From: Chappell, Coley [ccchappell@STPEGS.COM]
Sent: Thursday, June 07, 2012 6:15 PM
To: Wunder, George
Subject: STP34 Radwaste Building
Attachments: STP34_Radwaste Building_06-07-2012.pdf; FSER-1503 RWB references.pdf

George,

Attached are two files related to the STP 3&4 Radwaste Building:

The first includes statements from NUREG-1503 regarding the ABWR DCD building design, and supporting information from the DCD/COLA.
The second is a list of conclusions from NUREG-1503 related to the Radwaste Building structure.

Regards,

Coley Chappell
NINA Licensing STP Units 3 & 4

Hearing Identifier: SouthTexas34Public_EX
Email Number: 3408

Mail Envelope Properties (C7F098E3C31A0141A02043F0B8E656EE39C1AD374D)

Subject: STP34 Radwaste Building
Sent Date: 6/7/2012 6:15:01 PM
Received Date: 6/7/2012 6:14:59 PM
From: Chappell, Coley

Created By: ccchappell@STPEGS.COM

Recipients:
"Wunder, George" <George.Wunder@nrc.gov>
Tracking Status: None

Post Office: exgmb1.CORP.STPEGS.NET

Files	**Size**	**Date & Time**
MESSAGE	379	6/7/2012 6:14:59 PM
STP34_Radwaste Building_06-07-2012.pdf	29491	
FSER-1503 RWB references.pdf	17066	

Options
Priority: Standard
Return Notification: No
Reply Requested: No
Sensitivity: Normal
Expiration Date:
Recipients Received:

STP 3&4 Radwaste Building:
Why the conclusions of the FSER remain valid

The ABWR design certification process reviewed the design of the Radwaste Building and found it acceptable as documented in NUREG-1503, Final Safety Evaluation Report Related to the Certification of the Advanced Boiling Water Reactor Design (FSER). The Radwaste Building described in the STP 3&4 COLA Final Safety Analysis Report (FSAR) meets or exceeds the structural design requirements of the ABWR Design Control Document (DCD) Radwaste Building as credited in the FSER. Therefore 10 CFR 50, Appendix A, General Design Criterion (GDC) 2 design bases for protection of the Radwaste Building against natural phenomena continue to be met. None of the STP 3&4 COLA departures for the Radwaste Building took exception to or changed these loading design criteria. Acceptance of the ABWR DCD Radwaste Building is documented in the FSER as follows:

- **NUREG-1503 Section 3.7.2 states: "**The radwaste building, which is not a seismic Category I structure and does not house any safety-related equipment and systems, is included in this review because GE elected to design this structure for the SSE seismic loads to ensure that the embedded portion of the building retains its structural integrity during and after an SSE, and to prevent unacceptable leakage of the radwaste material outside the building.**"**

- **NUREG-1503 Section 3.8.4 states:** "Because GE elected to design the radwaste building substructure to remain structurally intact during an SSE to help contain liquid from a possibly ruptured tank, the radwaste building substructure also is included in this safety evaluation, although it does not house any safety-related systems and components, and hence, is not seismic Category I."

- **NUREG-1503 Section 3.1.1.4 states**: "The staff guidelines in RG 1.143, 'Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light-Water-Cooled Nuclear Power Plants,' Revision 1… recommend a seismic design of radwaste buildings… based on the OBE. With the elimination of the OBE, GE committed to designing these structures and features to withstand the SSE. The structural design criteria, using the SSE loading, use the corresponding loads and load combinations provided in SRP Section 3.8.4. The staff finds that designing these structures and features to the SSE provides a bounding design comparable to that recommended in the regulatory guides and is acceptable."

- **NUREG-1503 Section 15.4.6 states:** "The base mat and outside walls of the building are seismic Category I to a height necessary to retain spill liquids within the building… all compartments containing liquid radwastes are steel lined up to a height capable of containing the release of all of the liquid radwastes into the compartments."

