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SUBJECT: Forwards draft Apps H & I to design assessment rept for facility.Apps will be incorporated into amend prior to 820701.

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Mr. A. Schwencer, Chief
Licensing Branch No. 2
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Schwencer:

Subject: NUCLEAR PROJECT NO. 2
APPENDICES TO WNP-2
DESIGN ASSESSMENT REPORT (DAR)

Enclosed are sixty (60) copies of Appendices H and I to the Design Assessment Report for WNP-2. These appendices are being submitted to NRC in draft form at this time and will be incorporated into a DAR amendment prior to July 1, 1982.

Very truly yours,

G D Bouchey

G. D. Bouchey, Deputy Director
Safety & Security

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APPENDIX I

SRV AND LOCA LOADS ON SUBMERGED STRUCTURES

I.1 INTRODUCTION

The LOCA/SRV discharge devices and other submerged structures are shown in Figures 2.1-2, 2.1-6, 2.1-7 and 2.1-8 and identified in Table 1.

The most significant hydrodynamic load for each structure is identified in Table 1.

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TABLE I-1

LOCA/SRV Loads on Submerged Structures

Identification of Structures	Identification of Most Significant Hydrodynamic Load
1. (a) SRV Line	SRV (Due to actuation of adjacent SRV)
(b) Quencher*	LOCA jet on arms
(c) Quencher Support*	None significant
2. Downcomer Vents*	SRV
3. Concrete Columns	SRV
4. Bracing Truss* @ Vent Exit	Pool Swell Drag
5. Platform with Grating (@ Elev. 472'-4", 78% open area)	Pool Swell Drag
6. Miscellaneous Piping, penetrations and supports along containment boundary	
(a) Below vent exit (Elev. 454'-4 3/4")	LOCA jet and SRV
(b) Above vent exit, below initial pool surface (Elev. 466'-4 3/4")	Pool Swell Drag
(c) Above initial pool surface, below maximum pool swell elevation (484'-4 3/4")	Pool Swell Impact

* Loads on discharge devices and their supports during discharge through the devices are addressed elsewhere.

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I.2 SUMMARY OF METHODOLOGY USED FOR DEFINING LOCA JET/BUBBLE LOADS

LOCA jet/bubble loads are defined using the ring vortex model. The pool is divided into zones and to ensure conservatism in design, the largest velocity and acceleration values seen by a submerged structure are assumed equal to the maximum calculated values anywhere in the applicable zone. The LOCA bubble charging model is used to verify/ensure that the design values are conservative.

I.3 SUMMARY OF METHODOLOGY USED FOR DEFINING LOCA STEAM CONDENSATION LOADS

Generic "drag load" methodology and plant unique flow fields are used for LOCA steam condensation loads on submerged structures in compliance with the NRC acceptance criteria. Plant unique flow fields are defined consistently with steam condensation boundary loads.

The generic methodology identifies three components of flow induced loads on submerged structures: acceleration dependent and velocity square dependent in-line loads, velocity square dependent lift load (normal to the direction of flow).

Representative plant unique chugging flow fields show that the chugging loads on submerged structures are due to acceleration or pressure gradients established in the pool during the impulsive chugging phenomenon, i.e., velocity dependent loads are small.

I.4 SUMMARY OF METHODOLOGY USED FOR DEFINING SRV LOADS

Caorso SRV test data on submerged structures are examined to supplement theoretical approaches of the acceptance criteria. The data and their correlation with theoretical approaches of the acceptance criteria confirm that SRV loads are primarily due to pressure gradients established in the pool during the SRV discharge, i.e., velocity dependent loads are small.

The dynamic pressure gradients measured across Caorso column, vent and SRV line are used to define the peak load values (at quencher elevation), the spatial distribution of the load and its time dependence.

The pressure time histories recorded on submerged structures show waveform characteristics similar to those recorded at pool boundary. The SRV loads on submerged structures are defined consistently with the plant unique boundary loads.

