ArevaEPRDCPEm Resource

From: BRYAN Martin (EXT) [Martin.Bryan.ext@areva.com]
Sent: Friday, March 12, 2010 5:06 PM
To: Tesfaye, Getachew
Cc: DELANO Karen V (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); ROMINE Judy (AREVA NP INC); VAN NOY Mark (EXT); GARDNER George Darrell (AREVA NP INC)
Subject: Response to U.S. EPR Design Certification Application RAI No. 335, FSAR Ch. 3, Supplement 1
Attachments: RAI 335 Supplement 1 Response US EPR DC.pdf

Getachew,

AREVA NP Inc. provided a schedule for a technically correct and complete response to RAI No. 335 on January 18, 2010. The attached file, "RAI 335 Supplement 1 Response US EPR DC.pdf" provides technically correct and complete responses to 3 of the remaining 6 questions, as committed. The response to Question 03.08.04-10 is deferred due to its dependency on results of work currently underway to support other responses on related topics.

Appended to this file are affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format which support the response to RAI 335 Questions 03.08.01-45, and 03.08.04-8.

The following table indicates the respective pages in the response document, "RAI 335 Supplement 1 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 335 — 03.08.01-45	2	2
RAI 335 — 03.08.01-46	3	3
RAI 335 — 03.08.04-08	4	5

The schedule for technically correct and complete responses to the remaining 3 questions has been changed and is provided below:

Question #	Response Date
RAI 335 — 03.08.01-44	August 13, 2010
RAI 335 — 03.08.04-09	June 4, 2010
RAI 335 — 08.08.04-10	August 13, 2010

Sincerely,

Martin (Marty) C. Bryan
Licensing Advisory Engineer
AREVA NP Inc.
Tel: (434) 832-3016
Martin.Bryan.ext@areva.com

From: DUNCAN Leslie E (AREVA NP INC)
Sent: Monday, January 18, 2010 3:24 PM
To: 'Tesfaye, Getachew'

Cc: BENNETT Kathy A (OFR) (AREVA NP INC); DELANO Karen V (AREVA NP INC)
Subject: Response to U.S. EPR Design Certification Application RAI No. 335, FSAR Ch. 3

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 335 Response US EPR DC.pdf" provides a schedule since technically correct and complete responses to the 6 questions are not provided.

The following table indicates the respective pages in the response document, "RAI 335 Response US EPR DC.pdf" that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 335 - 03.08.01-44	2	3
RAI 335 - 03.08.01-45	4	4
RAI 335 - 03.08.01-46	5	5
RAI 335 - 03.08.04-08	6	6
RAI 335 - 03.08.04-09	7	7
RAI 335 - 03.08.04-10	8	9

A complete answer is not provided for 6 of the 6 questions. The schedule for a technically correct and complete response to these questions is provided below.

Question #	Response Date
RAI 335 - 03.08.01-44	August 13, 2010
RAI 335 - 03.08.01-45	March 12, 2010
RAI 335 - 03.08.01-46	March 12, 2010
RAI 335 - 03.08.04-08	March 12, 2010
RAI 335 - 03.08.04-09	June 4, 2010
RAI 335 - 03.08.04-10	March 12, 2010

Sincerely,

Les Duncan
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AREVA NP Inc.
An AREVA and Siemens Company
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From: Tesfaye, Getachew [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Saturday, December 05, 2009 6:52 AM
To: ZZ-DL-A-USEPR-DL
Cc: Xu, Jim; Hawkins, Kimberly; Patel, Jay; Miernicki, Michael; Colaccino, Joseph; ArevaEPRDCPEm Resource
Subject: U.S. EPR Design Certification Application RAI No. 335 (4059, 4061),FSAR Ch. 3

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on November 30, 2009, and on December 4, 2009, you informed us that the RAI is clear and no further clarification is needed. As a result, no change is made to the draft RAI with the exception of typographical error correction in Draft RAI Question 03.08.04-8 identified by AREVA. The schedule we have established for review of your application assumes technically correct and complete responses within 30 days of receipt of RAIs, excluding the time period of **December 25, 2009 thru January 3, 2010, to account for the holiday season** as discussed with AREVA NP. For any RAIs that cannot be answered **within 40 days**, it is expected

that a date for receipt of this information will be provided to the staff within the 40-day period so that the staff can assess how this information will impact the published schedule.

Thanks,
Getachew Tesfaye
Sr. Project Manager
NRO/DNRL/NARP
(301) 415-3361

Hearing Identifier: AREVA_EPR_DC_RAIs
Email Number: 1233

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Response to

Request for Additional Information No. 335, Supplement 1

12/05/2009

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 03.08.01 - Concrete Containment
SRP Section: 03.08.04 - Other Seismic Category I Structures

Application Section: FSAR Section 3.8

QUESTIONS for Structural Engineering Branch 2 (ESBWR/ABWR Projects) (SEB2)

Question 03.08.01-45:

Follow-up to RAI Question 03.08.01-11

In the original RAI, AREVA was requested to provide a Design Summary report consistent with the guidance provided for such reports that is presented in Appendix C of SRP Section 3.8.4. AREVA has instead decided to include relevant design information and calculation results in Sections 2.0, 2.4, 2.5, 3.3, 3.5, 3.8.1 through 3.8.5, and Appendix 3E of the FSAR. The staff has a concern that the design information presented in this manner may not be complete and presents a difficulty in ensuring that it is also technically acceptable in accordance with the guidance provided in Appendix C of SRP 3.8.4. Therefore, AREVA is requested to provide the relevant design information in one of the following forms: (1) separate AREVA Design Report or calculation, (2) include all of the required design information in one area of the FSAR, or (3) provide a detailed cross-reference which identifies the specific FSAR subsections that contain the information corresponding to each item listed in Appendix C of SRP Section 3.8.4, for all Seismic Category I structures.

Response to Question 03.08.01-45:

As stated in U.S. EPR FSAR Tier 2, Sections 3.8.1.4.12, 3.8.2.4.3, 3.8.3.4.5, 3.8.4.4.6, and 3.8.5.4.5, design information and criteria for Seismic Category I structures are provided in multiple U.S. EPR FSAR sections, and design results for critical sections are provided in U.S. EPR FSAR Tier 2, Appendix 3E. Instead of providing a separate Design Report that contains information already in the U.S. EPR FSAR, option (3) of this question is selected. U.S. EPR FSAR Tier 2, Table 3.8-17 will be added to provide a cross-reference between the information in the U.S. EPR FSAR and information required by SRP Section 3.8.4, Appendix C. Design Report statements in U.S. EPR FSAR Tier 2, Sections 3.8.1.4.12, 3.8.2.4.3, 3.8.3.4.5, 3.8.4.4.6, and 3.8.5.4.5 will be revised to reference U.S. EPR FSAR Tier 2, Table 3.8-17.

Information required by SRP Section 3.8.4, Appendix C will be added to U.S. EPR FSAR Tier 2, Table 3.7.2-9 and Appendices 3E.1, 3E.2, and 3E.3.

Revised U.S. EPR FSAR Tier 2, Appendix 3E critical section design results with descriptions of loadings, analysis, modeling techniques, and design methods will be provided with the Response to RAI 155 Question 03.08.04-6. Cross-references to U.S. EPR FSAR Tier 2, Appendix 3E are provided for the critical sections design results.

FSAR Impact:

U.S. EPR FSAR Tier 2, Table 3.7.2-9, Table 3.8-17, Section 3.8.1.4.12, Section 3.8.2.4.3, Section 3.8.3.4.5, Section 3.8.4.4.6, Section 3.8.5.4.5, and Appendix 3E will be revised as described in the response and indicated on the enclosed markup.

Question 03.08.01-46:

Follow-up to RAI Question 03.08.01-17

AREVA provided the criterion/basis used to include only the equipment hatch, personnel air lock, site access opening (construction opening), and emergency air lock in the overall computer model of the RCB, as well as the methodology for evaluation of more refined submodels for the local design of the regions near these openings. It is not clear from the RAI response if submodels for the remaining smaller openings (i.e. main steam line, feed water line, and smaller) were also created.

To complete the response to this RAI, clarify whether submodels for the smaller openings (i.e. main steam line, feed water line, and smaller) were also created. If they were not, provide the technical basis for not doing so and indicate how the design of the regions near these smaller openings is performed.

Response to Question 03.08.01-46:

Main steam line (MSL), feedwater line, and smaller penetrations are not modeled in the global finite element analysis of the Reactor Containment Building (RCB). The MSL and feedwater penetration area of the RCB is a critical section associated with RAI 155 Question 03.08.04-6. AREVA NP is analyzing effects produced by including the MSL and feedwater line openings near the personnel airlock in the submodel that was created for the equipment hatch.

Structural effects of openings in the RCB are captured by modeling the larger penetrations in containment. Design of smaller penetrations will be performed later in the design process by combining the results of the finite element global model load cases at the penetration with local loads (i.e., pipe rupture loads and penetration dead load) not included in the finite element model (FEM) according to the appropriate load combinations. Local loads are determined through classical analysis methods. Once total forces at a penetration are determined, they are distributed to the RCB wall on either side of the penetration. The RCB is designed according to the provisions of ASME BPV Code, Section III, Division 2, Article CC-3000.

FSAR Impact:

The U.S. EPR FSAR will not be changed as a result of this question.

Question 03.08.04-8:

Follow-up to RAI Question 03.08.04-3

a. The response to Item 2 of the RAI describes a procedure for determining the live load effects on buried items such as pipe, pipe ducts, conduit, and duct banks. This procedure follows the "Guidelines for the Design of Buried Steel Pipe" (American Lifelines Alliance, 2001). Specific live loads described in this guideline document for trucks are based on AASHTO H20 and HS20 loads, and rail loads are based on Cooper E80 loads. Finally, it is noted that loads applied to buried items are considered soil loads (H), which have the same load factors as live loads in all applicable load combinations.

   In this regard, the staff points out that, according to FSAR Section 3.8.4.4.5: "The design of buried conduit and duct banks, and buried pipe and pipe ducts is site-specific." This section adds that "A COL applicant that references the U.S. EPR design certification will describe the design and analysis procedures used for buried conduit and duct banks, and buried pipe and pipe ducts, (...) will use results from site specific investigations to determine the routing of buried pipe and pipe ducts, (...and) will perform geotechnical analyses to determine if the surface load will cause lateral or vertical displacement of bearing soil for the buried pipe and pipe ducts and consider the effect of wide or extra heavy loads." Finally, this section refers to an internal report, ANP-10264NP "U.S. EPR Piping Analysis and Pipe Support Design" (AREVA NP, 2006), for additional guidance on analysis and design procedures applicable to buried piping.

   To complete the response to Item 2 of the RAI, include the information provided in the RAI response in the relevant sections of the FSAR. In addition, if the procedures described in "Guidelines for the Design of Buried Steel Pipe" will be used during the detailed design phase, then this should be clearly stated in the FSAR. The staff will evaluate the adequacy of these procedures on a case-by-case basis during the COL application.

b. The response to Item 3 of the RAI indicates that National Climatic Data Center maps show an average "air temperature" that ranges from approximately 40°F to 70°F for the central and eastern portions of the U.S. Given this range, a ground temperature of 50°F was selected to account for the average temperatures.

   The staff notes that the mention of "air temperature" in the response appears to be an error since the RAI referred to "ground temperature." Clarify this inconsistency. Furthermore, provide the technical basis for using an average value of 50°F instead of considering the whole range, 40°F to 70°F, in the design.