The conclusions of the FSER remain valid since:

- STP 3&4 FSAR Section 3H.3, as modified by the response to RAI 03.07.02-13, Supplement 5 (U7-C-NINA-NRC-120028, April 10, 2012), states: "The seismic response spectra are the envelop of 0.3g RG 1.60 response spectra and the resulting SSE response spectra at the ground surface of the Radwaste Building considering the effect of presence of the Reactor Building when subjected to site-specific SSE. This satisfies the requirement noted in item (3) of DCD Tier 2 Section 3.7.2.8."
- FSAR Subsection 3.7.2.8 (3), incorporating the ABWR DCD by reference, states: "The non-Category I structures, systems or components will be analyzed and designed to prevent their failure under SSE conditions in a manner such that the margin of safety of these structures, systems or components is equivalent to that of Seismic Category I structures, systems or components." This requirement is satisfied by the design of the STP 3&4 Radwaste Building.
- The STP 3&4 Radwaste Building must meet the design requirements specified in FSAR Subsection 3.7.2.8 and COLA Part 9 ITAAC Table 3.0-23, "Radwaste Building – Seismic II/I Interaction," to remain elastic under the extreme environmental loads. Conservatively, the design of the Radwaste Building for Seismic II/I criteria will be based on elastic design.
- FSAR Subsection 3H.3.5.3 "Seismic II/I Evaluation" documents the load combinations used to design the Radwaste Building and shows that the STP 3&4 Radwaste Building design requirements are consistent with the ABWR DCD requirements stated in Tier 2 Subsection 3.8.4.1.3: "Although the radwaste superstructure is not a Seismic Category I structure, its major structural concrete walls, slabs, columns and roof are designed to resist Seismic Category I loads."
- FSAR Subsection 3H.3.1 states: "Although, the RWB is classified as RW-IIb, it is designed conservatively for earthquake, tornado and wind loadings based on the requirements for RW-IIa classification. Design for other loads is based on the requirements for RW-IIb classification. Due to its close proximity to safety-related seismic category I structures, the RWB structure is also designed to meet Seismic II/I requirements to ensure that the building does not collapse on the nearby safety-related buildings. "
- FSAR Subsection 15.7.3.3, incorporating the ABWR DCD by reference, states: "Based on the above discussion, a single pathway is considered for release of fission products to the environment via airborne releases. The liquid pathway is not considered due to the **mitigative capabilities** of the Radwaste Building."

Consequently, the Radwaste Building, regardless of the seismic category classification, is designed to maintain structural integrity (below grade and above grade) for Seismic Category I loads. STP 3&4 COLA departure STD DEP T1 2.15-1 re-classified the Radwaste Building substructure from Seismic Category I to non-seismic; however, the building design for Seismic Category I loading is not changed.

In summary, the Radwaste Building as approved by the NRC for the ABWR design retains its capability to perform its safety function of protecting the public and occupational workers from radiation dose from building contents because the major structural concrete walls and slabs are designed to remain intact. None of the departures related to the STP 3&4 Radwaste Building affected these design criteria.

NINA therefore concludes that the STP 3&4 Radwaste Building meets or exceeds the capability of the ABWR DCD Radwaste Building to perform the GDC 2 safety function of protecting the public and occupational workers from dose from the radioactive inventory of the building. This was found acceptable in the FSER because the Radwaste Building structure was designed to remain intact and withstand the effects of natural phenomena.

A comparison of the Radwaste Building design for the ABWR DCD and the STP 3&4 is shown in the table below.

Table Radwaste Building (RW/B) design in accordance with GDC 2: STP 3&4 versus ABWR DCD

Item	ABWR DCD RW/B as evaluated in NUREG-1503	STP 3&4 RW/B	Comparison of STP 3&4 to ABWR DCD	DCD/FSAR Reference
Substructure	Seismic Category I, the basemat and exterior walls of the Radwaste Building which are at and below grade are Seismic Category I	Seismic Category II/I, foundations, major structural concrete walls and slabs designed to ensure structural integrity under Seismic Category I loads	Equivalent	Tier 1 Section 2.15.13
	All compartments containing liquid radwastes are concrete cubicles located below grade and stainless steel-lined up to a height capable of containing release of all liquid radwastes into the compartment	All compartments containing liquid radwastes are concrete cubicles located below grade and stainless steel-lined up to a height capable of containing release of all liquid radwastes into the compartment	Same	Section 15.7.3 Section 11.2
Superstructure	Non-seismic, major structural concrete walls and slabs of these above grade structures are designed to resist Seismic Category I loads	Seismic Category II/I, major structural concrete walls and slabs designed to ensure structural integrity under Seismic Category I loads	Same	Section 3H.3
Codes	ACI 349 (1980)	ACI 349 (1997)	Equivalent	Table 1.8-21
	AISC / N690 (1984)	AISC / N690 (1984)	Same	Table 1.8-21
Seismic	0.3g Regulatory Guide 1.60 SSE	Envelope of Amplified Site-specific SSE and 0.3g Regulatory Guide 1.60 SSE	Same	
Tornado Wind	483 km/hr (300 m/hr)	483 km/hr (300 m/hr), for II/I loads	Same	Tier 1 Table 5.0
Tornado Missiles	Missile Spectrum 1 as defined in Tier 1 Table 5.0	Missile Spectrum 1 as defined in Tier 1 Table 5.0	Same	Tier 1 Table 5.0

