TENNESSEE VALLEY AUTHORITY
CHATTANOOGA, TENNESSEE 37401
400 Chestnut Street Tower II

November 27, 1984

Director of Nuclear Reactor Regulation
Attention: Ms. E. Adensam, Chief
Licensing Branch No. 4
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Ms. Adensam:

In the Matter of the Application of	)	Docket Nos. 50-390
Tennessee Valley Authority	)	50-391

By letter dated May 25, 1984 from L. M. Mills to you, TVA provided information concerning the Permanent Hydrogen Mitigation System (PHMS) at Watts Bar Nuclear Plant. During a conference call on August 24, 1984, the NRC requested additional information as follows:

1. Additional details on the location of hydrogen igniters including the number and size of spray shields utilized.

2. Operator action for reset of the breaker following air return fan motor trip on overcurrent.

3. Clarification of the bases used by the CLASIX computer code to determine heat transfer coefficients when T_{wall} is greater than T_{sat}.

4. Additional details on the location of essential equipment required to function after a degraded core event.

Enclosed is the requested information.

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Director of Nuclear Reactor Regulation November 27, 1984

If you have any questions concerning this matter, please get in touch with D. P. Ormsby at FTS 858-2682.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

R. H. Shell

R. H. Shell
Nuclear Engineer

Sworn to and subscribed before me
this 27th day of Nov. 1984

Paulette H. White
Notary Public
My Commission Expires 8-24-88

Enclosure
cc: U.S. Nuclear Regulatory Commission (Enclosure)
Region II
Attn: Mr. James P. O'Reilly Administrator
101 Marietta Street, NW, Suite 2900
Atlanta, Georgia 30323

ENCLOSURE

WATTS BAR NUCLEAR PLANT UNITS 1 AND 2

TVA RESPONSES TO INFORMAL NRC REQUEST FOR ADDITIONAL INFORMATION ON PHMS

1. During a telephone conference call on August 24, 1984, NRC asked for a site inspection to verify the installation of hydrogen igniter spray shields. The survey of the Hydrogen Mitigation System hydrogen igniters for spray shields has been completed. The results are summarized below.

   All of the igniters located in the dead-ended compartments that were inspected (14 of 16) have small spray shields. Two igniters located in the Regenerative Heat Exchanger Room have small spray shields.

   All eight igniters located in the lower containment on elevation 726 were also equipped with small spray shields.

   Seven igniters were installed on elevation 754 at the entrance to the steam generator and pressurizer doghouses. No spray shields are installed on these units as they are attached flush to the ceiling. One igniter is located just inside each of the steam generator 1, 3, and 4 doghouses at elevation 754. Small spray shields are installed on these units. Two igniters located at elevation 795 inside the pressurizer doghouse are installed with small shields. The two igniters at elevation 753 under the missile shield have small spray shields.

   All igniters located in the upper plenum of the ice condenser have small spray shields installed.

   Four igniters are located on the polar crane wall at elevation 810. Four more are located on the sides of the steam generator doghuses at elevation 798. Two igniters are also located on the ice condenser end walls inside the crane wall opening. All ten of these igniters are equipped with large spray shields.

   Four igniters are located at elevation 869 above the spray headers. These are equipped with small spray shields.

2. During a telephone conference call with NRC on August 24, 1984, TVA was asked to address the potential for containment air return fan motor trips during hydrogen burns. NRC's concern was that the motors could trip on overcurrent. NRC questioned how the operator would know that a fan motor tripped on overcurrent and what was required to reset the breaker.

   The alarm that would alert the operator that either or both containment air return fan motors tripped on overcurrent is the motor trip out alarm for panel M-9. Any motor controlled from panel M-9, such as the containment air return fan motors, will cause this alarm when tripped on overcurrent. This alarm window is located inside the main horseshoe on panel M-3. The audible portion of the alarm is separate and distinct from the normal annunciator system audible alarm. An operator would then go to main control room panel M-9 to identify which motor tripped on overcurrent.

Overcurrent trips are reset at the breaker panel before the containment air return fan motors can be restarted. The breakers for these fans are located on the 480-volt shutdown boards. These electric boards are located on the same elevation as and just outside the main control room. The environment in the electric board rooms is controlled under positive pressure for habitability reasons.

TVA believes that a containment air return fan motor that trips on overcurrent will be identified and reset within ten minutes. This is based on the fact that an alarm window is located inside the main horseshoe, that the motor trip out alarm has a distinct and unique sound, and the proximity of the 480-volt shutdown boards to the main control room.

