F TERA

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

October 6, 1980

Docket Nos. 50-295
and 50-304

Mr. J. S. Abel
Director of Nuclear Licensing
Commonwealth Edison Company
Post Office Box 767
Chicago, Illinois 60690

Dear Mr. Abel:

The NRC staff has been reviewing the subject of control rod guide thimble wear in pressurized water reactors. The enclosure to this letter describes our review and makes an assessment of this problem in facilities with fuel assemblies designed by Westinghouse. Based on our review, we have concluded that this issue is resolved for the 15x15 fuel assemblies designed by Westinghouse for the Zion Station Units 1 and 2.

Sincerely,

Steven A. Varga, Chief
Operating Reactors Branch #1
Division of Licensing

Enclosure:
Evaluation of Control Rod
Guide Thimble Wear

cc: w/enclosure
See next page

P

Mr. J. S. Abel
Commonwealth Edison Company

cc: Robert J. Vollen, Esquire
109 North Dearborn Street
Chicago, Illinois 60602

Dr. Cecil Lue-Hing
Director of Research and Development
Metropolitan Sanitary District
of Greater Chicago
100 East Erie Street
Chicago, Illinois 60611

Zion-Benton Public Library District
2600 Emmaus Avenue
Zion, Illinois 60099

Mr. Phillip P. Steptoe
Isham, Lincoln and Beale
Counselors at Law
One First National Plaza
42nd Floor
Chicago, Illinois 60603

Susan N. Sekuler, Esquire
Assistant Attorney General
Environmental Control Division
188 West Randolph Street, Suite 2315
Chicago, Illinois 60601

Dr. Linda W. Little
Research Triangle Institute
P. O. Box 12194
Research Triangle Park, N. C. 27709

Dr. Forrest J. Remick
305 East Hamilton Avenue
State College, Pennsylvania 16801

Rick Konter
617 Piper Lane
Lake Villa, Illinois 60046

U. S. Nuclear Regulatory Commission
Resident Inspectors Office
Post Office Box 288
Deerfield, Illinois 60015

Enclosure

EVALUATION OF CONTROL ROD GUIDE THIMBLE

WEAR IN FACILITIES DESIGNED BY WESTINGHOUSE

A degradation of control rod guide thimble/tube walls has been observed during post-irradiation examinations of irradiated fuel assemblies taken from several operating pressurized water reactors. Subsequently, it has been determined that coolant flow up through the guide tubes and turbulent cross flow above the fuel assemblies have been responsible for inducing vibratory motion in the normally fully withdrawn ("parked") control rods position. When these vibrating rods are in contact with the inner surface of the guide tube wall, a fretting wear of the wall occurs. Significant wear has been found to be confined to the relatively soft Zircaloy-4 guide tubes because the control rod claddings--stainless steel for Westinghouse-NSSS designs--provide a relatively hard wear surface.* The extent of the observed wear is both time and NSSS-design dependent and has, in some non-Westinghouse cases, been observed to extend completely through the guide tube walls, thus resulting in the formation of holes.

Guide thimble/tubes function principally as the main structural members of the fuel assembly and as channels to guide and decelerate control rod motion. Significant loss of mechanical integrity due to wear or hole formation could: (1) result in the inability of the guide thimble to withstand their anticipated loadings for fuel handling accidents and condition 1-4 events; and, (2) hinder scramability.

In response to the staff's attempt to assess the susceptibility and impact of guide thimble wear in Westinghouse plants, two meetings were held with Westinghouse and information was submitted (References 1 and 2) on their experience and understanding of the issue. This information consisted of guide thimble wear measurements taken on irradiated fuel assemblies from Point Beach, Units 1 and 2 (two-loop plants using 14 x 14 fuel assemblies). Also described was a mechanistic wear model (developed from the Point Beach data) and the impact of the model's wear predictions on the safety analyses of plant designs.

Westinghouse believes that their fuel designs will experience less wear than that reported in some other NSSS designs because the Westinghouse designs use thinner, more flexible, control rods that have a relatively more lateral support in the guide thimble assembly of the upper core structure. Such construction provides the housing and guide path for the rod cluster control assemblies (RCCAs) above the core and thus restricts control rod vibration due to lateral exit flow. Also, Westinghouse believes that their wear model conservatively predicts guide thimble wear and that even with the worst anticipated wear conditions (both in the degree of wear and the location of wear) their guide thimbles will be able to fulfill their design functions.

The staff concluded that the Westinghouse analysis probably accounts for all of the major variables that control this wear process. However, because of the complexities and uncertainties in (a) determining contact forces, (b) surface-to-surface wear rates, (c) forcing functions, and (d) extrapolations of these variables to the new 17 x 17 fuel assembly design, the staff required several near-term OL applicants to submit to a surveillance program. For acceptability, the minimum objective of such program was to demonstrate that there is no occurrence of hole formation in rodded guide thimbles.

*Plants using Westinghouse HIPAR fuel assembly designs (stainless steel guide thimble tubes) are not considered susceptible to significant wear.

To satisfy this request for confirmation of the Westinghouse analytical predications, a cooperative owners group was established which is now sponsoring a program to obtain post-irradiation examination (PIE) data from the Salem, Unit No. 1 facility. This PIE program will examine all guide thimbles in six rodded fuel assemblies having either one or two cycles of burnup. It is our expectation that the program will confirm Westinghouse predictions, and therefore this issue should be considered resolved for all Westinghouse plants using the newer 17 x 17 fuel assembly design.

The relevant primary system design differences in plants fueled with the 15 x 15 fuel assemblies as compared with those of plants fueled with 14 x 14 fuel assemblies are minimal. And certainly the extrapolation of wear prediction is less than that associated with the extrapolation to the newer plants using 17 x 17 fuel assemblies. Thus it is reasonable to conclude that the wear in 15 x 15 fuel assemblies should be equivalent to that experienced and measured in 14 x 14 fuel assemblies, and therefore these designs are not likely to experience significant wear to the degree that the design capabilities will be impaired. Therefore, we conclude that the information that has been provided is sufficient to resolve the issue of guide thimble/tube wear in plants fueled with 14 x 14 and 15 x 15 fuel assemblies.

References

1. Letter from L. M. Mills, Tennessee Valley Authority, to L. S. Rubenstein, NRC, Dockets 50-327 and 50-328, dated November 27, 1979.

2. Letter from T. M. Anderson, Westinghouse, to H. R. Denton, NRC, NS-TMA-2238, dated April 29, 1980.