Response to Question 03.08.04-8:

a) U.S. EPR FSAR Tier 2, Section 3.8.4.4.5 will be revised to incorporate information provided in the Response to RAI 155 Supplement 3, Question 03.08.04-3, part 2. This information is taken from Topical Report ANP-10264NP-A, "U.S. EPR Piping Analysis and Pipe Support Design," Section 3.10 and provides the surface traffic surcharge loads and method for determining the pressure acting on a buried pipe as a result of these loads.

b) The term “ground temperature” in U.S. EPR FSAR Tier 2, Section 3.8.4.3.1 refers to the average temperature of the soil as a function of depth below the ground surface. Air temperature was provided in the Response to RAI 155 Supplement 3, Question 03.08.04-3 because soil temperature below ground surface is a function of such factors as air temperature and its variation with time, and the thermal properties of the soil.

   A value of 50°F for ground temperature is based on the following three factors:

   - The temperature of soil at depths greater than ten feet is a constant 50°F to 55°F.
   - The average air temperature at the ground surface ranges between 40°F and 70°F for the central and eastern U.S.
   - The thermal properties of the soil act to insulate it from the average low of 40°F and the average high of 70°F.

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 3.8.4.4.5 will be revised as described in the response and indicated on the enclosed markup.

U.S. EPR Final Safety Analysis Report Markups

Table 3.7.2-9—Soil Properties Associated With Different Generic Shear Wave Velocities

Shear Wave Velocity (ft/s)	Shear Wave Velocity (m/s)	Poisson's Ratio μ	Weight Density (pcf)	Weight Density (kN/m3)	S-Wave Damping (%)	Dynamic Shear Modulus (ksf)	Static Shear Modulus (ksf)
700	213	0.40	110	17.28	7	1668	834.2
820	250	0.40	110	17.28	7	2298	1149
1640	500	0.40	110	17.28	4	9193	4597
2625	800	0.40	115	18.07	2	24610	12310
3937	1200	0.40	120	18.85	1	57760	28880
5249	1600	0.40	125	19.64	1	107000	53500
13,123	4000	0.35	156	24.51	1	834500	417300

03.08.01-45

Notes:

1. P-wave damping is taken to be 1/3*S-wave damping.
2. When shear wave velocity varies linearly in a layer, other properties vary accordingly.
3. P-wave velocity = S-wave velocity*$[2(1-\mu)/(1-2\mu)]^{1/2}$.
4. Shear-wave velocities and S-wave damping values are strain compatible. Damping values do not exceed 15 percent.
5. Dynamic (best-estimate) shear modulus = mass density*S-wave velocity^2.
6. Static shear modulus is taken as half of the dynamic shear modulus.

03.08.01-45

~~pressure capacity reported is the median pressure capacity for the vertical plane section.~~

~~The equipment hatch cover and cylinder, shown inFigure 3.8-25—Equipment Hatch General Assembly has a cover ultimate pressure capacity based on ASME Section II, Part D material specification minimum required strengths and an elastic, perfectly plastic stress-strain relationship at 400°F. The internal pressure from containment is applied to the convex surface of the cover and non-embedded portion of the cylinder. The ultimate pressure capacity reported corresponds to ASME Service Level C stress limits for the hatch cover and cylinder.~~

3.8.1.4.12 Design Report

Design information and criteria for Seismic Category I structures are provided in Sections ~~2.0,~~ 2.4, 2.5, 3.3, 3.5, 3.7, 3.8.1, 3.8.2, 3.8.3, 3.8.4, and 3.8.5. Design results are presented in Appendix 3E for Seismic Category I structure critical sections. A cross-reference between U.S. EPR FSAR sections and information required by SRP Section 3.8.4, Appendix C is provided in Table 3.8-17.

3.8.1.5 Structural Acceptance Criteria

03.08.01-45

The limits for RCB allowable stresses, strains, deformations and other design criteria are in accordance with the requirements of Subsection CC-3400 of the ASME BPV Code, Section III, Division 2 and RG 1.136 (GDC 1, GDC 2, GDC 4, GDC 16, and GDC 50). This applies to the overall containment vessel and subassemblies and appurtenances that serve a pressure retaining function, except as noted in Section 3.8.2. Specifically, allowable concrete stresses for factored loadings are in accordance with Subsection CC-3420 and those for service loads are in accordance with Subsection CC-3430.

The limits for stresses and strains in the liner plate and its anchorage components are in accordance with ASME BPV Code, Section III, Division 2, Tables CC-3720-1 and CC-3730-1.

Limits for allowable loads on concrete embedments and anchors are in accordance with Appendix ~~B~~D of ACI-349-~~20~~06 (with exceptions stated in Section 3.8.1.2.1, Codes) and guidance given in RG 1.199.

Section 3.8.1.6 describes minimum requirements for concrete, reinforcing, post-tensioning tendons, and the liner plate system for the RCB.

A SIT is performed as described in Section 3.8.1.7.1.

The RCB is stamped to signify compliance with the ASME BPV Code Section III, Division 2.

The equipment hatch, airlocks, and construction opening closure cap and sleeve will be evaluated for the combinations of loads described in Section 3.8.2.3.2. Analyses and limits for the resulting stress intensities in the equipment hatch, airlocks, and the construction opening closure cap and sleeve will be designed in accordance with Articles NE-3130, NE-3200, NE-3325, and NE-3326 of Section III, Division 1 of the ASME BPV Code.

3.8.2.4.2 Piping, Electrical, and Fuel Transfer Tube Penetration Sleeves

The penetration sleeves are welded to the containment liner plate and are anchored to the RCB concrete shell. Penetration sleeves are subjected to various combinations of mechanical, thermal, and seismic loadings and will be evaluated for the combination of loads described in Section 3.8.2.3.2.

If the penetration sleeves are subjected to cyclic service, the associated peak stress intensities will be evaluated. The required analysis and associated stress intensity limits will be in accordance with Articles NE-3130 and NE-3200 of Section III, Division 1 of the ASME BPV Code.

3.8.2.4.3 Design Report

Design information and criteria for Seismic Category I structures are provided in Sections ~~2.0,~~ 2.4, 2.5, 3.3, 3.5, 3.7, 3.8.1, 3.8.2, 3.8.3, 3.8.4, and 3.8.5. Design results are presented in Appendix 3E for Seismic Category I structure critical sections. A cross-reference between U.S. EPR FSAR sections and information required by SRP Section 3.8.4, Appendix C is provided in Table 3.8-17.

03.08.01-45

3.8.2.5 Structural Acceptance Criteria

Structural acceptance criteria for steel containment items described in Section 3.8.2.1 are in accordance with Subsection NC and NE of the ASME BPV Code, Section III, Division 1, including allowable stress limits, strain limits, deformation limits, and factors of safety. These are augmented by the requirements of RG 1.57 (GDC 1, GDC 2, GDC 4, GDC 16, and GDC 50). Containment steel items not backed by concrete that are intended to resist pressure will be designed to meet the acceptance criteria for the load combinations listed in Section 3.8.2.3.2.

Steel items that are an integral part of the RCB pressure boundary will be designed to meet minimum leakage rate requirements. The leakage rate must not exceed the acceptable value indicated in the applicable technical specification.

The design and analysis methods, as well as the type of construction materials, are chosen to allow assessment of the capability of steel items to function properly throughout the plant life.

to these component supports in separate load cases to determine overall effects on the RB internal structures (GDC 4 and GDC 50). Worst-case accident pipe reaction loads are further evaluated in local designs of the component supports in the critical sections described in Appendix 3E. Concrete and steel members are designed to accommodate accident pipe reaction loads within the elastic range of their section strength.

Pipe break reaction, jet impingement, and missile loads (R_{rr}, R_{rj}, R_{rm}) are not applied to the overall ANSYS computer model because they do not result in global loadings on the RB internal structures. These loads are considered in local design of concrete walls and floors and steel members. As defined in Section 3.8.3.3.1 under the definitions of abnormal loads, dynamic load factors are applied when analyzing structures for the static equivalent of these loads. Elasto-plastic behavior may be assumed with appropriate ductility ratios, provided that excessive deflections do not result in the loss of function of any safety-related SSC. Appendix C of ACI 349-2001 is used to determine pipe break reactions, jet impingement, and missile impact impulsive and impactive loads. The design of the RB internal structures for these loads conforms to the procedures described in Section 3.5 for internally generated missiles. Section 3.5 also describes ductility limits that are met for impactive and impulsive loadings.

Local flood loads (F_a) are applied to walls and floors of the RB internal structures in the overall ANSYS computer model. Concrete and steel members are designed to accommodate these flood loads within the elastic range of their section strength.

3.8.3.4.5 Design Report

Design information and criteria for Seismic Category I structures are provided in Sections ~~2.0,~~ 2.4, 2.5, 3.3, 3.5, 3.7, 3.8.1, 3.8.2, 3.8.3, 3.8.4, and 3.8.5. Design results are presented in Appendix 3E for Seismic Category I structure critical sections. A cross-reference between U.S. EPR FSAR sections and information required by SRP Section 3.8.4, Appendix C is provided in Table 3.8-17.

3.8.3.5 Structural Acceptance Criteria

03.08.01-45

Limits for allowable stresses, strains, deformations, and other design criteria for reinforced concrete RB internal structures are in accordance with ACI 349-2001, and its appendices, including the exceptions specified in RG 1.142, with the exception that the shear strength reduction factor of 0.85 is used as allowed in ~~ACI 349-2006~~ACI 349-06 . The exceptions specified in RG 1.142 (GDC 1, GDC 2, GDC 4 and GDC 50) are considered.

Limits for allowable loads on concrete embedments and anchors are in accordance with ~~Appendix B of ACI 349-2006~~ACI 349-06 (Appendix D with exceptions stated in Section 3.8.1.2.1, "Codes") and guidance given in RG 1.199.

Concrete components of buried items will be designed in accordance with ACI 349-2001, including the exceptions specified in RG 1.142. Steel components of buried items will be designed in accordance with ANSI/AISC N690-1994 (R2004), including Supplement 2.

Static and long-term analyses of buried items will be based on soil properties under consolidated drained conditions of the soil. Buried items will be designed for soil loads corresponding to the weight of the overlying soil prism.

Live loads will be applied, such as those imposed by truck and rail traffic and by construction equipment and activities. ~~Impact factors will be applied to live loads as appropriate.~~ Where buried items are vulnerable to highway or railway traffic loads, the potential for fatigue-induced failure will be evaluated. The minimum burial depth of buried items will conform to guidance from ASME 31.4 and ASME 31.8.

03.08.04-8

The pressure transmitted to a buried component by surface traffic live load is determined according to Boussinesq's equation:

$$P_P = 0.48 \frac{P_S}{H^2 \left[1 + \left(\frac{d}{H} \right)^2 \right]^{2.5}}$$

Where:

P_p = surface load transmitted to the buried item.

d = offset distance from the surface load to buried item.

H = thickness of soil cover above the item.

P_s = concentrated surface load.

The calculated value of P_p is multiplied by an impact factor which can be found in the AREVA NP Topical Report "U.S. EPR Piping Analysis and Pipe Support Design." For the U.S. EPR, specific live loads for trucks are based on the AASHTO H20 and HS20 trucks. In addition, rail loads are based on the Cooper E80 railway loads, but may be controlled by anticipated shipping weights. Recommended surface loads transmitted to the buried components (Pp) for the AASHTO H20/HS20 truck and Cooper E80 railway loads can be found in the Topical Report.

For the U.S. EPR, the load for buried components is considered an equivalent soil load. The same load factors are applied for live load and soil load in all applicable soil loads so the net effects for buried components are the same.

