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January 22, 1979 SNRC-355

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

SHOREHAM NUCLEAR POWER STATION - UNIT 1
DOCKET NO. 50-322

Dear Mr. Denton:

Enclosed are fifteen (15) copies of information supplementing the Shoreham Plant Design Assessment Report (DAR) for SRV and LOCA Loads, Revision 3, dated November, 1978. The DAR was submitted to the NRC on December 18, 1978 via letter SNRC-347.

This submittal presents additional load assessment results for selected NSSS pressure vessel internals, pressure vessel appurtenances, and piping systems for certain limiting load conditions. The results contained herein provide the information for Tables 9-20 through 9-23, which were delineated and marked as "later" in the DAR.

Very truly yours,

J. P. Novarro,
Project Manager
Shoreham Nuclear Power Station

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If the results using the first method for seismic vibratory motions and suppression pool structural system responses cause unacceptable results for the piping or pipe mounted/connected equipment, then the second method is used in a refined analysis to demonstrate NSSS piping and equipment adequacy.

9.2.5.1 SAP-IV Computer Program

This computer program was constructed from three earlier programs developed under the direction of Professor E.L. Wilson, Department of Civil Engineering, University of California at Berkeley. The element library and static analysis options were taken from the 'SOLID/SAP" program, (Reference 19) the eigenvalue extraction algorithms were incorporated from coding that was originated by Dr. K.J. Bathe (Reference 20) and the forced vibration and response spectrum analyses were adapted from the original version of Professor Wilson's "SAP" program (Reference 21).

The method of analysis for this program version is presented in some detail in a recent report by Bathe (Reference 22).

Systems composed of large numbers of joints and members may be analyzed. The capacity of the program depends mainly on the total number of joints in the system. There is practically no restriction on the number of elements, number of static load cases, or the equation "bandwidth". Note that while the program has the capacity to analyze very large models, the system is relatively efficient in the solution of smaller problems.

9.2.5.2 Multiple Excitation Methods

The equations of motion used in the formulation of the multiple excitation methods conform to the fundamental laws of mechanics. The theory is based on the same assumptions used for the uniform excitation methods, that is: small system damping, damping matrix orthogonal and applicable for linear systems. A general acceptance by the technical community has been made for the multiple excitation method. The procedure has briefly been described in textbooks and procedural details were presented in a General Electric publication at the Fourth SMIRT conference, August 1977. The use of the multiple excitation method was accepted by the NRC Staff on the GESSAR docket.

9.2.6 NSSS Evaluation Results

Representative results are presented in Tables 9-20 through 9-31 for the analyses described in Sections 9.2.1 and 9.2.2. These results are presented for selected NSSS pressure vessel internals, pressure vessel appurtenances, and piping systems for certain limiting load combinations selected from Tables 2-3 and 4. A complete tabulation will be presented in the FSAR. |

As shown in Tables 9-20 through 9-31, the NSSS equipment is expected to generally meet the loading conditions and acceptance |

criteria as analyzed. These analyses have conservatively used dynamic loads, for safety relief valve discharge, based on ramshead discharge devices. The Shoreham plant will actually use quencher discharge devices which generally create lower dynamic loads.

Three options are available for NSSS equipment not found acceptable on the initial analyses using ramshead devices. The first option is to perform more sophisticated analyses which eliminate conservative simplifying assumptions used in the initial analyses. The second option is to re-evaluate the equipment using dynamic loads based on the actual SRV discharge devices. The third option is to modify the equipment. We anticipate little, if any, NSSS equipment to require modification.

