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Attachment 1 contains proprietary information

GNRO-2011/00021

March 31, 2011

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

SUBJECT: Request for Additional Information Regarding
Extended Power Uprate
Grand Gulf Nuclear Station, Unit 1
Docket No. 50-416
License No. NPF-29

REFERENCES:
1. Email from A. Wang to F. Burford, dated March 1, 2011, GG EPU Containment and Ventilation Branch Request for Additional Information (ME4679) (Accession Number ML110600717)
2. License Amendment Request, Extended Power Uprate, dated September 8, 2010 (GNRO-2010/00056, Accession Number ML102660403)

Dear Sir or Madam:

The Nuclear Regulatory Commission (NRC) requested additional information (Reference 1) regarding certain aspects of the Grand Gulf Nuclear Station, Unit 1 (GGNS) Extended Power Uprate (EPU) License Amendment Request (LAR) (Reference 2). Attachment 1 provides responses to the additional information requested by Containment and Ventilation Branch.

GE-Hitachi Nuclear Energy Americas, LLC (GEH) consider portions of the information provided in support of the responses to the request for additional information (RAI) in Attachment 1 to be proprietary and therefore exempt from public disclosure pursuant to 10 CFR 2.390. An affidavit for withholding information, executed by GEH, is provided in Attachment 3. The proprietary information was provided to Entergy in a GEH transmittal that is referenced in the affidavit. Therefore, on behalf of GEH, Entergy requests to withhold Attachment 1 from public disclosure in accordance with 10 CFR 2.390(b)(1). A non-proprietary version of the RAI responses is provided in Attachment 2.

No change is needed to the no significant hazards consideration included in the initial LAR (Reference 2) as a result of the additional information provided. There are no new commitments included in this letter.

When Attachment 1 is removed, the entire letter is non-proprietary.

If you have any questions or require additional information, please contact Jerry Burford at 601-368-5755.

I declare under penalty of perjury that the foregoing is true and correct. Executed on March 31, 2011.

Sincerely,

MAK/FGB/dm

Attachments:

1. Response to Request for Additional Information, Containment and Ventilation Branch (Proprietary)
2. Response to Request for Additional Information, Containment and Ventilation Branch (Non- Proprietary)
3. GEH Affidavit for Withholding Information from Public Disclosure

cc: Mr. Elmo E. Collins, Jr.
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Attachment 2

GNRO-2011/00021

Grand Gulf Nuclear Station Extended Power Uprate

Response to Request for Additional Information

Containment and Ventilation Branch (Non-Proprietary)

This is a non-proprietary version of Attachment 1 from which the proprietary information has been removed. The proprietary portions that have been removed are indicated by double square brackets as shown here: [[ ]].

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**Response to Request for Additional Information
Containment Ventilation Branch**

By letter dated September 8, 2010, Entergy Operations, Inc. (Entergy) submitted a license amendment request (LAR) for an Extended Power Uprate (EPU) for Grand Gulf Nuclear Station, Unit 1 (GGNS). The U.S. Nuclear Regulatory Commission (NRC) staff has determined that the following additional information requested by the Containment Ventilation Branch is needed for the NRC staff to complete their review of the amendment (Accession Number ML110600717). Entergy's response to each item is also provided below.

The response to Request for Additional Information (RAI) # 1 was provided informally on March 4, 2011 to support confirmatory evaluations by the NRC.

<u>RAI # 1</u>

Information needed for confirmatory analysis:

(a) Location of the main steam flow limiter relative to the reactor vessel.

(b) Break area for main steam line break for short term analysis.

(c) Is the feedwater mass and energy input to the reactor for short term analysis the same as given in NEDC-33477P Revision 0, Table 2.6-2 item 8. In case different values were used please provide reasons.

(d) PUSAR Table 2.6-2, items 2b, 2c, 2d, 3a, 3d, 3e, and 3f, please specify which input values from the given range were used for the various long term analyses i.e. for design basis accident (DBA) loss of coolant accident (LOCA) for containment response, DBA LOCA for NPSH, Appendix R Fire, station blackout (SBO), and anticipated transient without scram (ATWS).

(e) PUSAR Table 2.6-2, item 5a, explain the reasons for variation of the RHR heat exchanger K-value for different modes.

<u>Response</u>

(a) The main steam flow limiter is positioned on the reactor side of the inboard main steam isolation valve, inside containment. The design basis break is between the nozzle and the flow limiter.

(b) The break area for the main steam line break for short term analysis is modeled as a function of time representing the finite opening of the break, a break area considering flow back from both the ends of the break plane, and then setting the break area for the

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duration of time following the event. The model for break area is patterned as shown below:

Time (sec)	Area (sq. ft.)
0.000000	5.306919
0.004028	5.306919
0.004028	6.191405
0.0110394	6.191405
0.0110394	4.424170
4.598104	4.424170
5.500000	3.537946
1.0 E8	3.537946

(c) Table 2.6-2, Item 8, is the feedwater model used for the Long-Term Containment Analysis only.

The limiting DBA-LOCA for Short-Term Peak Drywell Pressure and Time is the MSLB. For the Short-Term MSLB analysis, the M3CPT code is used which has its own internal vessel model. For this analysis, it is conservatively assumed that feedwater isolates immediately (zero feedwater mass injected.) This is conservative as the relatively colder feedwater flow will depress reactor pressure vessel steam dome pressure, resulting in a decrease of break flow rate.

(d) The selection of the initial conditions from Table 2.6-2 is represented below:

		Item # (Table 2.6-2)	RSLB (DBA)	DBA NPSH *	FSSD (App. R)	FSSD NPSH Case	SBO	ATWS +
DW init P	psig	2b	3.5	--	3.0	-0.3	-0.03	0
DW init T	°F	2c	65	--	135	140	140	95
DW init RH	%	2d	20	--	20	90	20	100
WW init P	psig	3d	1.5	--	1.0	-0.1	-0.07	0
WW init T	°F	3e	40	--	95	100 $	95	95
WW init RH	%	3f	20	--	20	100	100	100
SP init V	cu. ft.	3a	133,750	--	133,750	133,750	134,000	135,291

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* No “NPSH” calculations are performed for GGNS DBA. NPSH case represented here is a check case of FSSD.

+ By nature of the ATWS methodology for Containment Response, no distinction made between DW and WW in the STEMP calculation.

$ Though beyond indicated temperature range of PUSAR Table 2.6-2, a conservatively high value selected for this analysis case.

(e) For Suppression Pool Cooling (SPC) and Containment Injection Cooling (CIC, or LPCI Cooling) modes, the design flow for RHR is 6600 gpm.

For Containment Spray Cooling mode, the design flow for RHR is 5085 gpm. This lower flow rate limits the RHR Heat Exchanger K-value compared to the SPC and LPCI modes.

For normal Shutdown Cooling (SDC) mode, the design flow for RHR is 6600 gpm. This flow, in conjunction with the higher temperature reactor vessel water for this mode, results in a higher RHR Heat Exchanger K-value compared to the SPC and LPCI modes.

RAI # 2

Section 2.6.5.2 specifies the runout pump flow rate for residual heat removal (RHR) pump as 8,940 gpm, and runout flow rate for low pressure core spray (LPCS) pump as 9,100 gpm. Table 2.6-2 specifies low pressure coolant injection (LPCI) pump (which is the RHR pump) runout flow rate of 6600 gpm, and LPCS pump runout flow rate of 7000 gpm. Please clarify or correct the discrepancy.