3. During the telephone conference call on August 24, 1984, the NRC requested additional clarification of the bases used by CLASIX to determine heat transfer coefficients when T_{wall} is greater than T_{sat}.

   The condensing heat transfer coefficient in TVA's version of CLASIX was based upon the stagnant portion of the Tagami correlation as discussed in section V.b.1 of the CLASIX users manual. The Tagami correlation (reference 1) is a widely accepted method for determining the condensing heat transfer coefficient for heat transfer to heat sinks with surface temperatures (T_{wall}) less than T_{sat}. A comparison of the heat transfer coefficient based upon the stagnant portion of the CLASIX Tagami correlation with those from the CONTEMPT4/MOD3 (reference 3) Uchida correlation demonstrate the conservatism of the CLASIX heat transfer coefficient during the condensing regime (a comparison previously provided to the NRC Staff via reference 4). However, due to a coding error, TVA's version of CLASIX determined the heat transfer coefficient utilizing the Tagami correlation for T_{wall} greater than T_{sat}. Correcting the error by incorporating a "Staff-accepted" natural convection heat transfer correlation into CLASIX should, by itself, increase the containment atmospheric temperature during periods when T_{wall} is greater than T_{sat}. However, as a result of NRC requests for information (see reference 6) on CLASIX heat removal, American Electric Power (AEP) funded Offshore Power Systems (OPS) to develop new heat transfer heat sink models which would:

   1. Incorporate the larger heat transfer coefficient of the Uchida correlation and base heat transfer on the temperature difference determined by (T_{sat} - T_{wall}) when T_{wall} is less than T_{sat}.

   2. Utilize a natural convection correlation when T_{wall} is greater than T_{sat} thus conforming to reference 2 and correcting the CLASIX heat sink heat transfer coding error.

   3. Contain a modified radiative heat transfer model to more correctly transfer radiative heat. This modification originated as a result of NRC question 6 on reference 5.

   4. Contain a modified condensation model to conform with the NRC criteria for condensate distribution to the sump and atmosphere.

Overcurrent trips are reset at the breaker panel before the containment air return fan motors can be restarted. The breakers for these fans are located on the 480-volt shutdown boards. These electric boards are located on the same elevation as and just outside the main control room. The environment in the electric board rooms is controlled under positive pressure for habitability reasons.

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2. Utilize a natural convection correlation when T_{wall} is greater than T_{sat} thus conforming to reference 2 and correcting the CLASIX heat sink heat transfer coding error.

3. Contain a modified radiative heat transfer model to more correctly transfer radiative heat. This modification originated as a result of NRC question 6 on reference 5.

4. Contain a modified condensation model to conform with the NRC criteria for condensate distribution to the sump and atmosphere.

The revised heat transfer models as described above were developed by OPS in consultation with the NRC Staff and were based upon reference 2, Branch Technical Position CSB 6-1, and the CONTEMPT program description document. The TVA CLASIX version would require precisely the same modifications to the heat transfer models as per the OPS model to conform to "Staff-accepted" methodology.

Two complete cases were analyzed by OPS to evaluate the effect of the "Staff-accepted" positions upon results from the original CLASIX code. The evaluation of the two cases, previously submitted to the NRC via reference 6, demonstrates that "Staff-accepted" modifications to the heat sink heat transfer models do not make any appreciable difference in peak calculated temperature ($1067^{o}F$ in the revised model versus $1038^{o}F$ in the original model). These differences in peak containment temperature amount to a change of less then 3 percent and are thus insignificant. During the period of hydrogen combustion, the baseline temperatures (the temperatures between the deflagration peaks) are essentially the same for both cases. The OPS study conclusively demonstrates that the original CLASIX version adequately predicts the containment response during a degraded core event. TVA, therefore, concludes the CLASIX analyses previously submitted to the Staff are still representative and the conclusions drawn from those analyses are still valid.

4. During the telephone conference call with the NRC on August 24, 1984, TVA was requested to provide a list of essential equipment required to function during and after a degraded core event. The requested information is provided below.

Equipment	Location	Comments
LT-3-148, 156, 164, 171, 172, 173, 174, 175	*Dead-ended compartment	
Air return fans	Dead-ended compartment	
H_2I-43-200, 210	See comments	All equipment is located in the annulus with sensing lines into containment. Installation of flame resistors will stop propagation of flame to equipment.
FCV-43-201, 202, 207, 208	Dead-ended compartment	
FSV-43-201, 202, 207, 208	Dead-ended compartment	
Ice condenser doors	Ice condenser	Lower inlet doors form boundary between lower compartment and ice condenser.