TABLE 9-20

LOAD ASSESSMENT

Component: RPV Support Skirt

Load Combination	Criterion	Allowable Stress	Calculated Stress
$N + (SRV^2_{ALL} + OBE^2)^{1/2}$	Upset	57.3 ksi	$<$ 54.3 ksi
$N + (SRV^2_{ADS} + IBA/SBA^2 + SSE^2)^{1/2}$	Faulted	43.1 ksi	$<$ 15.3 ksi
$N + (LOCA^2 + SSE^2)^{1/2}$	Faulted	43.1 ksi	$<$ 15.3 ksi

TABLE 9-21

LOAD ASSESSMENT

Component: Shroud Support

Load Combination	Criterion	Allowable Stress	Calculated Stress
$N + (SRV^2_{ALL} + OBE^2)^{1/2}$	Upset	*69.9 ksi	*74.2 ksi
$N + (SRV^2_{ADS} + IBA/SBA^2 + SSE^2)^{1/2}$	Faulted	55.9 ksi	$<$43.2 ksi
$N + (LOCA^2 + SSE^2)^{1/2}$	Faulted	55.9 ksi	$<$43.2 ksi

* G.E. is currently pursuing more sophisticated analyses which are expected to show that the more realistic stress level is within the allowables. (See Paragraph 5.2.5, Pg. 9-22) This exceedance of the Upset Allowable Stress value results from the initial conservative analysis.

TABLE 9-22

LOAD ASSESSMENT

Component: RPV Stabilizer Bracket

Load Combination	Criterion	Allowable Stress	Calculated Stress
$N + (SRV^2_{ALL} + OBE^2)^{1/2}$	Upset	80.1 ksi	<40.0 ksi
$N + (SRV^2_{ADS} + IBA/SBA^2 + SSE^2)^{1/2}$	Faulted	60.0 ksi	<40.0 ksi
$N + (LOCA^2 + SSE^2)^{1/2}$	Faulted	60.0 ksi	<40.0 ksi

TABLE 9-23

LOAD ASSESSMENT

Component: RPV Stabilizer

Load Combination	Criterion	Allowable Load	Calculated Load
$N + (SRV^2_{ALL} + OBE^2)^{1/2}$	Upset	540 kips	388 kips
$N + (SRV^2_{ADS} + IBA/SBA^2 + SSE^2)^{1/2}$	Faulted	1292 kips	<817 kips
$N + (LOCA^2 + SSE^2)^{1/2}$	Faulted	1292 kips	1093 kips

TABLE 9-24

LOAD ASSESSMENT

Component: CRD Housing Restraint Beam

Load Combination	Criterion	Allowable Load	Calculated Load
$N + (SRV^2_{ALL} + OBE^2)^{1/2}$	Upset	91 kips	16 kips
$N + (SRV^2_{ADS} + IBA/SBA^2 + SSE^2)^{1/2}$	Faulted	136.5 kips	<112 kips
$N + (LOCA^2 + SSE^2)^{1/2}$	Faulted	136.5 kips	122 kips

TABLE 9-25

LOAD ASSESSMENT

Component: Core Support

Load Combination	Criterion	Allowable ΔP Buckling	Calculated ΔP Buckling
$N + (SRV^2_{ALL} + OBE^2)^{1/2}$	Upset	31.6 psi	28.7 psi
$N + (SRV^2_{ADS} + IBA/SBA^2 + SSE^2)^{1/2}$	Faulted	54.6 psi	33.8 psi
$N + (LOCA^2 + SSE^2)^{1/2}$	Faulted	54.6 psi	30.3 psi

TABLE 9-26

LOAD ASSESSMENT

Component: Shroud (Buckling)

Load Combination	Criterion	Allowable Stress	Calculated Stress
$N + (SRV^2_{ALL} + OBE^2)^{1/2}$	Upset	8.6 ksi	2.6 ksi
$N + (SRV^2_{ADS} + IBA/SBA^2 + SSE^2)^{1/2}$	Faulted	17.2 ksi	3.8 ksi
$N + (LOCA^2 + SSE^2)^{1/2}$	Faulted	17.2 ksi	3.7 ksi