Response

The ECCS pump runout flow values in Section 2.6.5.2 are design maximums used to obtain conservative $NPSH_A$ results. The ECCS pump runout flow values in Table 2.6-2 are relaxed values used for the containment analysis purposes. Relaxed flow values were used to be consistent with those applied in the ECCS performance analysis. Use of the relaxed flow values for the containment response has negligible effect on the containment response results.

RAI # 3

PUSAR Section 2.6.5.2, for the required net positive suction head (NPSH) of the pumps

(a) Provide the basis of the values of the required NPSH that were used to compare with the available NPSH for the RHR, LPCS, and HPCS pumps.

(b) What uncertainties were included in the evaluation of the required NPSH from the data provided by the vendor?

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Response

a) Required NPSH is a design characteristic associated with a particular pump. It is typically provided by the pump vendor; it is confirmed by testing along with the pump flow-head curve. The required NPSH for the GGNS ECCS pumps are provided below. These values are the required head at a reference datum that is 3 feet above the pump mounting flange.

Pump	$NPSH_R$ (ft)
RHR (all 3 pumps)	2.0
LPCS	1.6
HPCS	2.0

b) No evaluation of uncertainties was performed for EPU on the pump vendors required NPSH. Rather, conservative assumptions of post-accident conditions are considered in the calculation of the NPSH available, including: pool temperature, calculated suppression pool level response, runout flow, and suction strainer debris loading. In addition, no credit is taken for containment overpressure.

RAI # 4

Refer to PUSAR Section 2.6.1, third and fourth paragraphs under "Technical Evaluation". The third paragraph states that M3CPT code was used to model the short-term containment pressure and temperature response. The fourth paragraph refers to LAMB computer code, but does not explicitly state that it was used for determining the extended power uprate (EPU) reactor vessel break flow for input to the M3CPT code. Please clarify whether LAMB computer code was used for mass and energy release input to M3CPT code or only M3CPT code was used to model both reactor and containment for short term response.

Response

As noted in Section 2.6.1.1, the short-term containment response analyses are performed for the limiting DBA LOCA that assumes a guillotine break of a recirculation suction line (RSLB) or a main steam line (MSLB). For GGNS, the DBA LOCA is the MSLB. It is confirmed that the LAMB code was not used to calculate the reactor vessel break flow for the limiting postulated DBA LOCA.

The LAMB code, which models the recirculation loop as a separate pressure node, is useful for the RSLB cases. The RSLB cases are evaluated to confirm that the MSLB case remains limiting. For the RSLB cases, the LAMB-based mass and energy release is input to the M3CPT code for the calculation of the short-term containment response.

RAI # 5

Please state the assumptions and input conditions for short term containment pressure and temperature analysis and provide a comparison with the assumptions and inputs with the current licensing basis (CLB) analysis. Provide justifications for any variation of the proposed assumptions and input condition from those in the CLB analysis

Response

For the EPU project, the original 1980's vintage inputs were updated applying current methods and input assumptions. The following table has been generated noting differences in initial conditions, which would account for much of the variation seen between the two analyses.

Parameter	CLB Basis	EPU Basis
Drywell Pressure (psig)	0.0	1.5
Drywell Temperature (°F)	135	100
Wetwell Pressure (psig)	0.0	1.5
Wetwell Temperature (°F)	95	100

Justification: Lower initial temperature and increased initial pressure indicates larger inventory of initial non-condensible gases (air), which, when considering the mass and energy release to the containment from the breaks, projects a conservatively higher pressure peak.

RAI # 6

Grand Gulf Nuclear Station Unit 1 (GGNS) updated final safety analysis report (UFSAR) Sections 6.2.1.1.5.4 and 6.2.1.1.5.5 provides results and assumptions of current licensing basis (CLB) steam bypass capability analysis 'without sprays and heat sinks' and 'with sprays and heat sinks' respectively for small reactor system breaks. Provide a table comparing the assumptions and results of the CLB and the EPU analysis including justification of differences in assumptions used in the EPU analysis.

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Response

The requested table with comparison of Key Assumptions is shown below:

Parameter	CLB basis	EPU basis	Justification/Comment
Containment Spray	Actuated at 13 minutes.	Actuated 70 seconds after the WW pressure reaches 9 psig, or at LOCA plus 772 seconds, whichever comes later.	Analytical limit (upper) for timer assumed.
Break sizes	Full range considered (sensitivity study across break sizes conducted in response to Humphrey Issues 5.1 and 9.2 (Grand Gulf Action Plan 19)	Full range considered.	Large break would produce larger drywell to wetwell differential pressure
Pump heat	No pump heat was found to be assumed.	1 - HPCS, 1 – LPCS and 3 - LPCI pumps assumed available for vessel water delivery	GEH's Safety Communication SC06-01 is considered to include all pump heat
Efficiency of containment spray	Based on local steam to air ratio (as defined in Bechtel Topical Report BN-TOP-3, "Performance and Sizing of Dry Pressure Containments," Dec. 1972.)	Based on guidelines in Section 6.2.2 of the NRC Standard Review Plan (SRP, NUREG-0800)	Consistent with NRC guidelines. (Key containment spray parameters such as spray droplet size and residence time.)
Depressurization rate	Operator action to reduce reactor vessel pressure at 100°F/hour, but not sooner than 10 minutes (smaller break sizes)	Operator action to reduce reactor vessel pressure at 100°F/hour when suppression pool bulk average temperature exceeds 125°F, but not sooner than 10 minutes.	No effective change
Air and Steam condition	Mixed, following spray actuation	Mixed, following spray actuation	No change
DW and WW initial conditions	Nominal initial DW & WW pressure, temperature and relative humidity.	Nominal initial DW & WW pressure, temperature and relative humidity.	No change
RHR heat exchanger	K value for WW spray is 454 Btu/s-°F.	K value for WW spray is 454 Btu/s-°F.	No change
Upper pool	The upper pool dump is included. This effect was analyzed in response to Humphrey Issue 5.6 (Grand Gulf Action Plan 19).	The upper pool dump is included.	No change
Initial suppression pool volume	Maximum TS High Water Level limit.	Maximum TS High Water Level limit.	No change

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Comparison of results of the analyses is presented below:

Parameter	Unit	CLTP	EPU	Design Value
Peak Wetwell Pressure	psia	29.7	29.7	29.7
Drywell Bypass Leakage (A / √k)	ft^2	0.9	0.8	N/A

RAI # 7

PUSAR Section 2.6.1.2.1 states that the containment dynamic loads are based on the short term DBA LOCA analysis for RSLB. However the load analysis for condensation oscillation and chugging which occurs in the long term is not described. Provide a description of the most limiting containment analyses which resulted in a response showing that it (the response) is bounded by the conditions used to define the condensation oscillation and chugging loads.