Equipment	Location	Comments
LT-63-180, 181, 182, 183	**Lower compartment	
FCV-63-172	See comments	Not required to operate; must only maintain closed position. All relays and controls for valve are outside containment. Hydrogen burn cannot cause valve to open.
LT-68-320, 335	Dead-ended compartment	
TE-68-1, 24, 43, 65	See comments	The only equipment inside containment are RTDs and cables inside conduit.
TE-68-18, 41, 60, 83	See comments	Same as TI-68-1, 24, 43, 65.
Hydrogen igniters	Lower, upper, upper plenum of ice condenser, dead-ended compartment	
Hydrogen recombiners	***Upper compartment	
Core exit	Lower compartment	The core exit thermocouples are thermocouples located entirely within the pressure vessel and are not exposed to H_2 burning.
TE-68-373 through 386	See comments	Same as TE-68-1, 24, 43, 65.
FSV-68-394, 395, 396, 397	Lower compartment	
Ice condenser seals	See comments	Seals form boundary between dead-ended and ice condenser compartments.
Penetrations X-003, 054, 079A, 079B	Dead-ended compartment	
Electrical penetrations	Dead-ended compartment, upper compartment	
Airlock, equipment hatch, and personnel airlock seals	Dead-ended compartment, upper compartment	

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Hydrogen recombiners	***Upper compartment	
Core exit	Lower compartment	The core exit thermocouples are thermocouples located entirely within the pressure vessel and are not exposed to H_2 burning.
TE-68-373 through 386	See comments	Same as TE-68-1, 24, 43, 65.
FSV-68-394, 395, 396, 397	Lower compartment	
Ice condenser seals	See comments	Seals form boundary between dead-ended and ice condenser compartments.
Penetrations X-003, 054, 079A, 079B	Dead-ended compartment	
Electrical penetrations	Dead-ended compartment, upper compartment	
Airlock, equipment hatch, and personnel airlock seals	Dead-ended compartment, upper compartment	

Equipment	Location	Comments
Containment isolation valves	Dead-ended compartment, upper compartment	
Containment sprays	Upper compartment	
LT-68-68, 66	Dead-ended compartment	

*Dead-ended compartment is defined as the volume below the ice condenser floor level that is bordered by the outside of the crane wall and the steel containment vessel.

**Lower compartment is defined as the volume inside the crane wall and generally below the divider deck with the exception of the steam generator and pressurizer doghouses.

***Upper compartment is defined as the volume above the divider deck with the exception of the ice condenser and doghouses. However, the upper compartment includes the refueling canal volume which forms a portion of the divider deck.

REFERENCES

1. T. Tagami, "Interim Report on Safety Assessment and Facilities Establishment Project in Japan for Period Ending June 1965 (No. 1)," unpublished work (February 1966).

2. A. J. Szukewiz, "Interim Staff Position on Environmental Qualification of Safety Related Electrical Equipment," NUREG 0588 (July 1981).

3. T. C. Cheng, L. Metcalfe, J. Hartman, W. Mings, and A. Crail, "CONTEMPT4/MOD3, A Multicompartment Containment System Analysis Program, "NUREG/CR-2558, December 1982.

4. Response to August 18, 1983, letter from E. Adensam to H. G. Parris, Request for Additional Information on Hydrogen Mitigation System, Sequoyah Nuclear Plant (L. M. Mills' letter to E. Adensam dated April 10, 1984).

5. Response to August 9, 1982, letter from Novak to H. G. Paris, Request for Additional Information on CLASIX Code, Sequoyah Nuclear Plant (D. S. Kammer letter to E. Adensam dated October 18, 1982).

6. Response to July 30, 1982, September 16, 1982, and August 10, 1983, letters from S. A. Varga to John E. Dolan of the Indiana and Michigan Electric Company, Request for Additional Information on Hydrogen Combustion and Control During Degraded Core Accidents for the D. C. Cook Nuclear Plant unit Nos. 1 and 2 (M. P. Alexich letter to Harold R. Denton dated March 30, 1984).

REFERENCES

1. T. Tagami, "Interim Report on Safety Assessment and Facilities Establishment Project in Japan for Period Ending June 1965 (No. 1)," unpublished work (February 1966).

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