Edison 02/21/83;
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corrected by incorporating errata.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
COMMONWEALTH EDISON COMPANY	)	Docket No. 50-454-OLA
	)	50-455-OLA
(Byron Station, Units 1 and 2)	)	

COVER SHEET

The testimony of Dr. Lawrence Conway addresses those portions of Contentions 42, 111 and 112 which assert that reduction of occupational exposure was not considered in the Byron Station design. Specifically, Dr. Conway's testimony describes his credentials qualifying him as an expert witness and explains how the Byron Station steam generators have incorporated mechanical and metallurgical design features to reduce occupational radiation exposure to workers. They are:

a. Elimination of crud traps

b. Material selection and control

c. Primary channel head external drain

d. Primary nozzle closure rings

e. Many access openings of secondary side instrument and access openings.

Dr. Conway explains how these design features reduce personnel radiation exposure by providing distance between the radiation source and workers, by reducing worker time in radiation fields, and by minimizing radiation sources in the steam generators. Dr. Conway concludes that the Byron Station steam generators embody the very best design features to reduce occupational radiation exposure.

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TESTIMONY OF DR. LAWRENCE CONWAY
CONCERNING REDUCTION OF
OCCUPATIONAL RADIATION EXPOSURE

Q.1. State your name, address and present occupation.

A.1. My name is Lawrence Conway. My address is 1603 The Oaks Drive, Maitland, Florida 32751. My employer is Westinghouse, Steam Turbine Generator Division, and I am employed as an Advisory Engineer.

Q.2. Please state your educational background.

A.2. I graduated from high school in 1952 and was then employed as an apprentice engineer at C.A. Parsons and Company, Ltd., England. For the years 1952-56, I co-oped between Parsons and Rutherford College of Technology where I studied Mechanical Engineering, graduating with a Diploma in Mechanical Engineering in May, 1956.

In October 1956, I entered the University of Durham, England and graduated in June 1959 with a First Class Honors Degree in Mechanical Engineering. I immediately re-enrolled at the University of Durham for post-graduate studies and graduated in December 1962 with a Ph.D. in Mechanical Engineering. During the course of my education, I was awarded the following academic honors - - Weighton Medal, Stephenson Medal, Doxford Scholarship, and the Doxford Prize.

Q.3. Please state your work experience.

A.3. The years December 1962 through December 1963 were occupied by teaching and performing mechanical engineering research at various educational institutions. In January 1964, I was employed by Brown Engineering Company, Huntsville, Alabama as a Mechanical Engineer, working on heat exchangers associated with Aero-space products. In the period from January through April 1967, I was successively promoted to instrumentation Systems Department Manager.

In April 1967, I accepted employment by Westinghouse at the Advanced Reactors Divison as a Fellow Engineer. For the period up to August 1968, I

performed heat transfer and safety and systems analyses on advanced nuclear power systems, predominately liquid-metal breeder concepts.

In August 1968, I transferred to Westinghouse Tampa Steam Generator facility as a Fellow Engineer. Initially, I performed heat transfer analyses of Westinghouse steam generators but in August 1969, I transferred disciplines to stress analysis and design. The tasks generally were to lay out the geometry of a steam generator, size the parts, then draft a stress report in accordance with the requirements of the ASME Boiler and Pressure Vessel Code, Section III.

In 1972, I was promoted to Manager of Stress Analysis and supervised the efforts of 10 to 20 mechanical engineers performing analyses of all steam generator models.

In 1977, I became Manager of Engineering Mechanics, which embraced all of fluids, heat transfer, stress analysis, and testing required for Westinghouse steam generators. In 1979, I became Manager of Heat Exchanger Engineering and I supervised the design, drafting, analysis and testing of all Tampa heat

transfer products. The personnel involved numbered 50 to 60, depending upon factory loading.

In September 1982, I transferred to the Steam Turbine Generation Divisions as an Advisory Engineer.

In sum, I have over 14 years experience with respect to the design and fabrication of Westinghouse Steam Generators.

Q.4. What is the scope of your testimony?

A.4. My testimony addresses those portions of Contentions 42, 111, and 112 which assert that plant design for reducing amounts of occupational radiation exposure were not considered in the design of the Byron Station. Specifically, my testimony will explain the design features that have been incorporated in the Westinghouse steam generators installed at Byron Station to reduce occupational radiation exposure to workers.

Q.5. What design features have been incorporated in the Westinghouse steam generators installed at the Byron Station to reduce occupational radiation exposure?

A.5. The Byron Station steam generator design minimizes personnel radiation exposure by providing distance between the radiation source and workers, by reducing the time spent by workers in the radiation field, and by minimizing radiation source levels in the steam generators. Mechanical and metallurgical design features have been incorporated in the Byron Station steam generators to directly address these considerations. They are:

a. Elimination of "crud traps"

b. Material selection and control

c. Primary channel head external drain

d. Primary nozzle closure rings

e. Manway access openings

f. Secondary side instrument and access openings.

Q.6. Please describe how the elimination of crud traps in the Byron steam generators reduce occupational radiation exposure.

A.6. Two design features have been incorporated into the Byron steam generators to reduce occupational radiation exposure. These design features reduce worker exposure by eliminating or reducing areas where radioactive crud sources could accumulate, thereby minimizing the build-up of radioactive

products within the primary side of the Byron steam generators.