Item	ABWR DCD RW/B as evaluated in NUREG-1503	STP 3&4 RW/B	Comparison of STP 3&4 to ABWR DCD	DCD/FSAR Reference
Hurricane Wind	Not explicitly stated	338 km/h (210 mph), see Section 3H.11, meets RG 1.221	Higher	Section 3.1.2
Hurricane Missiles	Not addressed	Missile Spectrum as defined in RG 1.221	Higher	Section 3H.11 Table 3H.9-1
Extreme Wind	177 km/hr (110 mph), basic wind speed 203 km (126 mph), 3-sec gust	177 km/hr (110 mph), basic wind speed 203 km (126 mph), 3-sec gust	Same	Tier 1 Table 5.0
Flood Loading	30.5 cm (1 ft) below grade	183 cm (6 ft) above grade, for II/I loading	Higher	Table 5.0 Section 3H.3
Rain	493 mm/hr (19.4 in/hr)	503 mm/hr (19.8 in/hr)	Equivalent	Tier 1 Table 5.0
Snow	2.39 kPa (50 psf)	2.39 kPa (50 psf)	Same	Tier 1 Table 5.0
Radwaste Source Term	Tier 2 Section 11.1	FSAR Section 11.1	Same	Section 11.1
Chapter 15 Radwaste Design Basis Limiting Accident	Unspecified event causing the complete release of the radioactive inventory in all Liquid Radwaste System tanks, rupture of limiting tank, and airborne release pathway – no liquid or significant (from airborne species) ground contamination is expected, and airborne doses are a fraction of 10CFR100 criteria	Unspecified event causing the complete release of the radioactive inventory in all Liquid Radwaste System tanks, rupture of limiting tank, and airborne release pathway – no liquid or significant (from airborne species) ground contamination is expected, and airborne doses are a fraction of 10CFR100 criteria	Same	Section 15.7.3

NUREG-1503 conclusions related to the Radwaste Building structure

3.1.1.4 Concrete and Steel Structures p. 3-6

SSE Relative Displacements Between Structures
In Appendix3A to the SSAR, the seismic response (building displacements, structural member forces, floor response spectra (FRS), etc.) of the reactor building (RB) is discussed. GE has considered the through-soil, structure-to-structure interaction effect under SSE loading in the analyses of ABWR structures, including the control building, ultimate heat sink pump house, radwaste building, and turbine building. Therefore, the staff concludes that the effects of through-soil, structure-to structure interaction under SSE loadings for all structures housing seismically designed piping have been adequately considered under SSE loadings to establish the relative displacements between buildings (seismic anchor movement for piping systems).

Use of Regulatory Guides 1.143 and 1.27
The staff guidelines in RG 1.143, 'Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light-Water-Cooled Nuclear Power Plants,' Revision 1, and in RG 1.27, "Ultimate Heat Sink for Nuclear Power Plants," Revision 2, recommend a seismic design of radwaste buildings and ultimate heat sink features based on the OBE. With the elimination of the OBE, GE committed to designing these structures and features to withstand the SSE. The structural design criteria, using the SSE loading, use the corresponding loads and load combinations provided in SRP Section 3.8.4. The staff finds that designing these structures and features to the SSE provides a bounding design comparable to that recommended in the regulatory guides and is acceptable. The staff will review alternative methods to ensure the seismic adequacy of these structures and features on a case-by-case basis.