Response

Condensation Oscillation (CO) is based on the generic Mark III CO load definition as defined in GESSAR II, which relates key thermal-hydraulic parameters to the Containment Oscillation pressure amplitude and frequency. Per the reference methodology, the pressure amplitude increases with vent steam velocity (i.e., vent steam mass flux) and suppression pool temperature; so the limiting conditions for CO are those which produce maximum vent steam mass flux and maximum suppression pool temperature. For GGNS EPU, four cases were chosen, based on this screening, to investigate CO: two RSLB cases using the M3CPT vessel model, one with normal feedwater temperature, the other with reduced feedwater temperature, another RSLB case with the LAMB08A vessel model, and a confirmatory MSLB case to certify the bounding nature of the RSLB assumption. The worst case demonstrated peak-to-peak pressure amplitude (PPA) of 4.31 psid, which is well below the PPA value (7.1869 psid) resulting from the generic Mark III CO load definition, and the basis of current CO loads for GGNS. This CO result based on the short term DBA-LOCA analysis will always be bounding since the maximum vessel flux condition, as the significant factor in defining maximum PPA, will occur early with the DBA-LOCA event, and will be bounding for vessel flux conditions in long term analyses.

For Chugging loads, the determining factor is a low threshold vent vapor flux, achieved with a very small air content. Chugging will not occur for bulk pool temperatures below 175°F. The bases for the chugging loads are the PSTF tests referenced in the PUSAR, which confirm these criteria over a wide range of conditions. The minimum mass flux for chugging is seen as 0.3 $lbm/sec/ft^2$. Evaluation for GGNS used the SHEX results from the EPU long-term analyses to demonstrate acceptability with regard to chugging. Although these cases were not performed specifically for this purpose, they were performed over a span of break sizes (IBA and SBA events) and provide a conservative computation of the total steam vent flow rate over time.

Each of these calculations confirm that the vent steam flux will be below the 0.3 lbm/sec/ft^2 threshold well before pool temperature would be calculated to reach the 175°F value. On this basis, the conclusion is drawn as to the continuing bounding nature of current Chugging Loads, under the assumption of Grand Gulf operating at EPU conditions.

RAI # 8

Describe the EPU analysis and its results that determined the effect of vent clearing pressure, condensation oscillation pressure and chugging pressure on the weir wall. Provide their comparison with the results for current licensing basis analysis.

Response

The EPU analysis for GGNS follows the direction of NEDC-33034P-A, "Constant Pressure Power Uprate," (CPPU), Revision 4, dated July 2003, which, for hydrodynamic loads determination, defers to the methods of NEDC-32424P-A, "Generic Guidelines for General Electric Boiling Water Reactor Extended Power Uprate," (ELTR1), dated February 1999, as accepted in the Safety Evaluation Report. Appendix G of ELTR1 describes the analysis approach in which the pressure, temperature and vent flow as calculated for the EPU short-term containment response is compared to the pressure, temperature and vent flow used as the basis for the dynamic loads. Showing qualitatively that the EPU containment response results are within the range of containment conditions used to define the dynamic loads demonstrates that dynamic design loads are not affected by the power uprate. The evaluation reported for GGNS is an analysis of bases to demonstrate that the containment conditions assuming EPU are within that range. Following the process described above, the Grand Gulf EPU evaluation of vent clearing, condensation oscillation and chugging pressures on the weir wall analysis identified the limiting short-term containment response events, and compared the calculated pressure, temperature, and vent flows from these events to the initial conditions assumed in the original containment analyses used for the design bases hydrodynamic loads. Comparisons of these inputs confirm that loads under EPU assumptions remain bounded by the original design loads.

RAI # 9

Refer to PUSAR Section 2.6.1.2.2; describe the analysis which demonstrated the low-low-set (LLS) SRV setpoint logic successfully prevented subsequent actuations of multiple valves. Also describe the analysis that demonstrated the time between successive actuation of SRV is long enough that water in the discharge line returns to its pre-actuation or lower than pre-actuation level.

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Response

The timing between subsequent actuations and number of valves which lift during subsequent actuations is performed [[

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The result of the above mentioned analysis was that the time between SRV closure and SRV re-opening for a postulated transient event is 32 seconds. The analysis that demonstrated the time between successive actuation of SRV is long enough is based on correlation of test data, including Caorso test data, documented in references below. A review of those tests show that the time that the water leg in the SRV Discharge Line would return to the initial (pre-actuation) water level or lower level (depressed water leg condition) is approximately 5 seconds. It is expected, therefore, that subsequent actuations, later in time, would not occur with an elevated water leg, but with level somewhat less. That condition would result in lower SRV loads. From this observation, the evaluation concludes that the current SRV loads for Grand Gulf would remain bounding under EPU.

1. NEDE-25100, "Caorso SRV Discharge Tests Phase 1 Test Report," May 1979.

2. NEDE-24757-P, "Mark II Containment Supporting Program Caorso Safety Relief Valve Discharge Tests Phase II Test Report," May 1980.

RAI # 10

GGNS UFSAR Revision 5 Section 6.2.1.2.3, "Design Evaluation", states that the subcompartment analysis was performed using Bechtel computer program COPDA described in Bechtel topical report BN-TOP-4, Rev 1. PUSAR Section 2.6.2 under heading "Subcompartment Pressurization Evaluation", states original design basis annulus pressurization analysis is based on mass and energy release rates generated using the instantaneous break NEDO-24548 methodology which is not documented in GGNS UFSAR. The following is requested:

(a) The topical reports which describe the methodologies used for current and proposed subcompartment mass and energy release and pressurization analysis. In case the PUSAR and UFSAR are in conflict please clarify or correct.

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(b) Differences in assumptions and justification of differences between the current and the proposed licensing basis methodologies for subcompartment mass and energy and pressurization calculations.

Response

(a)

Component	Method	Topical Reports
Current Mass and Energy Release Methodology	NEDO-24548*	NEDO-24548*
Current Annulus Pressurization Methodology	COPDA**	Bechtel Topical Report BN-TOP-4**
EPU Mass and Energy Release Methodology	TRACG***	NEDE-32176P, NEDE-32177P
EPU Annulus Pressurization Methodology	TRACG***	NEDE-32176P, NEDE-32177P

* The mass and energy release methodology used in the Grand Gulf analysis of record is described in Appendix 6C of the Grand Gulf UFSAR. The methodology is identical to the GEH methodology described in NEDO-24548, Technical Description Annulus Pressurization Load Adequacy Evaluation, dated January 1979. The Grand Gulf analysis of record predates NEDO-24548.

** The COPDA code is a Bechtel proprietary code. As reported in the Grand Gulf UFSAR (Section 6.2.1.2.3), a complete description of the COPDA code is provided in Bechtel Topical Report BN-TOP-4 Revision 1.

*** TRACG is best-estimate code for analysis of boiling water reactor (BWR) transients ranging from anticipated operational occurrences (AOO) transients to design basis loss-of-coolant accidents (LOCAs), stability and anticipated transients without scram (ATWS). TRACG incorporates a two-fluid thermal-hydraulic model for the reactor vessel, the primary coolant system and the containment and a three-dimensional kinetics model for the reactor core. The physical models and the numerical scheme are described in NEDE-32176P, TRACG Model Description, Revision 4, dated January 2008. Qualification of the TRACG against test facility data, including separate effects tests, component performance tests, integral effects tests, and full-scale plant data is presented in NEDE-32177P, TRACG Qualification, Revision 3, dated August 2007.