First, Byron utilizes a flush or slightly recessed weld of the tube to tubesheet seal. This weld is used in lieu of a protruding tube seal weld and results in a smoother face of the tubesheet. This eliminates an area where radioactive deposits can potentially accumulate.

Second, the entire primary channel head interior in the Byron steam generators, exclusive of the primary nozzle closure ring seals discussed in the answer to Q.10, are free of crevices, ledges or baffles which might act as traps for radioactive deposits from the reactor primary coolant or from external sources that might inadvertently be brought into the steam generators during inservice inspection.

Q.7. What materials or material controls have been incorporated in the design of the Byron steam generators to reduce occupational radiation exposure?

A.7. Austenitic stainless steel and Inconel 600 (a nickel-chronium-iron alloy) are the only materials utilized in the Byron steam generators that come in

contact with the primary coolant. Cobalt 59 (CO-59), a stable isotope, is always present as an impurity in these materials. CO-59 when exposed to neutron radiation present in the primary coolant will be changed to the radioactive isotope Cobalt 60 (CO-60). Redeposition of this radioactive CO-60 back to the wetted surfaces of the primary side of the steam generators increases the radiation levels.

To minimize such exposures, the amount of CO-59 contained in the stainless steel and Inconel used in the Byron steam generators is limited. At Byron, specifications for these materials limit the amount of cobalt to 0.2 percent in stainless steel and 0.1 percent in Inconel. By limiting the amount of CO-59 present in the stainless steel and Inconel used in the Byron steam generators to these levels, the potential occupational exposure from CO-60 can be minimized.

Q.8. Please describe how the primary channel head external drain has been designed to minimize occupational radiation exposure.

A.8. In preparing for primary side steam generator maintenance, all of the reactor coolant should be drained from the steam generator. Most of the

coolant is drained via the reactor coolant loop piping. A few gallons remain in each channel head because the loop piping nozzle is not the lowest point. In the Byron steam generators, a single central drain has been installed at the lowest level of the channel head bowl to facilitate the removal of the radioactive water remaining in both the hot and cold leg sides of the divider plate. Without this provision, maintenance workers would have to enter the radioactive channel head to mop-up or dry this trapped water. Removal of this source of potential radioactivity minimizes occupational exposure to workers by largely eliminating the need to perform this manual mop-up operation.

Q.9. Please describe how the Byron steam generators primary nozzle closure rings reduce occupational radiation exposure.

A.9. Each primary nozzle has a closure ring seal welded to the inside surface of the channel head bowl. These rings provide a seat for nozzle maintenance covers which help shield workers from dose rates due to radiation streaming from the reactor coolant piping.

Q.10. Please describe how the design of the manway access openings in the Byron steam generators reduce occupational radiation exposure.

A.10. The Byron steam generators each have four sixteen inch inside diameter manways to provide easy access to steam generator internals. Two of these manways provide access to the primary side of the steam generator and two provide access to the secondary side. These manways utilize standard bolted and gasketed covers and are designed with the minimal number of component parts to facilitate disassembly and reassembly operations for quick access. This feature minimizes worker exposure time in entering and exiting the manways.

A sixteen inch diameter was chosen as the optimal design for the Byron steam generators primary manways to minimize the external radiation shine area from the tubes and tubesheet. This diameter size also provides an adequate opening for unhindered movement of personnel and tools in and out of the steam generator in order to minimize exposure time.

The two secondary manways in the Byron steam generators have been located in the upper shell of

the steam generator well above the top of the tube bundle. This positioning provides additional shielding, from three levels of deck plates and primary water separators, to workers in the normal work area on the mid-deck plate. If work is required at a lower level, suitable built-in ladders and deck plate access openings have been provided to hasten worker ingress and egress. The presence of these built-in design features also minimizes worker exposure levels by eliminating the need to install and then remove temporary ladders and/or scaffolding inside the upper shell of the steam generators. The secondary manways also serve as additional points of ingress and egress to the steam generator, thereby reducing the amount of time a worker has to spend inside the generator to get to his work area.

Q.11. How do the design features of the secondary side instrument and access openings of the Byron steam generators reduce occupational radiation exposure?

A.11. The minimum necessary number of small instrument and access openings (handholes) have been provided for necessary inspection and maintenance operations of the Byron steam generators. These openings have been optimally placed to minimize radiation exposure on the lower portion of the steam generator shell.

The location of these openings has been selected to provide optimum visibility of steam generator internals for functional duties, such as sludge lancing above the tubeplate, which can then be performed by workers positioned at greater distances from the radiation source.

In the case where the wrapper (a thin cylinder just inside the outer steam generator shell) is penetrated by an instrument or access opening, a simple wrapper seal plug is used. All of these seal plugs have simple standard gasketed and bolted closures. This design facilitates disassembly and assembly operations for quick access to the steam generator interior.

Finally, all secondary side openings have simple standard gasketed and bolted closures which also minimize worker disassembly and reassembly time.

Q.12. Do you have an opinion concerning the design adequacy of the Byron Station steam generators from the standpoint of minimizing occupational radiation exposure.

A.12. Yes. I consider the steam generators in both units of Byron Station to embody the state-of-the-art

design features from the perspective of minimizing occupational radiation exposures.