3.4.1 Flood Protection p. 3-15
The reactor and control buildings are designed to seismic Category I standards. In addition, portion of the radwaste building that is below plant grade is also designed to seismic Category1 standards. The flood levels and conditions are described in SSAR Table2.0-1. GE assumed maximum ground water and flood levels to be 61.0 cm (2 ft) and 30.5 cm (1 foot) below grade, respectively. As discussed in SSAR Section 3.4.2 and Table 2.0-1, GE did not consider dynamic force resulting from flooding because the design flood elevation is assumed to be below the plant finish grade. GE considered only the hydrostatic pressure caused by the design flood water level, ground water, and soil pressures in its analysis of the seismic Category I structures.

p. 3-17
The radwaste building contains no safety-related equipment and is isolated from the other plant structures with the exception of a tunnel which connects the r eactor, control, turbine, and radwaste buildings. Liquid radwaste from these buildings is transferred to the waste processing system via lines running through this tunnel. The tunnel is sloped and connects to the turbine building at elevation 8,800 mm (28 ft-7/8 in.), the radwaste building at -1.500 mm (4 ft-11 in.), and the reactor and control buildingsat -8,200 mm (-26 ft-10 718 in.). All ends of the tunnel are sealed to protect safety-related equipment from flooding which may originate in another building.

p. 3-38
Appdix 3H to the SSAR, Amendment 33, specifies the following embedment depths from the plant finished grade to tho bottom f the bssemat for each seismic Category I structure: 25.9 m (85 ft) for RB complex (shield building, containment structure, drywell, and reactor pedestal)
23.2 m (76.1 ft) for control building 16.0 m (52.5 fi) for radwaste building substructures
These thrse buildings are designed to have independent foundations. During the design calculation audits, GE dm discussed the use of these embedment depths for the seismic analysis to determine the seismic mil-structure interaction (SSI) effects for all seismic Category1 structures except the radwaste building that is assumed to be surface-founded in the seismic analysis.

3.7.2 Seisnic System Analysis pp. 3-38,3-39
The staffs review of the seismic analysis of the seismic Category I SSCs includes the seismic analysis methods and acceptance criteria used for the ABWR seismic Category I structures, the reactor pressure vessel (RPV) and containment internal structures design. The radwaste building, which is not a seismic Category I structure and does not house any safety-related equipment and systems, is included in this review because GE elected to design this structure for the SSE seismic loads to ensure that the embedded portion of the building retains its structural integrity during and after an SSE, and to prevent unacceptable leakage of the radwaste material outside the building.

p. 3-40
From comparing the natural frequencies obtained from a 2-D fixed base building model and a 3-D fixed base building model with the embedment effect included, GE found that the torsional effect resulting from the eccentricity between the center-of-mass and center-ofl rigidity of the seismic Category I structures (RB, control building, and embedded portion of radwaste building) on the seismic fesponses is negligible because of the symmetry the geometrical layout of the buildings.

In Appendix 3H to the SSAR, Amendment 33, GE provided the analysis procedures used for the dynamic overturning of the RB, control building, and radwaste building and the evaluation results (safety factors against overturning, sliding, and flotation) of these three buildings. From the review of Appendix 3H to the SSAR and the design calculation audit conducted on February 22 through 25, 1993, the staff concludes that the r-tor, control, and radwaste buildings will be dynamically stable under the specified SSE.

p. 3-41
To demonstrate that the as-built plant structures (primary containment structure, internal structures, RB, control building, radwaste building, and turbine building) are able to withstand the structural design basis loads as defined in SSAR Section 3.8, Amendment 33, GE, in SSAR Section3H. 5, Amendment 33, stated that when the construction is complete, a structural analysis report will be prepared to document the results of the review of construction records for material properties used in construction (i.e., in-process testing of concrete properties and procurement specifications for structural steel and reinforcing bars) and the inspection of as-built building

dimensions. In this report, according to GE, construction deviations and design changes, if any, will be assessed to determine appropriate disposition. The as-built plant structures are considered acceptable 'as-they-are,' if the structural design meets the acceptance criteria and load combinations delineated in SSAR Section 3.8, and the dynamic responses (i.e., FRS, shear forces, axial forces and moments) of the as-built plant structures are bounded by the responses documented in Appendices 3A, 3G, and 3H to the SSAR, Amendment 33.

p. 3-45
As a result of discussions during the audit on February 22 through 26, 1993, in SSAR Section 3H.3, Amendment 33, GE provided the analysis methods and results of the radwaste building. As a result of its review, the staff concludes that they are acceptable. Also in a letter dated September 15, 1993, GE certified that the implementation of the QA program for the design calculations of the radwaste building had been completed. Therefore, DFSER Confirmatory Item 3.7.2-6 is resolved.

