DUANE ARNOLD

December 15, 2017

NG-17-0233
10 CFR 50.90

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

Duane Arnold Energy Center
Docket No. 50-331
Renewed Facility Operating License No. DPR-49

License Amendment Request (TSCR-178)

Application to Reduce the Required Number of Operable Suppression Chamber-to-Drywell Vacuum Breakers

Pursuant to 10 CFR 50.90, NextEra Energy Duane Arnold, LLC (NextEra) is submitting a request for an amendment to the Technical Specifications (TS) for the Duane Arnold Energy Center (DAEC). The proposed change will modify TS 3.6.1.7, "Suppression Chamber-to-Drywell Vacuum Breakers," by revising the required number of operable vacuum breakers for opening from six to five.

The Enclosure to this letter provides NextEra's evaluation of the proposed change. Attachment 1 to the enclosure provides a markup of the TS showing the proposed change, and Attachment 2 provides the clean TS page containing the proposed TS change. The change to the TS Bases is provided for information in Attachment 3 and will be incorporated in accordance with the TS Bases Control Program upon implementation of the approved amendment.

Attachments 4 and 6 contain non-proprietary and proprietary versions, respectively, of GE-Hitachi document 003N7091, "NextEra Energy Duane Arnold (DAEC) Vacuum Breaker Sizing Analysis." Attachment 6 contains information proprietary to GE-Hitachi Nuclear Energy Americas, LLC (GEH) and is supported by an affidavit in Attachment 5, signed by GEH, the owner of the information. The affidavit sets forth the basis on which the information may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in paragraph (b)(4) of 10 CFR 2.390. Accordingly, it is requested that the information that is proprietary to GEH be withheld from public disclosure in accordance with 10 CFR 2.390.

NextEra requests approval of the proposed license amendment by December 31, 2018, and implementation within 90 days. In accordance with 10 CFR 50.91, a copy of this application with enclosures is being provided to the designated State of Iowa official.

As discussed in the Enclosure, the proposed change does not involve a significant hazards consideration pursuant to 10 CFR 50.92, and there are no significant environmental impacts associated with the change. The DAEC Onsite Review Group has reviewed the proposed license amendment.

This letter contains no new or revised regulatory commitments.

If you have any questions or require additional information, please contact Michael Davis, Licensing Manager, at 319-851-7032.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on December 15, 2017

Dean Curtland

Dean Curtland
Site Director
NextEra Energy Duane Arnold, LLC

Enclosure

cc: Regional Administrator, USNRC, Region III,
Project Manager, USNRC, Duane Arnold Energy Center
Resident Inspector, USNRC, Duane Arnold Energy Center
A. Leek (State of Iowa)

NEXTERA ENERGY DUANE ARNOLD, LLC
DUANE ARNOLD ENERGY CENTER

License Amendment Request (TSCR-178)

Application to Reduce the Required Number of Operable Suppression Chamber-to-Drywell Vacuum Breakers

EVALUATION OF PROPOSED CHANGE

1.0 SUMMARY DESCRIPTION

NextEra Energy Duane Arnold, LLC (NextEra) requests an amendment to the Technical Specifications (TS) for the Duane Arnold Energy Center (DAEC). The proposed change will modify TS 3.6.1.7, "Suppression Chamber-to-Drywell Vacuum Breakers," by revising the required number of operable vacuum breakers for opening from six to five.

2.0 DETAILED DESCRIPTION

2.1 <u>Vacuum Breaker Design and Operation</u>

The primary containment is designed for an external pressure not more than 2 psi greater than the concurrent internal pressure. Automatic vacuum relief devices are used to prevent any unacceptable pressure differential. There are two groups of vacuum breakers: the suppression chamber-to-drywell group, which is connected to the vent header inside the torus and prevents drywell pressure from being significantly less than torus pressure; and the reactor building-to-suppression group, which prevents the torus pressure from being significantly lower than building pressure.

The purpose of the suppression chamber-to-drywell vacuum breakers is to relieve vacuum, preventing an excessive negative differential pressure. A negative differential pressure across the drywell wall is caused by rapid depressurization of the drywell. Events that cause this rapid depressurization are cooling cycles, inadvertent drywell spray actuation, and steam condensation from sprays or subcooled re-flood water flowing out of a postulated break in the primary system. Cooling cycles result in minor pressure transients in the drywell that occur slowly and are normally controlled by heating and ventilation equipment. Spray actuation or spill of subcooled water out of a break results in more significant pressure transients and becomes important in sizing these vacuum breakers.

