21.0 DESIGN CHANGES PROPOSED IN ACCORDANCE WITH ISG-11

21.4 Hydrogen Vent ITAAC

21.4.1 Introduction

The applicant requests a change to the AP1000 Design Control Document (DCD) Revision 19 information. The Levy Nuclear Plant (LNP) Combined License Application (COLA) incorporates the AP1000 DCD by reference. The change involves a departure from DCD Tier 1 Inspections, Tests, Analyses and Acceptance Criteria (ITAAC) as well as an associated DCD Tier 2 departure.

The applicant has determined that the ITAAC described in Tier 1 Table 2.3.9-3 cannot be met by the certified design, and has elected to request to revise the ITAAC described in Tier 1 Table 2.3.9-3, Item 3, Acceptance criterion iii. This ITAAC requires 98% of the primary openings through the ceilings of the passive core cooling system (PXS) valve/accumulator rooms in containment must be at least 19 feet away from the containment shell and all other openings must be at least 3 feet away.

The applicant also requests that the Tier 2, section 6.2.4.5.1 Preoperational Inspection and Testing, Hydrogen Ignition Subsystem, second paragraph be revised, and Tier 2, section 19.41.7, "Diffusion Flame Analysis".

21.4.2 Summary of Application

Tier 1 and Tier 2 Departures

- LNP DEP 6.2-1

LNP DEP 6.2-1 proposes to change the acceptance criteria to be applied to a specific ITAAC design commitment and associated inspection, test, or analysis in Tier 1 Table 2.3.9-3, Item 3 to establish consistency with the current design of the plant. The ITAAC currently contained in the AP1000 DCD, Tier 1 Table 2.3.9-3, Item 3, for control of containment hydrogen concentration for beyond design basis accidents, was based on the original AP600 and AP1000 design. The design of these areas has evolved over time, causing the ITAAC acceptance criteria to not be consistent with the current design of the plant for (1) the primary vent paths through the ceilings of the PXS valve/accumulator rooms and (2) the proximity of these paths to the containment shell.

The staff reviewed a request for an exemption submitted by the applicant. The request proposed changes to Tier 1 Table 2.3.9-3, Item 3. Additionally, the staff reviewed the Tier 2 changes for potential effects on safety functions and design criteria of the PXS valve/accumulator room vents as described in DCD Subsections 6.2.4.5.1 and 19.41.7. The regulatory evaluation of the exemption request appears in Subsection A, below, and the technical evaluation of the exemption request and departure appears in Subsection B, below.

21.4.3 Regulatory Basis

The regulatory basis for this change shall comply with the requirements of Appendix D to Part 52—Design Certification Rule for the AP1000 Design, VIII. Processes for Changes and Departures. Specifically the Tier 1 information shall comply with the requirements for exemptions from Tier 1 information which are governed by the requirements in 10 CFR 52.63(b)(1) and 52.98(f). The Commission will deny a request for an exemption from Tier 1, if it finds that the design change will result in a significant decrease in the level of safety otherwise provided by the design. Request for generic changes to Tier 2 information are governed by the requirements in 10 CFR 52.63(a).

21.4.4 Technical Evaluation

A. Regulatory Evaluation of Exemption Request

A.1 Summary of Exemption

The applicant requested an exemption from the provisions of 10 CFR Part 52, Appendix D, Section III.B, "Design Certification Rule for the AP1000 Design, Scope and Contents," that require the applicant referencing a certified design to incorporate by reference Tier 1 information. Specifically, the applicant proposed to revise Tier 1 Table 2.3.9-3, Item 3, Acceptance Criteria iii, to make it consistent with the current design of the plant.[1]

A.2 Regulations

- 10 CFR Part 52, Appendix D, Section VIII.A.4 states that exemptions from Tier 1 information are governed by the requirements of 10 CFR 52.63(b) and 10 CFR 52.98(f). It also states that the Commission may deny such a request if the design change causes a significant reduction in plant safety otherwise provided by the design. This subsection of Appendix D also provides that a design change requiring a Tier 1 change shall not result in a significant decrease in the level of safety otherwise provided by the design.