The SRV loads on WNP-2 structures are calculated using the following formula:

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$$P = \frac{\pi}{4} D^2 \times \left[\frac{d_{Caorso}}{d_{WNP-2}}\right]^2 \times \alpha P_b \times L$$

where:

P = load on a WNP-2 structure (force/unit length)

D = diameter of the structure

α = a load gradient factor established using Caorso SRV test data on submerged structures. The method to calculate (α) is explained in Page 6 and Figure I-1.

d_{Caorso} = horizontal distance of the structure from the nearest actuating quencher in Caorso plant

d_{WNP-2} = horizontal distance of the WNP-2 structure from the nearest actuating quencher

P_b = boundary pressure load definition from Reference I-1 including any modifications agreed upon with the NRC

L = load margin = a minimum value of 1.4 is used for all piping which are adequately braced and a value of 2.0 is used for the column which is the only unbraced structure and is closest to the nearest quencher

Notes on Figure I-1

1. The SRV load gradient is obtained from Caorso data as follows:

$$A = \frac{P_f - P_{ba}}{D} = \alpha P_{19}$$

where:

A = measured gradient across the cylindrical structure

P_f = P_{front}

P_{ba} = P_{back}

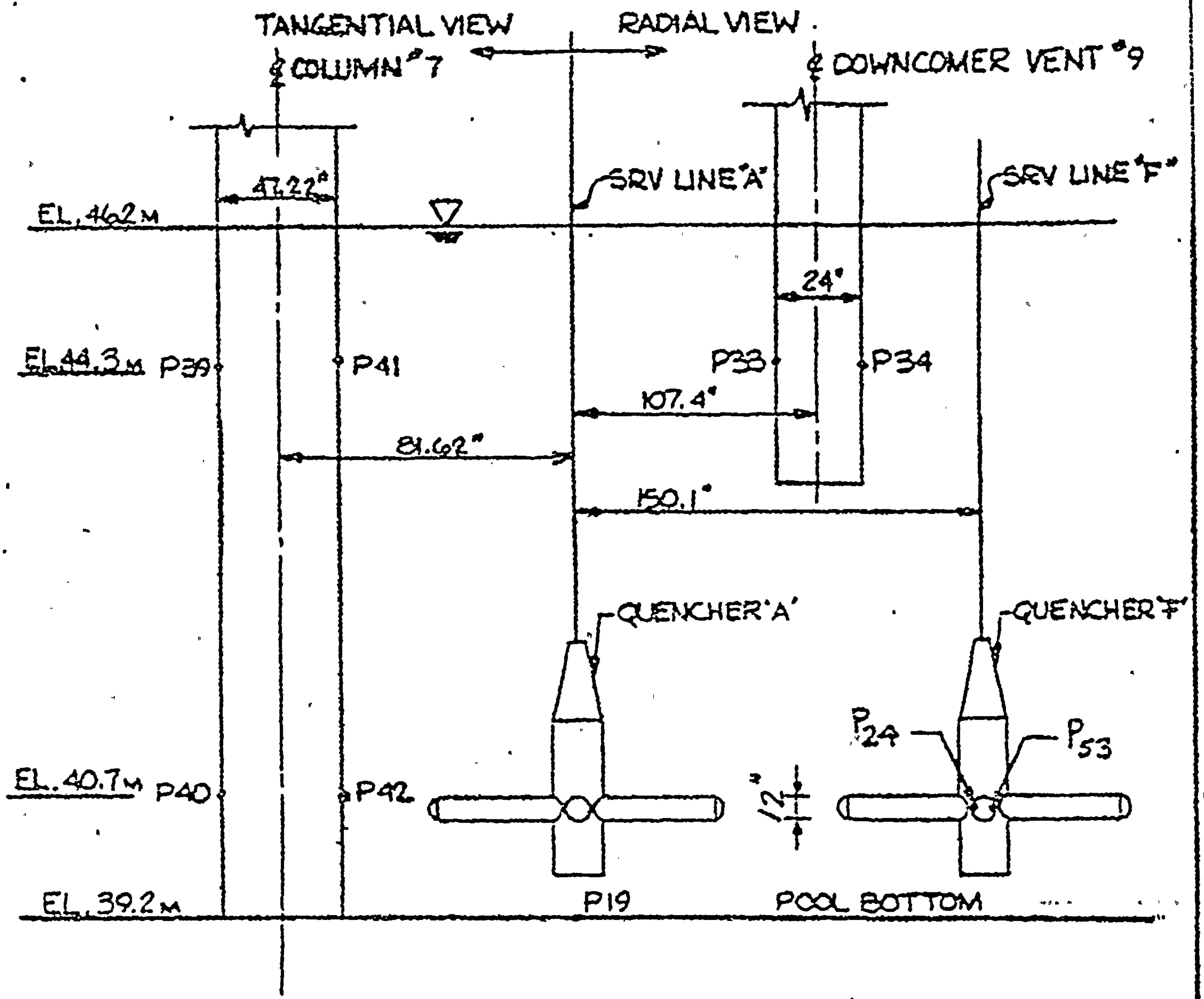
2. P_{19}, P_f, P_{ba} waveform characteristics are similar.

