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AREA CODE 409 838-6631

December 17, 1984
RBG- 19710
File No. G9.5, G9.19.2

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Denton:

River Bend Station - Unit 1
Docket No. 50-458

Enclosed for your review is Gulf States Utilities Company's (GSU) dynamic analysis results for the River Bend Station (RBS) Atwood & Morrill feedwater isolation check valves. This response addresses Safety Evaluation Report (SER) Confirmatory Item No. (4) identified in Section 3.6.2 by the Nuclear Regulatory Commission's (NRC) Mechanical Engineering Branch (MEB). Enclosure 2 provides a table which compares the analysis results with the allowable stress limits for the feedwater isolation check valves. Enclosure 1 will be included in a future amendment to the FSAR.

Sincerely,

J E Booker

J. E. Booker
Manager-Engineering
Nuclear Fuels & Licensing
River Bend Nuclear Group

JEB/RJK/je

Enclosure

B001
1/1

QUESTION 210.82 (3.6.2)

Provide the basis for assuring that the feedwater isolation check valves can perform their function following a postulated pipe break of the feedwater line outside containment.

RESPONSE

11 The response to this request is provided in revised Appendix 3C, Section 3C.2.2.

(SRV), CRD lines, the primary shield wall, and the drywell wall.

To preclude damage caused by a whipping feedwater pipe, a total of 22 restraints have been installed on the feedwater system inside the drywell.

All restraints on the feedwater system are omnidirectional except 1FWS-PRR-811 and 831 which are moment-limiting "zero gap" restraints to keep the stresses within acceptable limits in the isolation valves and break exclusion zones.

All equipment inside the drywell, whose operation during or after a LOCA is required for safe shutdown, is qualified for the post-LOCA drywell environment as discussed in Section 3.11.

Inside the Steam Tunnel

All feedwater piping from inboard of the first moment-limiting (zero gap) restraint in the drywell to outboard of the jet impingement wall is defined as a break exclusion zone.

In the Auxiliary Building

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A check valve dynamic analysis is performed for the main feedwater isolation check valve to assure its functional performance following a postulated pipe break outside the containment. A dynamic forcing function is used in the valve stress analysis. First, a flow transient analysis is performed for the feedwater system to simulate the pipe break condition. The reverse flow condition at the check valve location is determined using the SWEC computer program WATHAM (Appendix 3A). Hydrodynamic torque exerted on the valve disk by the reverse flow is calculated. The valve closing time and the disk alarm velocity is determined from the valve dynamic model. 11

The structural analysis of the check valve consists of disc-to-shaft analysis utilizing finite element methods, and assuming that the valve body is rigid. This method of analysis is based on past experience of the valve vendor that indicates that the valve internals are limiting under this design condition.

From the drywell, the two 20-in. feedwater lines enter the auxiliary building from the north side of the north-south centerline (steam tunnel) at approximate el 121 ft-6 in., and then drop vertically to approximate el 109 ft-0 in. A

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(for page 3C.2-5)

The reactor vessel water is protected from blowdown following a postulated rupture of the feedwater piping outside the containment, by check valves 1B21*F010A,B inside the containment and by testable check valves 1B21*AOVF32A,B outside the containment. Breaks are not postulated in the piping between the valves because that region is classified as a break exclusion area. Analyses were performed to demonstrate that the feedwater isolation check valves can perform their function following a postulated pipe break of the feedwater line outside the containment.

The reverse flow caused by the sudden pressure reduction at the break rapidly closes both valves. A dynamic analysis was performed to obtain the forcing function for use in the valve stress analysis. First, a flow transient analysis was performed for the feedwater system to simulate the pipe break condition. The reverse flow condition at the check valve location was determined using the SWEC computer program WATHAM (App. 3A.21). Hydrodynamic torque exerted on the valve disk by the reverse flow was applied to determine the valve closing time and the disk impact speed on its seat.

A stress analysis was conducted to determine the ability of these isolation valves to withstand impact of the disk on the seat, at the speeds obtained from that dynamic analysis. The acceptance criterion is that gross leak rates do not occur because of disk rupture, serious fracture of the seat/disk interface or misalignment of the disk.

Loads on the critical elements, i.e., the disk, tail link, rockshaft and seat, were computed by simulation of the impact dynamics using the STARDYNE and GT-STRUDL computer program (Appendix 3A.5). Both uniform and point impact were considered to determine the worst case kickback loads generated by the point of impact not being at the center of percussion. Seismic, hydrodynamic and dead loads were not considered because of their insignificant magnitude compared to impact loads.

In most cases, linear stresses were below their allowables. If not, a non-linear time history strain analysis was conducted to demonstrate integrity.

It is concluded that both valves will remain intact and perform their function following rupture of the feedwater piping outside the containment.

Summary of Results - Feedwater Check Valve Analysis

		Check Valves 1B21*AOVF032A,B			Check Valves 1B21*F010A,B		
Valve Item	Value	Calculated Value	Allowable Value[(1)]	Factor of Safety	Calculated Value	Allowable Value[(1)]	Factor of Safety
Disk	Shear Load (lb) (at inside dia. of seat)	7.9×10^6	8.3×10^6	1.05	2.7×10^6	7.7×10^6	2.9
	Strain (%)	2.1	15.4	7.3	3.6	15.4	4.3
Rockshaft	Stress (ksi)	-	-	-	13.6	53.8	4.0
	Interactive Ratio[(2)]	0.71	1.0	1.4	-	-	-
Tail Link	Stress (ksi)	46.4	98	2.1	68.1	70	(4)
	Interactive Ratio[(2)]	0.48	1.0	2.1	-	-	-
Pin	Stress (ksi)	(3)	-	-	23	49	2.1
Stud	Stress (ksi)	(3)	-	-	41	49	1.2
Seat/Disk Interface	Stress (ksi)	74	98	1.3	98.8	140	1.4

Notes:

(1) Allowable values are defined as follows:

a. Primary stress from a steady state load must be less than 0.7 times the ultimate strength (Su) of the material (Ref. ASME Code, Section III, 1974 Edition through Winter 1976 Addenda).

b Stresses acting for a very short time (-0.5 millisec) must be less than the ultimate strength of the material.

c. Strain due to absorption of energy must be less than 0.7 times the ultimate elongation (based on Table CB-3700-1 of the ASME Code, Section III, Division II, 1983 Edition).

It is assured that strain rates are sufficiently high to warrant doubling the material allowables (Ref. Juvinal, R.C., Stress, Strain, and Strength, McGraw-Hill, 1967, pg. 168).

(2) Interactive ratio is as defined in Appendix A, Section 9231 of the ASME Code, Section III, 1974 Edition through Winter 1976 Addenda.

(3) Valves 1B21*AOVF032A,B do not have a pin/stud. The tail link and disk are integral.

(4) The duration of this stress is less than 1 millisec., which is not of sufficient duration to develop the strain necessary for serious failure.