- 10 CFR 52.63(b)(1) allows the licensee to request NRC approval for an exemption from one or more elements of the certification information. The Commission may only grant such a request if it complies with the requirements of 10 CFR 52.7 which in turn points to the requirements listed in 10 CFR 50.12 for specific exemptions, and if the special circumstances present outweigh the potential decrease in safety due to reduced standardization. Therefore, any exemption from the Tier 1 information certified by Appendix D to 10 CFR Part 52 must meet the requirements of 10 CFR 50.12, 52.7, and 52.63(b)(1).

[1] While the applicant describes the requested exemption as being from Section III.B of 10 CFR Part 52, Appendix D, the entirety of the exemption pertains to proposed departures from Tier 1 information in the generic DCD. In the remainder of this evaluation, the NRC will refer to the exemption as an exemption from Tier 1 information to match the language of Section VIII.A.4 of 10 CFR Part 52, Appendix D, which specifically governs the granting of exemptions from Tier 1 information.

A.3 Evaluation of Exemption

As stated in Section VIII.A.4 of Appendix D to 10 CFR Part 52, an exemption from Tier 1 information is governed by the requirements of 10 CFR 52.63(b)(1) and 52.98(f). Additionally, the Commission will deny an exemption request if it finds that the requested change to Tier 1 information will result in a significant decrease in safety. Pursuant to 10 CFR 52.63(b)(1), the Commission may, upon application by an applicant or licensee referencing a certified design, grant exemptions from one or more elements of the certification information, so long as the criteria given in 10 CFR 50.12 are met and the special circumstances as defined by 10 CFR 50.12 outweigh any potential decrease in safety due to reduced standardization.

Applicable criteria for when the Commission may grant the requested specific exemption are provided in 10 CFR 50.12(a)(1) and (a)(2). Section 50.12(a)(1) provides that the requested exemption must be authorized by law, not present an undue risk to the public health and safety, and be consistent with the common defense and security. The provisions of 10 CFR 50.12(a)(2) list six special circumstances for which an exemption may be granted. It is necessary for one of these special circumstances to be present in order for NRC to consider granting an exemption request. The applicant stated that the requested exemption meets the special circumstances of 10 CFR 50.12(a)(2)(ii). That subsection defines special circumstances as when "[a]pplication of the regulation in the particular circumstances would not serve the underlying purpose of the rule or is not necessary to achieve the underlying purpose of the rule." The staff's analysis of each of these findings is presented below.

A.3.1 Authorized by Law

This exemption would allow the applicant to implement approved changes to Tier 1 Table 2.3.9-3, Item 3. This is a permanent exemption limited in scope to particular Tier 1 information, and subsequent changes to this information or any other Tier 1 information would be subject to full compliance with the change processes specified in Section VIII.A.4 of Appendix D to 10 CFR Part 52. As stated above, 10 CFR 52.63(b)(1) allows the NRC to grant exemptions from one or more elements of the certification information, namely, as discussed in this exemption evaluation, the requirements of Tier 1. The NRC staff has determined that granting of the applicant's proposed exemption will not result in a violation of the Atomic Energy Act of 1954, as amended, or the Commissions regulations. Therefore, as required by 10 CFR 50.12(a)(1), the exemption is authorized by law.

A.3.2 No Undue Risk to Public Health and Safety

The underlying purpose of AP1000 Tier 1 Table 2.3.9-3, Item 3 is to ensure that in the postulated beyond-design-basis accident scenarios discussed in DCD Subsections 19.34 and 19.41, hydrogen generated as a result of the accident which migrates to the PXS compartments is vented through large openings in the ceilings of these rooms such that, in the event of ignition of the hydrogen plume, the containment shell will not fail.

A change to Tier 1 Table 2.3.9-3, Item 3, Acceptance Criteria iii, is required to establish consistency with the current design of the plant by changing the ITAAC acceptance criteria for the primary ventilation paths through the ceilings of the PXS valve/accumulator rooms and the proximity of the paths to the containment shell; this change maintains the design margins of the Containment Hydrogen Control System, therefore supporting the intended design functions. The plant-specific Tier 1 DCD will continue to reflect the approved licensing basis for the applicant and will maintain a level of detail consistent with that which is currently provided elsewhere in Tier 1 of the plant-specific DCD. The affected design description in the plant-specific Tier 1 DCD will continue to provide the detail necessary to support the performance of the associated ITAAC. The proposed changes to Tier 1 information are evaluated and found to be acceptable in Section 21.x of this safety evaluation. Therefore, the staff finds the exemption presents no undue risk to public health and safety as required by 10 CFR 50.12(a)(1).

