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MFN 14-013 R2
Specification 000N7289-R2

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

Subject: 10 CFR Part 21.21(a)(2) Closure Report Notification: Containment Loads Potentially Exceed Limits with High Suppression Pool Water Level in the ABWR Design

This letter provides notification of completion regarding the evaluation performed by GE Hitachi Nuclear Energy (GEH) for the potential increase in hydrodynamic loads that may be experienced by containment structures during a postulated Loss of Coolant Accident (LOCA). The concern was previously communicated via Interim Reports indicated in Reference 1 and Reference 2.

The GEH assessment has concluded that the predicted increase in the suppression pool water level above the value used for defining the ABWR loads and applied in structural analysis will not result in the creation of a Substantial Safety Hazard nor will it lead to exceeding a Technical Specification Safety Limit for the US ABWR Certified Design. Furthermore, the GEH assessment concludes that a similar concern for the higher suppression pool water level does not extend to other BWR containment types and does not result in the creation of a Substantial Safety Hazard nor will it lead to exceeding a Technical Specification Safety Limit for all US plants that use the GEH BWR containment designs, including Mark I, Mark II, Mark III, and ESBWR containments.

The evaluation performed by GEH addresses the impact on ABWR hydrodynamic loads determined by using the Technical Specification Suppression Pool High Water Level (HWL) as an analysis input condition. Vessel coolant inventory is transferred into the containment suppression pool during a postulated LOCA blowdown, thereby increasing the suppression pool water level. Thermal-hydraulic response with this condition determines the magnitude of changes to the forcing functions defining the hydrodynamic loads, with concomitant impact on the structural analyses performed for the ABWR containment and affected safety systems that use the defined hydrodynamic loads as an input. The evaluation considers loads which act on the submerged ABWR pool boundary walls, loads on the ABWR access tunnel, and loads on submerged structures. The limiting event for this concern is the Design Basis Accident – Loss of Coolant Accident (LOCA) for a feedwater line break (FWLB), which limits the short-term Drywell

(DW) and Wetwell (WW) pressure response. The scenario results in the highest suppression pool water level rise during the blowdown period due to the additional inventory from the feedwater system in addition to the water added from the Reactor Pressure Vessel (RPV). The impact on hydrodynamic loads is assessed in three main categories: Loads on Suppression Pool Wall Boundaries, Loads on the Access Tunnel, and Loads on Submerged Structures. Each of the three main categories is further subdivided into subcategories. Subcategories for LOCA loads include Pool Swell, Condensation Oscillation (CO), and Chugging. An additional subcategory assesses Safety Relief Valve (SRV) Loads for external loads including the air clearing bubble pressure loads on the walls and loads on submerged structures, SRV Internal discharge pressure and discharge thrust loads, and internal SRV Discharge Line (SRVDL) piping loads during SRV actuations.

The general method applied by GEH in performing the assessment includes steps to identify margin in the containment hydrodynamic loads analysis basis. Relative conservatisms are considered in developing load and/or pressure increase scale factors for applicable subcategories within each main category. These scale factors are determined for application of conservative assumptions within the method, and alternate factors are determined for conditions in which aspects of the conservative assumptions are justifiably relaxed. This approach yields a bounding scale factor increase for the loads when full conservatism is applied, along with a lowered scale factor increase from more realistic assumptions. Affected plants and plant designs could then use the set of scale factors in assessing plant-specific consequences on their design basis. Further details and resultant scale factors are given in Attachment 1. When considered with the realistic assumptions and the lowered scale factors, the condition reported in Reference 1 is determined as non-reportable, and there is no Substantial Safety Hazard nor will it lead to exceeding a Technical Specification Safety Limit for the affected plants and plant designs. The GEH evaluation within 10 CFR Part 21 is now closed.

If you have any questions, please call me at (910) 819-4491.

Sincerely,

Dale E. Porter
Safety Evaluation Program Manager
GE-Hitachi Nuclear Energy Americas LLC

Reference:

1. 60-Day Interim Report Notification, Titled: Containment Loads Potentially Exceed Limits with High Suppression Pool Water Level in the ABWR Design, Numbered: MFN 14-013 R0, Dated: March 13, 2014.
2. 60-Day Interim Report Notification, Titled: Containment Loads Potentially Exceed Limits with High Suppression Pool Water Level in the ABWR Design, Numbered: MFN 14-013 R1, Dated: June 26, 2014.