2.2 <u>Current TS Requirements</u>

TS 3.6.1.7, "Suppression Chamber-to-Drywell Vacuum Breakers," currently requires the following in Modes 1, 2, and 3:

> Six suppression chamber-to-drywell vacuum breakers shall be OPERABLE for opening.
>
> <u>AND</u>
>
> Seven suppression chamber-to-drywell vacuum breakers shall be closed, except when performing their intended function.

2.3 Reason for the Proposed Change

TS 3.6.1.7 currently requires six suppression chamber-to-drywell vacuum breakers operable for opening. With one vacuum breaker inoperable for opening, the TS provides a 72-hour completion time to restore operability before a plant shutdown is required. However, a DAEC calculation shows that there is margin available in the current vacuum breaker design, which suggests that the current TS has excess conservatism with respect to the number of vacuum breakers required to open to maintain suppression pool-to-drywell differential pressure. In addition, an analysis performed by GE-Hitachi Nuclear Energy Americas, LLC (GEH) concluded that with four vacuum breakers open, there is margin available to meet the most limiting design basis accident conditions. Therefore, NextEra is requesting a reduction in the required number of operable vacuum breakers for opening from six to five.

This change will provide operational flexibility while maintaining the capability to meet the limiting design basis accident conditions. The proposed change will eliminate the unnecessary transient and operational risks that would result from initiating a plant shutdown in accordance with the current TS with one of six vacuum breakers inoperable for longer than 72 hours.

2.4 Description of the Proposed Change

TS 3.6.1.7, "Suppression Chamber-to-Drywell Vacuum Breakers," is revised as shown below.

> ***Five*** ~~Six~~ suppression chamber -to-drywell vacuum breakers shall be OPERABLE for opening.
>
> AND
>
> Seven suppression chamber -to-drywell vacuum breakers shall be closed, except when performing their intended function

3.0 TECHNICAL EVALUATION

The proposed change revises the minimum number of operable suppression chamber-to-drywell vacuum breakers for opening contained in TS 3.6.1.7 from six to five. The proposed change is based on GEH document "NextEra Energy Duane Arnold (DAEC) Vacuum Breaker Sizing Analysis," which is provided in Attachment 4 (non-proprietary) and Attachment 6 (proprietary).

Information supporting the change in the minimum number of operable suppression chamber-to-drywell vacuum breakers for opening is included in Attachments 4 and 6. These attachments summarize the methodology, inputs, and results for the proposed change to the minimum number of operable suppression chamber-to-drywell vacuum breakers for opening.

The required number of vacuum breakers is calculated using an NRC accepted methodology described in NEDC-33004P-A Revision 4, "Constant Pressure Power Uprate" (Reference 2). A discussion on the methodology for calculating the required number of vacuum breakers is provided in Section 2.1, Containment Response Methodology, of Attachments 4 and 6.

Three analysis cases were performed for the DAEC vacuum breaker sizing evaluation. These cases simulated events developed from a review of the analyses performed in Reference 2. For all three cases, a single failure of a suppression chamber-to-drywell vacuum breaker and two suppression chamber-to-drywell vacuum breakers out-of-service are assumed. Only one of the two reactor building-to-suppression chamber vacuum breakers is used. The specific inputs for these three cases are listed in Appendix A of Attachments 4 and 6. The analysis concludes that the size and number of vacuum breakers are sufficient to prevent exceeding the differential pressure design limit with two vacuum breakers out of service and the failure of one vacuum breaker to open.

4.0 REGULATORY EVALUATION

4.1 Applicable Regulatory Requirements/Criteria

The DAEC Updated Final Safety Analyses Report contains an evaluation of the design basis of DAEC as measured against the AEC General Design Criteria (GDC) for nuclear power plants, Appendix A of 10 CFR 50, effective May 21, 1971, and subsequently amended July 7, 1971. The GDC applicable to the proposed change include:

- GDC 16, Containment Design, states that reactor containment and associated systems shall be provided to establish an essentially leak-tight barrier against the uncontrolled release of radioactivity to the environment and to assure that the containment design conditions important to safety are not exceeded for as long as postulated accident conditions require.

- GDC 38, Containment Heat Removal, states that a system to remove heat from the reactor containment shall be provided. The system safety function shall be to reduce rapidly, consistent with the functioning of other associated systems, the containment pressure and temperature following any LOCA and maintain them at acceptably low levels. Suitable redundancy in components and features and suitable interconnections, leak detection, isolation, and containment capabilities shall be provided to ensure that . . . the system safety function can be accomplished, assuming a single failure.

