VOLUME 19
TANSAO 19 1-482 (1974)

1974 WINTER MEETING

WASHINGTON, D.C.

OCTOBER 27-31, 1974

AMERICAN NUCLEAR SOCIETY

AMERICAN NUCLEAR SOCIETY

A N S

TRANSACTIONS

TRANSACTIONS

OF THE AMERICAN NUCLEAR SOCIETY 1974 WINTER MEETING

Sheraton-Park Hotel | October 27-31, 1974 | Washington, D.C.

Technical Program Chairman
George A. Ferguson (Howard Univ)

Assistant Technical Program Chairman
Charles F. Baxter (USAEC)

National Program Chairman
Walt H. Wolf (SWUCO)

Editor
Ruth Farmakes (ANS)

Reviewers

David E. Bartine (ORNL) - *Shielding and Dosimetry*
John Connelly (Carolina P&L) - *Reactor Operations*
David R. Cuneo (Bechtel) - *Remote Systems Technology*
Robert Cushman (USAEC) - *Power*
Howard J. Faulkner (USAEC) - *Nuclear Reactor Safety*
Norman C. Francis (KAPL) - *Reactor Physics*
David L. Hetrick (U of Ariz) - *Nuclear Criticality Safety*
George Hopkins (GA) - *Controlled Nuclear Fusion*
William A. Jester (Penn State Univ) - *Education*
Werner K. Kern (USAEC) - *Isotopes and Radiation*
William H. Reed (LASL) - *Mathematics and Computation*
J. L. Scott (ORNL) - *Materials Science and Technology*
James R. Tulenko (B&W) - *Nuclear Fuel Cycle*
Donald E. Wood (Kaman Sci Corp) - *Environmental Sciences*

Francis Alcorn (B&W)
Robert Barry (W-NES)
William Bartels (USAEC)
R. E. Blanco (ORNL)
Gail de P. Burke (USAEC-HASL)
Steven Carpenter (NBS)
George I. Coulbourn (Con Ed)
R. L. Crowther (GE-San Jose)
M. D'Agostino (Grumman Aero)
Monte V. Davis (Ga Tech)
David Dawson (GE-Md)
K. Disney (WARD)
E. Linn Draper (U of Texas-Austin)
André Gage (PEPCO)
Farno L. Green (Genl Motors Mfg Div)
Thomas Gutman (C-E)
Phillip Hemmig (USAEC)
C. M. Henderson (Monsanto-Mound)
M. R. Hertz (Monsanto-Mound)
J. Holman (USAEC)
H. C. Honeck (duPont-SRL)
J. A. Horak (ORNL)
H. Jaffe (USAEC)
John Kallfelz (Ga Tech)
Walter Y. Kato (ANL)
J. Howard Kittel (ANL)
William Kreger (USAEC)
K. D. Lathrop (LASL)
Joseph D. Lee (LLL)
R. B. Leggett (Westinghouse-Hanford)
Robert H. Logue (Phila Elec)
T. B. McCall (Westinghouse)
J. E. Meyer (W-BAPL)
Warren Miller (LASL)
Barry Naft (SAI)
R. A. Neff (Monsanto-Mound)
M. J. Ohanian (U of Fla)
Harry Pearlman (AI)
S. Ramchandran (WARD)
Forrest Remick (Penn State Univ)
Peter Shen (So. Cal Ed)
Lewis Spencer (NBS)
Ted Tarr (USAEC)
J. Thie (Consultant-Ill)
D. E. Thomas (Westinghouse)
W. D. Tucker (BNL)
Jan B. van Erp (ANL)
John Vanston (U of Texas-Austin)
Edward Warman (Stone & Webster)
J. Williams (USAEC)
Thomas Williamson (U of Va)

NUCLEAR CRITICALITY SAFETY

APPLICATION OF NEUTRON POISONS IN NUCLEAR CRITICALITY SAFETY

Sponsored by Nuclear Criticality Safety Division

All Papers Invited

1. Use of Borosilicate-Glass Raschig Rings in a Hostile Environment, *E. O. Nurmi (B&W)*

Borosilicate-glass Raschig rings purchased to ANSI N16.4-1971 standard are used as neutron absorbers in a hostile, corrosive chemical atmosphere in the NNFD uranium scrap recovery process. In the processing of highly enriched uranium, fixed neutron absorbers are required in all vessels greater than five-inch diameter to prevent the occurrence of possible critical reactions.