Attachments:

1. Assessment Information for Affected ABWR Designs or Plants

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<u>Attachment 1</u> – Assessment Information for Affected ABWR Designs or Plants

Background

A condition was identified regarding the ABWR hydrodynamic loads determined by using the Technical Specification Suppression Pool High Water Level (HWL) as an analysis input condition. Vessel coolant inventory is transferred into the containment Suppression Pool during a postulated LOCA blowdown, thereby increasing the Suppression Pool (SP) water level. The correction in the analysis may lead to a SP water level greater than what is currently assumed in structural analyses which apply the containment hydrodynamic loads generated during a postulated LOCA event. For example, a postulated Feedwater Line Break (FWLB) may transfer a large quantity of FW liquid into the Suppression Pool with a notable increase in pool water level, even assuming a portion of the discharged fluid spills over into the lower drywell region of the ABWR containment. Lower predicted increases in SP water would be anticipated for steam breaks or for non-LOCA events. A higher SP water level from the FWLB may result in increased hydrodynamic loads acting on the submerged walls and structures in the containment. The higher SP water level can extend the wetted regions of the SP walls and the ABWR access tunnel, as well as result in wetted submerged structure segments that were not previously considered wetted. This condition affects the LOCA containment hydrodynamic loads including condensation oscillation (CO) and chugging, as well as Safety Relief Valve (SRV) actuation loads.

Safety Analysis Results

Assessment of the increased SP water level during the time period important for containment hydrodynamic loads was performed to determine magnitude of changes to the forcing functions that define the hydrodynamic loads and also a separate structural response assessment to determine the impact of changes to the hydrodynamic loads on structural analyses performed for the ABWR containment and affected safety systems that use the defined hydrodynamic loads as an input. The impact on hydrodynamic loads is assessed in three main categories: Loads on Suppression Pool Wall Boundaries, Loads on the Access Tunnel, and Loads on Submerged Structures. Each of the three main categories is further subdivided into subcategories. Subcategories for LOCA loads include Pool Swell, Condensation Oscillation (CO), and Chugging. An additional subcategory assesses Safety Relief Valve (SRV) Loads for external loads including the air clearing bubble pressure loads on the walls and loads on submerged structures, SRV Internal discharge pressure and discharge thrust loads, and internal SRV Discharge Line (SRVDL) piping loads during SRV actuations. The impact on containment structure is also considered.

Results for each assessment category are provided below. Two plant configurations are presented for comparison – results for the US ABWR design and results for a non-domestic ABWR design. Other affected plants or designs may determine the applicable comparative basis relative to these two designs.

Attachment 1 – Assessment Information for Affected ABWR Designs or Plants

Loads on Suppression Pool Wall Boundaries

Pool Swell Loads on Pool Wall Boundaries:

Pool swell loads result from the forced expulsion of drywell air through the vent system into the suppression pool and the subsequent acceleration of displaced water above the vent exit elevation immediately following a LOCA. The pool swell loads include vent clearing loads, LOCA air bubble pressure loads on submerged boundaries and structures and impact and drag loads on structures above the initial water surface. The limiting pool-swell loads occur during the DBA-LOCA which for the ABWR includes the Main Steam Line Break (MSLB) and Feedwater Line Break (FWLB). The pool swell loads occur at the beginning of the event before there is any significant transfer of vapor or liquid water into the suppression pool with a resultant increase in water level. Therefore, there is no impact of increased suppression pool water level on the pool swell loads.

Condensation Oscillation Loads on Pool Wall Boundaries:

Condensation Oscillation (CO) loads occur following the pool swell phase. These loads result from the condensation of steam at high mass flux in the suppression pool. CO will occur during periods of relatively high steam mass flux, which is then followed by steam condensation with chugging when the steam flux fall below a given threshold value. CO pressure amplitudes are generally higher with vent flow rate and higher suppression pool water temperatures (or reduced subcooling of the pool water). The limiting CO loads typically occur during the first 5 to 30 seconds of a DBA- LOCA.

The ABWR design CO loads are defined with a "source load" methodology that is described in the US ABWR Standard Safety Analysis Report Appendix 3B. In this methodology a CO vent source is developed from the ABWR Horizontal Vent Test (HVT) CO test data, subsequently calibrated using an acoustic model of the HVT and then applied to the full scale ABWR containment to generate the full scale ABWR design CO wall pressure histories.