3. The value of (α) for each set of P_f (P_{42}, P_{41}, P_{33}, P_{24}) and P_{ba} (P_{40}, P_{39}, P_{34}, P_{53}) is obtained from Caorso SRV test data (single and multiple valve actuations).

4. For miscellaneous piping which run along the suppression pool boundary, the load gradient factor (α) equal to that for the column is specified.

I.5 REFERENCES

I-1 "SRV Loads - Improved Definition and Application Methodology for Mark II Containments," Technical Report (Proprietary), prepared by Burns and Roe, Inc. for application to Washington Public Power Supply System Nuclear Project No. 2, submitted to the Nuclear Regulatory Commission on 7/29/80.



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WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	LOCATION OF PRESSURE TRANSDUCERS ON CAORSO SUBMERGED STRUCTURES	FIGURE I-1

APPENDIX B

CONFORMANCE OF WNP-2 DESIGN TO NRC ACCEPTANCE CRITERIA

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H.0 Conformance of WNP-2 Design to NRC Acceptance Criteria

H.1 The following Table (Table H-1) is a summary of the WNP-2 position for each of the pool dynamic loads. This table provides a description of each load or phenomenon, the Mark II Owner's Group load specification, the NRC evaluation reference and the WNP-2 position on the acceptance criteria for each load.

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Table H-1 Conformance of WNP-2 Design to NRC Acceptance Criteria

Load or Phenomenon	Mark II Owners Group Load Specification	NRC Evaluation	WNP-2 Position on Acceptance Criteria
I. LOCA-Related Hydrodynamic Loads			
A. Submerged Boundary Loads During Vent Clearing	24 psi over-pressure added to local hydrostatic below vent exit (walls and basemat) - linear attentuation to pool surface.	II.A.1 [3]	Acceptable.
B. Pool Swell Loads 1. Pool Swell Analytical Model			
a) Air Bubble Pressure	Calculated by the pool swell analytical model (PSAM) used in calculation of submerged boundary loads.	III.B.3.a [1]	Acceptable.
b) Pool Swell Elevation	Use PSAM with polytropic exponent of 1.2 to a maximum swell height which is the greater of 1.5 vent submergence or the elevation corresponding to the drywell floor uplift P per NUREG 0487 criteria I.A.4. The associated maximum wetwell air compression is used for design assessment.	II.A.2 [2]	Acceptable.

Table B-1 (Continued)

Load or Phenomenon	Mark II Owners Group Load Specification	NRC Evaluation	WNP-2 Position on Acceptance Criteria
c) Pool Swell Velocity	Velocity history vs. pool elevation predicted by the PSAM used to compute impact loading on small structures and drag on gratings between initial pool surface and maximum pool elevation and steady-state drag between vent exit and maximum pool elevation. Analytical velocity variation is used up to maximum velocity. Maximum velocity applies thereafter up to maximum pool swell. PSAM predicted velocities multiplied by a factor of 1.1.	III.B.3.a.3 [1]	Acceptable.
d) Pool Swell Acceleration	Acceleration predicted by the PSAM. Pool acceleration is utilized in the calculation of acceleration loads on submerged components during pool swell.	III.B.3.a.4 [1]	Acceptable.
e) Wetwell Air Compression	Wetwell air compression is calculated by PSAM.	II.A.2 [2]	Acceptable.
f) Drywell Pressure	Methods of NEDM-10320 and NEDO-20533 Appendix B. Utilized in PSAM to calculate pool swell loads.	III.B.3.a.6 [1]	Acceptable.

