SHOREHAM NUCLEAR POWER STATION UNIT 1

DYNAMIC QUALIFICATION

COMPONENT NAME: Recirculation Discharge Gate Valve

MPL OR EDL ITEM NO.: B31-F031

MPL REFERENCE: 238X114BD Rev. 23

EQUIPMENT CLASSIFICATION: ☒ ACTIVE ☐ PASSIVE

THE SEISMIC QUALIFICATION REPORT(S) IDENTIFIED HEREIN HAVE BEEN EVALUATED AND REQUALIFIED WHERE NECESSARY TO SHOW THAT THE ABOVE-MENTIONED COMPONENT IS CAPABLE OF MEETING THE NUCLEAR REGULATORY COMMISSION SEISMIC QUALIFICATION REVIEW TEAM (SQRT) REQUIREMENTS.

PREPARED BY: Hung Le Hung Le DATE 11/11/82

ORGANIZATION General Electric Company - NEBO

REVIEWED BY: G. H. Kirstad Jr DATE 11/22/82
SQRT PROGRAM MANAGER

APPROVED BY: Hung Le Hung Le DATE 11/11/82
RESPONSIBLE DESIGN ENGINEER

GENERAL ELECTRIC

QUALIFICATION SUMMARY

1. COMPONENT NAME: Recirculation Discharge Gate Valve

2. MPL OR EDL ITEM NO: B31-F031

3. QUALIFICATION DOCUMENTATION (ENCLOSED WITH THIS REPORT)

A. QUALIFICATION SUMMARY OF EQUIPMENT (SQRT FORM), INCLUDING REQUIRED RESPONSE SPECTRA WITH TRS PLOTTED ON RRS GRAPH, AS APPROPRIATE

Qualification summary is attached. RRS and TRS were not used because test conducted was a RIM test.

B. SQRT EVALUATION FLOW CHARTS (MARKED TO SHOW DECISION PATH).

Attached

C. REFERENCE DOCUMENTS

REFERENCE NUMBER	DOCUMENT IDENTIFICATION	REVISION OR DATE	TITLE/SUBJECT
1	VPF #2806-1	Rev. 10	Recirculation Discharge Valve Outline & Assembly Drawing
2	VPF #2806-3	Rev. 2	Limitorque Valve Control Drawing
3	16511-9	12/3/81	Report of Test for Seismic Qualification of two Actuators SMB-1-60 (DC) and SMB-2-60 (AC) for Limitorque Corporation
4	B-0115	6/24/82	Hydrodynamic Vibration Testing (New Loads)
5	DRF #206-B33-BLKV-KS1 PP. 238-322		Recirculation Gate Valve Analysis - Shoreham Discharge Valve
6	VPF #2809-40	Rev. 5	Vendor Stress Report
7	NEDE-24788-1	June, 1981	SQRT Technical Approach for Re-evaluation of BWR Equipment

D. ADDITIONAL SUPPORTING DOCUMENTS

DOCUMENT IDENTIFICATION	REVISION OR DATE	TITLE/SUBJECT
GE 21A9200	Rev. 9	Purchase Specification - Gate Valve
GE 385HA777	Rev. 0	Dynamic Loads Methods and Criteria - NSSS Equipment, Piping, RPV & Internal - BWR 4 & 5

QUALIFICATION SUMMARY (CONTINUED)

MPL ITEM NO B31-F031

4. REQUIREMENTS

The pressure retaining parts (valve body and bonnet) of the recirculation discharge valve (Ref. 1) must maintain their pressure integrity during the applicable loading events. In addition, since the valve is classified as active, its structure including the actuator (Ref. 2) must be capable of withstanding the maximum accelerations in these events and remain operable.

Functional Description: The valve is open during normal operation and is required to be closed during an LPCI injection to the reactor pressure vessel.

5 DEMONSTRATED CAPABILITY

A three-dimensional finite element model of the valve and actuator was developed and analyzed to determine the valve maximum capability for structural integrity. In addition, the valve was modeled as a single element and included in the piping system. Dynamic analysis using the response spectrum analysis method was performed on the piping system. Seismic and suppression pool hydrodynamic loads were considered. Critical location stresses were evaluated and compared with the allowable stress criteria. The operability of the actuator was demonstrated by a single-axis, single-frequency test on similar actuators.