The rise in suppression water level during the FWLB blowdown period with high vent steam mass flux, when CO conditions occur, was determined from a review of the FWLB short-term containment analyses. A water level rise of 1.4 m during CO was predicted for the Non-domestic ABWR FWLB and a rise of 0.8 m was predicted for US ABWR FWLB. A revised normalized wall pressure distribution is considered in the assessment with an extended attenuation from the vent exit to the higher pool surface. The normalized pressure distribution below the vent elevation is unaffected. The total force acting on the pedestal wall and reinforced concrete containment vessel (RCCV) wall is affected by the change in CO pressure amplitude as well as the change in the wetted wall regions which affect the wall pressure distribution. Since there is no change in the normalized wall pressure distribution acting on the basemat, the change in total force acting on the basement is only affected by the change in predicted pressure amplitude. An assessment for the load factors of pressure amplitude and wall force following the source load methodology provides a conservative evaluation of the impact from an increased SP water level.

Several conservative assumptions are identified in the CO wall load analysis: source load methodology applied to ABWR, empirical testing conditions compared to the ABWR FWLB prediction,

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initial pool temperature adjustment, diversion of FWLB liquid flow into the lower drywell, and scaled HVT test data comparison to the wall pressure distribution. The overall effect of these conservative assumptions was evaluated and used to adjust the conservative evaluation, yielding the realistic assumption basis. Scale factors for each set of assumptions may be applied to the specified hydrodynamic loads to determine the impact of the higher SP water level. The corresponding CO loads scale factors are:

<u>Pool Boundary Loads Scale Factors– Conservative Assumptions</u>

1.502	(Pedestal and RCCV Wall - Non-domestic ABWR)
1.326	(Pedestal and RCCV Wall - US ABWR)
1.315	(Basemat - Non-domestic ABWR)
1.232	(Basemat - US ABWR)

<u>Pool Boundary Loads Scale Factors – Realistic Assumptions</u>

1.0	(Pedestal and RCCV Wall - Non-domestic ABWR)
0.88	(Pedestal and RCCV Wall - US ABWR)
0.9	(Basemat - Non-domestic ABWR)
0.82	(Basemat - US ABWR)

<u>Chugging Loads on Pool Wall Boundaries:</u>

Chugging loads are intermittent steam condensation loads which occur during steam vent flow into the suppression pool at low vent steam mass flux. The chugging loads occur after CO loads during a DBA-LOCA (FWLB or MSLB) when vent steam mass flux falls below a threshold flux for chugging. Chugging can also occur during intermediate and small liquid and steam breaks for the duration of the event. Therefore, chugging loads are defined for DBA-LOCA. Intermediate Breaks (IBA) and Small breaks (SBA). However, the water level rise with chugging is potentially greatest for the FWLB and therefore selected as the basis for establishing the water level rise for the pool boundary chugging load evaluation.

Chugging during a FWLB or MSLB, if present, occurs at or near the end of the blowdown period. The maximum suppression pool water level occurs at the end of the blowdown period and there establishes the water level rise during chugging. A water level rise of 1.9 m during chugging was predicted for the Non-domestic ABWR FWLB and a rise of 1.4 m was predicted for US ABWR FWLB. An assessment for the load factors of pressure amplitude and wall force following the source load methodology provides a conservative evaluation of the impact from an increased SP water level.

Several conservative assumptions are identified in the chugging wall load analysis: selection of HVT steam break chugs for liquid breaks, source load methodology applied to ABWR, diversion of FWLB liquid flow into the lower drywell, and scaled HVT test data comparison to the wall pressure distribution. Application of these conservative assumptions occurs with differing values depending on the break type (liquid or steam), however the general nature of the assumptions are prescribed on

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a consistent basis. The overall effect of these conservative assumptions was evaluated and used to adjust the conservative evaluation, yielding the realistic assumption basis. Scale factors for each set of assumptions may be applied to the specified hydrodynamic loads to determine the impact of the higher SP water level. Realistic assumptions are applied as appropriate for each break type. The corresponding Chugging loads scale factors are:

<u>Pool Boundary Loads Scale Factors– Conservative Assumptions</u>

1.220	(Pedestal Wall - Non-domestic ABWR)
1.160	(Pedestal Wall - US ABWR)
1.179	(RCCV Wall - Non-domestic ABWR)
1.132	(RCCV Wall - US ABWR)
1.0	(Basemat- Non-domestic ABWR)
1.0	(Basemat - US ABWR)