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(b)

Mass and Energy Release Analysis Comparison			
Assumption	Analysis of Record	TRACG	Comparison
Break Model	Instantaneous Double Ended Guillotine	Instantaneous Double Ended Guillotine	Identical
Flow Splits due to Diverters	15/85 – RS and FW No RD flow diverters	15/85 – RS and FW No RD flow diverters	Identical
Reservoir Pressure	Constant at initial pressure	Simulated vessel response to HELB mass and energy release.	Different
Ruptured Pipe Fluid Inertia	Not Modeled	Modeled	Different
Pipe Friction and Flow Losses	Not Modeled	Modeled	Different
Impact of Flashing on Line Losses	Not Modeled	Modeled	Different
Critical Flow Model	Moody – Slip critical flow model	See Section 6.3 of NEDE-32176P	Different

Justification of Differences

The Grand Gulf annulus pressurization analysis was the first annulus pressurization analysis performed following the issuance of GEH Safety Information Communication SC 09-01, Annulus Pressurization Loads Evaluation, dated June 8, 2009. Safety Communication SC 09-01 identified the need to accurately estimate the frequency content of the annulus pressurization response in order to ensure that the downstream loads analyses are conservative. At the beginning of the Grand Gulf EPU project, it was believed that simple hand calculation methods for mass and energy release, similar to the Grand Gulf analysis of record, might artificially shift pressure response frequencies away from the harmonic frequencies of structures, piping and components. An artificial frequency shift could potentially result in non-conservative load calculations.

The use of TRACG for the Grand Gulf EPU mass and energy release rate analysis is consistent with the application of other detailed thermal-hydraulic analysis codes, such as RELAP, that have been previously used to determine mass and energy release rates for annulus pressurization analyses. The use of TRACG introduces the effects of line losses, fluid inertia and flashing in the ruptured piping into the mass and energy release calculation. The result is a more realistic mass and energy release rate profile that will minimize potential pressure response frequency shifts that could potentially impact downstream dynamic load analyses.

The use of TRACG will also result in more accurate estimates of the impact of off-rated condition operation on the annulus pressurization analysis (See Response to RAI 12(b) below).

The ability of the TRACG code to accurately model critical flow and the mechanisms that control flashing within the ruptured pipe are demonstrated by critical flow model test comparisons documented in Section 3.4 of NEDE-32177P. Section 3.4.1 of NEDE-32177P presents comparisons to Marviken Critical Flow Tests. Section 3.4.2 of NEDE-32177P presents comparisons to PSTF Critical Flow Tests. Section 3.4.3 of NEDE-32177P presents comparisons to the Edwards Pipe Blowdown Tests.

The comparisons to the Marviken and PSTF tests show that TRACG is capable of accurate estimates of critical flow for a range of initial conditions ranging from subcooled water to saturated steam for pressures consistent with BWR vessel pressures. The comparisons to the Edwards Pipe tests documented in Section 3.4.3 of NEDE-32177P demonstrate that the TRACG code accurately simulates flashing in the ruptured piping on a time scale consistent with that of the annulus pressurization analysis. When taken in total, the comparisons documented in Section 3.4 of NEDE-32177P support the conclusion that the TRACG code can be used to generate best-estimate mass and energy release rates for the postulated high energy line breaks in the annulus between the reactor vessel and the biological shield wall on a time scale consistent with that of the annulus pressurization transient.

TRACG Annulus Pressurization Application

The analysis of record is performed with the COPDA code. COPDA is a Bechtel proprietary code that has been used for a number of annulus pressurization analyses. The table below compares several key aspects of the COPDA and TRACG methodologies as they relate to annulus pressurization loads.

For the Grand Gulf EPU project, the TRACG 3-D vessel component is used to model the annulus pressurization response. TRACG is a best-estimate code for analysis of boiling water reactor (BWR) transients ranging from AOO transients to design basis LOCAs, stability and ATWS. The physical models and the numerical scheme are described in NEDE-32176P. Qualification of the TRACG code against test facility data, including separate effects tests, component performance tests, integral effects tests, and full-scale plant data is presented in NEDE-32177P.

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Annulus Pressurization Analysis Comparison			
Assumption	Analysis of Record	TRACG	Comparison
Nodalization	25 nodes (Z and Theta directions modeled)	384 nodes (Z and Theta directions modeled)	Increased Resolution
Vertical Reflective Metal Insulation (RMI) Panels	Instantly moves to the shield wall with no loss in thickness.	Same as AOR.	Identical
Horizontal RMI Panels	Assumed to Move with no Resistance to Flow.	Modeled as Dynamic Vent Paths.	Difference
Pipe Insulation	Remains in place with no reduction of thickness	Same as AOR.	Identical
Initial Thermodynamic Conditions	T = 150°F P = 14.7 psia rh = 50%	Base Cases: Same as AOR Temperature Study Cases; - For cells between the horizontal RMI Panels T = 550°F P = 14.7 psia rh = (Steam partial pressure equal to steam partial pressure associated with AOR initial conditions: T = 150°F, P = 14.7 psia and rh = 50%) - For Cells outside the horizontal RMI panels; Same as AOR.	Identical with additional study for initial temperature.
Cell Thermodynamic Condition Model	*	Two-fluid model, with unequal phase temperatures and velocities. Heat, mass and momentum transfer between phases are defined by models described in NEDE-32176P.	Potential Difference
Critical Flow Model	*	No external critical flow model is applied for flow in the vessel component. Sonic velocity / pressure wave velocity / maximum fluid velocity within the model are defined by basic	Potential Difference

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Annulus Pressurization Analysis Comparison			
Assumption	Analysis of Record	TRACG	Comparison
		thermodynamic property models and relationships.	
Fluid Inertia	*	Z and Theta direction velocities and momentum modeled in cells.	Potential Difference
Entrainment Model	*	Entrainment is based on TRACG vapor to liquid momentum transfer models described in NEDE-32176P.	Potential Difference
Break Fluid Inertia	*	Kinetic energy converted to increased break fluid enthalpy and initial Z and Theta direction velocities set to zero.	The EPU assumption is believed to be consistent with the analysis of record.

* Grand Gulf UFSAR Section 6.2.1.2.3.c refers to BN-TOP-4, Rev. 1 for a description and justification of the subsonic and sonic flow models used in COPDA and the degree of entrainment used in vent flow calculations.

The Grand Gulf EPU annulus pressurization analysis TRACG model uses modeling assumptions that are generally consistent with those used in the ESBWR TRACG annulus pressurization analysis (ESBWR Design Control Document, Tier 2, 26A6642AT, Revision 9, December 2010 (Section 6.2.1.2) and NEDE-33440P, ESBWR Safety Analysis – Additional Information, Revision 2, March 2010). The use of the three-dimensional, two-fluid, two-phase TRACG Vessel component together with a fine mesh model (384 node) of the Grand Gulf annulus provides a more realistic annulus pressurization response than the analysis of record, which uses a coarse node (25 node) COPDA model.

The EPU TRACG analysis expands the original analysis of record by (1) using a fine mesh nodal model of the annulus to more accurately model pressure waves in the annulus (2) modeling the horizontal reflective metal insulation panels inside the annulus as dynamic vent paths and (3) Investigating the impact of high annulus temperatures in the region of the annulus between the upper and lower horizontal insulation panels.

RAI # 11

PUSAR Section 2.6.2 under heading “Subcompartment Pressurization Evaluation”, states “Because of issues identified in SC 09-01 the simplistic instantaneous break NEDO-24548 mass and energy release methodology was judged to be potentially non-conservative as the method could potentially result in artificial shifts of the pressure response frequency content.” Please describe the issues that make the NEDO-24548 methodology non-conservative.