- GDC 50, Containment Design Basis, states that the reactor containment structure, including access openings, penetrations, and the containment heat removal system shall be designed so that the containment structure and its internal compartments can accommodate, without exceeding the design leakage rate and with sufficient margin, the calculated pressure and temperature conditions resulting from any loss-of-coolant accident. This margin shall reflect consideration of (1) the effects of potential energy sources which have not been included in the determination of the peak conditions, such as energy in steam generators and as required by § 50.44 energy from metal-water and other chemical reactions that may result from degradation but not total failure of emergency core cooling functioning, (2) the limited experience and experimental data available for defining accident phenomena and containment responses, and (3) the conservatism of the calculation model and input parameters.

The analysis of this change, which credits opening of four of the seven suppression chamber-to-drywell vacuum breakers, shows that the design pressure of the primary containment is not exceeded even under worst case accident scenarios. One of the operable vacuum breakers is assumed to fail to open, thus, only four of the five operable vacuum breakers are credited. In addition, the requirement for all suppression chamber-to-drywell vacuum breakers to be closed (except when performing their intended design function) ensures that there is no excessive bypass leakage should a LOCA occur. Therefore, the requirements of GDC 16, 38 and 50 will continue to be met with the implementation of this proposed change.

4.2 No Significant Hazards Consideration

NextEra Energy Duane Arnold, LLC (NextEra) requests an amendment to the Technical Specifications (TS) for the Duane Arnold Energy Center (DAEC). The proposed change will modify TS 3.6.1.7, "Suppression Chamber-to-Drywell Vacuum Breakers," by revising the required number of operable vacuum breakers from six to five.

NextEra has evaluated the proposed change against the criteria of 10 CFR 50.92(c) to determine if the proposed change results in any significant hazards. The following is the evaluation of each of the 10 CFR 50.92(c) criteria:

1. Does the proposed change involve a significant increase in the probability or consequences of an accident previously evaluated?

   Response: No

   Operable suppression chamber-to-drywell vacuum breakers are required for accident mitigation. Failure of the vacuum breakers is not assumed as an accident initiator for any accident previously evaluated. Therefore, any potential failure of a vacuum breaker to perform when necessary will not affect the probability of an accident previously evaluated.

   The proposed change maintains a sufficient number of operable vacuum breakers to meet the limiting design basis accident conditions. The consequences of an accident previously evaluated while utilizing the proposed change are no different than the consequences of an accident prior to the proposed change. As a result, the consequences of an accident previously evaluated are not significantly increased

Therefore, the proposed TS change does not involve an increase in the probability or consequences of a previously evaluated accident.

2. Does the proposed change create the possibility of a new or different kind of accident from any accident previously evaluated?

   Response: No

   The proposed change does not alter the protection system design, create new failure modes, or change any modes of operation. The proposed change does not involve a physical alteration of the plant; and no new or different kind of equipment will be installed. Consequently, there are no new initiators that could result in a new or different kind of accident.

   Therefore, the proposed change does not create the possibility of a new or different kind of accident from any accident previously evaluated.

3. Does the proposed change involve a significant reduction in a margin of safety?

   Response: No

   The proposed change to the minimum number of operable suppression chamber-to-drywell vacuum breakers for opening ensures that an excessive negative differential pressure between the suppression chamber and the drywell will be prevented during the most limiting postulated design-basis event. The minimum number of operable suppression chamber-to-drywell vacuum breakers for opening is set appropriately to ensure adequate margin based on the number of available vacuum breakers not having an effect on the containment system analysis report.

   Therefore, the proposed change does not involve a significant reduction in a margin of safety.

Based on the above, NextEra concludes that the proposed change presents no significant hazards consideration under the standards set forth in 10 CFR 50.92, and, accordingly, a finding of "no significant hazards consideration" is justified.

4.3 Conclusions

Based on the considerations discussed above, (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

5.0 ENVIRONMENTAL CONSIDERATIONS

A review has determined that the proposed amendment would change a requirement with respect to installation or use of a facility component located within the restricted area, as defined in 10 CFR 20, or would change an inspection or surveillance requirement. However, the proposed amendment does not involve (i) a significant hazards consideration, (ii) a significant change in the types or a significant increase in the amounts of any effluents that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed amendment meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed amendment.

6.0 REFERENCES

1. GE Company, "Mark I Containment Program Mark I Wetwell-to-Drywell Vacuum Breaker Functional Requirements, Task 9.4.3," NEDE-24802, April 1980.
2. GE Nuclear Energy, "Constant Pressure Power Uprate," NEDC-33004P-A, Revision 4, July 2003.

