



**Idaho
National
Engineering
Laboratory**

*Managed
by the U.S.
Department
of Energy*



*Work performed under
DOE Contract
No. DE-AC07-76ID01570*

EGG-NTA-7567
March 1987

INFORMAL REPORT

DEMONSTRATION OF CONTAINMENT PURGE AND VENT
VALVE OPERABILITY FOR THE SHEARON HARRIS
NUCLEAR POWER PLANT UNIT 1

C. Kido

Prepared for the
U.S. NUCLEAR REGULATORY COMMISSION

8703310117 XA
19pp

DISCLAIMER

This book was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights. References herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

SHEARON HARRIS NUCLEAR POWER PLANT UNIT 1
DOCKET NUMBER 50-400
DEMONSTRATION OF CONTAINMENT PURGE AND VENT VALVE OPERABILITY

C. Kido

Published March 1987

NRR AND I&E SUPPORT BRANCH
NRC TECHNICAL ASSISTANCE DIVISION
EG&G Idaho, Inc.
Idaho Falls, Idaho 83415

Prepared for the
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555
Under DOE Contract No. DE-AC07-76ID01570
FIN No. A6415

ABSTRACT

The containment purge and vent valve qualification program for the Shearon Harris Nuclear Power Plant Unit 1 has been reviewed by the NRR and I&E Support Branch of EG&G Idaho, Inc. The review indicates that the licensee has demonstrated the ability of the 8-inch BIF butterfly valves 2CP-B1SA-1, 2CP-B2SB-1, 2CP-B5SA-1, and 2CP-B6SB-1 to close against the buildup of containment pressure in the event of a LOCA/DBA.

FOREWORD

This report is supplied as part of the "Equipment Qualification Case Reviews" project that is being conducted for the U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Division of PWR Licensing-A, Engineering Branch by EG&G Idaho, Inc., NRR Technical Assistance Division, NRR and I&E Support Branch.

The U.S. Nuclear Regulatory Commission funded this work under the authorization, B&R 20-19-40-41-2, FIN Number A6415.

SUMMARY

The Shearon Harris containment purge and vent valve qualification program has been reviewed by the NRR and I&E Support Branch of EG&G Idaho, Inc., who provides technical assistance to the NRR Division of PWR Licensing-A, Engineering Branch. Demonstration of operability of the containment purge and vent 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 Plant (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.

Information contained in the Shearon Harris Final Safety Analysis Report (FSAR), purge valve flow test report, stress analyses, and supplemental material formed the basis for this evaluation. The applicant's demonstration of operability of the 2CP-B1SA-1, 2CP-B2SB-1, 2CP-B5SA-1, and 2CP-B6SB-1 valves was based upon fluid dynamic analyses which simulated the as-built configuration and worst case load combinations. Stress analyses were performed to consider the effects of a combined LOCA and seismic event. In summary, we find that the information submitted by the applicant has demonstrated the ability of the 8-inch BIF manufactured butterfly valves to close against the buildup of containment pressure in the event of a LOCA/DBA.

CONTENTS

ABSTRACT	ii
FOREWORD	ii
SUMMARY	iii
1. REQUIREMENT	1
2. DESCRIPTION OF NORMAL CONTAINMENT PURGE (NCP) VALVES	2
3. DEMONSTRATION OF OPERABILITY	3
4. EVALUATION	7
5. CONCLUSIONS	11
6. REFERENCES	12

SHEARON HARRIS NUCLEAR POWER PLANT UNIT 1

DOCKET NUMBER 50-400

DEMONSTRATION OF CONTAINMENT PURGE AND VENT VALVE OPERABILITY

1. REQUIREMENT

Demonstration of operability of the containment purge and vent 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 Plant (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).

2. DESCRIPTION OF NORMAL CONTAINMENT PURGE (NCP) VALVES

The following valves are identified in the licensee submittals, FSAR Sections 6.2.4.2.7 and 9.4.7.2.2, and FSAR Table 6.2.4-1, (Amendment 29) as being part of the Normal Containment Purge (NCP) system.