The chemical conditions found in the process vessels at the head end or feed preparation part of the recovery process exceed conditions outlined in ANSI-N16.4-1971. Although dissolver solutions are treated with aluminum nitrate to complex fluoride ions as well as to provide salting strength, a free acid concentration of 1 to 3 molar establishes the possibility of a highly corrosive atmosphere to borosilicate glass. Glass Raschig rings have been used for neutron absorption, or fixed poison, since 1968 in these process vessels. The vessels are filled to the overflow line with random-packed glass Raschig rings. Daily checks of the level of the rings are made and new rings are added as needed to maintain the proper level. A stringer of rings in a pipe is periodically checked to ascertain the integrity of the rings throughout the depth of the vessel. Semiannually, the tanks are completely emptied, the glass rings are cleaned, inspected, and returned to the vessel. Broken and/or thin, worn rings are discarded and replaced with new rings. The two tanks containing the most corrosive solutions have about 14,000 rings each. The monthly replacement rate is about 1% of the total rings per tank. The last cleanout required replacement of 20% of the glass rings in one tank and 10% of the glass in the other tank.

Those tanks or vessels containing solutions with little or no fluoride ions experience essentially no loss of glass rings. Any loss that occurs is the result of the semiannual cleanout and inspection which causes some Raschig ring breakage due to handling.

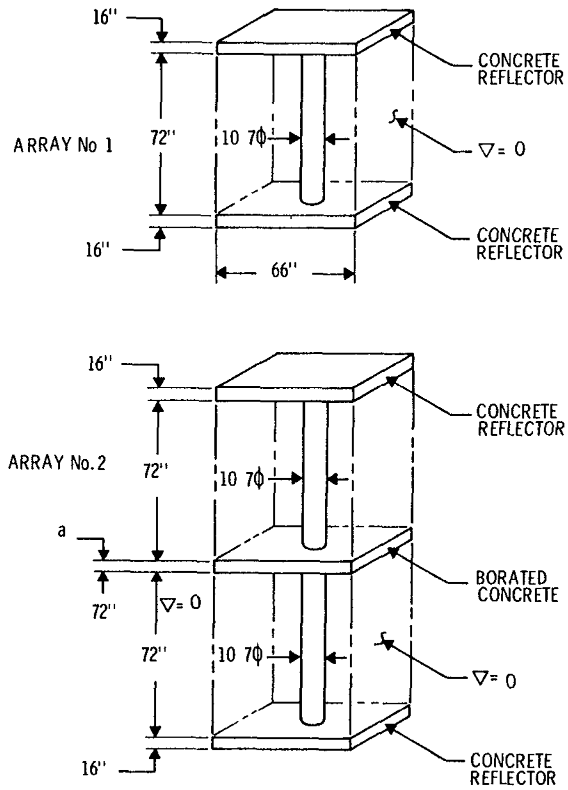
Samples of rings taken from the various vessels semiannually are analyzed for boron content. No selective leaching of boron has been observed.

Borosilicate-glass Raschig rings have been successfully employed in a chemically hostile environment as neutron absorbers or fixed poisons. The hostile environment does require diligent inspection of the Raschig rings in the process units to ensure nuclear safety.

2. Array Poisoning, *Thomas Gutman (C-E)*

The use of 8- to 10-in.-thick concrete layers to isolate arrays of interacting subcrits of fissile material had, until recent years, been considered standard practice.[1] The use of KENO calculations, however, has shown that concrete thickness of significantly <16 in. fails to provide isolation, and may even increase array reactivity in some cases.[2]

We have performed studies to identify the isolation provided by various materials for specific arrays. Although some general statements about isolating materials



ARRAY	a (INCHES)	a (COMPOSITION)	k_{eff}
1*	NA	NA	0.9447 ± 0073
2a	6	CONCRETE	0.9841 ± 0073
2b	8	CONCRETE	0 9657 ± 0067
2c	10	CONCRETE	0 9555 ± .0076
2d**	6	BORATED CONCRETE	0 8941 ± .0073
2e**	3	BORATED CONCRETE	0 9083 ± 0073

* ARRAY No 1 CONSISTS OF A ONE HIGH PATTERN OF CYLINDERS WITH TOP AND BOTTOM CONCRETE REFLECTION

** BORATED CONCRETE SUPPLIED BY REACTOR EXPERIMENTS, INC.

Fig. 1. Layout and reactivities of tiered arrays of $U(3.5)O_2$ cylinders containing 2.05 g U/cm^3.