A.3.3 Consistent with Common Defense and Security

The proposed exemption would allow the applicant to implement modifications to the Tier 1 information requested in the applicant's submittal. This is a permanent exemption limited in scope to particular Tier 1 information. Subsequent changes to this information or any other Tier 1 information would be subject to full compliance with the change processes specified in Section VIII.A.4 of Appendix D to 10 CFR Part 52. This change is not related to security issues. Therefore, as required by 10 CFR 50.12(a)(1), the staff finds that the exemption is consistent with the common defense and security.

A.3.4 Special Circumstances

Special circumstances, in accordance with 10 CFR 50.12(a)(2)(ii), are present whenever application of the regulation in the particular circumstances would not serve the underlying purposes of the rule or is not necessary to achieve the underlying purpose of the rule. The underlying purpose of the specific Tier 1 Table 2.3.9-3, Item 3, Acceptance Criteria iii, modified in the exemption request is to ensure that, in the postulated beyond-design-basis accident scenarios discussed in DCD Subsections 19.34 and 19.41, hydrogen generated as a result of the accident which migrates to the PXS compartments is vented through large openings in the ceilings of these rooms such that, in the event of ignition of the hydrogen plume, the containment shell will not fail. A change to the ITAAC acceptance criteria is required to establish consistency with the current design of the plant.

Application of the requirements in Tier 1 Table 2.3.9-3, Item 3, Acceptance Criteria iii, as stated in the certified design, is not necessary to achieve the underlying purpose of those portions of the rule. The proposed change to the ITAAC acceptance criteria maintains the design margins of the Containment Hydrogen Control System, therefore supporting the intended design functions. This change does not impact the ability of any structures, systems, or components to perform their functions or negatively impact safety and, therefore, meets the underlying purposes of the rule. Accordingly, because application of the current requirements in Tier 1 Table 2.3.9-3, Item 3 is not necessary to achieve the underlying purpose of the rule, special circumstances are present. Therefore, the staff finds that special circumstances required by 10 CFR 50.12(a)(2)(ii) for the granting of an exemption from the Tier 1 information described above.

A.3.5 Special Circumstances Outweigh Reduced Standardization

This exemption, if granted, would allow the applicant to change certain Tier 1 information incorporated by reference from the AP1000 DCD into the LNP COL application. An exemption from Tier 1 information may only be granted if the special circumstances of the exemption request, required to be present under 10 CFR 52.7 and 10 CFR 50.12, outweigh any reduction in standardization. The proposed exemption would modify the ITAAC acceptance criteria for the primary ventilation paths through the ceilings of the PXS valve/accumulator rooms and the proximity of the paths to the containment shell. The proposed changes to the ITAAC acceptance criteria maintain the design margins of the Containment Hydrogen Control System, therefore supporting the intended design functions.[2]

As described below in the technical evaluation, the change to the ITAAC acceptance criteria for the primary ventilation paths through the ceilings of the PXS valve/accumulator rooms and the proximity of the paths to the containment shell is necessary to establish consistency with the current design of the plant. Consequently, while there is a small possibility that standardization may be slightly reduced by the granting of the exemption from the ITAAC acceptance criteria in Tier 1 Table 2.3.9-3, Item 3, the proposed exemption modifying the ITAAC acceptance criteria for combustible gas control does not reduce the design margins of the Containment Hydrogen Control System, and the proposed exemption will result in no reduction in the level of safety. For this reason, the staff determined that even if other AP1000 licensees and applicants do not request similar departures, the special circumstances supporting this exemption outweigh the potential decrease in safety due to reduced standardization of the AP1000 design, as required by 10 CFR 52.63(b)(1).

A.3.6 No Significant Reduction in Safety

The proposed exemption would modify the ITAAC acceptance criteria for combustible gas control presented in the original application. As described below in the technical evaluation, the change to the ITAAC acceptance criteria for the primary ventilation paths through the ceilings of the PXS valve/accumulator rooms and the proximity of the paths to the containment shell is necessary to establish consistency with the current design of the plant. Because the proposed change does not reduce the design margins of the Containment Hydrogen Control System, there is no reduction in the level of safety. Therefore, the staff finds that granting the exemption would not result in a significant decrease in the level of safety otherwise provided by the design, as required by 10 CFR Part 52, Appendix D, Section VIII.A.4.