A COL applicant that references the U.S. EPR design certification will describe the design and analysis procedures used for buried conduit and duct banks, and buried pipe and pipe ducts.

A COL applicant that references the U.S. EPR design certification will use results from site-specific investigations to determine the routing of buried pipe and pipe ducts.

A COL applicant that references the U.S. EPR design certification will perform geotechnical engineering analyses to determine if the surface load will cause lateral or vertical displacement of bearing soil for the buried pipe and pipe ducts and consider the effect of wide or extra heavy loads.

3.8.4.4.6 Design Report

Design information and criteria for Seismic Category I structures are provided in Sections ~~2.0,~~ 2.4, 2.5, 3.3, 3.5, 3.7, 3.8.1, 3.8.2, 3.8.3, 3.8.4, and 3.8.5. Design results are presented in Appendix 3E for Seismic Category I structure critical sections. A cross-reference between U.S. EPR FSAR sections and information required by SRP Section 3.8.4, Appendix C is provided in Table 3.8-17.

03.08.01-45

3.8.4.5 Structural Acceptance Criteria

Limits for allowable stresses, strains, deformations and other design criteria for other Seismic Category I reinforced concrete structures are in accordance with ACI 349-2001 and its appendices, with the exceptions that the shear strength reduction factor of 0.85 is used as allowed in ACI 349-~~20~~06. (GDC 1, GDC 2, and GDC 4). Limits for concrete design include the exceptions specified in RG 1.142.

Limits for allowable loads on concrete embedments and anchors are in accordance with the requirements of ~~Appendix B of~~ ACI 349-~~2001~~06 (Appendix D with exceptions stated in Section 3.8.1.2.1, "Codes") and RG 1.199.

Limits for the allowable stresses, strains, deformations, and other design criteria for other structural steel Seismic Category I structures are in accordance with ANSI/AISC N690-1994 (R2004) including Supplement 2 (GDC 1, GDC 2, and GDC 4).

Allowable settlements for other Seismic Category I structures are described in Section 2.5.

The design of other Seismic Category I structures is generally controlled by load combinations containing SSE seismic loads. Stresses and strains are within the ACI 349-2001 limits, with the exceptions previously listed, and ANSI/AISC N690-1994 limits.

In addition, dynamic soil pressure and passive earth pressure have been considered for the below-grade walls, reflecting the total embedment depth of nominally 22 feet.

Similar to the approach for the EPGB, the foundation basemat is analyzed and designed using the GT STRUDL v.29.1 finite element analysis code. The finite element model contains both the building superstructure (i.e., reinforced concrete walls, slabs, and beams) and the foundation basemat. Analysis of the ESWB includes all applicable design loads and design load combinations described in Section 3.8.4.3. Figure 3.8-105—Essential Service Water Building Foundation Basemat Model illustrates the foundation basemat portion of the overall ESWB finite element model.

The GT STRUDL finite element model representing the ESWB foundation basemat consists of SBHQ6 rectangular elements, each with six degrees of freedom. This element type is capable of capturing both in-plane and out-of-plane behavior. Elastic boundary conditions are included in the finite element model in order to simulate the stiffness of the supporting soil. Basemat flexibility and SSI are addressed by inclusion of the basemat section properties and aforementioned soil spring boundary conditions in the finite element model. Illustrations of the complete finite element model representing the ESWB are provided in Section 3.7.2.

Detailed analysis and design procedures are described in the critical sections presented in Appendix 3E for the ESWBs.

3.8.5.4.5 Design Report

Design information and criteria for Seismic Category I structures are provided in Sections ~~2.0,~~ 2.4, 2.5, 3.3, 3.5, 3.7, 3.8.1, 3.8.2, 3.8.3, 3.8.4, and 3.8.5. Design results are presented in Appendix 3E for Seismic Category I structure critical sections. A cross-reference between U.S. EPR FSAR sections and information required by SRP Section 3.8.4 Appendix C is provided in Table 3.8-17.

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3.8.5.5 Structural Acceptance Criteria

Limits for allowable stresses, strains, deformations, and other design criteria for Seismic Category I concrete foundations are in accordance with ACI 349-01 and its appendices, with the exception that the shear reduction factor of 0.85 is used as allowed in ACI 349-06 (GDC 1, GDC 2 and GDC 4). Limits for concrete design include the exceptions specified in RG 1.142. In addition, the portion of the NI Common Basemat Structure foundation basemat that supports the RCB/RSB is in accordance with the ASME BPV Code and RG 1.1~~.~~36 for containment loadings as described in Section 3.8.1.

Limits for the allowable stresses, strains, deformations, and other design criteria for structural steel elements of Seismic Category I foundations are in accordance with ANSI/AISC N690-1994 (R2004), including Supplement 2 (GDC 1, GDC 2 and GDC 4).

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Table 3.8-17—Design Report Cross-Reference Table
Sheet 1 of 5

SRP Section 3.8.4, Appendix C	U.S. EPR FSAR Sections			
	Concrete Containment (Section 3.8.1)	Steel Containment (Section 3.8.2) & Concrete and Steel Internal Structures (Section 3.8.3)	Other Seismic Category I Structures (Section 3.8.4)	Foundations (Section 3.8.5)
II. Structural Description and Geometry				
1. Structural Geometry and Dimensions	Section 3.8.1.1	Sections 3.8.2.1, 3.8.3.1	Section 3.8.4.1	Section 3.8.5.1
2. Key Structural Elements and Description	Sections 3.8.1.1	Sections 3.8.2.1, 3.8.3.1	Section 3.8.4.1	Section 3.8.5.1
3. Floor Layout and Elevations	Figures 3.8-1 - 3.8-13	Figures 3.8-3 - 3.8-13, 3.8-32 - 3.8-37	Figures 3.8-3 - 3.8-13 (Reactor Shield Building); Figures 3.8-38 - 3.8-85 (Fuel Building and Safeguard Buildings); and Figures 3.8-89 - 3.8-102 (Emergency Power Generating Buildings and Essential Service Water Buildings)	Figures 3.8-11, 3.8-12, 3.8-13, 3.8-50, 3.8-51, 3.8-52, 3.8-63, 3.8-74, 3.8-85, 3.8-93, 3.8-94, 3.8-101, 3.8-102, 3.8-103 and 3.8-118
4. Conditions of Vicinity and Supports	Sections 3.8.1.1	Sections 3.8.2.1, 3.8.3.1	Section 3.8.4.1	Section 3.8.5.1
5. Special Structural Features	Section 3.8.1.1.2-Grouted Tendon System	Sections 3.8.3.1.9-Core Melt Retention Area, IRWST	Sections 3.8.4.1.1-Reactor Shield Building, Section 3.8.4.1.2-Fuel Building dual walls, Section 3.8.4.1.3-Safeguard Buildings 2 and 3 dual walls	None

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Table 3.8-17—Design Report Cross-Reference Table
Sheet 2 of 5

SRP Section 3.8.4, Appendix C		U.S. EPR FSAR Sections			
		Concrete Containment (Section 3.8.1)	Steel Containment (Section 3.8.2) & Concrete and Steel Internal Structures (Section 3.8.3)	Other Seismic Category I Structures (Section 3.8.4)	Foundations (Section 3.8.5)
III. Structural Material Requirements					
1. Concrete	A. Compressive Strength	Section 3.8.1.6.1, Table 3.8-2, Appendix 3E.1	Section 3.8.3.6.1, Appendix 3E.1	Section 3.8.4.6.1, Appendix 3E.1	Section 3.8.5.6.1, Appendices 3E.1
	B. Modulus of Elasticity	Table 3.8-2	Appendix 3E.1	Appendices 3E.1, 3E.2, 3E.3	Appendix 3E.1
	C. Shear Modulus	Section 3.8.1.6.1	Appendix 3E.1	Appendices 3E.1, 3E.2, 3E.3	Appendix 3E.1
	D. Poisson's Ratio	Table 3.8-2	Section 3.8.3.6.1	Section 3.8.4.6.1, same as 3.8.3.6.1	Section 3.8.5.6.1, same as 3.8.3.6.1
2. Reinforcement	A. Yield Stress	Table 3.8-2	Appendix 3E.1	Appendices 3E.1, 3E.2, 3E.3	Appendix 3E.1
	B. Tensile Strength	Appendix 3E.1	Appendix 3E.1	Appendices 3E.1, 3E.2, 3E.3	Appendix 3E.1
	C. Elongation	Appendix 3E.1	Appendix 3E.1	Appendices 3E.1, 3E.2, 3E.3	Appendices 3E.1
3. Structural Steel	A. Grade	Section 3.8.1.6.4	Section 3.8.3.6.3, Table 3.8-8	Section 3.8.4.6.1, Table 3.8-8	Section 3.8.5.6.1, Table 3.8-8
	B. Ultimate Tensile Strength	Appendix 3E.1	Table 3.8-8	Table 3.8-8	Table 3.8-8
	C. Yield Stress	Appendix 3E.1	Table 3.8-8	Table 3.8-8	Table 3.8-8

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Table 3.8-17—Design Report Cross-Reference Table
Sheet 3 of 5

SRP Section 3.8.4, Appendix C		U.S. EPR FSAR Sections			
		Concrete Containment (Section 3.8.1)	Steel Containment (Section 3.8.2) & Concrete and Steel Internal Structures (Section 3.8.3)	Other Seismic Category I Structures (Section 3.8.4)	Foundations (Section 3.8.5)
4. Prestressing Stage	A. Type of System	Section 3.8.1.1.2	N/A	N/A	N/A
	B. Description of Tendons	Sections 3.8.1.1.2, 3.8.1.6.3	N/A	N/A	N/A
	C. Description of Surcharge	Table 3.8-5	N/A	N/A	N/A
	D. Tendons and Sheeting Layout	Section 3.8.1.1.2, 3.8.1.6.3, Figures 3.8-18 and 3.8-19	N/A	N/A	N/A
	E. Dome Prestressing	Section 3.8.1.1.2	N/A	N/A	N/A
5. Foundation Media	A. General Description	Section 2.5, 3.7.1.3, Table 3.7.2-9			
	B. Unit Weight	Section 2.5.4.2; Table 3.7.2-9			
	C. Shear Modulus	Table 3.7.2-9			
	D. Angle of Internal Friction	Section 2.5.4.2, Table 2.1-1			
	E. Cohesion	Section 2.5.4.2			
	F. Bearing Capacity	Section 2.5.4.10.1, Table 2.1-1			
6. Special Considerations		None	None	None	None

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Table 3.8-17—Design Report Cross-Reference Table
Sheet 4 of 5