Response

The NEDO-24548 methodology has not been shown to be non-conservative in any analyses performed to date. However, Safety Communication 09-01 identified the potential that simple methods, such as NEDO-24548, could result in shifts of the frequency content of the annulus pressurization response due to unphysical and artificially imposed jumps in mass and energy release rates. If the simple method results in a shift of the frequency content of the pressurization response away from the resonant frequencies of the structures and components that are evaluated in downstream load analyses, the dynamic amplification of pressurization loads could be underestimated.

The application of more realistic methods for both the mass and energy release analysis and the annulus pressurization analysis is necessary to ensure that a realistic response frequency is used in all downstream load analyses. The use of a realistic response frequency is required to ensure that the dynamic amplification of pressurization loads is accurately modeled.

RAI # 12

PUSAR Section 2.6.2 under heading “Break Flow Analysis” states: “The TRACG model used for the EPU evaluation provides a better estimate of the mass and energy releases resulting from breaks in the recirculation suction, recirculation discharge, and FW lines. The use of TRACG mass and energy release allows the effect of alternate operating conditions to be realistically predicted.”

(a) Describe what is meant by better estimate of mass and energy estimate in terms uncertainty in the current methodology and the TRACG calculation.

(b) Provide explanation of: “The use of TRACG mass and energy release allows the effect of alternate operating conditions to be realistically predicted.”

Response

(a) The use of TRACG for the mass and energy release analysis will result in better (i.e., more realistic) estimates of the mass and energy release rates through more detailed modeling of the reactor vessel, the associated high-energy piping and the effects of power and core flow variations on the initial conditions of the fluid that is initially in the affected lines and reactor vessel.

The current analysis methodology ignores the real effects of line losses, fluid inertia, and the flashing that occurs in the ruptured lines.

The application of TRACG for the mass and energy release analysis is consistent with the application other detailed thermal-hydraulic analysis codes, such as RELAP, for the annulus pressurization loads mass and energy release analysis. The TRACG model considers line losses, fluid inertia, and the flashing that occurs in the ruptured lines. The TRACG mass and energy release model also includes a detailed vessel model that will simulate conditions inside the vessel during the blowdown transient.

The TRACG critical flow model is documented in Section 6.3 of NEDE-32176P. The correlations used in the critical flow model are described in Section 6.3 of NEDE-32176P.

The ability of the TRACG code to accurately model critical flow and the mechanisms that control flashing within the ruptured pipe are demonstrated by critical flow model test comparisons documented in Section 3.4 of NEDE-32177P. Section 3.4.1 of NEDE-32177P presents comparisons to Marviken Critical Flow Tests. Section 3.4.2 of NEDE-32177P presents comparisons to PSTF Critical Flow Tests. Section 3.4.3 of NEDE-32177P presents comparisons to the Edwards Pipe Blowdown Tests.

The comparisons to the Marviken and PSTF tests show that TRACG is capable of accurate estimates of critical flow for a range of initial conditions ranging from subcooled water to saturated steam for pressures consistent with BWR vessel pressures. The comparisons to the Edwards Pipe tests documented in Section 3.4.3 of NEDE-32177P demonstrate that the TRACG code accurately simulates flashing in the ruptured piping on a time scale consistent with that of the annulus pressurization analysis. When taken in total, the comparisons documented in Section 3.4 of NEDE-32177P support the conclusion that the TRACG code can be used to generate best-estimate mass and energy release rates for the postulated high energy line breaks in the annulus between the reactor vessel and the biological shield wall on a time scale consistent with that of the annulus pressurization transient.

(b) The use of the terminology ‘alternate operating conditions’ generally refers to off-rated conditions. TRACG provides more realistic predictions of mass and energy releases for these conditions. The NEDO-24548 hand calculation methodology ignores fluid inertia, line losses and the associated flashing that occurs prior to exiting the break. As a result, the mass and energy releases are a function of initial reservoir pressure and fluid enthalpy. The approach yields high estimates of the mass and energy releases at all power flow conditions. However, as subcooling increases, the conservative margin built into the NEDO-24548 methodology also increases.

The TRACG mass and energy release methodology produces a much more realistic estimate of the HELB mass and energy releases, as described in the response to Part (a) of this RAI. As a result, the TRACG mass and energy release methodology also generates a more realistic estimate of the HELB mass and energy releases at off-rated conditions. Two key observations that are made when comparing HELB mass and energy release results generated with the NEDO-24548 methodology to those generated with a more realistic method such as TRACG, RELAP or RETRAN are:

1. When compared to best estimate methods, the NEDO-24548 mass and energy methodology produces the greater mass and energy release rates at rated conditions and,

2. Increases in subcooling typically have the opposite effects on the mass and energy releases calculated with NEDO-24548 and best estimate methods. The NEDO-24548 methodology will always predict increases in mass and energy release rates, while the more realistic methods will either predict a decrease in mass and energy releases or, in the case of a short nozzle (Small L/D ratio), a less significant increase in mass and energy release rates.

The use of TRACG generated mass and energy release rates for both rated and off-rated conditions will provide a more realistic assessment of the impact of off-rated condition operation on the annulus pressurization transient than mass and energy release rates generated with the NEDO-24548 instantaneous break hand calculation methodology. The TRACG generated mass and energy release rates have a consistent level of conservatism at all conditions, whereas the NEDO-24548 based mass and energy releases exhibit a significant increase in conservative margin as break fluid subcooling increases.

RAI # 13

PUSAR Table 2.6-1 Note 7 states "The current design limit for the bulk suppression pool temperature is 185°F. For EPU implementation, this design limit has been increased to 210°F." Please describe the impact on environmental qualification of safety related systems, structures, and components (SSCs) due to this change.

Non-Proprietary

Response

The impact on environmental qualification of safety related systems, structures, and components due to the design limit change in the bulk suppression pool temperature from 185°F to 210°F is summarized as follows:

Equipment - EQ equipment outside containment was qualified for the revised environmental zone (room area) temperatures caused by the increase in the bulk suppression pool design limit change to 210°F. The maximum such temperature change was 9°F. In addition, several zones with a mild temperature environment (<125°F) became harsh environments (>125°F); however, it was determined no safety related equipment was located in these zones.

EQ Equipment inside containment was qualified to a temperature profile that envelops the bulk suppression pool design limit of 210°F.

Components in systems that circulate suppression pool water were originally designed for temperatures higher than 210°F and have been found to be acceptable without modification.

Piping Systems – Piping systems, including supports and structural attachments, were evaluated at a temperature of 210°F and found acceptable without modification, as discussed in Section 2.2.2.2.2.2 and Table 2.2-6.

Structures – The containment structure exposed to the suppression pool temperature, including the liner and basemat, was evaluated for the EPU and was found to be acceptable without modification. Please also refer to the response to RAI 26.

RAI # 14

Refer to Section 2.6.2, under heading “Annulus Pressurization” third paragraph, please explain why maintaining the cell aspect ratio approximately one (1) will ensure the nodalization will not distort the acoustic wave propagation?

Response

The use of uniform node sizes with a height to width aspect ratio of approximately 1.0 is a “good modeling” approach that is applied in the Grand Gulf EPU analysis. The use of uniform node sizes with a height to width aspect ratio of approximately 1.0 will result in an analysis that more accurately captures pressure waves in the annulus and prevents the creation of a preferred direction for pressure wave diffusion. The goal of this approach is an analysis that more accurately captures the frequency content of the annulus pressurization response for downstream load analyses.