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Table H-1 (Continued)

Load or Phenomenon	Mark II Owners Group Load Specification	NRC Evaluation	WNP-2 Position on Acceptance Criteria
2. Loads on Submerged Boundaries	Maximum bubble pressure predicted by the PSAM added uniformly to local hydrostatic below vent exit (walls and basemat) linear attentuation to pool surface. Applied to walls up to maximum pool elevation.	III.B.3.b [1]	Acceptable.
3. Impact Loads			
a) Small Structures	1.35 x Pressure-Velocity correlation for pipes and I beams based on PSTF impulse data and flat pool assumption. Variable pulse duration.	III.B.3.c.1 [1]	Acceptable.
b) Large Structures	None - Plant-unique load where applicable.	III.B.3.c.6 [1] Criteria A.5 [3]	Acceptable. WNP-2 has no large structures in the pool swell zone.
c) Grating	No impact load specified. P drag vs. open area correlation and velocity vs. elevation history from the PSAM. P drag multiplied by dynamic load factor.	III.B.3.c.3 [1] Criteria A.3 [3]	Acceptable.
4. Wetwell Air Compression			
a) Wall Loads	Direct application to the PSAM calculated pressure due to wetwell compression.	III.B.3.d.1 [1]	Acceptable.
b) Diaphragm Upward Loads	5.2 psid for diaphragm loadings only.	2.12.7 [3]	Acceptable.

Table H-1 (Continued)

Load or Phenomenon	Mark II Owners Group Load Specification	NRC Evaluation	WNP-2 Position on Acceptance Criteria
5. Asymmetric Pool LOCA	Use 20 percent of maximum pressure statistically applied to 1/2 of the submerged bubble.	Criteria A-4 [3] II.A.3 [2]	Acceptable.
C. Steam Condensation and Chugging Loads			
1. Downcomer Lateral Loads			
a) Single Vent Loads (24 in.)	Use single vent dynamic lateral load developed in NEDE-23806.	2.3.3.2 [3] Criteria B.1.a [3]	Acceptable.
b) Multiple Vent Loads (24 in.)	Use multivent dynamic lateral load developed in NEDE-24106-P and NEDE-24794-P.	2.3.3.3 [3]	Acceptable
c) Single/Multiple Vent Loads (28 in.)	Multiply basic vent loads by factor f=1.34.	2.3.2.1 [3] B.1.b [3]	Acceptable
2. Submerged Boundary Loads			
a) High/Medium Steam Flux Condensation Oscillation Load	Use method described in NEDE-24288-P[4].	2.2.2.1.3 [3]	C.O. loads are not governing design condition for WNP-2.
b) Low Steam Flux Chugging Loads	Representative pressure fluctuation taken from 4TCO (NEDE-24285-P) test added to local hydrostatic.	2.2.2.3 [3]	Plant unique. chugging report entitled "Chugging Loads-Revised Definition and Application Methodology for Mark II Containments" submitted July, 1981.

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Table H-1 (Continued)

Load or Phenomenon	Mark II Owners Group Load Specification	NRC Evaluation	WNP-2 Position on Acceptance Criteria
b) Low Steam Flux Chugging Loads (continued)			
- Uniform loading conditions	Use method described in NEDE-24302-P[4]		See previous page.
- Asymmetric loading	Representative pressure fluctuation taken from 4TCO test [NEDE-24285-P] applied as described in NEDE-24822-P.		See previous page.
II. SRV-Related Hydrodynamic Loads			
A. Pool Temperature Limits for X-quencher	210 degrees Fahrenheit.	NRC Criteria II.1 and II.3 [1]	Acceptable.
B. Quencher Air Clearing Loads	Mark II plants utilizing the four arm quencher, use quencher load methodology described in DFFR.	Criteria II.2 [1]	WNP-2 Plant unique SRV (X-quencher) load report entitled "SRV Loads - Definition and Application Methodology for Mark II Containments" submitted August, 1980.
C. Quencher Arm and Tie-Down Loads	Includes vertical and lateral arm load transmitted to the basemat via the tie-down.	III.C.2.e.2 [1]	Acceptable.
1) X-quencher Arm loads	Vertical and lateral loads developed on the basis of bounding assumption for air/water discharge from the quencher and conservative combinations of maximum/minimum bubble pressure acting on the quencher.	III.C.2.e.1	Acceptable.