TABLE 9-27

LOAD ASSESSMENT

Component: Top Guide Beam

Load Combination	Criterion	Allowable Stress	Calculated Stress
$N + (SRV^2_{ALL} + OBE^2)^{1/2}$	Upset	25.4 ksi	9.7 ksi
$N + (SRV^2_{ADS} + IBA/SBA^2 + SSE^2)^{1/2}$	Faulted	50.7 ksi	11.8 ksi
$N + (LOCA^2 + SSE^2)^{1/2}$	Faulted	50.7 ksi	12.3 ksi

TABLE 9-28

LOAD ASSESSMENT

Component: Top Guide Hold-down Latch

Load Combination	Criterion	Allowable Load	Calculated Load
$N + (SRV^2_{ALL} + OBE^2)^{1/2}$	Upset	3.6 kip	negligible
$N + (SRV^2_{ADS} + IBA/SBA^2 + SSE^2)^{1/2}$	Faulted	8.7 kip	5.0 kip
$N + (LOCA^2 + SSE^2)^{1/2}$	Faulted	8.7 kip	4.4 kip

TABLE 9-29

LOAD ASSESSMENT

Component: Main Steam Piping

Service Level	No.	Load Combination	Acceptance Criteria	Actual Stress	Allowable Stress	Stress Ratio	Location
Design	1	$P_D+W+OBE_I$	Eq.9≤1.5S_m	17.4 ksi	26.9 ksi	0.65	Hanger HB-1 Weld to pipe
A&B Normal & Upset		P_O, TE, OBE_I, OBE_D, RV1, $RV2_I^{ALL}$, $RV2_D^{ALL}$, TSVC, W	Eq.12≤3.0S_m	29.8 ksi	55.2 ksi	0.54	Sweepolet F013-E
	1	$P_P+W+[(OBE_I)^2+(TSVC)^2]^{1/2}$	Eq.13≤3.0S_m	35.8 ksi	55.2 ksi	0.65	Sweepolet F013-B
	2	$P_P+W+[(OBE_I)^2+(RV1)^2]^{1/2}$	U.F. ≤1.0	0.34	1.0	0.34	Sweepolet F013-G
	3	$P_P+W+[(OBE_I)^2+(RV2_I^{ALL})^2]^{1/2}$					
C Emergency	1	$P_P+W+[(CHUG_I)^2+(RV1)^2]^{1/2}$	Eq.9≤2.25S_m	24.2 ksi	41.4 ksi	0.59	Sweepolet F013-B
	2	$P_P+W+[(COND_I)^2+(RV1)^2]^{1/2}$					
	3	$P_P+W+[(CHUG_I)^2+(RV2_I^{ALL})^2]^{1/2}$					
	4	$P_P+W+[(COND_I)^2+(RV2_I^{ADS})^2]^{1/2}$					
D Faulted	1	$P_P+W+[(SSE_I)^2+(RV2_I^{ALL})^2]^{1/2}$	Eq.9≤2.25S_m	31.1 ksi	41.4 ksi	0.75	Sweepolet F013-H
	2	$P_P+W+[(SSE_I)^2+(TSVC)^2]^{1/2}$					
	3	$P_P+W+[(SSE_I)^2+(CHUG_I)^2+(RV2_I^{ADS})^2]^{1/2}$					
	4	$P_P+W+[(SSE_I)^2+(COND_I)^2+(RV2_I^{ADS})^2]^{1/2}$					
	5	$P_P+W+[(SSE_I)^2+(VLC_I)^2]^{1/2}$					
	6	$P_P+W+[(SSE_I)^2+(CHUG_I)^2+(RV1)^2]^{1/2}$					
	7	$P_P+W+[(SSE_I)^2+(COND_I)^2+(RV1)^2]^{1/2}$					
	8	$P_P+W+[(AP_I)^2+(SSE_I)^2]^{1/2}$					

Note: See Table 9-31 for definition of terms.