<u>Pool Boundary Loads Scale Factors – Realistic Assumptions</u>

For MSLB and Steam Line Breaks:

0.93	(Pedestal and RCCV Walls- Non-domestic ABWR and US ABWR)
0.9	(Basemat - Non-domestic ABWR and US ABWR)

For FWLB and Liquid Breaks:

0.77	(Pedestal Wall- Non-domestic ABWR)
0.73	(Pedestal Wall- US ABWR)
0.74	(RCCV Wall - Non-domestic ABWR)
0.71	(RCCV Wall - US ABWR)
0.63	(Basemat - Non-domestic ABWR and US ABWR)

Additionally, chugging can produce local upward directed pressures on the horizontal vent protruding from the pedestal wall to the suppression pool. A local vertically oriented chugging load is therefore defined for the ABWR vent that was derived from direct HVT test measurements. The chugging loads, including the local horizontal vent load, are mainly controlled by the thermal hydraulics of the test conditions that account for increases in water level during the tests. Since the vent is fully submerged there is no impact of extended wetted regions as there is for the suppression pool walls and access tunnel. Therefore, there is no impact elevated water level on the ABWR horizontal vent chugging local load definition.

<u>Safety Relief Valve Loads on Pool Wall Boundaries:</u>

Safety Relief Valves (SRVs) provide pressure relief during reactor transients. Steam discharged from the SRVs is routed through the SRV discharge lines (SRVDLs) and through the SRV quencher into the suppression pool. Actuation of SRVs introduces high pressure steam in the SRVDL which quickly pressurizes the SRVDL resulting in the forced expulsion of the water leg initially in the SRVDL and subsequently the air in the SRVDL to the suppression pool. The SRV loads resulting from SRV operation include the pressure, reaction and thrust loads acting on the SRVDL and quencher and the air-bubble loads which are transmitted to the submerged boundaries and structures. During

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isolation events or Small Break Accidents (SBA) SRV actuations can occur following the transfer of vessel liquid to the suppression pool due to break flow (for SBA events) or due to SRV steam discharge to the suppression pool. Therefore, the evaluation determined the impact of an increase in water level on the SRV loads.

For the DBA-LOCA events (MSLB and FWLB) it was determined that SRV actuations either do not occur, or occur at the start of the event before there is any significant increase in suppression pool water level. For the smaller break sizes, a review of the analyses indicated that a water level increase above 1 ft (0.3 m) does not occur until after the RPV has depressurized sufficient to preclude the occurrence of significant SRV loads. A maximum water level rise of 0.3 m was selected as a reasonable bounding approximation for assessing SRV loads. The increase factor for total force associated with the change in wall distribution for a 0.3 m water level increase is insignificant in relation to the large conservatism in the wall pressure and wall pressure distribution. Therefore, the existing ABWR defined SRV pool boundary loads have sufficient margin of conservatism to compensate for any increase associated with elevated water level.

Loads on the Access Tunnel

There are two lower drywell access tunnels situated on the ABWR suppression pool that are located 180° apart. The ABWR lower drywell access tunnel traverses the width of the suppression pool radially and is partially submerged. The submerged surface of the access tunnel is subject to the hydrodynamic loads in the suppression pool. Changes in water level can have a relatively large impact on the suppression pool loads for the access tunnel due to the effects of increased submergence and wetted surface area.

Pool Swell Loads on the Access Tunnel:

As identified previously, there is no impact on pool swell loads from the increased suppression pool water level resulting from FWLB of MSLB events, including the loads that act on the ABWR access tunnel.

Condensation Oscillation Loads on the Access Tunnel:

The FWLB water level rise and corresponding increased pool depths selected for the pool boundary CO wall pressure evaluation given above is also applied for the access tunnel evaluation. Access tunnel submergence is calculated at 2.75 m for the Non-domestic ABWR and 2.05 m for the US ABWR.

GEH evaluated the increased SP water level by considering the access tunnel as a partially submerged structure. This approach accounts for structure-to-acoustic source distances and relative positions, the direction of CO induced flow fields in the suppression pool, and obliquity of the resultant CO induced pressures and forces acting on the access tunnel surface. Two sets of analyses were performed using the conservative assumptions as well as using with the realistic assumptions

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as discussed above for the wall loads. Each assessment includes the integrated normal force acting on the tunnel structure, as well as the net vertical force required for dynamic structural analysis.