A.4 Conclusion

The staff has determined that pursuant to Section VIII.A.4 of Appendix D to 10 CFR Part 52, the exemption: (1) is authorized by law, (2) presents no undue risk to the public health and safety, (3) is consistent with the common defense and security, (4) has special circumstances that outweigh the potential decrease in safety due to reduced standardization, and (5) does not significantly reduce the level of safety at the licensee's facility. Therefore, the staff grants the applicant an exemption from the requirements of Tier 1 Table 2.3.9-3, Item 3, Acceptance Criteria iii.

B. Technical Evaluation of Exemption Request and Departure

B.1 Request for Exemption Regarding Combustible Gas Control in Containment

The purpose of the ITAAC in Tier 1 Table 2.3.9-3, Item 3 is to keep postulated diffusion flame sources away from the containment pressure boundary to mitigate potential for over temperature leading to failure of the containment shell, hatches and penetrations.

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[2] Based on the nature of the proposed change to the Tier 1 Table 2.3.9-3, Item 3, Acceptance Criteria iii, and the understanding that this change is necessary to establish consistency with the current design of the plant and does not impact the design function of the Containment Hydrogen Control System, other AP1000 licensees and applicants may request the same exemption, preserving the intended level of standardization.

The applicant's review of the assessment of the hydrogen diffusion flame locations and zones of influence for equipment survivability showed that a burning hydrogen plume from the passive core cooling system (PXS)-A compartment (room 11206) to the core makeup tank (CMT)-A room 11300 in the current design could potentially challenge containment thermal limits.

The staff's technical evaluation is largely based on the following Westinghouse Electric Company (WEC) documents, which were reviewed during an audit described in Audit Plan, Levy Nuclear Plant, Units 1 and 2, Hydrogen Vent ITAAC, MLxxxxxxxxx

WEC Doc. No.: APP-VLS-M3C-008, rev 0, 50 pp, 15 Oct 2015, "Hydrogen Diffusion Flame and Containment Integrity Analysis".

WEC E&DCR, APP-VLS-GEF-017, rev 0, 23pp "Containment Structural Assessment for Hydrogen Venting", 23pp, which includes Appendix A, "Structural Assessment for Equipment Survivability of the Containment Pressure Boundary during Diffusion Flame in CMT Compartment". Appendix A will be added to the APP-VLS-M3C-008 calculation.

APP-VLS-M3C-008, Appendix A, calculates temperature distributions on the containment pressure boundary near the lower equipment hatch for a hydrogen diffusion flame from the PXS-A room vent exit to the CMT-A room. The temperature distribution will be input to a containment structural model to assess the containment pressure boundary severe accident survivability under the heat load of a hydrogen diffusion flame.

WEC Doc. No. APP-VLS-M3C-007, rev 0, "Thermal Analysis of Hydrogen Venting and Burning from the PXS-A compartment", documents a CFD analysis which models a hydrogen diffusion flame in the CMT-A room that creates a containment wall temperature response. The CFD analysis, which models the hydrogen plumes exiting both the CMT-A opening and the floor hatch opening, shows that plume behavior is affected by the cutout for the equipment hatch in the CMT-A compartment ceiling. The hot plume is drawn toward the containment wall at the location of the lower equipment hatch, creating a hot spot. The CFD analysis was used only as a sensitivity analysis and to identify non conservative assumptions.

B.1.1 Hydrogen Diffusion Flame and Temperature Distribution Evaluation

The applicant first performed a CFD sensitivity analysis to evaluate location of hot spots and any flow split variation effects from the PXS-A room below. Using the insights gained from the CFD analysis, the applicant then performed an analysis to calculate temperature distributions on the containment pressure boundary in the CMT-A area near the lower equipment hatch for a hydrogen diffusion flame from the PXS-A room vents following a beyond design basis accident. This 1D calculation was based on first principle heat transfer and thermodynamic correlations. A conservative hydrogen plume temperature is calculated and the radiation and convection heat transfer is assessed to calculate a maximum containment wall temperature. The temperature distribution was then used as input to a containment structural model to assess the containment pressure boundary severe accident survivability under the heat load from a hydrogen diffusion flame.

