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U.S. NUCLEAR REGULATORY COMMISSION

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FROM: NIAGARA MOHAWK POWER CORP.
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DESCRIPTION
LTR. RE. TELEPHONE CONVERSATION ON 10-28-76... TRANS THE FOLLOWING......

PLANT NAME: NINE MILE PT. # 1

ENCLOSURE
ADDITIONAL INFORMATION CONCERNING THE PLANT UNIQUE ANALYSIS REPORT FOR TORUS SUPPORT SYSTEM ...W/ ATTACHED PIPING.......

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(9 PAGES)

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FOR ACTION/INFORMATION

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NIAGARA MOHAWK POWER CORPORATION

NIAGARA MOHAWK

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RECEIVED NOV 9 1976 U.S. NUCLEAR REGULATORY COMMISSION Mail Section

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November 3, 1976

Director of Nuclear Reactor Regulation
Attn: Mr. George Lear, Chief
Operating Reactors Branch #3
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Re: Nine Mile Point Unit 1
Docket No. 50-220
DPR-63

Dear Mr. Lear:

Attached is information concerning a request made by members of your staff during an October 28, 1976 telephone conversation. This information concerns the Plant Unique Analysis Report for Torus Support System and Attached Piping for Nine Mile Point Nuclear Power Station.

Very truly yours,
NIAGARA MOHAWK POWER CORPORATION

R. R. Schneider
R. R. SCHNEIDER
Vice President - Electric Production

MGM/sz
Attachment

11439

Question 1

a. *Why did the upward displacement of the torus decrease when the normalizing factor used increased from 0.375 to 1.0 (Figure 3-9, Mark I Containment Evaluation Short Term Program Final Report, Addendum 3)?*

b. *What is the correlation between anchor bolt strain and upward displacement?*

Response

a. *The original plant unique analysis did not include damping in the 1-D model. Two percent critical damping as structure damping is now being used. Also, a slight error in the elastic modulus of the bolt was corrected. These changes resulted in lower displacements.*

b. *Due to the modeling of the nonlinear anchor bolt element*[(1)] *the element stress-strain relationship approximates the load-deflection of the actual anchor as it is pulled out of the concrete. Figure 13*[(1)] *shows the equivalent stress-strain diagram. It may be seen that the equivalent material is much "softer" than the carbon steel anchor bolt. To obtain the anchor bolt strain, we used the following relationship*

$$\varepsilon = \frac{\sigma}{E}$$

where

ε	=	*strain*
σ	=	*F/A*
F	=	*maximum upward force*
A	=	*anchor bolt cross-section area*
E	=	*"actual" modulus of anchor bolt material* = $27.9(10)^5$ *psi*

(1) *Plant Unique Analysis Report for Torus Support System and Attached Piping for Nine Mile Point Nuclear Power Station*

Question 2

Document the effects of parameter changes and increased submergence on the pipe stresses and the ability of the piping to withstand the Loss of Coolant Accident.

Response

Differential support motion during a Loss of Coolant Accident will induce pipe stresses. Tables 11 and 12[1] show that these stresses (calculated on an elastic basis) are well within the code allowable values. Studies done for increased submergence and parameter changes show decreased upward displacement of the torus and, hence, decreased differential support motion (see Question 1a). Therefore, the pipe stresses due to increased submergence and parameter changes will be reduced. It is concluded that pipe stresses are acceptable for all cases.

(1) Same as Question 1.

Question 3

a. *Explain why the upward displacement and column forces decreased when the downcomer submergence was increased.*

b. *Explain why strength ratios were reduced in some cases and provide method for calculating revised strength ratios. Also, give revised tables of strength ratios.*

Response

a. *This is basically due to the change in arrival time of the vent header loads. A large downward load in the vent header columns now occurs when the mass in the 1-D model is moving upward. Hence, the vent header column load now counteracts the motion of the mass. An analysis was performed using the same arrival time as used in Plant Unique Analysis Report for Torus Support System and Attached Piping for Nine Mile Point Nuclear Power Station for increased downcomer submergence (3'-3"). The response is approximately the same as that for 3'-0" submergence.*

b. *As seen in Table 9*[1]*, the strength ratios for the ring girder and the inner column were at their limits for the conditions analyzed in the Short Term Program report. The ring girder strength capacity was increased by using the material certification to obtain a greater yield stress. This was increased from 32 ksi to 40.8 ksi. The strength capacities were based on 2 times yield stress.*