TABLE 9-30

LOAD ASSESSMENT

Component: Recirculation Piping

Service Level	No.	Load Combination	Acceptance Criteria	Actual Stress	Allowable Stress	Stress Ratio	Location
Design	1	$P_D + W + OBE_I$	Eq.9≤1.5S_m	18.4 ksi	25.2 ksi	0.73	RHR Suction Tee-Line B
A&B		P_O, TE, OBE_I, OBE_D, RV1, $RV2_I^{ALL}$, $RV2_D^{ALL}$, TSVC, W	Eq.12≤3.0S_m	18.2 ksi	50.3 ksi	0.36	RHR Suction Tee-Line B
Normal & Upset	1	$P_P + W + [(OBE_I)^2 + (TSVC)^2]^{1/2}$	Eq.13≤3.0S_m	38.6 ksi	50.3 ksi	0.77	Reducer Weld A&B Discharge Riser
	2	$P_P + W + [(OBE_I)^2 + (RV1)^2]^{1/2}$	U.F. ≤ 1.0	0.21	1.0	0.21	RHR Discharge Tee-Line A & B
	3	$P_P + W + [(OBE_I)^2 + (RV2_I^{ALL})^2]^{1/2}$					
C Emergency	1	$P_P + W + [(CHUG_I)^2 + (RV1)^2]^{1/2}$	Eq.9≤2.25S_m	37.1 ksi	37.8 ksi	0.98	RHR Suction Tee-Line B
	2	$P_P + W + [(COND_I)^2 + (RV1)^2]^{1/2}$					
	3	$P_P + W + [(CHUG_I)^2 + (RV2_I^{ADS})^2]^{1/2}$					
	4	$P_P + W + [(COND_I)^2 + (RV2_I^{ADS})^2]^{1/2}$					
D Faulted	1	$P_P + W + [(SSE_I)^2 + (RV2_I^{ALL})^2]^{1/2}$	Eq.9≤2.25S_m	37.5 ksi	37.8 ksi	0.99	RHR Suction Tee-Line B
	2	$P_P + W + [(SSE_I)^2 + (TSVC)^2]^{1/2}$					
	3	$P_P + W + [(SSE_I)^2 + (CHUG_I)^2 + (RV2_I^{ADS})^2]^{1/2}$					
	4	$P_P + W + [(SSE_I)^2 + (COND_I)^2 + (RV2_I^{ADS})^2]^{1/2}$					
	5	$P_P + W + [(SSE_I)^2 + (VLC_I)^2]^{1/2}$					
	6	$P_P + W + [(SSE_I)^2 + (CHUG_I)^2 + (RV1)^2]^{1/2}$					
	7	$P_P + W + [(SSE_I)^2 + (COND_I)^2 + (RV1)^2]^{1/2}$					
	8	$P_P + W + [(AP_I)^2 + (SSE_I)^2]^{1/2}$					

Note: See Table 9-31 for definition of terms.

TABLE 9-31

NOMENCLATURE

AP_I	=	Annulus Pressurization Loads (Inertia Effect)
$CHUG_I$	=	Chugging Load (Inertia Effect)
$COND_I$	=	Condensation Oscillation (Inertia Effect)
OBE_I	=	Operating Basis Earthquake (Inertia Effect)
OBE_D	=	Operating Basis Earthquake (Anchor Displacement Load)
P_O	=	Operating Pressure
P_D	=	Design Pressure
P_P	=	Peak Pressure
RV1	=	Safety Relief Valve Opening Loads (Acoustic Wave)
$RV2_I^{ALL}$	=	Safety Relief Valve Basemat Acceleration Loads (Inertia Effect)
$RV2_D^{ALL}$	=	Safety Relief Valve Basemat Acceleration Loads (Anchor Displacement Loads)
$RV2_I^{ADS}$	=	Safety R/Valve Basemat Acceleration Due to Automatic Depressurization System Valve (Inertia Effect)
SSE_I	=	Safe Shutdown Earthquake (Inertia Effect)
TE	=	Thermal Expansion
TSVC	=	Turbine Stop Valve Closure Loads
VLC_I	=	Vent Line Clearing Loads (Inertia Effect)
W	=	Dead Weight