RAI #15

PUSAR Table 2.6-1 states the peak containment temperature for DBA LOCA EPU-with EPU Model is 142°F. PUSAR Section 2.6.3.1.1, second paragraph states "Table 2.6-1 shows the calculated WW gas space temperature of 142°F for the DBA LOCA at EPU. " Explain and/or clarify the difference between containment and wetwell?

Response

The Mark-III containment design includes a drywell, a wetwell and containment regions. The wetwell is considered to be the portion of the containment below the HCU floor and including the suppression pool. The mixing between these regions is significant such that, for the long-term containment response, the containment is effectively equivalent to the wetwell. For the short-term containment response, these areas are modeled separately in order to capture the relative short-term pressurization effects as illustrated in PUSAR Figure 2.6-4.

RAI #16

Refer to PUSAR Section 2.6.5.1, third paragraph and last sentence; explain what is meant by "ECCS NPSH pump limit of 194°F"?

Response

Since the post-LOCA pool temperature exceeded 185ºF, the ECCS net positive suction head was evaluated at higher pool temperatures. As reported in PUSAR Section 2.6.5.2, it was concluded that, for debris-generating events like the LOCA, a pool temperature as high as 194ºF would provide sufficient $NPSH_A$ to the most limiting ECCS pump. This statement refers to this evaluation.

RAI #17

Refer to PUSAR Section 2.6.5.1, third paragraph, what is the limiting value of available NPSH at 189°F and the limiting values of the required NPSH (including uncertainties) for the ECCS pumps during the EPU DBA-LOCA event.

Response

The required NPSH for the ECCS pumps is presented above in response to RAI 3. The available NPSH for the pumps considering a suppression pool temperature of 189°F is presented below. Conservative assumptions of post-accident conditions have been considered including: minimum initial suppression pool level, runout flow conditions, and design debris loading. No credit is taken for elevated containment pressure.

Non-Proprietary

Pump	$NPSH_A$ @ 189°F (ft)
RHR (limiting pump)	4.4
LPCS	7.0
HPCS	8.5

See the response to RAI 3b for a discussion of the consideration of uncertainties in the required NPSH.

RAI #18

Refer to PUSAR Section 2.6.5.1, fourth paragraph, what are the values of available NPSH at 198°F and the required NPSH (including uncertainties) for the RHR pump during the non-ASDC event. Provide a comparison with the current values of available and required NPSH for this event.

Response

LAR Attachment 5, Section 2.6.5.1, fourth paragraph notes that the highest bulk suppression pool temperature result from any non-LOCA (i.e., non-debris generating) event, is based on the ASDC event. Note that, as presented in LAR Attachment 5, Table 2.6-3, the highest predicted suppression pool temperature is actually 200.1°F calculated for the Station Blackout event. The adequacy of the ECCS pump available NPSH must be assured at the highest calculated pool temperature for the non-LOCA events of 200.1°F.

An evaluation of ECCS pumps available NPSH was performed for the EPU non-LOCA events. The $NPSH_A$ evaluation for CLTP non-LOCA event conditions had already considered a conservative suppression pool temperature of 212°F. This evaluation bounds the peak suppression pool temperature for EPU non-LOCA events of 200.1°F; thus, the existing $NPSH_A$ evaluation remains bounding for EPU. The $NPSH_A$ for the ECCS pumps at a pool temperature of 212°F are tabulated below.

Pump	$NPSH_A$ @ 212°F (ft)
RHR (limiting pump)	5.7
LPCS	6.4
HPCS	7.0

See the response to RAI 3b for a discussion of the consideration of uncertainties in the required NPSH.

Non-Proprietary

RAI #19

Refer to PUSAR Table 2.6-3, at the peak bulk suppression pool temperature for the three events stated in this table; provide the limiting value of available NPSH and the limiting value of required NPSH for the ECCS pumps used during these events. Provide a comparison with the current values of available and required NPSH for these events.

Response

See the response to RAI 18. The existing available NPSH evaluation for non-LOCA (i.e., non-debris generating) events has been performed at 212°F. The CLTP evaluation results bound the EPU conditions.

RAI #20

Refer to PUSAR Section 2.6.5.2, first paragraph states that no change in the suppression pool temperature results from the implementation of EPU. This statement is in conflict with the results given in Table 2.6-1 which gives the peak suppression pool temperature for EPU DBA LOCA as 189°F compared to the current value of 181°F, resulting in a reduced NPSH margin. Provide an explanation for the differences in the statements. By how much would the NPSH margin be reduced with EPU implementation?

Response

The statement in question mis-states the impact on the suppression pool temperature. The statement should read as clarified below.

Current: "No changes to any of these parameters result from the implementation of EPU."

Clarification: "With the exception of the suppression pool temperature, there are no changes to any of these parameters due to the implementation of EPU. The maximum SP temperature for the DBA LOCA has increased from 181°F to 189°F for EPU; the maximum SP temperature for any non-LOCA event is 200.1°F."

The evaluation of available NPSH was performed considering these temperatures. Available NPSH is calculated using the equation:

$$NPSH_A = (P_{atm} - P_{vap}) \times 144 / \rho + H_S - H_F - H_O$$

Non-Proprietary

Where:

P_{atm}	=	Containment pressure (psia) (note – for plants that do not credit accident pressure, this value is limited to 14.7 psia)
P_{vap}	=	saturation pressure of water at the temperature in question, psia
ρ	=	density of water at the temperature in question, lb/ft^3
H_S	=	static head, ft
H_F	=	friction loss, ft
H_O	=	other losses (strainer and entry losses), ft

Over the temperature range of interest (from 180°F to 212°F), the only term that is appreciably affected by the temperature is the first one: $(P_{atm} - P_{vap}) \times 144 / \rho$. To estimate the relative effect of a pool temperature change the values for this term at various temperatures are tabulated below.

SP Temperature (°F)	$(P_{atm} - P_{vap}) \times 144 / \rho$ (ft)	Resulting temperature dependent term of $NPSH_A$ (ft)
181	(14.7 - 7.7) x 144 / 60.56	16.6
185	(14.7 - 8.4) x 144 / 60.47	15.0
189	(14.7 - 9.2) x 144 / 60.36	13.1
200	(14.7 - 11.5) x 144 / 60.12	7.7
212	(14.7 - 14.7) x 144 / 59.83	0

From the above table, it can be seen that the increase in pool temperatures due to the LOCA reduces the available NPSH by 3.5 ft. It should be noted that the CLTP LOCA $NPSH_A$ evaluation was performed based on a pool temperature of 185°F; thus, the reduction in $NPSH_A$ margin from the current values is 1.9 ft. As noted in the response to RAI 18, the CLTP $NPSH_A$ evaluation for the non-LOCA events was based on a pool temperature of 212°F; thus, the CLTP evaluation bounds the EPU conditions.

RAI #21

Refer to PUSAR Section 2.6.6; provide an evaluation of the effect of increased secondary containment heat load due to EPU on the drawdown time and offsite dose.

Response

As a part of the Standby Gas Treatment System (SGTS) evaluation for EPU implementation, the ability of the GGNS SGTS to acceptably drawdown secondary containment is addressed.

Non-Proprietary

This is done using the current site drawdown calculation and evaluating it relative to the rise in temperature of those secondary containment compartments that were evaluated to change post-LOCA due to EPU implementation. In the current calculation, the worst case post-accident steady state building volume average temperature is calculated to be 107.6°F at pre-EPU conditions. However, this value is rounded up to 110°F for the actual drawdown calculation. For EPU implementation, this average temperature is calculated to be 108.1°F. Therefore, the rise in average temperature is bounded by the current drawdown calculation and the results of that calculation are valid for this EPU evaluation.

