3E.3 Essential Service Water Buildings

Description of the Essential Service Water Building Analysis and Design

Four Essential Service Water Buildings (ESWB) are located adjacent to the NI Common Basemat Structures and in the general vicinity of the Emergency Power Generating Buildings (EPGB).

Cross sections and plans associated with each typical ESWB are provided in Section 3.8.4, Figure 3.8-95, Figure 3.8-96, Figure 3.8-97, Figure 3.8-98, Figure 3.8-99, Figure 3.8-100, Figure 3.8-101, and Figure 3.8-102. A general description of the structure, including descriptions of functional equipment at all floor levels, is provided in Section 3.8.4.1.5.

The lateral load resisting system primarily consists of interior and exterior reinforced concrete shear walls and a concrete basemat foundation situated at approximately 33 ft 0 in below grade. The structural elements pertaining to the ESWBs are described in Sections 3.8.4.1.5 and 3.8.5.1.3.

The list of ESWB critical sections is shown in Table 3E.3-1—Essential Service Water Building Critical Sections.

Materials

Concrete for the ESWB will have compressive strength f'_c = 5000 psi (minimum), modulus of elasticity, E= 4031 ksi, shear modulus, G = 1722 ksi, and Poisson's ratio is 0.17.

Reinforcing Steel – deformed steel bars conforming to ASTM A615 Grade 60 with minimum yield strength of F_y = 60 ksi, and minimum tensile strength F_u = 90 ksi. Minimum bar elongation is based on ASTM A615.

Structural Steel – conforms to the requirements specified in Table 3.8-8.

Floor Live and Dead Load Distribution

Dead loads include self weight of the structure, platforms, electric equipment, conduits, small bore pipes, and permanent equipment loads. Live loads include design live load. Design snow loads are provided in Section 3.8.4.3.1 and Table 2.1-1.

- Concrete self weight - based on concrete density of 150 pcf.
- Beams self weight – based on cross section area and concrete density of 150 pcf.
- Uniform floor live load = 100 psf.
- Pump area slab live load at El. 14'-0" = 100 psf.

- Fan deck live load at El. 63'-0" = 100 psf.
- Walkways and access areas live load at El. 14'-0" = 100 psf.
- Steel beam and grating load at El. 80'-0" = 4.1 kip/ft.
- Missile shield load at El. 80'-0" = 4.5 kip/ft.

Equipment Loads

The weight of all major equipment is applied as point load throughout the building.

Equipment	Elevation	Weight (kips)
Fan	63'-0"	85.00 each
Fill	47'-0"	953.4 each
Eliminator	47'-0"	54.00 each
Equipment in pump area	14'-0"	41.50
Pumphouse platform	33'-0"	93.00
6.9KV Switchgear	33'-0"	10.00
6.9KV/480V Transformer	33'-0"	9.00
480V LC Switchgear	33'-0"	6.00
480V MCC	33'-0"	3.00

Foundation Stability

The ESWB is evaluated for stability against overturning, sliding, and floatation for the generic soil profiles used in establishing the certified plant design. The minimum and calculated factors of safety against overturning, sliding, and floatation are shown in Table 3E.3-2—Minimum Factors of Safety for the Essential Service Water Building and satisfy the acceptance criteria.

The sliding and overturning factors are determined using load combination containing dead load (D), lateral earth pressure (H), SSE (E'), hydrostatic load (F), and buoyant force (F_b). It is conservatively assumed that the E' and F_b occur simultaneously. The floatation factor of safety is determined based on dead load (D) and buoyant force (F_b). The dead load used in the analysis includes 25 percent of the live load, which is consistent with the generation of total base shear resultants and total overturning moment due to SSE. For uniformity of site characteristics, the minimum static and dynamic bearing capacity of the foundation soil is the same as the NI. The static and dynamic bearing pressure demands for the ESWB are shown in Table 3E.3-3—Static and Dynamic Bearing Pressure Demands for the Essential Service Water Building.

Design Criteria

SSI analysis using MTR/SASSI is used to determine enveloping structural response accelerations for development of equivalent static SSE loads for the GTSTRUDL FEM.

The use of GTSTRUDL for the design of the critical sections is described in Sections 3.8.4.4.4 and 3.8.5.4.4. Design forces and moments are extracted from GTSTRUDL analyses for basemat foundation and superstructure component design.

All applicable loads used for the design of the critical sections located within the ESWBs are described in Sections 3.8.4.3.1 and 3.8.5.3; the applicable loading combinations are described in Sections 3.8.4.3.2 and 3.8.5.3. The design also accommodates the soil analysis cases shown in Table 3.7.1-6.

Reinforced concrete components are designed in accordance with the applicable codes, standards, and specifications described in Sections 3.8.4.2 and 3.8.5.2.

Table 3E.3-1—Essential Service Water Building Critical Sections

CS No.	Description of Critical Section
CS-32	Basemat Foundation at Elevation -16 ft 0 in
CS-33	Shear Wall on Column Line 4
CS-34	Fan Deck Slab at Elevation 63 ft 0 in
CS-35	Shear Wall on Column Line D

Table 3E.3-2—Minimum Factors of Safety for the Essential Service Water Building

Soil Case	Sliding			Overturning			Flotation	
	Required	Calculated X-DIR	Calculated Y-DIR	Required	Calculated X-DIR	Calculated Y-DIR	Required	Calculated
2sn4u	1.1	1.19	1.15	1.1	1.75	1.28	1.1	2.8
5a	1.1	1.10	1.15	1.1	1.79	1.33	1.1	2.8
4u	1.1	1.10	1.19	1.1	1.64	1.40	1.1	2.8
1n2u	1.1	1.18	1.19	1.1	1.89	1.46	1.1	2.8
1n5a	1.1	1.10	1.28	1.1	1.64	1.38	1.1	2.8
hf_c	1.1	1.56	1.49	1.1	2.86	2.57	1.1	2.8
hf_s	1.1	2.32	2.86	1.1	3.85	3.50	1.1	2.8

Notes:

hf_c is a high frequency profile with concrete and hf_s is a high frequency profile with soil. See Table 3.7.1-9 for more information.

Table 3E.3-3—Static and Dynamic Bearing Pressure Demands for the Essential Service Water Building

Analysis Case	Dead Load plus Seismic Bearing Pressures (ksf)
1n2u	10.25
1n5a	11.88
2sn4u	11.08
4u	11.57
5a	11.82
HFS	8.79
HFC	10.36