Table 1 shows resulting loads scale factors with conservative assumptions for maximum pressure and integrated force that are determined from the ratio of the normal force prediction. Similarly, Table 1A gives the results considering the realistic assumptions.

Table 1. Access Tunnel CO Loads Scale Factors for Integrated Normal Force using Conservative Assumptions

SP Water Level/Wall Location	Pressure Increase	Force Increase Factor
8.6M @ Pedestal End (Non-domestic ABWR)	1.299	1.631
8.6M @ RCCV End (Non-domestic ABWR)	0.790	0.933
7.9M @ Pedestal End (US ABWR)	0.985	1.147
7.9 M @RCCV End (US ABWR)	0.526	0.575

Table 1A. Access Tunnel CO Loads Scale Factors for Integrated Normal Force using Realistic Assumptions

SP Water Level/Wall Location	Pressure Increase	Force Increase Factor
8.6M @ Pedestal End (Non-domestic ABWR)	0.870	1.093
8.6M @ RCCV End (Non-domestic ABWR)	0.529	0.626
7.9M @ Pedestal End (US ABWR)	0.660	0.768
7.9 M @RCCV End (US ABWR)	0.352	0.385

Table 2 shows the resulting loads scale factors for the net vertical force with conservative assumptions. Similarly, Table 2A gives the results considering the realistic assumptions. The results are applicable to Non-domestic and US ABWR designs.

Table 2. Access Tunnel CO Loads Scale Factors for Vertical Force using Conservative Assumptions

SP Water Level/Wall Location	Vertical Force Increase Factor
8.6M @ Pedestal Wall	1.460
8.6M @ RCCV Wall	0.846

Table 2A. Access Tunnel CO Loads Scale Factors for Vertical Force using Realistic Assumptions

SP Water Level/Wall Location	Vertical Force Increase Factor
8.6M @ Pedestal End	0.978
8.6M @ RCCV End	0.567

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<u>Chugging Loads on the Access Tunnel:</u>

Chugging loads on the access tunnel are determined in a similar fashion as the CO loads, however the tunnel submergence is adjusted for the SP level at the time period for chugging. Access tunnel submergence is calculated at 3.15 m for the Non-domestic ABWR and 2.65 m for the US ABWR in the event of FWLB. A pool level increase of 0.3 m is bounding for the MSLB event.

The methodology applied for CO loads is applied in a similar fashion for chugging loads with adjustment to the SP water level. Table 3 gives the resultant scale factors for the normal pressure load and the integrated normal force obtained with the conservative assumptions. These factors are equivalent for the submergence associated with both SP water level increase conditions listed above. As stated in the discussion on wall loads for chugging, the specific elements of the realistic assumptions are applied for different break types. Table 3A gives the corresponding scale factors for liquid and steam breaks, respectively, with application of the realistic assumptions. The results are applicable to Non-domestic and US ABWR designs.

Table 3. Access Tunnel Chugging Loads Scale Factors for Normal Pressure and Integrated Normal Force using Conservative Assumptions

SP Water Level/Wall Location	Pressure Increase	Force Increase Factor
9.0 & 8.5 m @ Pedestal Wall	0.856	1.182
9.0 & 8.5 m @ RCCV Wall	0.995	1.552

Table 3A. Access Tunnel Chugging Loads Scale Factors for Normal Pressure and Integrated Normal Force using Realistic Assumptions

SP Water Level/Wall Location	Pressure Increase	Force Increase Factor
FWLB or Liquid Breaks		
9.0 & 8.5 m @ Pedestal Wall	0.540	0.866
9.0 & 8.5 m @ RCCV Wall	0.627	1.164
MSLB or Steam Breaks		
7.4 m @ Pedestal Wall	0.771	1.127
7.4 m @ RCCV Wall	0.896	1.478

The spectral content of the load definition time histories, which is utilized in the structural dynamic analysis, is mainly controlled by the chugging ringout response. Therefore the ringout response is examined for evaluation of the access tunnel vertical chugging load for dynamic analysis. Table 4 shows the resulting chugging loads scale factors for the vertical pressure and net vertical force with conservative assumptions. Similarly, Table 4A gives the results considering the realistic assumptions. The results are applicable to Non-domestic and US ABWR designs.