<u>Valve Tag No.</u>	<u>Size (Inch)</u>	<u>Use</u>	<u>Location</u>
2CP-B1SA-1	8	Normal Containment Purge Makeup	Inboard containment
2CP-B2SB-1	8	Normal Containment Purge Makeup	Outboard containment
2CP-B5SA-1	8	Normal Containment Purge Exhaust	Inboard containment
2CP-B6SB-1	8	Normal Containment Purge Exhaust	Outboard containment

The 8-inch butterfly valves are manufactured by BIF (Model 0657, 45 psig pressure rating) and driven by a Bettis air/spring actuator (Model N721C-SR60-12). The four Normal Containment Purge valves are maintained open during normal plant operation conditions 1, 2, 3, and 4 (power operation, startup, hot standby, and hot shutdown, respectively).

The 42-inch Containment Pre-Entry Purge System (CPP) valves (2CP-B3SA-1, 2CP-B5SB-1, 2CP-B7SA-1 and 2CP-B8SB-1) are normally closed during operating conditions 1, 2, 3, and 4 and are opened only during refueling. Consequently, they are not included in the scope of this review.

3. DEMONSTRATION OF OPERABILITY

The following documents were submitted by the Carolina Power and Light Company to demonstrate dependability of containment isolation regarding operability of the Shearon Harris Normal Containment Purge (NCP) valves.

1. A. B. Cutter, Vice President, Nuclear Engineering and Licensing, Carolina Power and Light Company, letter to H. R. Denton, Director, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, Shearon Harris Nuclear Power Plant Unit 1--Containment Purge and Vent Valve Operability Review, NLS-86-070, April 1, 1986.
2. Qualification of Containment Purge Butterfly Valves Under LOCA Condition--Dynamic Torque Calculation of Butterfly Valve, BIF Report DT-67926 Revision A, November 22, 1983.
3. Hydrodynamic and Headloss Test of 12-inch 150 lb Butterfly Valve with Directly Connected Short Radius Elbow Upstream, BIF Test Report TR-0650-43, February 24, 1982.
4. Dynamic Torque and Headloss Tests of Cast Iron Streamline Disc Versus Fabricated Flat Plate Disc, BIF Test Report, dated May 13, 1975.
5. Seismic Analysis of Butterfly Valves for Ebasco/Carolina Power and Light, BIF Seismic Analysis Report N-67926 Revision A, November 3, 1983.
6. Y. Jagannath, Carolina Power and Light Company, Purge and Vent Valves Operability Review Form, December 11, 1984.

The operability demonstration, presented by the applicant in References 1 through 6, is based on the following considerations.

1. The accident which produces the peak containment atmosphere pressure is a double-ended hot leg guillotine (DEHLG) with minimum safety injection. FSAR Figure 6.2.1-2 and Table 6.2.1-2 show that the maximum pressure is 36.7 psig. The containment design pressure is 45 psig.
2. The worst case configuration (Reference 2, page 13) is a vertical valve shaft position (perpendicular to the horizontal plane of the 90° elbow) with the flat side of the disc downstream and turning clockwise to close (upstream flow passes counter clockwise through the elbow before impacting the disc). Data from flow tests of 12-inch valves were used to identify the worst case configuration. These flow tests used water and determined that the maximum dynamic torque coefficient corresponds to an 80° valve opening (Reference 2, page 41).
3. Standard fluid hydraulic equations were used to calculate the maximum dynamic torque developed by the valve (1731 in lb). This is a closing torque imposed by the valve on the actuator. The torque capacity of the actuator is 2319 in lb (Reference 1, Response 1).
4. Instead of using the peak containment pressure of 45 psig, the applicant took credit for the time dependent buildup in containment pressure. The valve is qualified to the containment atmosphere conditions at 4.75 seconds: 19.65 psig (34.35 psia), 220°F, and .1117 lb/ft³ density (Reference 2, Table 2).
5. The 4.75 seconds elapsed time is based on the sum of .75 seconds when the pressure reaches 4.5 psig and the containment isolation signal is energized, .5 seconds delay before the signal reaches the solenoid valve of the operator to initiate valve closure, and a maximum period of 3.5 seconds to close the valve from the fully open position. The valve is required by the Shearon Harris

Technical Specifications to close in less than 5 seconds
(Reference 1, Response 3).