SGTS flowrate is not adversely affected by EPU implementation. Similarly, neither the primary containment leakage rate nor the SGTS radionuclide retention efficiency is adversely affected. As such, (and based on the drawdown evaluation conclusion) neither drawdown time nor offsite dose is affected by the rise in secondary containment heat load due to EPU implementation.

RAI #22

PUSAR Section 2.6.6 last paragraph states "The secondary containment temperature and pressure are not evaluated further in the CLTR because there is no effect as result of EPU." Provide an explanation as to why the secondary containment temperature and pressure are not affected due to increased heat load in the secondary containment.

Response

This statement focuses on the ability of the SGTS to effectively filter all of the secondary containment volume based on its ability to perform at its design flowrate (at post EPU implementation temperature and pressure). As seen in the response to RAI 21, post EPU implementation post-LOCA secondary containment temperature has been evaluated and the net temperature increase is bounded by the current calculation of SGTS drawdown performance.

The intent of the cited passage was not to say that secondary containment temperature and pressure cannot change due to EPU, rather they were "…not evaluated further in the CLTR because there is no effect (on secondary containment functionality) as a result of EPU." Because the assumed average temperature bounds that due to EPU, temperature and pressure conditions post-EPU implementation do not adversely affect the functionality of secondary containment.

RAI #23

PUSAR Table 2.6-1, explain why the peak drywell to containment differential pressure for the analysis of record (AOR) is due to MSLB (per footnote number 2 for table 6.2-1), whereas for the EPU analysis method with CLTP assumptions and for the EPU analysis is due to RSLB (per footnote number 4 for Table 2.6-1).

Response

For EPU, the peak differential pressure is 24.2 psid for the RSLB case. The MSLB event case results in a peak differential pressure of 24.0 psid, which is not significantly less.

The CLTP peak differential pressure is approximately 22.0 psid for MSLB and approximately 19.6 psid for the RSLB (see FSAR Figures 6.2-10 and 6.2-2, respectively).

The EPU results show both MSLB and RSLB event cases to yield comparable differential pressure. In the analyst's judgment, it is likely that the more limiting initial drywell conditions for the EPU analysis/method have a stronger impact on the RSLB case.

RAI #24

PUSAR Table 2.6-1, provide reasons why the results of containment analysis for DBA LOCA at CLTP from AOR (column number 2 of Table 2.6-1) are different from DBA LOCA at CLTP with EPU model (column number 3 of Table 2.6-1).

Response

The differences between the two CLTP cases, historical results vs. results using the new model, principally represent cumulative changes in analysis input and refinements of methodology since the time of the AOR. For GGNS specifically, the predominant reason for change is that more limiting conditions are now assumed for initial containment and drywell environment (even for the CLTP analysis, as described in Note 1 of PUSAR Table 2.6-1). As noted in the response to RAI 5:

- Drywell and wetwell initial pressures were increased from 0.0 psig to 1.5 psig.
- Drywell initial temperature was decreased from 135°F to 100°F for short-term containment response.
- For long-term containment response, addressing peak suppression pool and containment temperature, the initial suppression pool temperature was raised from 95°F to 100°F.

Peak containment temperature is radically decreased because the analysis methodology no longer forces thermal equilibrium in the containment to be applied as it was applied in the analysis of record. This assumption also decreases the long-term containment pressure.

It is for such reasons that benchmark results are posted for CLTP conditions based on the updated model, so that the apparent change from CLTP to the EPU conditions is clearly portrayed.

RAI #25

PUSAR Table 2.6-1, please confirm that the 10 CFR 50 Appendix J containment integrated leak rate test pressure would be based on the short term peak pressure of 14.8 psig.

Response

The 10 CFR 50 Appendix J containment integrated leak rate test pressure will be performed at 11.9 psig. As noted in PUSAR Table 2.6-1, "GGNS Containment Performance Results," the EPU design basis accident (DBA) loss of coolant accident (LOCA) new long-term pressure, which is driven by the main steam line break, results in peak containment pressure of 11.9 psig occurring at about 10 hours after the event.

The short-term wet well pressure can reach 14.8 psig. This pressure will be terminated in about 6 seconds after the event and occurs in a localized area of containment and is therefore not representative of containment bulk pressure. Table 4, "LOCA Release Phases," of Regulatory Guide 1.183, Rev. 0, *Alternate Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors*, shows that the Boiling Water Reactor (BWR) core source terms do not begin to be released from the reactor vessel until 2 minutes after a LOCA. The only radioactivity released from the reactor during the first 6 seconds is associated with the reactor coolant. This release is very small and scrubbed by the suppression pool before exhausting into the region between the pool and the hydraulic control unit (HCU) floor. Considering the primary containment function is to mitigate radioactivity leakage, the impact of any additional leakage rate associated with this early period would be negligible due to its low source term.

RAI #26

As indicated in Section 2.6.1 of NEDC-33477, EPU implementation at GGNS requires the evaluation of the containment pressure and temperature response due to increased decay heat resulting from EPU implementation. However, there is no discussion regarding the effects of the suppression pool (SP) temperature increase on the structural integrity of the containment structures, including the wetwell (WW) and drywell (DW). Please discuss the impact of the

Non-Proprietary

revised suppression pool limit (from 185 degrees Fahrenheit (°F) to 210°F) on the structural integrity of the containment structures. Specifically, please address the effects of the temperature rise on the design basis requirements related to the structural evaluation of the containment, including a discussion of the effects on the design basis loading combinations and whether the associated stress limits are satisfied following EPU implementation.

Response

GGNS evaluated the structural integrity of the existing containment wall for the increased design temperature of 210ºF. The design thermal gradients used in the original design were examined and the load combinations that are affected due to the temperature increase were identified. Also, the structural integrity of the containment wall was assessed for EPU conditions using the original design acceptance criteria.

Three load combinations were determined to be adversely affected by this temperature increase. These are:

Normal Operating and Abnormal Plant Conditions (LC1)

$1.0D + 1.0L + 1.0(T_O + T_A) + 1.0P_{CD} + 1.0E'$

Normal Operating, Abnormal Plant Conditions, and Severe Environmental Conditions (LC2)

$1.0D + 1.0L + 1.0(T_O + T_A) + 1.25P_{CD} + 1.25(E \text{ or } W)$

Normal Operating, Abnormal Plant Conditions, and Extreme Environmental Conditions (LC3)

$1.0D + 1.0L + 1.0(T_o + T_A) + 1.5P_{CD}$

Where:

D = Dead load

L = Live load

T_O = Thermal effects during normal operation, startup, or shutdown conditions

T_A = Added thermal effects during design accident

P_{CD} = Design LOCA pressure (15 psig)

E = Operating Basis Earthquake (OBE)

W = Design wind load

E' = Safe Shutdown Earthquake (SSE)

Non-Proprietary

It was found that LC2 and LC3 were already evaluated at elevated pool temperatures of 215°F and 226°F respectively. Therefore, only LC1 was evaluated for a pool temperature of 215 °F consistent with LC2. Examination of sectional resultant forces for both thermal and non-thermal loads indicated that the containment wall at El. 93'-9" is the most critical area for LC1.