The hydrogen venting scenario from the PXS-A room is for a beyond design basis event involving significant core damage and hydrogen generation due to fuel cladding oxidation. The scenario pertains to only one specific initiating event, a direct vessel injection (DVI) double ended or large line break which spills into the PXS-A compartment below the CMT room floor. The break must be large to defeat injection through the DVI line for the accident to progress to core damage. The PSX-B line must also fail to inject. Multiple failures of the automatic depressurization (ADS) -4 valves must occur for the hydrogen generated in the core to reach the DVI line break and be released into the PXS-A compartment. This potential challenge applies only to a small subset of severe accident scenarios by frequency. The cutset frequency for this scenario, from the AP1000 PRA, APP-GW-GL-022, rev. 8, is 6.4E-09/reactor-year.

The purpose of calculation APP-VLS-M3C-008 was to perform a simple heat transfer calculation independent of the CFD analysis, to calculate potential pressure boundary transients during a diffusion flame hydrogen burn in the CMT-A compartment for the bounding hydrogen release scenario described above. The source term for the hydrogen and steam from the PXS-A vents are from a MAAP analysis, referenced in APP-VLS-M3C-007.

The diffusion flame hydrogen temperature is calculated from the heat balance on the plume, which is modeled as a cylinder. The area for heat transfer to the containment wall is based on the hydraulic radius of the source and the distance from the source to the wall and the height of the CMT-A compartment. The calculation assumed that the hydrogen igniters are operable and preventing global hydrogen combustion. The temperature distributions are based on the peak temperatures assuming that 100% of the hydrogen release is from the floor hatch. Sensitivity analyses in the CFD calculation showed that the hydrogen release from the floor hatch only produced the most challenging temperature results.

The APP-VLS-M3C-008, Appendix A analysis creates two temperature distributions on the containment pressure boundary, based on insights from the CFD analysis. The first assumes the plume creates a hot spot that spans the lower containment equipment hatch cover, the hatch barrel, the insert plate and the containment shell. The second distribution is located where the hot spot occurs on the containment shell at the vent exit (opening in ceiling above the lower equipment hatch).

The hot spot is the local area where the hot plume impacts the containment pressure boundary. Heat transfer to the hot spot consists of radiation and convection from the hydrogen diffusion flame. Heat transfer to the containment shell away from the hot spot consists of radiation from the hydrogen diffusion flame. For the structural analysis, the surface temperatures within the hot spot are assumed to be the bounding temperature limits of the containment shell and the hatch door cover. For the hatch barrel hot spot temperature, where the hatch seals are located, the average wall temperature is assumed to be the temperature limit of the EPDM rubber and the corresponding surface temperature is reported.

Zone 1 is the area of the containment pressure boundary above the hot spot in contact with the plume flow up the containment wall. The heat transfer consists of radiation and flat plate in parallel flow convection. Zone 2 is the area of the containment pressure boundary below the hot spot where the containment shell is not in contact with the plume flow, but is receiving radiation from the plume.

Temperatures outside of zones 1 and 2 are assumed unaffected and remain at 200 °F. The calculations are performed to capture the maximum temperature on the inside surface of the heat sink in each region. The average temperatures in each region are also reported because the structural analysis uses the average through-wall temperatures for assessing integrity.

The peak surface and average temperatures from the limiting scenario identified by the sensitivity analysis for each of the zones are shown in the table below. The peak average through wall temperatures are assigned to the structural model. For temperature distribution #1 the temperatures were assigned as both a gradient from the hot spot outward to the base shell temperature and also as a constant value over the zone. Temperature distribution #2 used the worst case from temperature distribution #1.

The component surface temperatures within each zone are calculated from these distributions.

The following table provides the results of the heat transfer calculations.

	Peak Surface Temp (°F)	**Peak Surface Temp (°F)**	**Peak Surface Temp (°F)**
Component	**Allowables**	**Zone 1=Rad and Conv**	**Zone 2=Rad only**
CTMT shell	650	470	436
Insert Plate/Barrel	488	366	344
Hatch Cover	800	591	543

	Peak Ave Wall Temp (°F)	**Peak Ave Wall Temp (°F)**	**Peak Ave Wall Temp (°F)**
Component	**Hot Spot**	**Zone 1=Rad and Conv**	**Zone 2= Rad Only**
CTMT Shell	607	442	411
Insert Plate/Barrel	390	308	293
Hatch Cover	780	577	530

The staff concludes that the methodology and assumptions in the analysis for determining the temperature source terms from the hydrogen burns are appropriately conservative, and the result are acceptable to be used as input to the structural analysis.