SRP Section 3.8.4, Appendix C	U.S. EPR FSAR Sections			
	Concrete Containment (Section 3.8.1)	Steel Containment (Section 3.8.2) & Concrete and Steel Internal Structures (Section 3.8.3)	Other Seismic Category I Structures (Section 3.8.4)	Foundations (Section 3.8.5)
IV. Structural Loads				
1. Live and Dead Load Floor Plans	Appendix 3E.1	Appendix 3E.1	Section 3.8.4.3.1, Appendices 3E.1, 3E.2 and 3E.3	Appendices 3E.1, 3E.2, 3E.3
2. Determination of Transient and Dynamic Loads	Section 3.8.1.3.1, Figures 3.8-20 - 3.8-23 (accident thermal and pressure)	Section 3.8.3.3.1, Figures 3.8-20 and 3.8-21 (accident thermal and pressure)	Section 3.8.4.3.1 (thermal), Table 3.5-1 (missiles)	Section 3.8.5.3, same as 3.8.4.3.1
3. Manufacturer's Data on Equipment Loads	Appendix 3E.1	Appendix 3E.1	Appendices 3E.1, 3E.2 and 3E.3	Appendices 3E.1, 3E.2, 3E.3
4. Environmental Loads	Sections 3.3, 3.7.1, 3.8.1.3.1, Figure 3.7.1-1, Tables 2.1-1, 3.7.2-10, Table 3.7.2-20	Sections 3.8.2.3.1, 3.8.3.3.1, Figure 3.7.1-1, Tables 2.1-1, 3.7.2-11, 3.7.2-19	Sections 2.4, 3.3, 3.8.4.3.1, Tables 2.1-1, 3.7.2-12 - 3.7.2-17, 3.7.2-21 - 3.7.2-25, 3.7.2-27, 3.7.2-28, Figures 3.7.1-1, 3.7.1-33 and 3.7-34	Sections 2.4, 3.3, Figure 3.7.1-1, Tables 2.1-1, 3.7.2-18
5. Torsional Effects	Table 3.7.2-20	Table 3.7.2-19	Tables 3.7.2-21 - 3.7.2-25	Table 3.7.2-26
V. Structural Analysis and Design				
1. Design Computations of Critical Elements	Appendix 3E.1.1, 3E.1.2 and 3E.1.3	Appendix 3E.1.4, 3E.1.5 and 3E.1.6	Appendix 3E.1.7, 3E.1.8, 3E.2 and 3E.3	Appendix 3E.1.9
2. Stability Calculations	Appendices 3E.1, 3E.2 and 3E.3			

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Table 3.8-17—Design Report Cross-Reference Table
Sheet 5 of 5

SRP Section 3.8.4, Appendix C	U.S. EPR FSAR Sections			
	Concrete Containment (Section 3.8.1)	Steel Containment (Section 3.8.2) & Concrete and Steel Internal Structures (Section 3.8.3)	Other Seismic Category I Structures (Section 3.8.4)	Foundations (Section 3.8.5)
3. Engineering Drawings Including Details of Connections and Joints	Figures 3E.1-3 - 3E.1-25	Figures 3E.1-26 - 3E.1-57	Figures 3E.1-58 - 3E.1-70, 3E.2-3 - 3E.2-12, 3E.3-3 - 3E.3-9	Figures 3E.1-71 - 3E.1-76
4. Discussion of Unique Features and Problem Resolution	None	None	None	None
VI. Summary of Results				
1. The Required Sections	Appendix 3E.1	Appendix 3E.1	Appendices 3E.1, 3E.2, 3E.3	Appendix 3E.1
2. The Provided Sections	Appendix 3E.1.1, 3E.1.2 and 3E.1.3	Appendix 3E.1.4, 3E.1.5 and 3E.1.6	Appendix 3E.1.7, 3E.1.8, 3E.2 and 3E.3	Appendix 3E.1.9
3. Breakdown of Individual Load Combinations	Appendix 3E.1.1, 3E.1.2 and 3E.1.3	Appendix 3E.1.4, 3E.1.5 and 3E.1.6	Appendix 3E.1.7, 3E.1.8, 3E.2 and 3E.3	Appendix 3E.1.9
4. Tabulation of Capacities of the Section Versus Capacities Required for Different Failure Modes (Bending, Shear, Axial Load)	Appendix 3E.1	Appendix 3E.1	Appendices 3E.1, 3E.2 and 3E.3	Appendix 3E.1
5. Margin of Safety Provided	Appendix 3E.1	Appendix 3E.1	Appendices 3E.1, 3E.2 and 3E.3	Appendix 3E.1

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3E Design Details and Critical Sections for Safety-Related Category I Structures

This appendix provides details of structural design and analysis for the critical sections relevant to Seismic Category I structures. Information is presented for the Nuclear Island (NI) Common Basemat Structures (3E.1), Emergency Power Generating Buildings (EPGB) (3E.2), and Essential Service Water Buildings (ESWB) (3E.3).

The following information is provided:

- Description of the critical section.
- Applicable loadings and design method.
- Results of structural analysis.

A COL applicant that references the U.S. EPR design certification will address critical sections relevant to site-specific Seismic Category I structures.

3E.1 Nuclear Island Structures

Description of Critical Sections in Nuclear Island Structures

The critical sections presented in this section are structures supported on the NI Common Basemat. This includes the Reactor Containment Building (RCB) containing the Reactor Building (RB) Internal Structure, the Fuel Building (FB), Safeguard Building (SB) 1, 2, 3, and 4 and the Reactor Shield Building (RSB).

The RCB is located inside of the reinforced concrete RSB, and is separated by an annular space to protect against interaction of the two structures when subjected to postulated design basis loading conditions. Figure 3.8-2, Figure 3.8-3, and Figure 3.8-4 show arrangements of the RCB. Figure 3.8.1.1 provides a description of the RCB.

The critical sections relating to the RCB consist of the following major structural elements:

- Reactor Containment Building—Wall to foundation connection (3E.1.1).
- Reactor Containment Building—Equipment hatch area (3E.1.2).
- Reactor Containment Building—Typical cylinder wall and buttress (3E.1.3).

The RB Internal Structures consist of concrete walls and floors, steel framing members, and other concrete and steel structural elements that are located inside of the RCB. Figure 3.8-32, Figure 3.8-33, Figure 3.8-34, Figure 3.8-35, Figure 3.8-36, and

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Materials

Concrete – conforms to the requirements specified in Sections 3.8.1.6.1, 3.8.3.6.1, 3.8.4.6.1, and 3.8.5.6.1 as summarized below:

	Compressive Strength f'_c (psi)	Modulus of Elasticity (ksi)	Shear Modulus (ksi)	Poisson's Ratio
Reactor Building	7000	4769	2038	0.17
RB Internal Structures	6000	4415	1887	0.17
Other Seismic Category I Structures(1)	6000	4415	1887	0.17
Foundations	4000	3605	1541	0.17

Notes:

1. EPGB and ESWB concrete material requirements, except foundations, are included in Appendix 3E.2 and 3E.3, respectively.

Reinforcing Steel – deformed steel bars conforming to ASTM A615 Grade 60 with minimum yield strength of F_y = 60ksi, and minimum tensile strength F_u = 90 ksi. Minimum bar elongation in 8 inches is based on ASTM A615: 9 percent for bar No. 3 to 6; 8 percent for bar No. 7 and 8; and 7 percent for bar No. 9, 10, 11, 14, and 18.

Structural Steel – conforms to the requirements specified in Section 3.8.1.6.4, Section 3.8.3.6.3, and Table 3.8-8. Liner plate material conforms to SA-516, Grades 55 to 70, with minimum yield strength F_y = 30-38 ksi, and minimum tensile strength F_u = 55-90 ksi.

Floor Live and Dead Load Distribution

Dead and live floor loads are tabulated for each room in the Nuclear Island Common Basemat Structure. Loads are uniformly distributed and/or point loads with associated load application coordinates. Point loads less than 20 kips are accounted for in the uniformly distributed equipment dead and live loads, and loads over 20 kips are applied as point loads. In cases where equipment point loads less than 20 kips are applied to grating, loads are distributed over the area of the grating. Distributed dead and live loads are determined for each room. Concrete self weight is based on concrete density of 150 pcf. Precipitation loads are given in Table 2.1-1 and are not included in the floor live loads. Pool loads are also determined separately.

The following distributed loads are applied to the floors of the Safeguard Buildings:

- Uniformly distributed slab load (live) = 125 psf.

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- Uniformly distributed slab load (dead) = 125 psf.
- Uniformly distributed grating load (live) = 175 psf.
- Uniformly distributed grating load (dead) = 25 psf.
- Uniformly distributed wall load (dead) = 25 psf.

The following distributed loads are applied to the floors of the Fuel Building:

- Uniformly distributed slab load (live) = 500 psf.
- Uniformly distributed slab load (dead) = 250 psf.
- Uniformly distributed grating load (live) = 175 psf.
- Uniformly distributed grating load (dead) = 25 psf.
- Uniformly distributed wall load (dead) = 25 psf.

The following distributed loads are applied to the floors of the Reactor Building:

- Uniformly distributed slab load (live) = 500 psf.
- Uniformly distributed slab load (dead) = 250 psf.
- Uniformly distributed grating load (live) = 175 psf.
- Uniformly distributed grating load (dead) = 25 psf.
- Uniformly distributed wall load (dead) = 50 psf.

Table 3E.1-38 provides the distribution of the dead and live floor loads in each building.

Equipment Loads

The weight of major equipment, switchgears, heat exchanges, pumps, conduits, exhaust, pipes, elevators, fans, tanks, filters, and cranes is accounted for in the floor loads and is applied as point load throughout the buildings based on location. Some of the major equipment loads are as follows:

Equipment	Elevation/Location	Weight (kips)
Crane SMF03	UFA29-090	137
Crane SMF02	UFA10-069	407
Polar crane	UJA40-001	1180
Reactor pressure vessel (RPV)	4’-11”	3768
Steam generator (SG)	4’-11”	1776 each

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Reactor coolant pump (RCP)	4'-11"	474 each
Pressurizer (PZR)	UJA23-019	639
Equipment hatch	64'-0"	154
Air lock	4'-11"; 64'-0"	61 each

Foundation Stability

The Nuclear Island Common Basemat Structure is evaluated for stability against overturning, sliding, and floatation for the generic soil profiles used in establishing the certified plant design. The calculated factors of safety against overturning, sliding, and floatation satisfy the acceptance criteria.

Minimum Factors of Safety

Sliding		Overturning		Floatation	
Required	Calculated	Required	Calculated	Required	Calculated
1.10	1.45	1.10	1.61	1.10	5.73

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 (Fb). It is conservatively assumed that the E' and Fb occur simultaneously. The floatation factor of safety is determined based on dead load (D) and buoyant force (Fb). The dead load used in the analysis includes 25 percent of the live load, which is consistent with the generation of dynamic soil pressure due to SSE.

The maximum foundation edge pressure when seismic loads are included is found to be 31203 psf.

Design Criteria

Sections 3.8.1.2, 3.8.2.2, 3.8.3.2, 3.8.4.2, and 3.8.5.2 describe codes, standards, and specifications applicable to the design of the RCB (Concrete), RCB (Steel), RB internal structures, RSB, and NI foundation basemat, respectively.

A global ANSYS Finite Element Model (FEM) (addressed in Sections 3.8.1.4.1, 3.8.3.4.1, 3.8.4.4.2, and 3.8.5.4.2) is developed and loaded with various independent loads and load combinations per the applicable codes and standards and solved to produce forces and moments throughout the structure. Sections 3.8.1.3, 3.8.2.3, 3.8.3.3, 3.8.4.3, and 3.8.5.3 describe loads and loading combinations applicable to the design of NI Common Basemat Structures.