The sectional resultant forces were then updated by combining the results of non-thermal (mechanical) loads and those of thermal loads for 215ºF. Based on the updated sectional resultant forces, the structural integrity of the existing containment wall was examined applying the same methodology and acceptance criteria as the original design calculation.

This evaluation concluded that the containment wall can withstand the maximum design temperature of 215ºF, which envelopes the design temperature of 210ºF for EPU conditions.

RAI #27

PUSAR Section 2.7.3 under heading "Technical Evaluation" states that EPU does not add any electrical or electrical equipment to the control room. Please state whether any existing equipment will be altered that would increase the control room heat load. If so, provide an evaluation of the of the control room area ventilation system (CRAVS) under the increased heat load due to equipment alteration.

Response

Plant modifications for EPU require minimal changes to equipment located within the control room environmental envelope. Equipment changes related to EPU modifications include, for example, strip chart recorder replacements, meter rescaling, repurposing existing switches, and changes to setpoints, none of which have an adverse impact to the control room heating, ventilation, and air conditioning (HVAC) heat load.

Installation of the PRNMS equipment is also required for EPU implementation, as noted in Attachment 8 to the EPU License Amendment Request (LAR). A conservative evaluation of the control room HVAC system demonstrates that the maximum expected control room temperature would increase by less than 1°F, which is well within acceptable environmental limits. Thus, installation of the PRNMS equipment will have no adverse impact on the control room HVAC system.

Attachment 3

GNRO-2011/00018

Grand Gulf Nuclear Station Extended Power Uprate

GEH Affidavit for Withholding Information from Public Disclosure

GE-Hitachi Nuclear Energy Americas LLC

AFFIDAVIT

I, Edward D. Schrull, PE state as follows:

(1) I am the Vice President, Regulatory Affairs, Services Licensing, GE-Hitachi Nuclear Energy Americas LLC ("GEH"), and have been delegated the function of reviewing the information described in paragraph (2) which is sought to be withheld, and have been authorized to apply for its withholding.

(2) The information sought to be withheld is contained in Enclosure 1 of GEH letter, GEH-GGNS-AEP-432, "NRC Containment Ventilation System Branch RAIs," dated March 30, 2011. The GEH proprietary information in Enclosure 1, which is entitled "GEH Responses to GGNS NRC CVSB RAIs" is identified by a dark red dotted underline inside double square brackets. [[This sentence is an example.{3}]] Figures and large equation objects containing GEH proprietary information are identified with double square brackets before and after the object. In each case, the superscript notation {3} refers to Paragraph (3) of this affidavit, which provides the basis for the proprietary determination.

(3) In making this application for withholding of proprietary information of which it is the owner or licensee, GEH relies upon the exemption from disclosure set forth in the Freedom of Information Act ("FOIA"), 5 USC Sec. 552(b)(4), and the Trade Secrets Act, 18 USC Sec. 1905, and NRC regulations 10 CFR 9.17(a)(4), and 2.390(a)(4) for trade secrets (Exemption 4). The material for which exemption from disclosure is here sought also qualifies under the narrower definition of trade secret, within the meanings assigned to those terms for purposes of FOIA Exemption 4 in, respectively, Critical Mass Energy Project v. Nuclear Regulatory Commission, 975 F2d 871 (DC Cir. 1992), and Public Citizen Health Research Group v. FDA, 704 F2d 1280 (DC Cir. 1983).

(4) The information sought to be withheld is considered to be proprietary for the reasons set forth in paragraphs (4)a. and (4)b. Some examples of categories of information that fit into the definition of proprietary information are:

a. Information that discloses a process, method, or apparatus, including supporting data and analyses, where prevention of its use by GEH's competitors without license from GEH constitutes a competitive economic advantage over other companies;

b. Information that, if used by a competitor, would reduce their expenditure of resources or improve their competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing of a similar product;

c. Information that reveals aspects of past, present, or future GEH customer-funded development plans and programs, resulting in potential products to GEH;

d. Information that discloses trade secret and/or potentially patentable subject matter for which it may be desirable to obtain patent protection.

(5) To address 10 CFR 2.390(b)(4), the information sought to be withheld is being submitted to NRC in confidence. The information is of a sort customarily held in confidence by GEH, and is in fact so held. The information sought to be withheld has, to the best of my knowledge and belief, consistently been held in confidence by GEH, not been disclosed publicly, and not been made available in public sources. All disclosures to third parties, including any required transmittals to the NRC, have been made, or must be made, pursuant to regulatory provisions or proprietary and/or confidentiality agreements that provide for maintaining the information in confidence. The initial designation of this information as proprietary information, and the subsequent steps taken to prevent its unauthorized disclosure, are as set forth in the following paragraphs (6) and (7).

(6) Initial approval of proprietary treatment of a document is made by the manager of the originating component, who is the person most likely to be acquainted with the value and sensitivity of the information in relation to industry knowledge, or who is the person most likely to be subject to the terms under which it was licensed to GEH. Access to such documents within GEH is limited to a "need to know" basis.

(7) The procedure for approval of external release of such a document typically requires review by the staff manager, project manager, principal scientist, or other equivalent authority for technical content, competitive effect, and determination of the accuracy of the proprietary designation. Disclosures outside GEH are limited to regulatory bodies, customers, and potential customers, and their agents, suppliers, and licensees, and others with a legitimate need for the information, and then only in accordance with appropriate regulatory provisions or proprietary and/or confidentiality agreements.

(8) The information identified in paragraph (2), above, is classified as proprietary because it contains detailed GEH design information of the methodology used in the design and analysis of the containment and ventilation systems for the GEH Boiling Water Reactor (BWR). Development of these methods, techniques, and information and their application for the design, modification, and analyses methodologies and processes was achieved at a significant cost to GEH.

The development of the evaluation processes along with the interpretation and application of the analytical results is derived from the extensive experience databases that constitute major GEH asset.

(9) Public disclosure of the information sought to be withheld is likely to cause substantial harm to GEH's competitive position and foreclose or reduce the availability of profit-making opportunities. The information is part of GEH's comprehensive BWR safety and technology base, and its commercial value extends beyond the original development cost. The value of the technology base goes beyond the extensive physical database and analytical methodology and includes development of the expertise to determine and apply the appropriate evaluation process. In addition, the technology base includes the value derived from providing analyses done with NRC-approved methods.

The research, development, engineering, analytical and NRC review costs comprise a substantial investment of time and money by GEH. The precise value of the expertise to devise an evaluation process and apply the correct analytical methodology is difficult to quantify, but it clearly is substantial. GEH's competitive advantage will be lost if its competitors are able to use the results of the GEH experience to normalize or verify their own process or if they are able to claim an equivalent understanding by demonstrating that they can arrive at the same or similar conclusions.

The value of this information to GEH would be lost if the information were disclosed to the public. Making such information available to competitors without their having been required to undertake a similar expenditure of resources would unfairly provide competitors with a windfall, and deprive GEH of the opportunity to exercise its competitive advantage to seek an adequate return on its large investment in developing and obtaining these very valuable analytical tools.

I declare under penalty of perjury that the foregoing affidavit and the matters stated therein are true and correct to the best of my knowledge, information, and belief.

Executed on this 30th day of March 2011.

Edward D. Schrull, PE
Vice President, Regulatory Affairs
Services Licensing
GE-Hitachi Nuclear Energy Americas LLC
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