ATTACHMENT 1

Proposed Technical Specification Change (Mark-Up)

One page follows

3.6 CONTAINMENT SYSTEMS

3.6.1.7 Suppression Chamber-to-Drywell Vacuum Breakers

LCO 3.6.1.7 ~~Six~~ Five suppression chamber-to-drywell vacuum breakers shall be OPERABLE for opening.

AND

Seven suppression chamber-to-drywell vacuum breakers shall be closed, except when performing their intended function.

APPLICABILITY: MODES 1, 2, and 3.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One required suppression chamber-to-drywell vacuum breaker inoperable for opening.	A.1 Restore one vacuum breaker to OPERABLE status.	72 hours
B. One suppression chamber-to-drywell vacuum breaker not closed.	B.1 Close the open vacuum breaker.	2 hours
C. Required Action and associated Completion Time not met.	C.1 Be in MODE 3.	12 hours
	AND	
	C.2 Be in MODE 4.	36 hours

ATTACHMENT 2

Revised Technical Specification Page

One page follows

3.6 CONTAINMENT SYSTEMS

3.6.1.7 Suppression Chamber-to-Drywell Vacuum Breakers

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B. One suppression chamber-to-drywell vacuum breaker not closed.	B.1 Close the open vacuum breaker.	2 hours
C. Required Action and associated Completion Time not met.	C.1 Be in MODE 3. AND C.2 Be in MODE 4.	12 hours 36 hours

ATTACHMENT 3

Proposed Technical Specification Bases Change (Mark-Up)

Two pages follow

BASES

BACKGROUND (continued)

chamber pressure, there will be an increase in the vent waterleg. This will result in an increase in the water clearing inertia in the event of a postulated LOCA, resulting in an increase in the peak drywell pressure. This in turn will result in an increase in the pool swell dynamic loads. The internal vacuum breakers limit the height of the waterleg in the vent system during normal operation.

APPLICABLE SAFETY ANALYSES

Analytical methods and assumptions involving the suppression chamber-to-drywell vacuum breakers are presented in Reference 1 as part of the accident response of the primary containment systems. Internal (suppression chamber-to-drywell) and external (reactor building- to-suppression chamber) vacuum breakers are provided as part of the primary containment to limit the negative differential pressure across the drywell and suppression chamber walls that form part of the primary containment boundary.

The safety analyses assume that the internal vacuum breakers are closed initially and are fully open at a differential pressure of 0.5 psid (Ref. 2). Additionally, 1 of the 7 internal vacuum breakers is assumed to fail in a closed position (Ref. 1). The results of the analyses show that the design pressure is not exceeded even under the worst case accident scenario. The vacuum breaker opening differential pressure setting is a result of the requirement placed on the vacuum breakers to prevent excessive water-level variations in the submerged portion of the vent downcomer lines. The vacuum breaker capacity, with one of the valves failed, is adequate to limit the pressure differential between the suppression chamber and the drywell during post accident drywell cooling operations to a value that is within the suppression chamber design values.

The suppression chamber-to-drywell vacuum breakers satisfy Criterion 3 of 10 CFR 50.36(c)(2)(ii).

LCO

Only ~~6~~ Five of the 7 vacuum breakers must be OPERABLE for opening. All suppression chamber-to-drywell vacuum breakers, however, are required to be closed (except during testing,

(continued)

BASES (continued)

ACTIONS

A.1

With one of the required vacuum breakers inoperable for opening (e.g., the vacuum breaker is not open and may be stuck closed or not within its opening setpoint limit, so that it would not function as designed during an event that depressurized the drywell), the remaining ~~five~~ four OPERABLE vacuum breakers are capable of providing the vacuum relief function. However, overall system reliability is reduced because a single failure in one of the remaining vacuum breakers could result in an excessive suppression chamber - to-drywell differential pressure during a DBA. Therefore, with one of the ~~six~~ five required vacuum breakers inoperable, 72 hours is allowed to restore at least one of the inoperable vacuum breakers to OPERABLE status so that plant conditions are consistent with those assumed for the design basis analysis. The 72 hour Completion Time is considered acceptable due to the low probability of an event in which the remaining vacuum breaker capability would not be adequate.

