DEMONSTRATION OF CONTAINMENT VACUUM/OVERPRESSURE RELIEF VALVE OPERABILITY FOR THE DIABLO CANYON POWER PLANT UNITS 1 AND 2

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DIABLO CANYON POWER PLANT UNITS 1 AND 2 DOCKET NUMBERS 50-275 AND 50-323 DEMONSTRATION OF CONTAINMENT VACUUM/OVERPRESSURE RELIEF VALVE OPERABILITY

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SUMMARY

The Diablo Canyon containment vacuum/overpressure relief valve qualification program has been reviewed by the NRR and I&E Support Branch of EG&G Idaho, Inc., who provide technical assistance to the NRR Division of PWR Licensing-A, Engineering Branch. Demonstration of operability of the containment vacuum/overpressure relief valves, particularly the ability of these valves to close during a design basis accident, is necessary to assure containment isolation. This demonstration of operability is required by Standard Review Plan (SRP) 6.2.4, Branch Technical Position (BTP) CSB 6-0, and SRP 3.10 for containment purge and vent valves which are not sealed closed during operational conditions 1, 2, 3 and 4.

Information contained in the Diablo Canyon Final Safety Analysis Report (FSAR), valve stress analyses, and supplemental material formed the basis for this evaluation. The methodology used by the applicant to evaluate the 12-inch valves was similar to that previously used for the 48-inch containment purge supply and vent lines. This methodology was evaluated and accepted by the NRC staff in SSER 9, SSER 14, and SSER 31.

Operability of the FCV-662, 663 and 664 valves was based upon fluid dynamic analyses, maintenance and surveillance tests, and environmental analyses, which simulated the as-built configuration and worst case load combinations. Stress analyses were performed to consider the effects of a LOCA event. In summary, we find that the information submitted has demonstrated the ability of the 12-inch Fisher butterfly values to close against the buildup of containment pressure in the event of a LOCA/DBA with the condition that the 12-inch values be limited to a 50 degree opening angle for the life of the plant.

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1. REQUIREMENT

Demonstration of operability of the containment vacuum/overpressure relief valves, particularly the ability of these valves to close during a design basis accident, is necessary to assure containment isolation. This demonstration of operability is required by Standard Review Plan (SRP) 6.2.4, Branch Technical Position (BTP) CSB 6-4, and SRP 3.10 for containment purge and vent valves which are not sealed closed during operational conditions 1, 2, 3, and 4 (power operation, startup, hot standby, and hot shutdown, respectively). As reported in SSER 9, 14, and 31, (Ref. 2, 3, and 4 respectively) the MRC staff reviewed and accepted the licensee's methodology for demonstrating operability of the 48-inch containment purge valves. Briefly, valve operability was based on a combination of analyses (time history models for LOCA events, valve disc rotation and component stresses) and tests (actuator spring force versus disc opening angle and valve stroke times). The NRC staff found the results of the radiological consequence analyses to be acceptable with one limiting condition. Until the licensee provided evidence to demonstrate operability of the 12-inch vacuum/overpressure relief valves, an interim restriction would be imposed to limit the disc opening to 50 degrees.

In a submittal dated August 8, 1986 the licensee demonstrated that the subject valves are qualified for their intended service with the condition that the valves be blocked to a maximum 50 degree opening. This valve configuration is consistent with the NRC interim restriction. Diablo Canyon Technical Specification 3.6.1.7 has been revised to limit the maximum valve opening angle to 50 degrees for the life of the plant. The balance of this report is a discussion and evaluation of the licensee's August 8, 1986 submittal¹ to qualify the 12-inch vacuum/overpressure relief valves.

structural parts of the valve (e.g., valve disc shaft and key). The results of the analysis met the 5-second limit and allowable stress criteria (Ref. 1, Page 4).

- The disc shaft and key stresses were conservatively calculated by assuming that all of the impact kinetic energy is transferred as strain energy in the angular deflection of the shaft (Ref. 1, Page 3).
- 7. The spring force of the actuator cylinder (including nonlinear and friction effects) as a function of valve disc opening angle was obtained from in situ tests. The test results were used as input to the dynamic analysis (Ref. 1, Page 3).
- 8. The dynamic equation of motion was derived by coupling the flow and disc dynamics to the aerodynamic torque expression provided by the valve manufacturer. The aerodynamic effect acts in a direction to close the valve (Ref. 1, Attachment 1, Page 1).
- 9. In SSER 9 (Ref. 2) the NRC determined that the dose consequences associated with the 48-inch purge valver meet the dose guidelines of 10 CFR 100. The 12-inch relief valves are much smaller than the 48-inch purge valves and they are blocked to a maximum 50 degree opening. Consequently, the dose consequences associated with use of the 12-inch relief valves provide an even greater margin of acceptability (Ref. 1, Page 4).
- No credit is taken for downstream backpressure on the design of the valves.
- No credit is taken for the reduced pressure, lower shaft stresses, and reduced steam and air losses due to the valves being positioned in series.

4. EVALUATION

We find that the information submitted by the licensee has demonstrated the ability of the 12-inch vacuum/overpressure relief valves FCV-662, FCV-663, and FCV-664 to close against the buildup of containment pressure due to a LOCA/DBA. The following considerations form the basis for our findings.

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- Review of the Diablo Canyon FSAR confirmed that the licensee considered the worst case accident conditions for demonstrating valve operability. The load combinations and assumptions are equal to or greater than the predicted accident.
- 2. The fluid dynamic equations used by the licensee to calculate dynamic torque developed by the valve are consistent with established industry practices (Ref. 1, Attachment 1). The valve sizing factors and aerodynamic torque expression were obtained from the valve vendor. The vendor data was based on the results of prototype tests performed years ago. The methodology has been reviewed and accepted for use by the industry.
- The licensee has not taken credit for factors that would reduce the incident pressure and differential pressure across the valve.
- 4. The subject relief valves are normally closed and are permanently blocked to prevent opening beyond 50 degrees. The administrative controls which govern valve use are consistent with Technical Specifications 3.6.1.7 and 3.6.3 (Ref. 1, Page 2).
- 5. The redundant inside and outside containment relief values are on separate safety trains and use a spring return actuator which closes on loss of air. The values also close on loss of electrical power. This degree of redundancy indicates that single failures of the hardware can be tolerated regardless of the cause of failure (Ref. 1, Page 2).