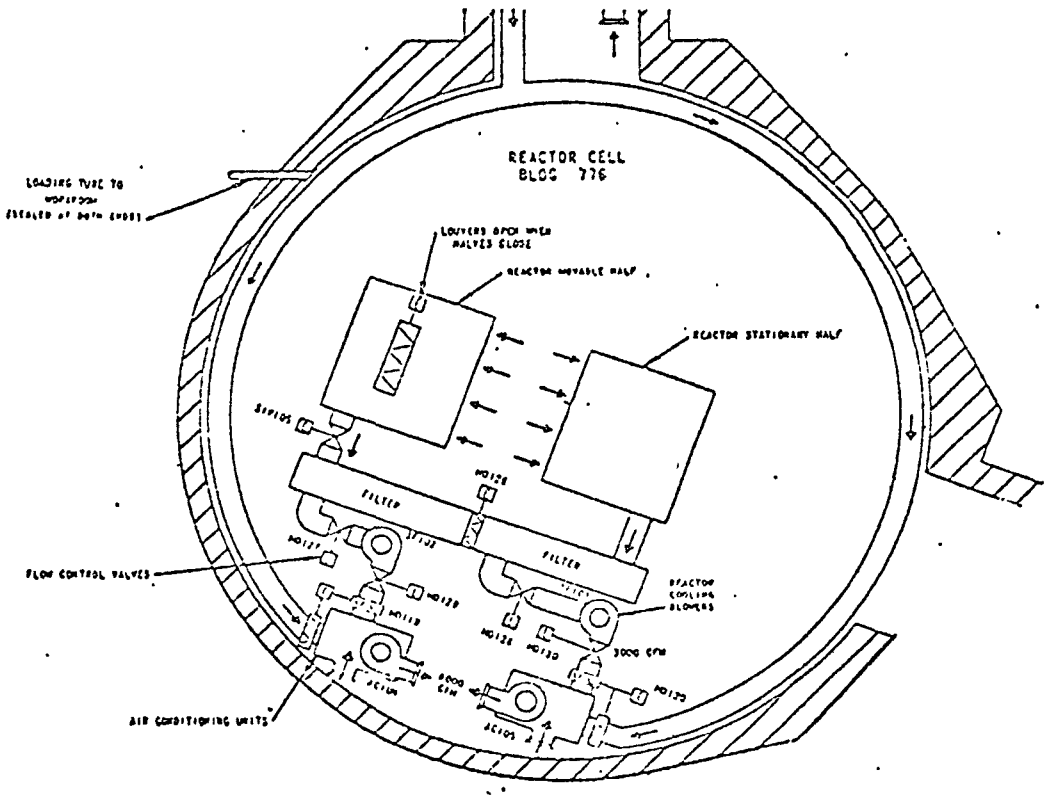

Figure 1. Schematic of ZPPR-5 Reactor Cell Room

Table 1. Wall Return Effects

Comparison	Initial Config.	Final Config.	Initial Det. Response	Final Det. Response	% Difference
1	A	B	3.1884-5	6.4403-5	101.99
2	A	C	3.1884-5	1.6994-5	-46.70
3	D	E	3.2115-5	3.2353-5	.74

Configurations

A - Containment room walls, floor, and ceiling replaced by low density nitrogen with 17.35 cm of bare matrix between detector and external surfaces

B - Containment room walls, floor, and ceiling in position with 17.35 cm of bare matrix between detector and external surfaces

C - Containment room walls, floor, and ceiling in position with 11.57 cm of 5% by weight borated poly followed by 5.78 cm of bare matrix between detector and external surfaces

D - Containment room walls, floor, and ceiling replaced by low density nitrogen with 17.35 cm of stainless steel between detector and external surfaces

E - Containment room walls, floor, and ceiling in position with 17.35 cm of stainless steel between detector and external surfaces

REFERENCES

1. D. L. Selby, J. W. McAdoo, G. F. Flanagan, G. C. Tillett, "The Effects of a Spectral Modifier on the Clinch River Breeder Reactor Low Level Flux Monitor Experiments Conducted in ZPPR-5," to be presented at the American Nuclear Society Meeting, June, 1976.