B.1

An open vacuum breaker allows communication between the drywell and suppression chamber airspace, and, as a result, there is the potential for suppression chamber overpressurization due to this bypass leakage if a LOCA were to occur. Therefore, the open vacuum breaker must be closed. A short time is allowed to close the vacuum breaker due to the low probability of an event that would pressurize primary containment. If vacuum breaker position indication is not reliable, an alternate method of verifying that the vacuum breakers are closed is to verify that a drywell to suppression chamber differential pressure of 0.5 psid is maintained for 1 hour without makeup. The required 2 hour Completion Time is considered adequate to perform this test.

C.1 and C.2

If the inoperable suppression chamber-to-drywell vacuum breaker cannot be closed or restored to OPERABLE status within the required Completion Time, the plant must be brought to a MODE in which the LCO does not apply. To achieve this status, the plant

(continued)

ATTACHMENT 4

NextEra Energy Duane Arnold (DAEC) Vacuum Breaker Sizing Analysis (Non-proprietary)

HITACHI

GE Hitachi Nuclear Energy

003N7091-NP
Revision 1
September 2017

Non-Proprietary Information - Class I (Public)

NextEra Energy Duane Arnold (DAEC) Vacuum Breaker Sizing Analysis

INFORMATION NOTICE

This is a non-proprietary version of the document 003N7091-P Revision 1, which has the proprietary information removed. Portions of the document that have been removed are indicated by an open and closed bracket as shown here [[ ]].

IMPORTANT NOTICE REGARDING CONTENTS OF THIS REPORT

Please Read Carefully

The design, engineering, and other information contained in this document is furnished for the purposes of supporting the NextEra in proceedings before the U.S. Nuclear Regulatory Commission (NRC). The only undertakings of GEH with respect to information in this document are contained in the contract between NextEra and GEH and nothing contained in this contract shall be construed as changing that contract. The use of this information by anyone other than NextEra for any purpose other than that for which it is intended, is not authorized; and with respect to any unauthorized use, GEH makes no representation or warranty, and assumes no liability as to the completeness, accuracy, or usefulness of the information contained in this document.

Revision Summary

Revision	Required Changes to Achieve Revision
0	N/A
1	Identified specific instances of GEH proprietary information and prepared the report for submittal to the NRC.

Acronyms and Abbreviations

Term	Definition
AOR	Analysis of Record
BWR	Boiling Water Reactor
CO	Condensation Oscillation
DAEC	Duane Arnold Energy Center
DBA	Design Basis Accident
DW	Drywell
ECCS	Emergency Core Cooling System
EPU	Extended Power Uprate
GEH	GE Hitachi Nuclear Energy
IBA	Intermediate Break Accident
LLS	Low-Low-Set
LOCA	Loss-of-Coolant Accident
LPCI	Low Pressure Coolant Injection
LTR	Licensing Topical Report
NPSH	Net Positive Suction Head
NRC	Nuclear Regulatory Commission
OOS	Out-of-Service
PULD	Plant Unique Load Definition
RB	Reactor Building
RHR	Residual Heat Removal
SBA	Small Break Accident
SE	Safety Evaluation Report
SRV	Safety Relief Valve
SRVDL	SRV Discharge Line
UFSAR	Updated Final Safety Analysis Report
US	United States
VB	Vacuum Breaker
WG	Water Gauge
WW	Wetwell

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1.0 Introduction and Scope

Vacuum breaker (VB) valves installed in the Duane Arnold Energy Center (DAEC) containment systems prevent potential negative differential pressure exceeding design limits between the wetwell (WW) and drywell (DW). Functional requirements established during the Mark I containment program (Reference 1) include a VB load definition, based upon dynamic modeling of the vent pressure transient, and VB number and size for predicting integrated containment response to prescribed events. Prior to the Mark I program, a general design requirement derived from the Bodega Bay Preliminary Hazards Summary Report included specification of VB area being no less than 1/16 of the total vent flow cross-sectional area. A number of plants revised their VB sizing technical bases by implementing the more systematic approach developed in the Mark I program (Reference 1). Calculations were performed using an approach similar to that applied for the Reference 1 analyses to serve as the technical basis supporting DAEC VB size and number requirements for operation.

These analysis cases performed for the DAEC VB sizing evaluation simulate events developed from a review of the analyses performed in Reference 1 and include:

Case 1: Inadvertent actuation of DW spray with one (1) DW spray header during normal plant operation.

Case 2: DW spray following a small steam line break loss-of-coolant accident (LOCA) with [[ ]] and use of two (2) DW spray headers.

Case 3: Emergency core cooling system (ECCS) vessel reflood into the DW following a large liquid break LOCA with [[ ]]

The design inputs for each case are summarized in Appendix A.

