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

SEP 26 1989

MEMORANDUM FOR: Ashok C. Thadani, Acting Chief
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THRU: Robert C. Jones, Section Chief
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FROM: Daniel Fieno, Senior Reactor Engineer (Nuclear)
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SUBJECT: MEETING WITH ABB ATOM INC. ON OSKARSHAMN 2 FUEL FAILURES

The staff met with representatives of ABB Atom Inc. (ABB) on July 20, 1989 in Rockville, Maryland to discuss the fuel failures at Oskarshamn 2 in late 1987 and early 1988. The meeting was held as an open meeting so that licensees and fuel vendors could be fully informed about the event and its causes. The enclosure presents a list of meeting attendees.

Oskarshamn 2 experienced stepwise increases in offgas and primary coolant activities during the period from December 1987 through mid February 1988. During the refueling outage in August 1988, four failed fuel rods in separate, fresh SVEA fuel assemblies were identified. Subsequent evaluations led to the conclusion that these rods failed because the fuel assemblies had operated under dryout conditions for an extended period of time (between 2 and 7 days) during normal power operating conditions. Each of the failed fuel rods was a corner rod located closest to the control rod center. The failed fuel rods also exhibited secondary failures caused by hydriding.

ABB performed an extensive evaluation of the cause of the failed fuel rods and concluded that the dryout failures were caused by two principal effects that increased the power in each of the failed fuel rods. To understand why the power in these fuel rods increased, a brief discussion of the fuel loading in an Oskarshamn 2 supercell will be given. A supercell is defined here as an array of four fuel assemblies having a cruciform shaped control rod located at the center of the array and in the water gaps between the fuel assemblies. Two of the four fuel assemblies were previously burned and located diagonally across from each other. The other two assemblies were fresh SVEA (watercross) fuel assemblies located in the other diagonal locations of the supercell. The previously burned fuel assemblies were contained in channel boxes that were on their second fuel assembly lifetime. These channel boxes exhibited bowing that increased the amount of water in the gap, adjacent to the control rod, of

the bypass water region of the supercell. In addition, the Oskarshamn 2 staff assumed that the previously burned fuel assemblies were moved closer to the center of the gap, as they would be in a core with all SVEA fuel assemblies. Thus, even without the channel bow, the gap was larger than assumed in plant process computer predictions of the critical power ratio (CPR). Therefore, the two effects, channel bow and geometrical positioning, combined to produce a wider gap than assumed in operations. The increased water gap led to increased neutron moderation and higher powers in the corner rods of the fresh SVEA fuel. The ABB analysis showed that the corner rods had operated below the safety limit CPR. The lower powers of the burned fuel assemblies did not result in dryout for its corner rods.

ABB concluded that the fuel failures were caused by dryout for the reasons stated above. ABB also concluded that its analytical methods were capable of predicting the dryout when the bypass water region gaps were properly taken into account. Finally, ABB concluded that the failures were not caused by any features of the SVEA watercross design and that other BWR fuel designs would have failed under similar circumstances.

A copy of the two documents on this Oskarshamn 2 failure event may be obtained from the Reactor Systems Branch.

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Enclosure:
As stated

cc: M. W. Hodges
L. Phillips
P. Wen

ENCLOSURE

Meeting with ABB on Oskarshamn 2 Fuel Failures

NRC

M. W. Hodges
Daniel Fiero

GE

Janice Charnley
Steve Congdon

ANF

Larry Nielsen
Scott State

Westinghouse

Bill Harris

Hitachi

Hideaki Utsuno

ABB

George Griffiths
Nils O. Jonsson
Johann Lindna
Per Sollbe
Harry Thornb g

S. M. Stoller

Istvan Frankl
Keith Sheppard (consultant)

Toshiba

Tetsuro Takeshita

Chuba E.P.C.

Yoshihiro Noguchi