December 19, 1983

Docket No. 50-206
LS05-83-12-023

Mr. K. Baskin, Vice President
Nuclear Engineering
Licensing and Safety Department
Southern California Edison Company
2244 Walnut Grove Avenue
Post Office Box 800
Rosemead, California 91770

Dear Mr. Baskin:

SUBJECT: NUREG-0737 ITEM II.D.1 - PERFORMANCE TESTING OF RELIEF AND SAFETY VALVES

Re: San Onofre Nuclear Generating Station, Unit No. 1

We have reviewed your submittals dated December 2, 1982 and July 13, 1983 regarding performance testing of relief and safety valves. Based on our review of your submittal we find that the information described in the enclosure is required to complete our review.

Please provide your response to the enclosure within 60 days of the receipt of this letter. We also suggest that we plan a meeting in Bethesda shortly after you provide your submittal. The purpose of this meeting would be to discuss your response. The NRC Project Manager will discuss this proposed meeting with your staff.

The reporting and/or recordkeeping requirements contained in this letter affect fewer than ten respondents; therefore, OMB clearance is not required under P.L. 96-511.

Sincerely,

Original signed by

Dennis M. Crutchfield, Chief
Operating Reactors Branch #5
Division of Licensing

Enclosure:
Request for Additional Information

cc w/enclosure:
See next page

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REQUEST FOR ADDITIONAL INFORMATION

TMI ACTION NUREG-0737 (II.D.1)

RELIEF AND SAFETY VALVE TESTING

FOR

SAN ONOFRE UNIT 1

Docket No. 50-206

November 1983

SAFETY EVALUATION QUESTIONS TMI ACTION NUREG-0737 II.D.1
FOR SAN ONOFRE 1

Questions Related to Selection of Transients and Valve Inlet Fluid Conditions

1. The submittal treats a steam flow discharge through the safety valves corresponding to a Locked Rotor event as the limiting overpressure transient. It does not discuss, though, whether single failures after the initiating event were considered that could lead to water flow through the valves. Provide such a discussion on single failures to show how the NUREG-0737 requirement that single failures be chosen so as maximize dynamic loads on the safety/relief valves has been met.

2. Overpressure transients cause the pressurizer sprays to activate which adds moisture to the steam volume. When the safety or relief valves open they would thus pass a steam-water mixture. Explain whether this effect was considered in selecting the transient that produces maximum loading on the system.

3. Results from the EPRI steam tests on the Crosby 3K6 safety valves indicate that blowdowns may exceed the 4% value from the valve specification, depending on the ring settings used (see related Question 6). If expected plant blowdowns do exceed 4%, these higher blowdowns could cause a rise in pressurizer water level such that water may reach the safety valve inlet line and result in a steam-water flow situation. Additionally, the pressure might be sufficiently decreased that adequate cooling might not be achieved for decay heat removal. Discuss these consequences of higher blowdowns if increased blowdowns are expected.

4. In discussions on valve inlet fluid conditions for low temperature overpressurization transients, the submittal identifies expected fluid conditions for a water discharge transient. According to the Westinghouse report on valve inlet fluid conditions, however, the fluid conditions for cold overpressurization events vary between steam

and water. To assure that the relief valves operate under all of these events, discuss the range of fluid conditions expected for the varying types of fluid discharge and identify the test data that demonstrate operability over the range of conditions. Verify that the fluid conditions were properly enveloped during the tests. Confirm that the high pressure steam tests demonstrate valve operability for the low pressure steam case for both opening and closing of the relief valve.

5. The Westinghouse valve inlet fluid conditions report stated that liquid discharge through both the safety and relief valves is predicted for an FSAR feedline break event. The Westinghouse report gave expected peak pressures and pressurization rates for some plants having a FSAR feedline break analysis. San Onofre 1 was not included in this list of plants having such a FSAR analysis. Nor does the submittal address the feedline break event. NUREG-0737, however, requires analysis of accidents and occurrences referenced in Regulatory Guide 1.70, Revision 2, and one of the accidents so required is the feedline break. Provide fluid pressure and pressurization rate, fluid temperature, valve flow rate, and the time duration for the feedline break event. Provide assurance that the valves passed water for a sufficient duration during the tests to cover this event and furnish an analysis which demonstrates safety of the safety/relief valve system for the feedline break event.

Questions Related to Operability of the Safety/Relief Valves

6. In the EPRI steam tests on a Crosby 3K6 Safety Valve, which was a test with a valve mounted on a short inlet pipe configuration, the valve opened and closed with 10-11% blowdown at the valve vendor's recommended ring settings. The rings were adjusted and blowdown was decreased to 4-5%, which meets the valve specification value of 4%. The submittal does not provide evidence, though, as to what the expected blowdown at the plant will be. It only states that "as installed" ring adjustments are expected to produce stable valve operation with 4-5% blowdown. Identify the "as installed" ring settings and determine the expected backpressure, since this too

affects the blowdown. Present a calculation for an expected blowdown value based on the plant ring settings and backpressure. If the blowdown falls outside the 4-5% range, evaluate valve performance for the expected blowdown value.

7. Thermal expansion of the pressurizer and inlet piping to the valve would be expected to induce loading on the inlet flange at the time the valve is required to lift. Evaluate the effect that this loading may have on valve operability.