6. The 8 inch NCP valves are driven by Bettis air/spring return operators. Accumulators and hand wheels are not used
(Reference 2, page 40).
7. No credit was taken for downstream back pressure on the design of the valves. The downstream pressure was assumed to be 14.7 psia in order to obtain the maximum dynamic torque effect on the valve
(Reference 2, page 41).
8. Containment back pressure due to a LOCA does not affect the time required to vent the valve actuators. Each side of the cylinder piston of the actuator is vented to the same local ambient conditions; no pressure differential will exist across the piston as a result of the surrounding containment pressure rise
(Reference 2, page 40).
9. No credit is taken for reduced pressure loads due to the inside and outside containment valves that are positioned in series. The applicant considered closure of the inside containment valve against the containment pressure to be the worst case
(Reference 2, page 40).
10. A static seismic analysis was performed which considered stresses due to seismic load (3 g horizontal and 4 g vertical), dead weight, design pressure (45 psig) and operator torque (1731 in lb). The analysis is based on all loads acting simultaneously, and the magnitudes of the resulting stresses are added together to give the worst possible loading situation. The stresses were compared to ASME Code criteria and found to be acceptable (Reference 5, pages 1, 2 and 4).
11. Vendor shop tests (Reference 1, Attachment C) were performed on the 8-inch butterfly valves. Hydrostatic leak tests were

completed on the valve body (450 psig for 10 minutes) and each side of the valve disc (150 psig for 5 minutes). The actuator cylinder pressure was 70 psig. The valve was stroked and timed for 3 cycles. The opening time was 2 seconds. The closing times were 1.0 second (for NCP makeup valves B1 and B2) and 1.5 seconds (for NCP exhaust valves B5 and B6).

12. A debris screen (FSAR Section 9.4.7.3) is provided on the NCP makeup line inside containment, approximately 2 pipe diameters from the inboard isolation valve 2CP-B1SA-1. The screen is ASTM GR A580 Type 304 stainless steel (.1205 inch diameter) with a .75-to-1-inch square mesh and is designed for a LOCA pressure differential of 45 psig. The debris screen will reduce the flow velocity as it approaches 2CP-B1SA-1. For added conservatism the applicant disregarded this reduction in velocity. Provision for a debris screen on the NCP exhaust line is not needed because the isolation valve 2CP-B5SA-1 is located in a closed duct work system that is classified as Seismic Category I.
13. In accordance with the applicant's planned maintenance/surveillance programs, elastomeric parts (packing, gaskets, seals, etc.) for the valves will be replaced during periodic maintenance (Reference 6, page 6).

4. EVALUATION

We found that the information submitted by the applicant has demonstrated the ability of the 8-inch Normal Containment Purge (NCP) valves 2CP-B1SA-1, 2CP-B2SB-1, 2CP-B5SA-1, and 2CP-B6SB-1 to close against the buildup of containment pressure due to a LOCA/DBA. The following considerations form the basis for our findings.

1. The piping isometric drawings (Reference 6, Attachments B and C) show that there are 42-inch containment wall penetrations for the NCP exhaust and makeup lines. There is a 42" x 8" x 42" piping tee on both sides of each containment penetration. The run sections of the tees go to 42-inch CPP isolation valves which are closed during normal operation. Containment atmosphere flow is bypassed through the 8-inch NCP valves and 8" branch connection of the tees. NCP makeup valve 2CP-B1SA-1 and its valve stem are mounted in the same horizontal plane as the tee. There is a debris screen located approximately 16 inches away from the valve. NCP purge valve 2CP-B5SA-1 is located inside a closed duct work and is mounted in the vertical (down) position with the valve stem horizontal. There are two 45° elbows upstream of this isolation valve.

The applicant assumed the worst case configuration (see Section 3 items 2, 7, 9, and 12) in order to qualify the isolation valves. This configuration more severely challenges the operability of the valves than does the as-built configuration described above. For example, the applicant evaluated nonuniform flow effects for a short radius 90° elbow directly connected upstream of the valve. By comparison, the as-built configuration shows that the flow direction is parallel to valve 2CP-B5SA-1, passing through two offset 45° elbows. The applicant determined that the worst case configuration results in a 30% increase in maximum dynamic torque coefficient compared to the results that were obtained for a straight pipe (Reference 2, page 13).

