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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION RELATING TO GENERIC LETTER 81-21 NATURAL CIRCULATION COOLDOWN TOLEDO EDISON COMPANY DAVIS-BESSE UNIT 1 DOCKET NO. 50-346

1.0 INTRODUCTION

On June 11, 1980, St. Lucie Unit 1 experienced a natural circulation cooldown event that resulted in the formation of a steam bubble in the upper head region of the reactor vessel. As a result, NRC Generic Letter 81-21, dated May 5, 1981, was sent to all licensees of pressurized water reactors (PWR) requiring them to assess the effectiveness of their facility's procedures and training programs to properly manage similar events. This assessment was to include:

(1) A demonstration (e.g., analysis and /or test) that controlled natural circulation cooldown from operating conditions to cold shutdown conditions conducted in accordance with their procedures, should not result in reactor vessel voiding,

(2) Verification that supplies of condensate grade auxiliary feedwater are sufficient to support their cooldown method, and

(3) A description of their training program and the revisions to their procedures.

Three Mile Island 1 (TMI-1), Rancho Seco, and Crystal River 3 are plants having virtually the same reactor design. In response to items 1 and 3 of the generic letter, the licensees for these plants applied the "TMI-1 Nuclear Generating Station Natural Circulation Cooldown Analysis Without Reactor Vessel Upper Head Void Formation," Topical Report 017, Revision 1, to identify improvements to plant-specific natural circulation cooling procedures. The staff found this application by these licensees to be acceptable. The licensee for Davis-Besse, Toledo Edison (TE), responded to Generic Letter 81-21 and to further requests from the NRC staff for additional information in References 1 through 6.

In response to another issue, item II.F.2 of NUREG-0737, TE provided a Babcock & Wilcox Company (B&W) analysis for a continuous reactor head vent (CVL) line as an alternative to providing reactor vessel level instrumentation (Ref. 7). The analysis included natural circulation cooldown rates with and without a head vent.

2.0 EVALUATION

TE reviewed TMI-1 Topical Report 017, Revision 1, and concluded that the reactor vessel configuration and cooling mechanisms are applicable to Davis-Besse Unit 1. Plant procedures were revised using a conservative, maximum 10°F/hr, reactor coolant system (RCS) cooldown rate instead of the 50°F/hr cooldown rate that the report justifies. The staff also notes that the CVL for the reactor head has been installed. This vent path via one steam generator will also enhance the reactor head cooling and therefore reduce the potential for void formation during tne cooldown.

We conclude that the implementation of the maximum 10°F/hr cooldown rate in the plant procedures will enable the operator to safely conduct a natural circulation cooldown without the formation of an upper head void.

In Reference 2, TE judged that the condensate storage tanks (CSTs) at their low alarm level have the capacity to support a 72-hour natural circulation cooldown. The technical specification (TS) requirement for the CSTs and the deaerator storage tank specifies a condensate water capacity (250,000 gallons) which will support a natural circulation cooldown for 34 hours. We find the TS capacity reasonable as it corresponds to the approximate maximum cooldown time for the Rancho Seco unit (32 hours), a plant of the same power rating as the Davis-Besse plant. We conclude that the condensate-grade auxiliary feedwater supply is more than ample for a natural circulation cooldown. In addition, if the water in the condensate storage tanks is depleted, a backup source of water may be obtained from the fire protection system or from the service water system, which has Lake Erie as its source.

Although Generic Letter 81-21 requested the licensee to demonstrate that a natural circulation cooldown could be performed without forming an upper head void, the staff also requested the licensee to demonstrate that the procedures provide guidance to the operator to recognize and respond to an upper head void, should one occur. The licensee described operator actions required by Emergency Procedure (EP) 1202.57 in the event of formation of a steam void in the reactor vessel head during natural circulation. Upon a rapid increase in pressurizer level, the procedure calls for stopping the cooldown and depressurization, and increasing the RCS pressure to allow for bubble collapse. In addition, the procedure requires that a subcooling margin of at least 50°F be maintained. The staff finds the above guidance acceptable. With the existing CVL, we expect a portion of any bubble to be displaced to the steam generator where it would be condensed by mixing with cooler incoming water from the hot leg.

In Reference 1, the licensee also provided a description of its training program dealing with voiding in the upper head of the reactor vessel. Tne operators have been trained on the use of procedures for natural circulation cooling, including recognition and mitigation of an upper head void. We conclude that the licensee's training program adequately addresses upper head voiding during a natural circulation cooldown.

3.0 CONCLUSION

Upper head voiding in itself does not present any safety concerns, provided the operator has been adequately trained and has access to procedures in order to recognize and react to the situation. Voiding in the upper head makes RCS pressure control more difficult and therefore, if the situation warrants, natural circulation cooldown should be performed without voiding. The licensee has added a CVL to vent the reactor head. This CVL will provide a path that will enhance the cooling of the reactor head and further minimize the potential for void formation. If a void forms, the CVL will also contribute to the reduction of the void during the repressurization process by providing a path for displacement to a steam generator, where the void will be condensed. The licensee's response to this issue is, therefore, acceptable.

4.0 REFERENCES

1. Letter from R. P. Crouse (TE) to D. C. Eisenhut(NRC), January 27, 1982.
2. Letter from R. P. Crouse (TE) to J. F. Stolz (NRC), August 2, 1983.
3. Letter from R. P. Crouse (TE) to J. F. Stolz (NRC), May 16, 1984.
4. Letter from R. P. Crouse (TE) to J. F. Stolz (NRC), June 29, 1984.
5. Letter from R. P. Crouse (TE) to J. F. Stolz (NRC), February 4, 1985.
6. Letter from D. C. Shelton (TE) to NRC, dated June 4, 1987.
7. Letter from R. P. Crouse (TE) to D. C. Eisenhut (NRC), April 15, 1983.