The independent loads shown in Table 3E.1-1—Independent Loads Considered in the FEM, are applied to the NI common basemat global ANSYS FEM to analyze and evaluate the overall structural response of the NI Common Basemat Structures as described in Section 3.8.1.4, 3.8.2.4, 3.8.3.4, 3.8.4.4, and 3.8.5.4. Additional loads

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Table 3E.1-38—Floor Dead and Live Loads
Sheet 1 of 27

Elevation	Room Number	Magnitude of Load Metric (kN)	Magnitude of Load US (kips)	Load Description	Load Type	Application X-Coordinate Metric (m)	Application X-Coordinate US (ft)	Application Y-Coordinate Metric (m)	Application Y-Coordinate US (ft)	Area Dead Load (psf)	Area Live Load (psf)
SAFEGUARD BUILDING DIVISION 1											
-9.60M (-31.5ft)	1UJH01-002	122.33	27.50	point	dead	-31.85	-104.50	11.12	36.50		
	1UJH01-006	110.76	24.90	point	dead	-32.92	-108.00	-2.16	-7.10		
	1UJH01-024	104.53	23.50	point	dead	-45.17	-148.20	3.35	11.00		
	1UJH01-026	141.90	31.90	point	dead	-47.40	-155.50	-9.45	-31.00	150	
	1UJH01-008									200	
	1UJH01-005									125	
	1UJH01-027									150	
-5.00M (-16.4ft)	1UJH05-005	233.98	52.60	point	dead	-36.58	-120.50	7.01	23.00		
	1UJH05-008									250	
	1UJH05-026									175	
0.00	1UJH10-001	160	35.97	point-- free action	live						
		170	38.22	point-- free action	live						
	1UJH10-026	415.02	93.30	point	dead	-47.40	-155.50	-5.79	-19.00	150	
		250	56.21	point-- free action	live						
		250	56.21	point-- free action	live						
	1UJH10-004									175	

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Table 3E.1-38—Floor Dead and Live Loads
Sheet 2 of 27

Elevation	Room Number	Magnitude of Load Metric (kN)	Magnitude of Load US (kips)	Load Description	Load Type	Application X-Coordinate Metric (m)	Application X-Coordinate US (ft)	Application Y-Coordinate Metric (m)	Application Y-Coordinate US (ft)	Area Dead Load (psf)	Area Live Load (psf)
+4.70M (+15.4ft)	1UJK14-025	160	35.97	point-- free action	live						
		120	26.98	point-- free action	live						
		120	26.98	point-- free action	live						
	1UJK14-026	150	33.72	point	live	-44.50	-146.00	-5.75	-18.86		
		100	22.48	point	live	-50.29	-165.00	-5.75	-18.86		
	1UJK14-027	130	29.23	point	live	-51.82	-170.00	-10.15	-33.30		
	1UJK14-029									175	
	1UJK14-028									225	
+8.10M (+26.6ft)	1UJK18-024									175	
	1UJK18-025									175	
	1UJK18-026	129.89	29.20	point	dead	-29.87	-98.00	5.49	18.00	225	
		97.42	21.90	point	dead	-31.70	-104.00	12.50	41.00		
	1UJK18-027	104.53	23.50	point	dead	-48.16	-158.00	5.49	18.00	200	
+12.00M (39.4ft)	1UJK22-028	86.30	19.40	point	dead	-47.40	-155.50	-6.40	-21.00	150	
	1UJK22-030									150	
	1UJK22-039									150	
	1UJK22-047									175	
	1UJK22-057									175	

Table 3E.1-38—Floor Dead and Live Loads
Sheet 3 of 27

Elevation	Room Number	Magnitude of Load Metric (kN)	Magnitude of Load US (kips)	Load Description	Load Type	Application X-Coordinate Metric (m)	Application X-Coordinate US (ft)	Application Y-Coordinate Metric (m)	Application Y-Coordinate US (ft)	Area Dead Load (psf)	Area Live Load (psf)
	1UJK22-046									175	
	1UJK22-056									175	
	1UJK22-042									175	
	1UJK22-043									175	
	1UJK22-044									175	
	1UJK22-052									175	
	1UJK22-053									175	
	1UJK22-054									175	
	1UJK22-045									175	
	1UJK22-055									175	
+16.80M (55.1ft)	1UJK26-028	100	22.48	point-- free action	live						
	1UJK26-030	89.45	20.11	point	dead	-35.87	-117.70	11.96	39.25	200	
	2UJE26-001	130.24	29.28	point	dead	-30.97	-101.60	12.34	40.50	150	
+21.00M (68.9ft)	1UJK31-030									150	
	1UJE26-001									175	
	2UJE26-001									150	
	1UJE29-002	207.38	46.62	point	dead	-35.59	-116.75	-3.11	-10.20		
	2UJE29-002	207.38	46.62	point	dead	-35.59	-116.75	3.11	10.20		
+24.70M (+81.0ft)	2UJE34-003									225	

Table 3E.1-38—Floor Dead and Live Loads
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Elevation	Room Number	Magnitude of Load Metric (kN)	Magnitude of Load US (kips)	Load Description	Load Type	Application X-Coordinate Metric (m)	Application X-Coordinate US (ft)	Application Y-Coordinate Metric (m)	Application Y-Coordinate US (ft)	Area Dead Load (psf)	Area Live Load (psf)
	1UJK34-025									175	
	1UJK34-031									225	
	1UJE34-002									125	
	2UJE34-002									125	
	1UJE34-023	160	35.97	point	dead	-48.62	-159.51	9.38	30.77	325	
+29.30M (96.1ft)	1UJE39-001	92.08	20.70	point	dead	-30.11	-98.80	-4.51	-14.80	75	100
	2UJE39-001	92.08	20.70	point	dead	-30.11	-98.80	4.57	15.00	75	100
		100	22.48	point-- free action	live	-43.34	-142.19	10.05	32.97		
SAFEGUARD BUILDING DIVISION 2/3											
-9.60M (-31.5ft)	2UJH01-007	122.33	27.50	point	dead	-17.83	-58.50	27.22	89.30		
	2UJH01-009	110.76	24.90	point	dead	-3.35	-11.00	30.21	99.10		
	2UJH01-020	141.90	31.90	point	dead	-15.09	-49.50	46.02	151.00	150	
	2UJH01-024	118.32	26.60	point	dead	-3.20	-10.50	45.05	147.80		
	3UJH01-007	122.33	27.50	point	dead	17.80	58.40	27.22	89.30		
	3UJH01-009	110.76	24.90	point	dead	3.29	10.80	30.21	99.10		
	3UJH01-020	141.90	31.90	point	dead	14.78	48.50	45.11	148.00	150	
	3UJH01-024	118.32	26.60	point	dead	3.05	10.00	45.05	147.80		
	2UJH01-011									225	
	3UJH01-011									225	

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Table 3E.1-38—Floor Dead and Live Loads
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Elevation	Room Number	Magnitude of Load Metric (kN)	Magnitude of Load US (kips)	Load Description	Load Type	Application X-Coordinate Metric (m)	Application X-Coordinate US (ft)	Application Y-Coordinate Metric (m)	Application Y-Coordinate US (ft)	Area Dead Load (psf)	Area Live Load (psf)
-5.00M (-16.4ft)	2UJH05-006	233.98	52.60	point	dead	-14.73	-48.50	35.60	116.00	150	
	3UJH05-006	233.98	52.60	point	dead	14.48	47.50	35.60	116.00	150	
	2UJH05-020									175	
	3UJH05-020									175	
0.00	2UJH10-003	250	56.21	point-- free action	live						
	3UJH10-003	250	56.21	point-- free action	live						
	2UJH10-006	250	56.21	point-- free action	live						
	2UJH10-010	260	58.45	point-- free action	live						
										125	
	2UJH10-020	123.66	27.80	point	dead	-15.70	-51.50	45.11	148.00	150	
		415.02	93.30	point	dead	-12.04	-39.50	45.72	150.00		
		250	56.21	point-- free action	live						
	3UJH10-006	250	56.21	point-- free action	live						
	3UJH10-020	123.66	27.80	point	dead	16.92	55.50	45.11	148.00	150	
		415.02	93.30	point	dead	12.04	39.50	45.72	150.00		

Table 3E.1-38—Floor Dead and Live Loads
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Elevation	Room Number	Magnitude of Load Metric (kN)	Magnitude of Load US (kips)	Load Description	Load Type	Application X-Coordinate Metric (m)	Application X-Coordinate US (ft)	Application Y-Coordinate Metric (m)	Application Y-Coordinate US (ft)	Area Dead Load (psf)	Area Live Load (psf)
		250	56.21	point-- free action	live						
	2UJH10-002									150	
	3UJH10-002									150	
+4.70M (+15.4ft)	2UJK14-002	160	35.97	point-- free action	live						
	3UJK14-002	160	35.97	point-- free action	live						
+8.10M (+26.6ft)	2UJK18-005									175	
	3UJK18-005									175	
	2UJK18-020									200	
	3UJK18-020									200	
	2UJK18-002	104.53	23.50	point	dead	-22.25	-73.00	25.91	85.00	200	
	3UJK18-002	104.53	23.50	point	dead	23.47	77.00	25.91	85.00	200	
	2UJK18-029									150	
	3UJK18-029									150	
+12.00M (+39.4ft)	2UJK22-028									200	
	3UJK22-028									200	
+16.30M (+53.5ft)	2UJK26-002									225	
	3UJK26-002									225	
	2UJK26-020									175	

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Table 3E.1-38—Floor Dead and Live Loads
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Elevation	Room Number	Magnitude of Load Metric (kN)	Magnitude of Load US (kips)	Load Description	Load Type	Application X-Coordinate Metric (m)	Application X-Coordinate US (ft)	Application Y-Coordinate Metric (m)	Application Y-Coordinate US (ft)	Area Dead Load (psf)	Area Live Load (psf)
	3UJK26-020									175	
	2UJK26-030									225	
	2UJK26-046									225	
	3UJK26-005									225	
+21.00M (+68.9ft)	2UJK31-007									150	
	3UJK31-007									150	
	2UJK31-026									150	
	3UJK31-026									150	
	2UJK31-035									150	
	3UJK31-035									150	
	2UJK31-034									150	
	3UJK31-034									150	
	2UJK31-003									150	
	3UJK31-003									150	
	2UJK31-032									150	
	3UJK31-032									150	
	2UJK31-029									150	
	3UJK31-029									150	
	2UJK31-021	160	35.97	point	dead	-20.01	-65.65	47.16	154.72		
	3UJK31-021	160	35.97	point	dead	20.01	65.65	47.16	154.72		

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Table 3E.1-38—Floor Dead and Live Loads
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Elevation	Room Number	Magnitude of Load Metric (kN)	Magnitude of Load US (kips)	Load Description	Load Type	Application X-Coordinate Metric (m)	Application X-Coordinate US (ft)	Application Y-Coordinate Metric (m)	Application Y-Coordinate US (ft)	Area Dead Load (psf)	Area Live Load (psf)
+28.80M (+94.5ft)										75	100
SAFEGUARD BUILDING DIVISION 4											
-9.60M (-31.5ft)	4UJH01-002	122.33	27.50	point	dead	31.49	103.30	11.13	36.50		
	4UJH01-006	110.76	24.90	point	dead	32.61	107.00	-2.16	-7.10		
	4UJH01-024	104.53	23.50	point	dead	45.11	148.00	3.35	11.00		
	4UJH01-026	141.90	31.90	point	dead	46.18	151.50	-9.45	-31.00	150	
	4UJH01-005									125	
	4UJH01-008									200	
	4UJH01-027									150	
-5.00M (-16.4ft)	4UJH05-005	233.98	52.60	point	dead	36.42	119.50	7.01	23.00		
	4UJH05-012	195.71	44.00	point	dead	31.09	102.00	-10.82	-35.50		
	4UJH05-026									175	
0.00	4UJH10-026	415.02	93.30	point	dead	47.09	154.50	-5.79	-19.00	150	
		332.73	74.80	point	dead	48.31	158.50	-10.06	-33.00		
		250	56.21	point--free action	live						
		250	56.21	point--free action	live						
	4UJH10-001	160	35.97	point--free action	live						
		160	35.97	point--free action	live						
	4UJH10-004									175	
+4.70M (+15.4ft)	4UJK14-027	130	29.23	point	live	51.82	170.00	-10.15	-33.30		