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Table 4. Access Tunnel Chugging Loads Scale Factors for Ringout Vertical Pressure and Vertical Force Component using Conservative Assumptions

SP Water Level/Wall Location	Pressure Increase	Vertical Force Increase Factor
9.0 M @ Pedestal Wall	1.505	1.910
9.0 M @ RCCV Wall	1.505	1.910

Table 4A. Access Tunnel Chugging Loads Scale Factors for Ringout Vertical Pressure and Vertical Force Component using Realistic Assumptions

SP Water Level/Wall Location	Pressure Increase	Vertical Force Increase Factor
FWLB or Liquid Breaks		
9.0 M @ Pedestal Wall	0.948	1.204
9.0 M @ RCCV Wall	0.948	1.204
MSLB or Steam Breaks		
7.4M @ Pedestal Wall	0.838	0.915
7.4M @ RCCV Wall	0.838	0.915

Safety Relief Valve Loads on the Access Tunnel:

The evaluation given previously for SRV loads on pool wall boundaries determined a maximum predicted water level rise of 0.3 m during periods of SRV actuations. It was also determined that the water level increase would have negligible impact on the SRV actuation wall pressures. For the access tunnel, however, an increase in the tunnel submergence can potentially produce higher normalized pressure factors which will increase pressures on the access tunnel, and a larger force due to the increase in the tunnel wetted boundary. The increase factor for total force associated with the change in wall distribution for a 1 ft (0.3 m) water level increase is insignificant in relation to the large conservatism in the wall pressure and wall pressure distribution. Therefore, the existing ABWR defined SRV loads on the access tunnel have sufficient margin of conservatism to compensate for any increase associated with elevated water level.

Loads on Submerged Structures

The US ABWR DCD, Appendix 3B, only identifies methods to be used in defining loads on submerged structures by citation to references. This includes the methods for loads due to LOCA pool swell, CO, chugging and SRV loads. It does not include guidance on a specific water level. There is therefore no direct impact of the increased SP water level on the US ABWR DCD description.

Submerged structure loads are however defined specific to the design of a Non-domestic ABWR, including structures situated below the suppression pool surface. These include the SRVDL piping and quenchers, ECCS suction strainers, ECCS piping and supports and other miscellaneous structures. Assessment of CO, Chugging, and SRV actuation submerged structure loads was performed for the Non-domestic plant design subjected to the increased suppression pool water level. The resulting evaluation indicates that there is very little change on submerged structure loads for structures or segments of structures such as the ECCS suction strainer that are situated at lower

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depths of the suppression pool, with no change in the wetted affected regions. The small changes in loads for these structures are off-set by the conservatism in the load definition identified for the pool boundary loads and also apply to the submerged structure loads since the source strengths used in the submerged structure calculations are derived from the design wall pressure loads.

For structures, or segments of structures that are near the pool surface, the predicted increase in load is greater due to the change in submerged affected region. However, when credit is considered for conservatism in the loads, the increase in the loads acting on these structures are significantly reduced. In addition, the load on supports that anchor the submerged structures to the suppression pool walls and basemat is established by the load contribution from forces acting on all segments of the submerged structure. An example is the SRVDL pipe and quencher that is anchored to the basemat. This means that the overall increase in the load on supports is established by overall increase in the load for the length of the submerged structure which would expectedly be significantly less than the local increase for segments near the pool surface.

SRV actuations can impose internal loads on the SRV Discharge Line (SRVDL) piping and quencher due to the rapid pressurization of the SRVDL and forced expulsion of the water leg initially within the submerged portion of the SRVDL piping and quencher. The SRV internal piping loads include the water clearing thrust loads and SRVDL piping pressure loads. An increase in the water leg inside the submerged SRVDL piping with elevated suppression pool water level can potentially result in a higher water leg in the SRVDL piping prior to SRV actuation which can increase the internal SRVDL piping and quencher loads during an SRV actuation. As previously identified, a maximum water level rise of 0.3 m is predicted under conditions where significant SRV loads can occur. The corresponding increase of the water leg in the submerged SRVDL piping is 1.2 ft (0.37 m). Evaluations performed for design-specific information of a Non-domestic ABWR plant determined that when conservatism in the SRV flow rate is credited, the loads determined based on normal water level and design SRV flow rates bound the values obtained with the more realistic nominal SRV flow rates and an elevated water level of 5.5 ft (1.7 m). Therefore, based on the results of this evaluation it was concluded that, when conservatism in the design calculation is considered, a 1 ft (0.3 m) higher suppression pool water level, with a corresponding 1.2 ft (0.37 m) increase in water leg, will produce internal SRVDL piping loads which are bounded by the design loads.