Radwaste Building Substructure
Turbine Building
During an earlier design calculation audit, GE indicated that the radwaste building does not house any safety-related equipment and components and hence, there is no need to generate FRS for the subsystems. To ensure that the building maintains its structural integrity during and after an SSE and to prevent unacceptable leakage of the radwaste material outside the embedded portion of the building, GE elected to analyze the radwaste building by the response spectrum analysis method and to design the radwaste building structure for the SSE seismic loads.

p. 3-47
GE performed the system and subsystem analyses on an elastic and linear basis. Time history methods form the bases for the analyses of all major seismic Category I structures except the radwaste building. The seismic analysis of the radwaste building and the seismic analysis of seismic Category I systems and components are based on the response spectrum analysis method.

p.3-53
Because GE elected to design the radwaste building substructure to remain structurally intact during an SSE to help contain liquid from a possibly ruptured tank, the radwaste building substructure also is included in this safety evaluation, although it does not house any safety-related systems and components, and hence, is not seismic Category I.

p. 3-54
According to SSAR Section 3.8.4.2, Amendment 33, the materials of construction and their fabrication, construction, and installation are in accordance with ACI 349 Code (1980 Edition) and ANSI/AISC Standard N-690 (1984 Edition), respectively, for the reinforced concrete and structural steel in the RB, control building, and radwaste building substructure. The use of these codes complies with SRP Section 3.8.4 and is acceptable.

Therefore,

DFSER Confirmatory Item 3.8.4-1 is resolved. In a letter dated September 15, 1993, GE certified the implementation of the QA program for the design calculations of the reactor, control, and radwaste buildings. Therefore, DFSER Confirmatory Item 3.8.4-2 is resolved.

p. 3-55
GE used the NASTRAN computer code to perform the static analysis and to calculate the structural element forces and moments of the control building and radwaste building subjected to the various loads and load combinations. A finite element analysis model for each building was used in the analysis. The load combinations for the reinforced concrete structures are in accordance with ACI Standard 349 (1980 Edition).

In the DFSER, the staff noted that in analyzing the control building, GE had not considered the effects of winds, tornados, and tornado missiles and, in analyzing the radwaste building, GE had not considered the effect of winds and had used incorrectly calculated soil pressure loads. These were DFSER Confirmatory Items 3.8.4-3 and 3.8.4-4, respectively. In SSAR Appendix 3H, Amendment 33, GE documented its design results of the control building and radwaste building for the wind, tornado and tornado missile loadings, and soil pressure loads, which is acceptable; therefore, DFSER Confirmatory Items 3.8.4-3 and 3.8.4-4 are resolved. The static analysis methods and the analysis results for the element forces and moments for the control building and radwaste building are acceptable.

p. 14-37
Review of the ABWR Structural Design Integrity The scope of structural design covers the major structural systems in the ABWR plant including the RPV, ASME Code Class 1, 2, and 3 piping systems, and major building structures (primary containment, reactor building, control building, turbine building, service building, and radwaste building). The RPV, piping systems, and primary containment

p. 14-40
ITAAC to verify pipe break loads are not required for the turbine, service, and radwaste buildings either because they are not safety-related structures or there are no high-energy lines located within the structure.

p. 15-25
All the liquid radwaste tanks, including the evaporator concentrate tanks, that could adversely affect the potable water supply if they fail are located in the radwaste building. The base mat and outside walls of the building are seismic Category 1 to a height necessary to retain spill liquids within the building (SSAR Section 11.2.1.2.2). Additionally, in accordance with SSAR Section 15.7.3.1, all compartments containing liquid radwaste are steel lined up to a height capable of containing the release of all the liquid radwastes into the compartments.