Table 3E.1-38—Floor Dead and Live Loads
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Elevation	Room Number	Magnitude of Load Metric (kN)	Magnitude of Load US (kips)	Load Description	Load Type	Application X-Coordinate Metric (m)	Application X-Coordinate US (ft)	Application Y-Coordinate Metric (m)	Application Y-Coordinate US (ft)	Area Dead Load (psf)	Area Live Load (psf)
		100	22.48	point	live	50.27	164.93	-5.75	-18.86		
	4UJK14-026	150	33.72	point	live	44.50	146.00	-5.75	-18.86		
	4UJK14-025	160	35.97	point--free action	live						
	4UJK14-028									225	
	4UJK14-029									175	
+8.10M (+26.6ft)	4UJK18-024									175	
	4UJK18-025									175	
	4UJK18-026	129.89	29.20	point	dead	29.87	98.00	5.49	18.00	225	
		97.42	21.90	point	dead	31.70	104.00	12.19	40.00		
	4UJK18-027	104.53	23.50	point	dead	47.85	157.00	5.79	19.00	200	
+12.00M (+39.4ft)	4UJK22-028	86.30	19.40	point	dead	45.57	149.50	-6.40	-21.00	150	
	4UJK22-030									150	
	4UJK22-039									150	
	4UJK22-042									175	
	4UJK22-043									175	
	4UJK22-044									175	
	4UJK22-045									175	
	4UJK22-046									175	
	4UJK22-052									175	
	4UJK22-053									175	

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Table 3E.1-38—Floor Dead and Live Loads
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Elevation	Room Number	Magnitude of Load Metric (kN)	Magnitude of Load US (kips)	Load Description	Load Type	Application X-Coordinate Metric (m)	Application X-Coordinate US (ft)	Application Y-Coordinate Metric (m)	Application Y-Coordinate US (ft)	Area Dead Load (psf)	Area Live Load (psf)
	4UJK22-054									175	
	4UJK22-055									175	
	4UJK22-056									175	
+16.80M (+55.1ft)	4UJK26-028	100	22.48	point--free action	live						
	4UJK26-030	89.45	20.11	point	dead	35.87	117.70	11.96	39.25	200	
	3UJE26-001	130.24	29.28	point	dead	30.97	101.60	12.34	40.50	150	
+21.00M (+68.9ft)	4UJK29-030									150	
	4UJE26-001									175	
	3UJE26-001									150	
	4UJE29-002	207.38	46.62	point	dead	-35.59	-116.75	-3.11	-10.20		
	3UJE29-002	207.38	46.62	point	dead	-35.59	-116.75	3.11	10.20		
+24.70M (+81.0ft)	4UJK34-025									175	
	4UJK34-030									225	
	4UJK34-031									225	
	3UJE33-002									125	
	4UJE33-002									125	
	4UJE34-023	160	35.97	point	dead	48.62	159.51	9.38	30.77		
+29.30M (+96.1ft)	4UJE39-001	92.08	20.70	point	dead	30.08	98.70	-4.51	-14.80	75	100
	3UJE39-001	92.08	20.70	point	dead	30.08	98.70	4.57	15.00	75	100
		100	22.48	point--free action	live	43.34	142.19	10.05	32.97		

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Table 3E.1-38—Floor Dead and Live Loads
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Elevation	Room Number	Magnitude of Load Metric (kN)	Magnitude of Load US (kips)	Load Description	Load Type	Application X-Coordinate Metric (m)	Application X-Coordinate US (ft)	Application Y-Coordinate Metric (m)	Application Y-Coordinate US (ft)	Area Dead Load (psf)	Area Live Load (psf)
FUEL BUILDING											
-9.60M (-31.5ft)	UFA01-078	160.14	36.00	point	live	9.60	31.50	-44.55	-146.12		
	UFA01-010	160.14	36.00	point	live	-22.28	-73.08	-25.76	-84.50		
	UFA01-004									125	
	UFA01-033									125	
	UFA01-085									125	
	UFA01-083									125	
	UFA01-035									125	
	UFA01-095									125	
	UFA01-061									125	
	UFA01-054									125	
	UFA01-082									125	
	UFA01-075									125	
	UFA01-026									325	
	UFA01-038									300	
	UFA01-072									275	
	UFA01-073									275	
	UFA01-088									300	
	UFA01-042									375	
	UFA01-048									325	

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Table 3E.1-38—Floor Dead and Live Loads
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Elevation	Room Number	Magnitude of Load Metric (kN)	Magnitude of Load US (kips)	Load Description	Load Type	Application X-Coordinate Metric (m)	Application X-Coordinate US (ft)	Application Y-Coordinate Metric (m)	Application Y-Coordinate US (ft)	Area Dead Load (psf)	Area Live Load (psf)
	UFA01-049									325	
	UFA01-076									300	
	UFA01-077									300	
	UFA01-097									375	
	UFA01-098									350	
	UFA01-099									350	
	UFA01-024										750
	UFA01-001										125
	UFA01-017										100
	UFA01-051										125
	UFA01-079										100
-6.20M (-20.3ft)	UFA05-026	482.19i	108.40	point	dead	-17.53	-57.50	-43.89	-144.00		
	UFA05-076	482.19	108.40	point	dead	19.05	62.08	-44.32	--145.42		
	UFA05-004									125	
	UFA03-001									125	125
	UFA03-002									125	
	UFA03-007									125	
	UFA03-006									125	
	UFA03-056									125	
	UFA03-051									125	125

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Table 3E.1-38—Floor Dead and Live Loads
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Elevation	Room Number	Magnitude of Load Metric (kN)	Magnitude of Load US (kips)	Load Description	Load Type	Application X-Coordinate Metric (m)	Application X-Coordinate US (ft)	Application Y-Coordinate Metric (m)	Application Y-Coordinate US (ft)	Area Dead Load (psf)	Area Live Load (psf)
	UFA03-058									125	
	UFA03-057									125	
	UFA05-054									125	
	UFA03-017										100
	UFA03-051										125
	UFA03-079										100
	UFA05-077										2600
-3.40M (-11.2ft)	UFA06-035	98.75	22.20	point	dead	-2.59	-8.50	-35.02	-115.00	125	
										300	
	UFA06-085	98.75	22.20	point	dead	-6.55	-21.50	-35.02	-115.00	125	
										300	
	UFA06-038									1220	
	UFA06-088									1220	
	UFA06-001									125	125
	UFA06-023									125	
	UFA06-024									125	
	UFA06-045									125	
	UFA06-095									125	
	UFA06-082									125	525
	UFA06-083									125	525

Table 3E.1-38—Floor Dead and Live Loads
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Elevation	Room Number	Magnitude of Load Metric (kN)	Magnitude of Load US (kips)	Load Description	Load Type	Application X-Coordinate Metric (m)	Application X-Coordinate US (ft)	Application Y-Coordinate Metric (m)	Application Y-Coordinate US (ft)	Area Dead Load (psf)	Area Live Load (psf)
	UFA06-075									125	
	UFA06-074									125	
	UFA06-051									125	125
	UFA06-094									125	
	UFA06-084									125	
	UFA05-051										125
	UFA06-017										100
	UFA06-079										100
	UFA06-096										125
0.00	UFA10-084	259.78	58.40	point	dead	7.16	23.50	-33.83	-111.00		
	UFA10-057	230	51.71	point-- free action	live						
	UFA10-015	285	64.07	point--free action	live	-16.17	-53.05	-33.98	-111.48		200
		285	64.07	point--free action	live	-16.17	-53.05	-34.75	-114.01		
		285	64.07	point--free action	live	-16.17	-53.05	-35.52	-116.54		
		285	64.07	point--free action	live	-16.17	-53.05	-36.29	-119.06		
		285	64.07	point--free action	live	-16.17	-53.05	-37.06	-121.59		
		285	64.07	point--free action	live	-16.17	-53.05	-37.83	-124.11		
		285	64.07	point--free action	live	-16.17	-53.05	-38.60	-126.64		
		285	64.07	point--free action	live	-16.17	-53.05	-39.37	-129.17		

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Elevation	Room Number	Magnitude of Load Metric (kN)	Magnitude of Load US (kips)	Load Description	Load Type	Application X-Coordinate Metric (m)	Application X-Coordinate US (ft)	Application Y-Coordinate Metric (m)	Application Y-Coordinate US (ft)	Area Dead Load (psf)	Area Live Load (psf)
		1401.19	315.00	point-- free action	live						
	UFA10-002									125	
	UFA10-001									125	125
	UFA10-045									125	
	UFA10-021									125	
	UFA10-022									125	
	UFA10-035									125	
	UFA10-085									125	
	UFA10-007									125	
	UFA10-082									125	
	UFA10-070									125	
	UFA10-071									125	
	UFA10-095									125	
	UFA10-051									125	125
	UFA10-017										100
	UFA10-079										100
+3.70M (+12.1ft)	UFA10-015	100	22.48	point-- free action	live						
		100	22.48	point-- free action	live						

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Table 3E.1-38—Floor Dead and Live Loads
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Elevation	Room Number	Magnitude of Load Metric (kN)	Magnitude of Load US (kips)	Load Description	Load Type	Application X-Coordinate Metric (m)	Application X-Coordinate US (ft)	Application Y-Coordinate Metric (m)	Application Y-Coordinate US (ft)	Area Dead Load (psf)	Area Live Load (psf)
	UFA13-070	1252.17	281.50	point	dead	20.27	66.50	-34.14	-112.00		
	UFA13-071	1252.17	281.50	point	dead	20.27	66.50	-39.62	-130.00		
	UFA15-022									1920	
	UFA13-004									125	
	UFA15-001									125	125
	UFA15-045									125	
	UFA13-057										200
	UFA13-075									125	
	UFA13-056										200
	UFA13-083									125	
	UFA13-082									125	
	UFA13-085									125	
	UFA13-080									125	
	UFA15-096									125	
	UFA13-095									125	
	UFA13-051									125	125
	UFA13-054									125	
	UFA13-072										200
	UFA15-016									125	
	UFA15-002									125	

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Table 3E.1-38—Floor Dead and Live Loads
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Elevation	Room Number	Magnitude of Load Metric (kN)	Magnitude of Load US (kips)	Load Description	Load Type	Application X-Coordinate Metric (m)	Application X-Coordinate US (ft)	Application Y-Coordinate Metric (m)	Application Y-Coordinate US (ft)	Area Dead Load (psf)	Area Live Load (psf)
	UFA13-017										100
	UFA13-079										100
+7.40M (+24.3ft)	UFA18-015	125	28.10	point-- free action	live					125	
		125	28.10	point-- free action	live						
	UFA18-004									125	
	UFA18-045									125	
	UFA17-025									125	
	UFA17-053									125	
	UFA17-057										200
	UFA17-017										100
	UFA17-051										125
	UFA17-079										100
	UFA18-001										125
	UFA19-021										1960
+11.10M (+36.4ft)	UFA21-081										200
	UFA21-082										200
	UFA21-083										200
	UFA21-084										200