Evaluation of Containment Structural Integrity

The important loads affecting structural integrity are CO and chugging. These loads were assessed for affected containment structures relative to their structural integrity. SRV loads increased from the higher SP water level do not adversely impact integrity of containment structures.

Pool Wall Boundary Structural Integrity

An evaluation for primary containment structural integrity was performed to confirm that predicted increases for the LOCA CO and chugging load acting on the ABWR suppression pool boundaries do not exceed structural safety design margins for the primary containment. For simplicity the evaluation assumed that forces due to CO and Chugging are increased 50% and 20% respectively to account for the increase in the loads with elevated SP water level. The evaluation applies the

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increase in pool boundary CO and chugging force scale factors considering conservative assumptions as given in the previous discussions. Based on structural evaluations performed, it was concluded that the stresses in the RCCV and RPV Pedestal for the governing faulted load combination will change less than 1% as a result of the predicted increases in the CO and chugging forces due to the SP water level increase. Consequently, the existing structural design basis of the RCCV and RPV Pedestal will not be affected by the rise in elevation of the SP surface resulting from a FWLB LOCA.

<u>Access Tunnel Structural Integrity</u>

The access tunnel design is only described in the US ABWR DCD; there is no associated stress analysis results included in the US ABWR DCD. An evaluation for the access tunnel structural integrity was performed, however, for a Non-domestic ABWR plant-specific design in order to confirm that the predicted increase in the CO and Chugging loads do not result in the exceeding of safety design margins of the access tunnel. The evaluation determined that sufficient margins existing in the design to accommodate stress limits and buckling limits of the access tunnel.

<u>Integrity of Primary Structure Safety Related Structures, Components and Equipment (SC&E)</u>

Increases in the CO and chugging contribution to the emergency and faulted load combinations can result in increases in the primary structure model responses that can impact the design margins for safety-related SC&E. The US ABWR DCD does not include design details for SC&E; there is no associated stress analysis results included in the US ABWR DCD. Evaluation for a Non-domestic ABWR plant-specific design, however, was performed and determined that the increase in loads associated with the maximum increase in suppression pool elevation resulting from a FWLB LOCA will lead to stresses that are within the code-allowable for emergency and faulted load combinations for all safety related Nuclear Steam Supply System components and equipment.

Extent of Condition for Other BWR Containment Types

The increased suppression pool water level was assessed explicitly for the ABWR containment type. The containment load application documents that GEH issued for the other operating BWR containment designs, Mark I, Mark II and Mark III do not explicitly identify a specific value or basis for water level to be used in applying the containment loads. The basis for the wall pressure distributions for CO, chugging and SRV loads do not identify a specific water level as is the case for the ABWR. The wall pressure distribution assumed to be attenuated linearly to the free pool surface without a specific value or basis for depth. This is appropriate for the operating BWR containment types since the containment load documents were developed for application to the BWR fleet of plants within each containment type with each plant having different physical dimensions and different operating limits on pool water level. Although there may be a small reduction in margin due to a slight increase in the affected loaded regions of the walls, the conservatism in the loads defined for the other BWR containment types (Mark I, Mark II, Mark III, and ESBWR) is more than adequate to cover the effects of an elevated suppression pool water level.

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Conclusion

Based on the results presented here it was determined that potential increases or changes to hydrodynamic loads that were defined for the ABWR containment which are associated with elevated suppression pool water level will not result in the exceeding of ABWR structural design limits.

The GEH assessment has concluded that the predicted increase in the suppression pool water level above the value used for defining the ABWR loads and applied in structural analysis will not result in the creation of a Substantial Safety Hazard nor will it lead to exceeding a Technical Specification Safety Limit for the US ABWR Certified Design. Furthermore, the GEH assessment concludes that a similar concern for the higher suppression pool water level does not extend to other BWR containment types and does not result in the creation of a Substantial Safety Hazard nor will it lead to exceeding a Technical Specification Safety Limit for all US plants that use the GEH BWR containment designs, including Mark I, Mar II, Mark III, and ESBWR containments.