Results of the structural integrity analysis and operability tests on the actuator demonstrated that the valve will maintain its structural integrity and the actuator will operate satisfactorily during and following the dynamic loading events

6 RATIONALE FOR QUALIFICATION CERTIFICATION

(INCLUDE DECISION ANALYSIS WITH COMPARISON TO ACCEPTANCE CRITERIA, APPROACH FOR DEMONSTRATING OPERABILITY, AND CONSIDERATION OF HIGH-FREQUENCY RESPONSE)

Qualification certification is justified because the methods used in the equipment analysis were based on requirements specified in the Reference 7 document.

A three-dimensional finite element model of the valve and its extended structure was prepared and used to perform a mode/frequency analysis using the SAP4G computer code. The valve fundamental frequency was determined by the frequency analysis to be less than the seismic cut-off frequency of 33 Hz. This required a dynamic analysis considering multimode response. However, since the valve is pipe-mounted and the required response spectra at the valve location were not available, it was necessary to perform a dynamic analysis on the entire piping system. A simple lumped-mass model of the valve and its actuator was developed based on the valve fundamental frequency, and was used to represent the valve dynamic characteristics in the piping analysis.

A dynamic analysis was performed on the recirculation piping system using the response spectrum analysis method. The analysis gave the maximum dynamic acceleration on the valve actuator and the maximum moment on the valve structure due to seismic and suppression pool hydrodynamic load combinations. Modes up to 60 Hz were considered and the effects of closely spaced modes were included using the double sum method. Dynamic responses were combined by SRSS.

6. Rationale for Qualification Certification (Continued)

The maximum accelerations calculated by the piping dynamic analysis was applied to the three-dimensional finite element model of the valve to calculate the stress at critical locations. Static analysis was used for the stress evaluation.

Structural integrity was addressed by completing the dynamic and static analyses described above, calculating stress at critical locations, and comparing the resulting stresses to the ASME code allowables. The code stamped pressure boundary components of the recirculation valve are classified as ASME B&P code Section VIII Class I equipment and must comply with the rules of this section. At locations where the ASME code does not specifically apply (e.g., valve yoke), methods employed by the vendor or methods based on stress analysis and mechanics principles were used.

Operability of the actuator was addressed by comparing the maximum actuator acceleration calculated by the piping dynamic analysis to the actuator performance test. The test conducted was a single-axis, single-frequency test (Ref. 3). Single-axis, single-frequency testing is justified because the actuator is rigid compared to the dynamic load cut-off frequency (lowest natural frequency is greater than 100 Hz, as shown in Ref. 3). The test was performed on the two Limitorque actuators, model SMB-1-60 and SMB-2-60 which were verified by the actuator manufacturer to be similar to the model SMB-3-100 used on this recirculation discharge valve (Ref. 4). The test followed the guideline of the IEEE 382-80 standard. An acceleration of 10g was applied to the test actuators at a frequency range from 2 Hz to 100 Hz. This test acceleration is sufficiently higher than the actuator maximum accelerations determined by the piping dynamic analysis (6.56g horizontally and 0.87g vertically, Ref. 5) to assure the actuator operability.

The dimensional information required to develop the valve finite element model was primarily obtained from the valve vendor stress report (Ref. 6). Additional information not available in the report was requested from the vendor and is contained in the design record file (Ref. 5).

Seismic and hydrodynamic loads were considered in the dynamic evaluation.

NUCLEAR POWER SYSTEMS ENGINEERING DEPARTMENT MEMO

TO: R. W. Hardy

DATE: December 20, 1982

FROM: H. Le

REQUIRED RESPONSE DATE:

FOR: ACTION ☐
DECISION ☐
INFORMATION ☒

SUBJECT: JUSTIFICATION OF LIMITORQUE ACTUATOR SINGLE-AXIS TESTING - SHOREHAM SQRT

References:
1. Limitorque Seismic Qualification Envelope, Report # B0037
2. Report of Test for Seismic Qualification of Two Actuators SMB-1-60 (DC) and SMB-2-60 (AC) for Limitorque Corporation, Report # 16511-9
3. Recirculation Gate Valve Analysis - Shoreham Discharge Valve, VPF# 206-B33-BLKV-KS1, pp.238-322

The multi-axis testing requirement is to address possible cross coupling effects of the equipment. Testing (Ref. 1, Section 2.0.7) has shown that no cross-coupling exists on the Limitorque actuators. The single-axis tests are, therefore, justified.

However, it should be noted that the Shoreham recirculation discharge valve actuators would be qualified even if cross coupling existed by applying the factor 1.414 to the required accelerations (Ref. 3). This gives 9.27g horizontally and 1.23g vertically. These accelerations are still lower than the test accelerations of 10g (Ref. 2). Therefore, qualification could be demonstrated.

CC: H. Ehsan G. Samstad C. T. Nieh