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Table 3E.1-38—Floor Dead and Live Loads
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Elevation	Room Number	Magnitude of Load Metric (kN)	Magnitude of Load US (kips)	Load Description	Load Type	Application X-Coordinate Metric (m)	Application X-Coordinate US (ft)	Application Y-Coordinate Metric (m)	Application Y-Coordinate US (ft)	Area Dead Load (psf)	Area Live Load (psf)
		300	67.45	point	dead	-12.65	-41.50	-34.15	-112.04		
		300	67.45	point	dead	0.29	0.95	-33.39	-109.55		
	UFA21-004									125	
	UFA21-002									125	
	UFA21-001									125	125
	UFA21-045									125	
	UFA21-015									125	
	UFA21-095									125	
	UFA21-051									125	125
	UFA21-053									125	
	UFA21-057										200
	UFA21-056									125	
	UFA21-097	158.35	35.60	point	dead	13.52	44.50	-44.81	-147.00		
	UFA21-017										100
	UFA21-079										100
+14.80M (+48.5ft)	UFA23-014									2450	
	UFA23-018									2600	
	UFA24-004									125	
	UFA24-001									125	125
	UFA24-045									125	

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Elevation	Room Number	Magnitude of Load Metric (kN)	Magnitude of Load US (kips)	Load Description	Load Type	Application X-Coordinate Metric (m)	Application X-Coordinate US (ft)	Application Y-Coordinate Metric (m)	Application Y-Coordinate US (ft)	Area Dead Load (psf)	Area Live Load (psf)
	UFA24-002									125	
	UFA23-015									125	
	UFA24-057										200
	UFA24-071									125	
	UFA24-086									125	
	UFA24-085									125	
	UFA24-070									125	
	UFA24-051									125	125
	UFA24-053									125	
	UFA24-017										100
	UFA24-079										100
	UFA15-022										
+19.5M (+64.0ft)	UFA29-015	200	44.96	point	live	-9.03	-29.63	-47.36	-155.38	125	225
		222.76	50.08	Point	Dead	1.83	6.00	-31.91	-104.70		
		222.76	50.08	Point	Dead	1.83	6.00	-41.51	-136.20		
	UFA29-001									125	125
	UFA29-005									125	
	UFA29-045									125	
	UFA29-090									125	225
	UFA29-054									125	

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Elevation	Room Number	Magnitude of Load Metric (kN)	Magnitude of Load US (kips)	Load Description	Load Type	Application X-Coordinate Metric (m)	Application X-Coordinate US (ft)	Application Y-Coordinate Metric (m)	Application Y-Coordinate US (ft)	Area Dead Load (psf)	Area Live Load (psf)
	UFA29-051									125	125
+24.20M (+79.4ft)	UFA10-069	470	105.67	point-- free action	live						
		470	105.67	point-- free action	live						
		120	26.98	point-- free action	dead	15.70	51.51	-51.05	-167.49		
		120	26.98	point-- free action	dead	23.95	78.58	-51.05	-167.49		
	UFA29-015	120	26.98	point-- free action	live-max						
		120	26.98	point-- free action	live-min						
	UFA34-010	180	40.47	point	dead	-22.03	-72.26	-27.13	-88.99		
	UFA35-078	180	40.47	point	dead	11.41	37.43	-44.76	-146.85		
	UFA34-001									125	125
	UFA34-045									125	
+34.00M (+111.5ft)	UKA	120	26.98	point-- free action	live	15.80	51.84	-28.95	-94.98	150	100
		120	26.98	point-- free action	live	15.80	51.84	-41.20	-135.17		

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Table 3E.1-38—Floor Dead and Live Loads
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Elevation	Room Number	Magnitude of Load Metric (kN)	Magnitude of Load US (kips)	Load Description	Load Type	Application X-Coordinate Metric (m)	Application X-Coordinate US (ft)	Application Y-Coordinate Metric (m)	Application Y-Coordinate US (ft)	Area Dead Load (psf)	Area Live Load (psf)
REACTOR BUILDING											
-6.15M (-20.2ft)	UJA04-003	152.50	34.29	point	dead	10.77	35.32	-6.64	-21.77		
		152.50	34.29	point	dead	-10.77	-35.32	-6.64	-21.77		
		127.66	28.70	point	dead	13.66	44.80	-3.40	-11.16		
		127.66	28.70	point	dead	-13.66	-44.80	-3.40	-11.16		
		108.89	24.48	point	dead	12.18	39.97	2.20	7.21		
		108.89	24.48	point	dead	-12.18	-39.97	2.20	7.21		
		108.89	24.48	point	dead	5.11	16.75	12.19	40.00		
		108.89	24.48	point	dead	-5.11	-16.75	12.19	40.00		
		114.14	25.66	point	dead	-10.86	-35.63	7.51	24.64		
		114.14	25.66	point	dead	10.86	35.63	7.51	24.64		
	UJA04-002	1979.36	445.00	pint	dead	4.05	13.29	-9.34	-30.63		
		1979.36	445.00	pint	dead	-5.51	-18.08	-9.78	-32.08		
		1979.36	445.00	pint	dead	-0.63	-2.08	-14.67	-48.13		
-2.30M (-7.5ft)	UJA07-013	110	24.73	point--free action	live						
	UJA07-015	110	24.73	point--free action	live						
	UJA07-016	125	28.10	point--free action	live						
	UJA07-018	234.42	52.70	point	dead	-0.15	-0.50	10.36	34.00		
		195.28	43.90	point	dead	-0.46	-1.50	14.02	46.00		

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Table 3E.1-38—Floor Dead and Live Loads
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Elevation	Room Number	Magnitude of Load Metric (kN)	Magnitude of Load US (kips)	Load Description	Load Type	Application X-Coordinate Metric (m)	Application X-Coordinate US (ft)	Application Y-Coordinate Metric (m)	Application Y-Coordinate US (ft)	Area Dead Load (psf)	Area Live Load (psf)
		195.28	43.90	point	dead	-0.46	-1.50	15.55	51.00		
	UJA07-021	226	50.81	point	dead	-5.82	-19.09	-18.25	-59.86	300	
	UJA07-024									400	
	UJA07-026	328	73.74	point	dead	5.82	19.09	-18.25	-59.86	350	
	UJA07-027	328	73.74	point	dead	-2.89	-9.48	-18.25	-59.86	350	
	UJA07-020									325	
	UJA07-023									350	
+1.50M (+4.9ft)	UJA11-016	170	38.22	point--free action	live					175	125
	UJA11-019	636.10	143.00	point	dead	-0.15	-0.50	14.94	49.00		
	UJA11-024	127.66	28.70	point	dead	4.42	14.50	-14.63	-48.00		
		362	81.38	point	dead	9.81	32.18	-14.65	-48.05		
	UJA11-032	155	34.85	point	dead	17.94	58.84	0.26	0.85		
	UJA11-031	155	34.85	point	dead	-17.94	-58.84	0.26	0.85		
	Airlock	300	67.45	point	dead	0.00	0.00	24.24	79.51		
	UJA11-025									175	125
	UJA11-026									175	125
	UJA11-027									175	125
	UJA11-028									175	125
	UJA11-015									175	125
	UJA11-013									175	125

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Table 3E.1-38—Floor Dead and Live Loads
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Elevation	Room Number	Magnitude of Load Metric (kN)	Magnitude of Load US (kips)	Load Description	Load Type	Application X-Coordinate Metric (m)	Application X-Coordinate US (ft)	Application Y-Coordinate Metric (m)	Application Y-Coordinate US (ft)	Area Dead Load (psf)	Area Live Load (psf)
	UJA11-014									175	125
	UJA11-020									175	125
+5.15M (+16.9ft)	UJA15-013	1098.71	247.00	point	dead	-17.83	-58.50	-8.23	-27.00		
		135	30.35	point	dead	-17.29	-56.71	-1.16	-3.80		
	UJA15-014	1098.71	247.00	point	dead	-16.31	-53.50	10.97	36.00		
		135	30.35	point	dead	-17.29	-56.71	1.16	3.80		
	UJA15-015	1098.71	247.00	point	dead	16.31	53.50	10.97	36.00		
		135	30.35	point	dead	17.29	56.71	1.16	3.80		
	UJA15-016	1098.71	247.00	point	dead	17.53	57.50	-8.23	-27.00		
		135	30.35	point	dead	17.29	56.71	-1.16	-3.80		
	UJA15-002	115.5	25.97	point	dead	-5.70	-18.70	-12.75	-41.82		
	UJA15-005	150	33.72	point	dead	-10.24	-33.59	14.18	46.51		
	UJA15-006	150	33.72	point	dead	10.24	33.59	14.18	46.51		
	UJA15-023	110	24.73	point	live	-2.64	-8.66	-14.34	-47.04		
	UJA15-001	1860	418.17	point	dead	-3.81	-12.50	-5.23	-17.15		
		1860	418.17	point	dead	3.81	12.50	-5.23	-17.15		
	UJA15-021									350	
+8.70M (+28.5ft)	UJA18-015	161	36.20	point	dead	11.12	36.47	14.11	46.28	100	
	UJA18-014	161	36.20	point	dead	-10.75	-35.26	14.35	47.07	100	
	UJA18-020	150	33.72	point	dead	-5.56	-18.24	-13.34	-43.76		

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Table 3E.1-38—Floor Dead and Live Loads
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Elevation	Room Number	Magnitude of Load Metric (kN)	Magnitude of Load US (kips)	Load Description	Load Type	Application X-Coordinate Metric (m)	Application X-Coordinate US (ft)	Application Y-Coordinate Metric (m)	Application Y-Coordinate US (ft)	Area Dead Load (psf)	Area Live Load (psf)
	UJA15-021	130	29.23	point	live	2.31	7.58	-12.99	-42.61		
		130	29.23	point	live	3.50	11.48	-14.94	-49.00		
	UJA15-023	130	29.23	point	live	-1.60	-5.25	-12.57	-41.23		
	UJA15-001	410	92.18	point	live	2.25	7.38	-12.33	-40.44		
		130	29.23	point	live	3.50	11.48	-10.38	-34.05		
	UJA18-013									100	
	UJA18-016									100	
+13.80M (+45.3ft)	UJA23-041									300	
	UJA23-013									50	
	UJA23-014									75	
	UJA23-015									75	
	UJA23-016									50	
+19.50M (+64.0ft)	UJA	200	44.96	point	dead	-3.82	-12.53	1.26	4.13		
		200	44.96	point	dead	-3.82	-12.53	-0.15	-0.49		
		200	44.96	point	dead	-3.82	-12.53	-1.71	-5.61		
		200	44.96	point	dead	-3.82	-12.53	-3.14	-10.30		
		200	44.96	point	dead	-3.82	-12.53	-4.68	-15.35		
		200	44.96	point	dead	-3.82	-12.53	-6.24	-20.47		
		200	44.96	point	dead	-3.82	-12.53	-7.75	-25.43		
		200	44.96	point	dead	-3.82	-12.53	-9.15	-30.02		