8. Since the Crosby 3K26 valve was not specifically tested in the EPRI program, results from tests on the Crosby 3K6 and 6N8 valves were used for comparison. Flow rate data were only obtained from tests on the Crosby 3K6. Provide further information on how the data for the Crosby 3K6 valve was extrapolated to verify that the plant safety valve will pass its rated flow, particularly with the ring settings as adjusted at the plant.

Questions Related to Thermal Hydraulic Analysis of Inlet and Discharge Piping

9. The submittal indicates that a simultaneous opening of the two safety valves was assumed to produce the highest loading on the discharge piping system. The experience of EG&G Idaho indicates that the maximum forces are obtained when the sequence of opening is such that the initial pressure waves from the two valves opening reach the common header simultaneously. Provide additional justification that a simultaneous opening of the valves is adequate.

10. To calculate the time-dependent forcing functions acting on the piping a simplified graphical solution technique was applied. This technique is based on an ideal gas assumption. High pressure steam, though, is not an ideal gas. How well the technique applies to PWR conditions has not been demonstrated. The authors of the paper on this technique did compare calculations with test data for steam at 995 psia and obtained a good comparison. Provide further comparisons or verification to show the validity of this technique for PWR steam discharges.

11. Differences between the ideal conditions assumed in the thermal hydraulic analysis and the conditions likely to be found in downstream piping, i.e., condensed liquid, were not addressed in the submittal. A sweeping along of this condensed liquid could result in larger forces on the piping. Thus, provide justification for the assumption of ideal conditions. Additionally, a valve opening time of 20 msec was selected for the analysis, while pop times on the order of 10 msec occurred in tests on the 3K6 and 6N8 valves. Provide justification for this difference.

<u>Questions Related to Structural Analysis of Inlet and Discharge Piping</u>:

12. Some of the information needed to evaluate the structural analysis was not supplied in the submittal. So as to provide information on the stiffness values used to model the supports, the calculated values for loads on the supports, the time step used in forcing functions and similar information, provide a computer printout of input and output for the Locked Rotor saturated steam case analysis.

13. The submittal does not make clear whether flexibility at the connection locations to the pressurizer and discharge tanks was considered in the development of the structural model. Explain how this flexibility was treated in the piping model.

14. Section 3.1, pg C-8, of the submittal states that an opening of the PORV's does not require analysis because the PORV opening time is much

slower than that of the safety valves. Thus, the safety/relief valve system was not analyzed for a PORV opening, and the PORV piping was ignored in the structural analysis. The PORV piping is, however, constructed of smaller size piping and is arranged in a different configuration from that of the safety valve piping. Additionally, the PORV piping ties into a header that is common with the safety valve piping, creating a complex interactive piping system. Thus, it is not obvious on the basis of relative opening times alone that the PORV piping can be ignored. Provide a more thorough evaluation of the safety of the PORV piping.

15. In the structural analysis only a net "wave" force was applied to each bounded segment of straight pipe. Applying only a wave force on a pipe segment, however, ignores axial extension that is caused by opposing blowdown forces acting at the ends of the segment. This axial extension induces bending moments on pipe segments adjacent to the bounded segment in question. Explain how such axial extension was accounted for in the analysis.

16. The submittal does not discuss the method used for modeling the safety valves. Of particular concern is the portion of the valve that lies off the main axis of the piping. The flexibility of this part of the valve structure should be accounted for in the model if its natural frequencies could potentially be excited by piping or support motion. Describe the methods used to represent the valves in the piping model.

17. Based on diagrams of the structural model that were provided in the submittal, the spacing between lumped masses appears to be far enough that the higher frequency response of the piping system will be precluded from the solution. Thus, though the solution time step (0.0001 s) is quite fine and would allow for contributions from the higher modes, the spacing between lumped masses would seem to eliminate these contributions. Explain how the nodal spacing in the piping model was established.

18. The submittal does not discuss the results of the stress analysis on the piping upstream of the safety valves. Identify the governing

Code, the applicable criteria from the Code, and the load combinations used in the analysis of this portion of the piping. Also, provide an evaluation of the stresses relative to the Code requirements.

19. For piping downstream of the safety valves, the operating basis earthquake (OBE) loading was not combined with the dynamic loads from the safety or relief valve discharge. The rationale for not combining these loads was that the downstream piping is nonsafety related and that the probability of a seismic event coinciding with a safety valve actuation is extremely low. According to the requirements of the governing ANSI B31.1 Code, however, the discharge transient loads and the earthquake loads should both be included in the stress calculation equation (Equation 12). Thus, though a simultaneous occurrence of these loads is not highly probable, they should be combined to meet governing criteria. In addition, a load combination in which safe shutdown earthquake (SSE) loads are combined with safety/relief valve fluid transient loads (as a faulted condition in Westinghouse report WCAP-10105) for the upstream piping should be considered. It is not clear whether the seismic loads mentioned in the submittal pertain to a safe shutdown earthquake. Present an assessment of the downstream piping whereby OBE loads are included. Verify that the load combinations on the upstream piping include a case in which SSE loads are combined with safety/relief valve loads. Identify the allowable stress limits used for this case.

20. In the stress analysis of the piping system, only the stresses due to primary loads were evaluated. The secondary stresses, particularly due to thermal expansion, should also be considered in accordance with Equations 13 and 14 of the ANSI B31.1 Code. Provide an evaluation of these secondary stresses.