B.1.2 Containment Structural Evaluation of Hydrogen Venting

The NRC staff considered UFSAR Section 3.8, "Design of Category I Structures" to perform the technical evaluation. The staff also reviewed portions of NUREG–1793, Supplement 2, "Final Safety Evaluation Report Related to Certification of the AP1000 Standard Plant Design" (NUREG-1793) (ADAMS Accession No. ML112061231), and the "Final Safety Evaluation Report for the Levy Plant Units 1 and 2 Combined License Application," (ADAMS Accession No. ML153498656), which are used as references for the staff's technical evaluation of the relevant aspects of the AP1000 DCD and Levy FSAR, respectively.

The requested changes are per Duke Energy Letter NPD-NRC-2016-001, dated January 06, 2016, pertaining to the ITAAC in AP1000 DCD Tier 1 Table 2.3.9-3 item 3 which reflects the actual design distances of the PXS vents, with consideration of the construction tolerances as evaluated in the SER Section 21.4.4. Also, corresponding changes to the Tier 2, Subsection 6.2.4.5.1, "preoperational inspection and testing for the Hydrogen Ignition Subsystem "and Tier 2, Subsection 19.41., "Diffusion Flame Analysis" are proposed. (This section of the SER evaluates the containment survivability and confirms that the containment integrity is not challenged due to diffusion flame hydrogen burn in the containment compartments.)

In the letter, dated January 6, 2016, the applicant discussed changes in the analytical approach for heat transfer calculation and the analysis to confirm that the containment integrity was not challenged due to a diffusion flame hydrogen burn in the containment compartments. Further assessment was required by the applicant because the lower equipment hatch cover temperature (Approximately 780 ^{0}F), in the local area, exceeded the ASME NE-3000 maximum service temperature of 650 ^{o} F, limits. The temperature exceedance occurs at low containment pressure on order of 1.5 to 2.0 bar absolute. In order to assess the containment survivability of the hydrogen burning in the PXS-A compartment, the staff conducted the audit of the structural calculation (Westinghouse Calculation number APP-VLS-GEF-017, Rev 0). In the calculation, two temperature distributions were developed and sensitivity cases were perform for the structural analysis. The first distribution assumes that the plume from the hydrogen burn creates hot spot that spans across the equipment hatch cover, hatch barrel, insert plate of the hatch and the containment shell. The second distribution was developed from the CFD (Computational Fluid Dynamics) analysis. In this case, hot spot occurs on the containment shell at the vent exit located on the floor. The temperature within the distributions is developed from the peak temperature within three areas on the containment pressure boundary. These areas are 1) hotspot (local area), 2) Zone 1 -containment above hot spot 3) Zone 2 Below hot spot containment boundary. The staff noted that the analysis results shows zone 1 and 2 are not affected by the hydrogen burn and remain below the service temperature limits. The hot spot area is a local area where burning plume flow impacts the containment pressure boundary. The hot spot area is about 2 meter in diameter and located on equipment hatch at top. For the hatch barrel hot spot temperature, where the hatch seal is located, the average temperature assumed to be the temperature limit of 350 ˚F of EPDM rubber seal for the containment hatch. The EPDM rubber is behind four inch lip of the hatch cover therefore it is exposed to lesser temperature than the surrounding area of the hatch door.

Below are the applicant's calculation results of the stress analysis following ASME NE-3000, Service level C code requirements.

Location Corresponding Temperature	ASME Section 2, Part D Yield strength Sy SA 738 Gr B	ASME Service Level C allowable for SA 738 Gr B
780 ˚F – Hot spot on equipment hatch	42.4 ksi	63.6 ksi
607 ˚F – Hot spot on containment shell	46.3 ksi	69.45 ksi

From the ANSYS stress analysis, the calculated maximum resultant stress intensity of 15.25 ksi is less than ASME service level C allowable of 63.6 ksi.

