UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

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| In the Matter of | ) | |
| | ) | |
| CINCINNATI GAS AND ELECTRIC COMPANY | ) | Docket No. 50-368 |
| | ) | |
| (Wm. H. Zimmer Nuclear Power Plant) | ) | |

DIRECT TESTIMONY OF FEDERICO A. MAURA

REGARDING METAL CHIPS IN CONTROL RODS

State of Illinois )
)
) ss.
)
County of DuPage )

Federico A. Maura, having previously appeared in this proceeding as a witness on June 26, 1979, (transcript 1522) my qualifications appear following transcript page 1643, hereby states the following:

As a result of an affidavit by Gorman L. Reynolds given to the Licensing Board (Attachment A) an inspection was conducted by me regarding the grinding of a chamfer in the upper corner of the control rod velocity limiter required by General Electric FDI No. 94/63000, Rev. 0. The modification was required to eliminate potential interference between the control rod and the fuel channel during the end of its insert travel. Prior to the inspection, I interviewed the concerned workman

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by telephone on June 7, 1979, to ensure that his concerns were fully understood. During that conversation the workman explained that his concern related to metal chips allegedly left inside the control rods. These chips had been generated during grinding done in late February 1979, to remove an oversized weld in the control rods. Mr. Reynolds further stated he was satisfied with the pregrinding cleaning job done to remove metal shavings left by the manufacturer.

I reviewed the records of the modification, which was performed during the period of February 21-23, 1979, and also interviewed Reactor Controls Inc., General Electric Co. and licensee personnel involved in the performance of the modification. I concluded that:

a. 80 control rods required grinding of a chamber in one or more corners of the velocity limiter.

b. All modification work was done with the control rods in the vertical position.

c. During the initial work the corner holes and lower holes in the sheath were covered with tape. Because removing the tape and cleaning the adhesive from the sheath slowed the work the use of tape was replaced with six inch shim stock to cover a length approximately one foot high.

d. Polyethylene was used to cover part of the blades, but the actual length of the blade covered could not be absolutely determined. The best estimate is that only the lower 3 to 4 feet were covered.

e. Reactor Control Inc. and licensee personnel at the job claim no one informed them that metal chips had entered the sheath holes during the modification. They also stated the chips traveled away from the blade due to the position of the blade and grinder, and they personnally did not see any chips in the blades after the modification was completed and prior to reinstalling the blades in the reactor.

At my request, a mockup of the grinding was made using a stainless steel 3 x 3 inch channel, half inch thick. Using the same grinder and burring tools used during FDI No. 94/63000, Rev. 0, a chamfer approximately 1/4 inch in depth was machined in the upper corner of the channel. During the operation, I held my hand over the channel to determine the direction of travel of the metal particles. In addition, the metal being removed was collected to determine the size of the particles. I determined that:

a. Most particles traveled at an angle away from the blade with a few particles traveling in the near vertical direction. No particles traveled in the direction of the blade.

b. The largest particle found was approximately 1/4 inch long x 3/64 inch wide. The thickness was a few mils. Most particles were the size of sugar grain particles.

Since particles were initially found in the control blades during their pre-installation inspection, I requested the licensee to consider:

a. If a heat transfer problem would exist if enough metal chips were able to block the flow path between the absorber rods and the sheathing.

b. The effect metal chips trapped between the absorber rods and the sheath could have on the life of the control rod, and how the problem, if any, could be monitored.

Following discussions with the licensee, General Electric Co. personnel, and NRR individuals responsible for evaluating General Electric Co.'s data on blade's design life, I have determined that:

a. There is no heat transfer problem even if enough metal chips succeed in blocking the flow path between the abosorber rods and sheath.

b. Relatively large chips trapped between absorber rods and the sheath, in the area where the control rod experiences the highest neutron flux exposure, could generate small cracks after the absorber rod becomes less ductile.

c. General Electric Co. data presented to NRR at meetings held on March 22 and August 2, 1979, and General Electric Co. written responses (to NRC questions) dated April 24, 1979 (Attachment B) and June 29, 1979 (Attachment C) indicate that leaching of $B_4C$ through wall cracks does not occur until after 50% local $B^{10}$ burnup exists.

d. The General Electric Co. design life of a control blade is defined as the time when its calculated reactivity worth has decreased by 10% of its original value. This value used to be equivalent to an average $B^{10}$ depletion, over the upper one-fourth of the blade, of 42%. No loss of boron due to leaching was considered. The new design life considers the boron loss due to localized leaching by reducing the percent depletion of $B^{10}$ due to neutron reaction, over the upper one-fourth of the blade, to 34% (or 80% of the previously defined end of life as measured by $B^{10}$ depletion).

e. The safety significance of the boron loss (shutdown capability and scram reactivity) has been evaluated by the General Electric Co. and NRR personnel for the new design life considerations and has been determined to be negligible.

f. Control rods should be replaced when the $B^{10}$ depletion averaged over the top quarter of the blade reaches 34%.

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During November 1979 the Office of Inspection and Enforcement plans to issue an IE Bulletin to all BWR power reactor facilities. The bulletin will require licensees to maintain a history of $B^{10}$ depletion averaged over the upper one-fourth of the blade for every control blade and describe their plan for the replacement of blades. In addition, more confirmatory measurements regarding the relationship between $B_4C$ leaching and $B^{10}$ depletion are planned.

Based on my review of the modification (FDT No. 94/63000, Rev. 0) records, interviews with personnel who performed the modification, the results of the mockup of the grinding done on the blades, the results of up-to-date studies regarding $B_4C$ leaching through cracks in the stainless steel tubing of the control blades, and the steps being taken by the NRC (IE Bulletin No. 79- ) to continue monitoring this problem it is my conclusion that any chips which may be left in the control rod blades at Zimmer Station do not represent a safety concern.

Federico A. Maura

Federico A. Maura

Subscribed and sworn to before me this 30th day of October, 1979

Notary Public

My Commission expires: 7-25-80

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