UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
SACRAMENTO MUNICIPAL UTILITY DISTRICT	)	Docket No. 50-312 (SP)
	)	
(Rancho Seco Nuclear Generating Station)	)	
	)	

NRC STAFF TESTIMONY OF PAUL E. NORIAN ON BUBBLE FORMATION
(Board Question CEC 1-10 and Board Question 24)

Q1. Please state your name and position with the NRC.

A. My name is Paul E. Norian. I am Section Leader of the Systems Analysis Section, Analysis Branch, Division of Systems Safety. I have held this position since 1975 and am responsible for supervising the review of reactor vendor transient and LOCA analysis methods, the improvement of NRC analysis methods used in related accident analyses, and the performance of staff audit calculations for transients and LOCAs. From June through December 1979, I was assigned to the Bulletins and Orders Task Force as a member of the Analysis Group. I served as Alternate Group Leader and coordinated the reviews of small break loss-of-coolant accidents (LOCA) and transient analyses submitted by the vendor owner's groups since the Three Mile Island accident.

Q2. Have you prepared a statement of professional qualifications?

A. Yes. A copy of the statement has been presented with other testimony in this proceeding.

Q3. Please state the purpose of this testimony.

A. The purpose of this testimony is to respond to Board Question CEC 1-10 and Board Question 24 which read as follows:

Board Question CEC 1-10 Is the physical configuration of the Rancho Seco primary system such as to permit unsafe accumulation of steam or other gas despite the modifications and actions of Sub-paragraphs A-E of Secion IV of the Commission's Order of May 7?

Board Question 24 Rancho Seco, being a Babcock and Wilcox designed reactor, is unable to avoid or control bubble formation in the primary system which may occur subsequent to a loss of feedwater accident, and therefore is unsafe and endangers the health and safety of Petitioners, constituent of Petitioners and the public.

Q4. Under what conditions can steam or other gas accumulate in the Rancho Seco primary system?

A. Steam would form in the primary system whenever the reactor coolant pressure is reduced below the saturation pressure for the fluid. This condition would result in flashing some of the fluid to steam. A significant quantity of steam could form in the primary system following a postulated loss of coolant accident (LOCA). Limited steam

formation is also expected following overcooling assuming a primary system scram and continued high feedwater flow. A small amount of steam may also form following a loss of feedwater or turbine trip transient with reactor scram.

Non-condensable gases could accumulate in the primary system following a postulated LOCA. The potential sources of such gases have been evaluated by Babcock and Wilcox and reported in a letter from J. J. Mattimoe (SMUD) to D. J. Ross (NRC), dated November 5, 1979. Typical sources include the nitrogen used to pressurize the core flooding tanks, hydrogen dissolved in the primary system and borated water storage tank fluid, hydrogen produced by the zirconium-water reaction, and helium used to pressurize the fuel rods.

Q5. Is this the phenomenon referred to as "bubble" formation?

A. Yes.

Q6. What are the safety implications of accumulation of steam or other gases in the primary system?

A. If a significant quantity of steam or non-condensable gas is postulated to exist in the primary system, natural circulation could be interrupted. Significant quantities of steam or non-condensibles are not expected in the primary system following postulated transients (loss of feedwater,

turbine trip, overcooling). The loss of natural circulation would result in the loss of the primary heat sink, and the system pressure could increase up to the PORV/safety valve actuation pressure if natural circulation is not re-established.

Q7. Where in the Rancho Seco primary system could steam or other gases accumulate?

A. Steam or other gases would tend to accumulate in the higher elevations of the primary system. These include the hot leg U bends (candy canes), the pressurizer, and the upper plenum.

Q8. Did a bubble form at TMI-2 during the March 21, 1979 accident?

A. A large amount of steam and non-condensable gas formed in the TMI-2 primary system following the accident.

Q9. What steps have been taken at Rancho Seco to reduce the probability of bubble formation and/or mitigate the effect of such formation?

A. Rancho Seco has been required to install a remotely operated high point venting system by January 1, 1981. In the unlikely event that significant quantities of steam or non-condensable gas should form in the primary system, this system will enable the operator to purge the system to aid in re-establishment of natural circulation.

Q10. In light of the steps taken at Rancho Seco, could formation of a bubble(s) in the primary system prevent adequate natural circulation.

A. If a bubble of sufficient size to interrupt natural circulation were to form in the primary system, the remotely operated high point venting system would allow purging of these gases. Thus, it is expected that natural circulation would be re-established under these conditions.

Q11. In lieu of the above steps taken at Rancho Seco, what means of adequate core cooling are available if natural circulation cannot be established.

A. If natural circulation cannot be established, the core can be adequately cooled in the feed and bleed mode of operation. This method is discussed in response to Board Question CEC 1-2.