Column capacities were increased by taking advantage of the Short Term Program criteria. The ASME Code, Section III, was used for the original evaluation in Table 9[1]*. Therefore, it was possible to reduce the strength ratios of the columns.*

The methods used for finding the effects of parameter changes and submergence changes on the plant unique analysis are essentially the same as those discussed with General Electric on September 24, 1976. The downward load phase and the upward load phase of the Loss of Coolant Accident transient were treated separately.

(1) Same as Question 1.

Response (Continued)

b. Continued

For the base case analysis, downward load phase, new values for loads in the torus support columns were computed as follows:

$$P^{New}_{\substack{Column\\Load}} = \frac{M^{New}_{Down}}{M^{Old}_{Down}} (P_{Dyn.}) + (P_{D.L.} + P_{\Delta\ Water}) + P_{Seismic} + P_{\Delta\ Water\ Seismic}$$

where:

M^{New}_{Down} = Revised value for the load factor M_{down} as a result of the increased submergence and/or revised plant geometry factors.

M^{Old}_{Down} = Value of M_{down} used in plant unique analysis report.

P_{Dyn} = The load in the torus support column due to the pool swell dynamic loading as reported in the plant unique analysis report.

$P_{D.L.}$ = Load in column due to weight of water plus steel as reported in the plant unique analysis report.

$P_{\Delta\ Water}$ = Increase in water dead weight due to higher water level (per column).

$P_{Seismic}$ = Load in column due to horizontal and vertical seismic as reported in plant unique analysis report.

Response (Continued)

b. Continued

$P_{\Delta \text{ Water Seismic}}$ = Increase in column seismic load due to horizontal and vertical accelerations acting on Δ water mass.

Having established new torus support column loads in this manner, a ratio was computed as follows:

$$R = \frac{P^{New}_{Column\ Load}}{P^{Old}_{Column\ Load}}$$

The factor "R" was then used to compute new "strength ratios" (SR) for components in the torus support structure load path, such as:

a) Torus Support Column

b) Connection of torus support column to torus shell

c) Connection at base of torus support column.

d) Torus shell adjacent to column connection

e) Reinforcing ring at torus mitered joint.

The original evaluation for the base case was given in Table 9[1]. The revised results are presented in Tables A, B, and C (attached) and show the revised evaluations. All strength ratios are within the allowable limits. For the upward load phase, the 1-D model was rerun. Because of the generally lower response, the resulting forces and stresses were less than those reported[1]. Therefore, the strength ratios are within the allowable limits.

(1) Same as Question 1.

TABLE A

SUMMARY OF ANALYSIS RESULTS
BASE CASE LOAD (ΔP = 1 psi)
MAXIMUM DOWN LOADS
For 3'-3" Submergence

Component Evaluation	ASME Code	STP Criteria	Load/Stress		Strength Ratio	
			Calculated	Capacity	Act.	Allow.
Ring Girder Stress, psi						
Membrane + Bending		X	34,800	81,600	.43	.50
Shear		X	9,170	40,800	.23	.50
Torus Shell Stress, psi						
Membrane + Bending		X	21,700	64,000	.33	.50
Shear		X	15,600	40,800	.38	.50
Column-Torus Weld Joint						
Inner Column						
Web Weld (kips)	X		508.2	678.0	.75	1.0
Flange Weld (in.-kips)	{ X		125.7	2,213.0	.05	1.0
	{ X		65.5	700.0	.10	1.0
Outer Column						
Web Weld (kips)	X		595.1	678.0	.87	1.0
Flange Weld (in.-kips)	{ X		201.2	2,213.0	.09	1.0
	{ X		158.7	700.0	.23	1.0
Column Buckling						
Inner Column						
Equation 19		X	N/A	N/A	.40	0.5
Equation 20		N/A	N/A	N/A	N/A	N/A
Outer Column						
Equation 19		X	N/A	N/A	.38	0.5
Equation 20		X	N/A	N/A	N/A	N/A
Column Base Joint						
Inner Column						
Down Load (kips)		X	510.2	1602.0	.31	.50
Up Load (kips)		X	107.0*	461.45	.23	.50
Outer Column						
Down Load (kips)		X	597.2	1602.0	.37	.50
Up Load (kips)		X	95.6*	461.45	.21	.50