2. The applicant used data from flow tests performed on BIF 12-inch Class 150 butterfly valves (References 3 and 4) in order to determine the maximum dynamic torque coefficient versus valve opening angle. The applicant did not describe the basis for similarity with the 8-inch valves, but indicated that the designs were the same configuration. After reviewing the submittal and test reports, the staff finds that qualification by similarity is justified.
3. The seismic analysis was based on all loads (3 g horizontal, 4 g vertical, deadweight, 45 psig, and 1731 in lb) acting simultaneously. All stresses were compared to ASME Code criteria and found to be acceptable. The smallest margin of allowable stress was calculated for the operator attachment bolts (18152 psi principal stress compared to 25000 psi allowable) (Reference 5, page 11).
4. The applicant provided a graphical comparison of the valve dynamic torque versus the closing (spring) torque capacity of the operator at various opening angles (Reference 1, Attachment B). The operator torque capability (minimum 2319 in lb at 30°) is always greater than the valve dynamic torque (maximum 1731 in lb at 80°). The applicant pointed out that the dynamic torque from the containment effluent flow is a closing torque and helps, rather than resists, the operator's spring return action to close the valve. Without the dynamic torque effect, the maximum valve closure time was 1.5 seconds as demonstrated by the BIF shop tests. Allowing 1.25 seconds for instrumentation time, the total elapsed time of 2.75 seconds meets the required 5 second limit.
5. There were two minor concerns regarding the applicant's method of qualification. The first concern was that the applicant considered the valve to be completely closed at 4.75 elapsed time and containment pressure of 34.35 psia. The Technical Specifications specify a maximum isolation time of 5 seconds, at

which time the pressure can rise to 35.06 psia (FSAR Figure 6.2.1-2). The staff asked the applicant to confirm that the valve closure time and containment isolation time are consistent and that any adjustment for containment pressure will not adversely affect the valve's ability to perform its function.

The applicant provided a response in a letter dated April 1, 1986 (Reference 1, Response 3). The 4.75 second time was estimated by the vendor prior to shop testing the valves. The 4.75 second time was carried through the analysis to determine the dynamic torque coefficient due to the containment atmosphere conditions following a LOCA/DBA. The 5 second time was used as input for the containment effluent release in the analysis of the DBA. The results of the shop tests indicate that the total containment isolation time will be approximately 3 seconds (1.25 to 1.5 seconds for instrumentation time delay plus 1.5 seconds for valve closure). Since the containment pressure at 3 seconds is 28.95 psia, the effect on valve operability will be small.

In order to be consistent with the containment pressure/time profile used in the vendor analyses, the applicant made a commitment to revise the Technical Specification to indicate a maximum isolation time of 4.75 seconds. The applicant's response is acceptable.

6. The second concern was that the flow tests were performed using water instead of air and that the torque wrench readings have an error band of $\pm 10\%$ (Reference 3, pages 3 and 6). The staff asked the applicant to justify the qualification methodology.

The applicant stated (Reference 1, Response 7) that the flow coefficient and dynamic torque coefficient are normally obtained from water tests and used for water, steam, and gas applications. If the tests had been performed with air, the error would be greater than 10% because of the velocity required to create significant dynamic torque for the torque wrench

readings. A 10% error in torque would create a 10% increase in stress. The stress report shows that the smallest margin of allowable stress is 27% (1 - 18132 psi/25000 psi). The applicant's response is acceptable.

7. On the basis of the valve tests and analyses plus additional clarification provided in the FSAR and References 1 through 6, we find that the operability criteria of Branch Technical Position BTP CSB 6-4 and Standard Review Procedures SRP 3.10 and 6.2.4 are satisfied for the Normal Containment Purge (NCP) valves 2CP-B1SA-1, 2CP-B2SB-1, 2CP-B5SA-1, and 2CP-B6SB-1.