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Table 3E.1-38—Floor Dead and Live Loads
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Elevation	Room Number	Magnitude of Load Metric (kN)	Magnitude of Load US (kips)	Load Description	Load Type	Application X-Coordinate Metric (m)	Application X-Coordinate US (ft)	Application Y-Coordinate Metric (m)	Application Y-Coordinate US (ft)	Area Dead Load (psf)	Area Live Load (psf)
		200	44.96	point	dead	-3.82	-12.53	-10.51	-34.48		
		200	44.96	point	dead	-3.82	-12.53	-11.62	-38.12		
		200	44.96	point	dead	-3.46	-11.35	3.42	11.22		
		200	44.96	point	dead	-2.59	-8.50	4.63	15.19		
		200	44.96	point	dead	3.82	12.53	1.26	4.13		
		200	44.96	point	dead	3.82	12.53	-0.15	-0.49		
		200	44.96	point	dead	3.82	12.53	-1.71	-5.61		
		200	44.96	point	dead	3.82	12.53	-3.14	-10.30		
		200	44.96	point	dead	3.82	12.53	-4.68	-15.35		
		200	44.96	point	dead	3.82	12.53	-6.24	-20.47		
		200	44.96	point	dead	3.82	12.53	-7.75	-25.43		
		200	44.96	point	dead	3.82	12.53	-9.15	-30.02		
		200	44.96	point	dead	3.82	12.53	-10.51	-34.48		
		200	44.96	point	dead	3.82	12.53	-11.62	-38.12		
		200	44.96	point	dead	3.46	11.35	3.42	11.22		
		200	44.96	point	dead	2.59	8.50	4.63	15.19		
	UJA29-016	685	154.00	point	dead	12.07	39.60	-20.91	-68.60		835
		1125	252.92	point	dead	14.08	46.19	-13.88	-45.54		
		640	143.88	point	dead	8.58	28.15	-9.80	-32.15		
	UJA29-013										835

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Table 3E.1-38—Floor Dead and Live Loads
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Elevation	Room Number	Magnitude of Load Metric (kN)	Magnitude of Load US (kips)	Load Description	Load Type	Application X-Coordinate Metric (m)	Application X-Coordinate US (ft)	Application Y-Coordinate Metric (m)	Application Y-Coordinate US (ft)	Area Dead Load (psf)	Area Live Load (psf)
		640	143.88	point	dead	-8.58	-28.15	-9.80	-32.15		
		171.87	38.64	point	dead	-7.83	-25.70	-15.78	-51.78		
		171.87	38.64	point	dead	-8.42	-27.62	-14.37	-47.14		
		171.87	38.64	point	dead	-9.83	-32.26	-13.78	-45.22		
		171.87	38.64	point	dead	-11.25	-36.90	-14.37	-47.14		
		171.87	38.64	point	dead	-11.83	-38.82	-15.78	-51.78		
		171.87	38.64	point	dead	-11.25	-36.90	-17.20	-56.42		
		171.87	38.64	point	dead	-9.83	-32.26	-17.78	-58.34		
		171.87	38.64	point	dead	-8.42	-27.62	-17.20	-56.42		
		228.14	51.29	point	dead	4.18	13.70	-16.98	-55.70		
		228.14	51.29	point	dead	-4.8	-13.70	-16.98	-55.70		
	UJA29-023	270	60.70	point	dead	-19.35	-63.48	-16.15	-52.99		
+24.10M (+79.0ft)	UJA34-018	130	29.23	point	dead	-3.98	-13.06	10.53	34.55		
		130	29.23	point	dead	-1.84	-6.04	15.10	49.54		
		130	29.23	point	dead	-6.10	-20.01	13.86	45.47		
	UJA34-014	120	26.98	point	dead	-16.68	-54.72	-12.92	-42.39	275	
		445	100.04	point	dead	-11.97	-39.27	13.81	45.31		
	UJA34-015									275	
+28.50M (+93.5ft)	UJA	300	67.45	point	dead	12.70	41.67	13.86	45.47		835
		150	33.72	point	dead	6.05	19.85	19.10	62.66		

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Table 3E.1-38—Floor Dead and Live Loads
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Elevation	Room Number	Magnitude of Load Metric (kN)	Magnitude of Load US (kips)	Load Description	Load Type	Application X-Coordinate Metric (m)	Application X-Coordinate US (ft)	Application Y-Coordinate Metric (m)	Application Y-Coordinate US (ft)	Area Dead Load (psf)	Area Live Load (psf)
		200	44.96	point	dead	-4.79	-15.72	19.53	64.07		
		230	51.71	point	dead	-9.20	-30.18	9.79	32.12		
		230	51.71	point	dead	9.20	30.18	9.79	32.12		
		650	146.13	point	dead	4.29	14.07	13.56	44.49		
	UJA41-003	128	28.78	point	dead	-10.33	-33.89	-7.43	-24.38		
	UJA41-004	128	28.78	point	dead	-10.33	-33.89	7.43	24.38		
	UJA41-008	128	28.78	point	dead	10.33	33.89	-7.43	-24.38		
	UJA41-007	128	28.78	point	dead	10.33	33.89	7.43	24.38		
+34.45M (+113ft)	SG Platform										1253

3E.2 Emergency Power Generating Buildings

Description of Emergency Power Generating Buildings

Two Emergency Power Generating Buildings (EPGB) are located adjacent to the NI Common Basemat and the Essential Service Water Buildings (ESWB) structures. Each EPGB is approximately 178 ft – 0 in long by 94 ft – 6 in wide. The height of the building, relative to the top of the mat foundation, varies from 51 ft – 6 inches in the diesel fuel storage tanks areas to 68 ft – 0 in at the remainder of the structure.

Cross sections and plan views associated with the typical EPGB are provided in Section 3.8.4, Figure 3.8-89, Figure 3.8-90, Figure 3.8-91, Figure 3.8-92, Figure 3.8-93, and Figure 3.8-94. A general description of the structure, including descriptions of functional equipment at each floor level, is provided in Section 3.8.4.1.4.

The lateral load resisting system primarily consists of exterior and interior reinforced concrete shear walls and a reinforced concrete mat foundation situated at grade. The basemat foundation, elevated concrete slabs, and steel framed platform levels consist of the structural elements described in Sections 3.8.4.1.4 and 3.8.5.1.2.

Upon evaluation of the EPGB, the following critical sections have been identified:

- Basemat Foundation (3E.2.1).
- Typical Wall at Column Line 11 (3E.2.2).
- Reinforced Concrete Slab and Composite Beams at Elevation 51 ft-6 in (3E.2.3).

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Materials

Concrete for the EPGB excluding basemat shall have compressive strength f'_c = 5000 psi, modulus of elasticity, E= 4287 ksi, shear modulus, G = 1832 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, piping, cable tray, conduits 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.

- Steel platform self weight at El. 33'-4" = 20 psf.
- Composite steel beam self weight on slab/roof at El. 51'-6" = 45 psf.
- Uniform area dead load for basemat = 100 psf.
- Uniform area dead load for slab at El. 51'-6" = 50 psf.
- Uniform area dead load for roof at El. 51'-6" = 70 psf.
- Uniform area dead load for roof at EL. 68'-0" = 20 psf.
- Uniform area live load for basemat = 100 psf.
- Steel platform at El. 33'-4" live load = 100 psf.

Equipment Loads

The weight of major equipment, combustion air ducts, and exhaust ducts is applied as point load throughout the building.

Equipment	Elevation (kips)	Weight
Engine/Generator skid	Basemat	3000
Combustion air filter	51'-6"	4.10 each
Combustion air silencers	51'-6"	4.00 each
Exhaust gas silencer	51'-6"	18.00
Air start equipment	Basemat	15.00
Fuel day tank	32'-0"	13.37
Lube oil make-up tank	Basemat	13.14
Jacket water expansion	16'-0"	1.815
Generator neutral grounding resistor	D/G skid	0.50
MCC's	Basemat	12.00
I&C TCP control panels	Basemat	0.772 each
I&C TXS control panels	Basemat	0.822 each
HVAC control room chiller	Basemat	2.37
HVAC control room air handler	19'-3"	0.55
HVAC supply fan-small	51'-6"	1.862
HVAC supply fan-large	51'-6"	3.20
Intake and exhaust louvers	51'-6"	2.10 each

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Foundation Stability

The EPGB is evaluated for stability against overturning, sliding, and floatation for the generic soil profiles used in establishing the certified plant design. Shear keys in the form of grade beams around the periphery of the building and in the middle of the building are used to ensure stability. The calculated factors of safety against overturning, sliding and floatation satisfy the acceptance criteria.

Minimum Factors of Safety					
Sliding		Overturning		Floatation	
Required	Calculated	Required	Calculated	Required	Calculated
1.10	1.10	1.10	61.9	1.10	8.50

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). The floatation factor of safety is determined based on dead load (D) and buoyant force (F_b). The factor of safety against overturning is determined using energy method.

The maximum dynamic pressure is 6966 psf and the average static pressure is 2712 psf.

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Design Criteria

SSI analysis by the Bechtel Code SASSI 2000 (v. 3.1) is used to determine enveloping structural response accelerations for development of equivalent static SSE loads for the GT STRUDL FEM.

The use of GT STRUDL for the design of the critical sections is described in Sections 3.8.4.4.3 and Sections 3.8.5.4.3. Design forces and moments are extracted from GT STRUDL analyses for basemat foundation and superstructure component design.

All applicable loads used for the design of the critical sections located within the EPGBs 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 and structural steel components (including composite beams) are designed in accordance with the applicable codes, standards, and specifications described in Sections 3.8.4.2 and 3.8.5.2.

The planar reference system for the GT STRUDL finite element analysis output is provided in Figure 3E.2-1—GT STRUDL Finite Element Planar Reference Frame Systems. The positive direction of the finite element bending moments M_{xx}, M_{yy} and M_{xy} and out-of plane shear forces V_{xx} and V_{yy} are shown in a) Plate Bending, included

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 22 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.

Upon evaluation of the ESWBs, the following critical sections have been identified:

- Basemat Foundation at Elevation -16 ft – 0 in (3E.3.1).
- Shear Wall at Column Line 4 (3E.3.2).
- Fan Deck Slab at Elevation 63 ft – 0 in (3E.3.3).

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Materials

Concrete for the ESWB excluding basemat will have compressive strength f'_c = 5000 psi, 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 equipments, 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.

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- 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 calculated factors of safety against overturning, sliding, and floatation satisfy the acceptance criteria.

Minimum Factors of Safety					
Sliding		Overturning		Floatation	
Required	Calculated	Required	Calculated	Required	Calculated
1.10	1.42	1.10	1.71	1.10	2.28

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).

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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.

Design Criteria

SSI analysis by the Bechtel Code SASSI 2000 (v. 3.1) is used to determine enveloping structural response accelerations for development of equivalent static SSE loads for the GT STRUDL FEM.

The use of GT STRUDL 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 GT STRUDL 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 3.8.4.2and 3.8.5.2.

The planar reference system for the GT STRUDL finite element analysis output is provided in Figure 3E.3-1—GT STRUDL Finite Element Planar Reference Frame Systems. The positive direction of the finite element bending moments M_{xx}, M_{yy} and M_{xy} and out-of-plane shear forces V_{xx} and V_{yy} are shown in a) Plate Bending, included on Figure 3E.3-1. The positive direction of the finite element in-plane forces N_{xx}, N_{yy} and N_{xy} are the same as the positive orientation of the plane stresses S_{xx}, S_{yy} and S_{xy} shown in b) Plane Stress/Strain, included on Figure 3E.3-1.

3E.3.1 Basemat Foundation at Elevation -16 ft – 0 in (Top of Concrete)

This critical section presents the structural design of the reinforced concrete basemat required to support the ESWBs. The ESWBs are composed of a 6 ft – 0 in thick reinforced concrete basemat foundation. The basemat foundation of the ESWB is a safety-related, Seismic Category I structure, as described in Section 3.8.5.

Description of the Critical Section and Computer Model

The overall layout and dimensions of each ESWB basemat foundation are described in Section 3.8.5.1.3. ESWBs 1, 2, 3, and 4 are essentially identical; therefore, only one of the ESWBs is evaluated as a critical section.

As described in Section 3.8.5.1.3, GT STRUDL is used to create a FEM to analyze the ESWBs for the forces and moments applied to the ESWB basemat foundation.