*Conservatively computed by multiplying values in original Plant Unique Analysis Table 9 by $\frac{\text{Mup, new}}{\text{Mup, old}}$

TABLE B

SUMMARY OF ANALYSIS RESULTS
BASE CASE LOAD (ΔP = 1 psi)
MAXIMUM DOWN LOADS
For 4'-0" Submergence

Component Evaluation	ASME Code	STP Criteria	Load/Stress		Strength Ratio	
			Calculated	Capacity	Act.	Allow.
Ring Girder Stress, psi						
Membrane + Bending		X	39,300	81,600	.48	.50
Shear		X	10,300	40,800	.25	.50
Torus Shell Stress, psi						
Membrane + Bending		X	24,500	64,000	.38	.50
Shear		X	17,600	40,800	.43	.50
Column-Torus Weld Joint						
Inner Column						
Web Weld (kips)	X		573.4	678.0	.85	1.0
Flange Weld (in.-kips)	{ X		138.4	2,213.0	.05	1.0
	X		73.9	700.0	.11	1.0
Outer Column						
Web Weld (kips)	X		671.6	678.0	.99	1.0
Flange Weld (in.-kips)	{ X		227.0	2,213.0	.10	1.0
	X		179.1	700.0	.26	1.0
Column Buckling						
Inner Column						
Equation 19		X	N/A	N/A	.47	0.5
Equation 20		N/A	N/A	N/A	N/A	N/A
Outer Column						
Equation 19		X	N/A	N/A	.44	0.5
Equation 20		N/A	N/A	N/A	N/A	N/A
Column Base Joint						
Inner Column						
Down Load (kips)		X	573.4	1602.0	.36	.50
Up Load (kips)		X	123.6*	461.45	.27	.50
Outer Column						
Down Load (kips)		X	671.6	1602.0	.42	.50
Up Load (kips)		X	110.3*	461.45	.24	.50

*Conservatively computed by multiplying values in original Plant Unique Analysis Table 9 by $\frac{M_{up,\ new}}{M_{up,\ old}}$ (Mup, new / Mup, old)

TABLE C

SUMMARY OF ANALYSIS RESULTS
BASE CASE LOAD (ΔP = 1 psi)
MAXIMUM DOWN LOADS
For 4'-6" Submergence

Component Evaluation	ASME Code	STP Criteria	Load/Stress		Strength Ratio	
			Calculated	Capacity	Act.	Allow.
Ring Girder Stress, psi						
Membrane + Bending		X	34,800	81,600	.43	.50
Shear		X	9,170	40,800	.23	.50
Torus Shell Stress, psi						
Membrane + Bending		X	21,700	64,000	.33	.50
Shear		X	15,600	40,800	.38	.50
Column-Torus Weld Joint						
Inner Column						
Web Weld (kips)	X		508.2	678.0	.75	1.0
Flange Weld (in.-kips)	{ X		126.7	2,213.0	.05	1.0
	{ X		65.5	700.0	.10	1.0
Outer Column						
Web Weld (kips)	X		595.1	678.0	.87	1.0
Flange Weld (in.-kips)	{ X		201.2	2,213.0	.09	1.0
	{ X		158.7	700.0	.23	1.0
Column Buckling						
Inner Column						
Equation 19		X	N/A	N/A	.40	0.5
Equation 20		N/A	N/A	N/A	N/A	N/A
Outer Column						
Equation 19		X	N/A	N/A	.38	0.5
Equation 20		N/A	N/A	N/A	N/A	N/A
Column Base Joint						
Inner Column						
Down Load (kips)		X	508.2	1602.0	.31	.50
Up Load (kips)		X	124.7*	461.45	.27	.50
Outer Column						
Down Load (kips)		X	595.1	1602.0	.37	.50
Up Load (kips)		X	111.3*	461.45	.24	.50

*Conservatively computed by multiplying values in original Plant Unique Analysis Table 9 by $\frac{M_{up,\ new}}{M_{up,\ old}}$