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Table II-1 (Continued)

Load or Phenomenon	Mark II Owners Group Load Specification	NRC Evaluation	WNP-2 Position on Acceptance Criteria
2. X-quencher Tie-down Loads	II.C.1 above plus vertical transient wave and thrust loads. Thrust load calculated using a standard momentum balance. Vertical and lateral moments for air or water clearing are calculated based on conservative clearing assumptions.	III.C.2.e.2 [1]	Acceptable.
III. LOCA/SRV Submerged Structure Loads			
A. SRV Air Bubble Loads			
1. Standard Drag in Accelerating Flow Fields	Drag Coefficients are presented in Attachment 1.k of the Zimmer FSAR.	Acceptable with the following modification: 1) Use $C_H = C_M - 1$ in the F_A formula. 2) For noncylindrical structures use lift coefficient for appropriate shape or $C_L = 1.6$ 3) The standard drag coefficient for pool swell and SRV oscillating bubbles should be based on data for structures with sharp edges.	Generic "drag load" methodology acceptable. Plant unique flow fields are consistent with II.B of this table. Amplitudes for SRV loads verified by CAORSO data on submerged structures (See DAR Appendix I).

Table H-1 (Continued)

Load or Phenomenon	Mark II Owners Group Load Specification	NRC Evaluation	WNP-2 Position on Acceptance Criteria
2. Equivalent Uniform Flow Velocity and Acceleration	Structures are segmented into small sections such that 1.0< L/D < 1.5. The loads are then applied to the geometric center of each segment.	Acceptable.	See III. A.1. above
3. Interference Effects	A detailed methodology is presented in Attachment 1.k of the Zimmer FSAR.	Acceptable.	See III. A.1. above
B. LOCA Jet Loads	Calculated by the Ring Vortex Model.	2.2.4.3 [3]	Acceptable
C. Steam Condensation Drag Loads	No generic load methodology provided.	WNP-2 load specification and NRC review is addressed in WNP-2 SER.	Generic "drag load" methodology acceptable. Plant unique flow fields are consistent with I.C.2.a and I.C.2.b of this table. (See DAR Appendix 1).
IV. Secondary Loads			
A. Sonic Wave Load	Negligible Load - none specified.	Acceptable.	Acceptable.
B. Compressive Wave Load	Negligible Load - none specified.	Acceptable.	Acceptable.
C. Post Swell Wave Load	No generic load provided.	Plant unique load specification addressed in WNP-2 SER.	See DAR Pg.M020.44-1
D. Seismic Slosh Load	No generic load provided.	Plant unique load specification addressed in WNP-2 SER.	See DAR Pg.M020-44-1

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Table H-1 (Continued)

Load or Phenomenon	Mark II Owners Group Load Specification	NRC Evaluation	WNP-2 Position on Acceptance Criteria
E. Fallback load on Submerged Boundary	Negligible Load - none specified.	Acceptable.	Acceptable.
F. Thrust Loads	Momentum balance.	Acceptable.	Acceptable.
G. Friction Drag Loads on Vents	Standard friction drag calculations.	Acceptable.	Acceptable.
H. Vent Clearing Loads	Negligible Load - none specified.	Acceptable.	Acceptable.

NOTES TO TABLE

[1] NRC Acceptance Criteria set forth in NUREG-0487.

[2] NRC Acceptance Criteria set forth in Supplement 1 of NUREG-0487.

[3] NRC Acceptance Criteria set forth in NUREG-0808.

[illegible]