5. CONCLUSIONS

We have completed our review of information concerning the ability of Normal Containment Purge (NCP) valves 2CP-B1SA-1, 2CP-B2SB-1, 2CP-B5SA-1, and 2CP-B6SB-1 to provide containment isolation for the Shearon Harris Nuclear Power Plant Unit 1. We find that the information submitted has demonstrated the ability of these valves to close against the buildup of containment pressure in the event of a LOCA/DBA.

6. REFERENCES

1. A. B. Cutter, Vice President, Nuclear Engineering and Licensing, Carolina Power and Light Company, letter to H. R. Denton, Director, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, Shearon Harris Nuclear Power Plant Unit 1--Containment Purge and Vent Valve Operability Review, NLS-86-070, April 1, 1986.
2. Qualification of Containment Purge Butterfly Valves Under LOCA Condition--Dynamic Torque Calculation of Butterfly Valve, BIF Report DT-67926 Revision A, November 22, 1983.
3. Hydrodynamic and Headloss Test of 12-inch 150 lb Butterfly Valve with Directly Connected Short Radius Elbow Upstream, BIF Test Report TR-0650-43, February 24, 1982.
4. Dynamic Torque and Headloss Tests of Cast Iron Streamline Disc Versus Fabricated Flat Plate Disc, BIF Test Report, dated May 13, 1975.
5. Seismic Analysis of Butterfly Valves for Ebasco/Carolina Power and Light, BIF Seismic Analysis Report N-67926 Revision A, November 3, 1983.
6. Y. Jagannath, Carolina Power and Light Company, Purge and Vent Valves Operability Review Form, December 11, 1984.

NRC FORM 335 (2-84) NRCM 1102, 3201, 3202 BIBLIOGRAPHIC DATA SHEET SEE INSTRUCTIONS ON THE REVERSE		U.S. NUCLEAR REGULATORY COMMISSION 1 REPORT NUMBER (Assigned by TIDC, add Vol. No., if any) EGG-NTA-7567					
2 TITLE AND SUBTITLE DEMONSTRATION OF CONTAINMENT PURGE AND VENT VALVE OPERABILITY FOR THE SHEARON HARRIS NUCLEAR POWER PLANT, UNIT 1		3 LEAVE BLANK					
5 AUTHOR(S) C. Kido		4 DATE REPORT COMPLETED <table border="1"> <tr> <td>MONTH</td> <td>YEAR</td> </tr> <tr> <td>March</td> <td>1987</td> </tr> </table>		MONTH	YEAR	March	1987
MONTH	YEAR						
March	1987						
7 PERFORMING ORGANIZATION NAME AND MAILING ADDRESS (Include Zip Code) NRR & I&E EG&G Idaho, Inc. P. O. Box 1625 Idaho Falls, ID 83415		6 DATE REPORT ISSUED <table border="1"> <tr> <td>MONTH</td> <td>YEAR</td> </tr> <tr> <td>March</td> <td>1987</td> </tr> </table>		MONTH	YEAR	March	1987
MONTH	YEAR						
March	1987						
10 SPONSORING ORGANIZATION NAME AND MAILING ADDRESS (Include Zip Code) Division of PWR Licensing - A Office of Nuclear Reactor Regulation U. S. Nuclear Regulatory Commission Washington, DC 20555		8 PROJECT/TASK/WORK UNIT NUMBER 9 FIN OR GRANT NUMBER A6415, Project VII					
11a TYPE OF REPORT Technical Evaluation Report b PERIOD COVERED (Inclusive dates)							
12 SUPPLEMENTARY NOTES							
13 ABSTRACT (200 words or less) The containment purge and vent valve qualification program for the Shearon Harris Nuclear Power Plant, Unit 1 has been reviewed by the NRR and I&E Support Unit of EG&G Idaho, Inc. The review indicates that the applicant has demonstrated the ability of the 8-inch BIF butterfly valves 2CP-B1SA-1, 2CP-B2SB-1, 2CP-B5SA-1, and 2CP-B6SB-1 to close against the buildup of containment pressure in the event of a LOCA/DBA.							
14 DOCUMENT ANALYSIS & KEYWORDS DESCRIPTORS b IDENTIFIERS/OPEN ENDED TERMS		15 AVAILABILITY STATEMENT 16 SECURITY CLASSIFICATION (This page) (This report) 17 NUMBER OF PAGES 18 PRICE					