Based on the presented results, the staff concluded that the applicant meets the Service Level C requirements of ASME Code, Section III, division 1 Subsection NE-3230,

Further, during audit, the staff discussed with the applicant on the containment metal creep values at peak average wall temperature. The applicant presented to the staff results of the creep calculation that was based on EGG-EA-7431, November 1986, "Creep Rupture Failure of Three Components of The Reactor Primary Coolant System during the TMLB Accident". Based on the creep calculation results, the time required to rupture at 800 ˚F is 6.3 E+07 hours and temperature required to rupture at stress level of 15.25 ksi is 1291 ˚F for one hour duration. Since the time at the elevated temperature exposed for the containment shell and hatch cover is short, less than 10 min, the staff concluded that the creep is not significant factor for the containment to rupture for the hydrogen burn event.

According to Regulatory Guide 1.216," Containment Structural Integrity Evaluation for Internal Pressure loadings Above Design Bases pressure", Regulatory position 2(b), an Instability (Buckling) calculation is not required for the steel containments. Therefore, buckling is not an issue for the hydrogen burn event.

21.4.5 Post Combined License Activities

There are no post-COL activities related to this request.

21.4.6 Conclusion

The NRC staff reviewed the application and checked the referenced DCD. The NRC staff's review confirmed that the applicant addressed the required information relating to the ITAAC change to be in conformance with the current design while continuing to preserve the containment integrity. The only outstanding information expected to be addressed in the LNP COL FSAR related to this section is the inclusion of the departure, LNP DEP 6.2-1 in the COLA, Part 7, "Departures and Exemption Requests" and in the COLA, Part 10, "Inspections, Tests, and Acceptance Criteria".

The staff reviewed the applicant's following proposed changes provided in the LNP COL application:

- Tier 1, Table 2.3.9-3, Item 3, Acceptance Criteria iii, be revised to state:

  "The equipment access opening and CMT-A opening constitute at least 98% of vent paths within Room 11206 that vent to Room 11300. The minimum distance between the equipment access opening and containment shell is at least 24.3 feet. The minimum distance between the CMT-A opening and the containment shell is at least 9.4 feet. The CMT-B opening constitutes at least 98% of vent paths within Room 11207 that vent to Room 11300 and is a minimum distance of 24.6 feet away from the containment shell. Other openings through the ceilings of these rooms must be at least 3 feet from the containment shell. An analysis exists and concludes that ignition of postulated hydrogen releases through these openings will not result in a failure of the containment shell."

- Tier 2, chapter 6.2.4.5.1 Preoperational Inspection and Testing, Hydrogen Ignition Subsystem, second paragraph be revised to read:

  "Pre-operational inspection is performed to verify the location of openings through the ceilings of the passive core cooling system valve/accumulator rooms with respect to the containment pressure boundary. An analysis will be used to demonstrate that postulated hydrogen releases through these openings does not result in a failure of the containment shell."

- Tier 2, chapter 19.41.7, "Diffusion Flame Analysis" the last two paragraphs should be revised to read:

  "In the event that ADS stage 4 fails to adequately direct hydrogen away from combined compartments, the compartment vents are designed to release the hydrogen at locations where it burns, but does not challenge the containment shell integrity.

  Vents from the PXS and CVS compartments to the CMT room are located away from the containment shell and containment penetrations. Access hatches to the subcompartments that are near the containment shell are covered and secured closed such that they will not open as a result of a pipe break inside the compartment. Therefore, hydrogen releases to the CMT room from the subcompartment have been shown to not challenge the containment integrity."

Based on the staff's technical evaluation documented above, the staff finds that the proposed change to allow short duration of the hydrogen burn temperature and pressure effect on the containment shell and equipment hatch with verification of the ITAAC distances from the containment shell is acceptable because the containment meets the Service Level C requirements of ASME Code, Section III, division 1 Subsection NE-3230 and Regulatory Guide 1.216, and the staff confirmed that the containment integrity is not challenged due to diffusion flame hydrogen burn in the containment compartment.

Therefore, the staff finds that the requested changes to Tier 1, Table 2.3.9-3, Tier 2, chapter 6.2.4.5.1, and Tier 2, chapter 19.41.7 should be granted, as the changes reflect the current certified design and ensure that containment integrity is preserved during a beyond design basis accident. The hydrogen diffusion flame and containment structural analyses demonstrate that the containment shell and hatch temperatures do not exceed ASME code allowable values for this beyond design basis accident.