2.0 Containment Response Analysis

2.1 Containment Response Methodology

The GE Hitachi Nuclear Energy (GEH) computer code SHEX was used to perform the containment pressure and temperature response analysis presented in this report. The SHEX code is the code currently used by GEH to perform analyses of the containment pressure and temperature response including analyses performed to evaluate VB sizing adequacy for events resulting in negative DW-to-WW differential pressure, negative DW-to-Reactor Building (DW-to-RB) and negative WW-to-RB differential pressures. [[

]]

SHEX is the standard code used by GEH for containment response calculations for boiling water reactor (BWR) Mark I, Mark II and Mark III plants where safety systems such as ECCS and residual heat removal (RHR) pump operation or use of containment spray is simulated.

A licensing topical report (LTR) was not issued for SHEX, and therefore an NRC safety evaluation (SE) report with formal NRC approval for SHEX was not issued. However, the NRC has accepted the use of SHEX for United States (US) BWR Mark I containment analyses (Reference 2), in particular containment analyses performed in support of power uprates performed for US BWR Mark I plants.

GEH report NEDC-33004P-A Revision 4 (Reference 3) documents the GEH guidelines for extended thermal power uprates while maintaining the current plant operating reactor pressure. This LTR was reviewed and approved by the NRC and includes a copy of the NRC SE with approval of the LTR. Included within the NRC SE is the NRC basis for acceptance of SHEX containment analysis applications.

The NRC SE approval for use of SHEX for power uprate containment analyses cited the Reference 2 NRC letter which included a requirement for benchmarking analyses. However, per the NRC SE approval for NEDC-33004P-A Revision 4, the NRC accepted the use of SHEX without need for benchmark analyses for Mark I containments, as originally stipulated in the cited NRC letter. This was based on NRC comparisons of their own benchmark cases results with SHEX results for Mark I plants.

2.2 Analysis Inputs and Assumptions

The sizing evaluation for the DAEC WW-to-DW VBs and RB-to-WW VB are based on the results of the GEH analysis of the DAEC containment system response to potentially limiting events for negative DW-to-WW differential pressure as well as for negative DW-to-RB differential pressure and WW-to-RB differential pressure. These analyses were performed for a set of cases which were [[ ]] presented originally in Reference 1.

The following three cases were performed for DAEC. For all three cases, a single failure of one WW-DW VB and two VBs out-of-service (OOS) are assumed and only one (1) RB-to-WW VB is used. The specific inputs for those three cases are listed in Appendix A.

Case 1: Inadvertent Actuation of DW Spray During Normal Plant Operation.

Case 1 assumes that one DW spray header is inadvertently actuated with [[
]] during plant normal operation.

Case 2: Actuation of Two DW Spray Headers Following a Small Steam Line Break LOCA.

Case 2 assumes that two DW spray headers are actuated [[

]]

Case 3: ECCS Reflood into the DW Following a Large Liquid Break LOCA.

[[

]]

Key assumptions for the analyses are presented below. Case specific inputs are summarized in Appendix A. Other analysis inputs not listed in Appendix A are based on Reference 4.

Key Assumptions for Analyses:

1. Single failure of one (1) WW-to-DW VB and two (2) WW-DW VBs OOS are assumed for all cases. For all cases in the report, only one RB-to-WW VB is used.
2. [[
]]
3. [[
]]
4. [[
]] throughout the transient event analysis period.
5. [[
]]

6. The VB flow component mass flow rates are calculated based on [[ ]] from the source volume, which is the WW for the WW-to-DW VBs and is the RB for the RB-to-WW VB.

7. [[ ]]

2.3 Results

Table 1 summarizes the results of the containment response analyses, showing peak values for DW-to-WW differential pressure, DW-to-RB and WW-to-RB differential pressures. Figures 1 through 3 show the plots of DW-to-WW differential pressure, DW-to-RB differential pressure and WW-to-RB differential pressure for those three cases.

Case 1 produces the most severe response with respect to the maximum negative DW-to-RB and WW-to-RB differential pressures, with a predicted DW-to-RB differential pressure of [[ ]] and predicted WW-to-RB differential pressure of [[ ]].

The LOCA cases, Cases 2 and 3, produce the more severe response with respect to maximum negative DW-to-WW differential pressure, with Case 2 limiting with a predicted DW-to-WW differential pressure of [[ ]]. For the LOCA cases, the predicted maximum values of negative DW-to-WW differential pressure occur within 20 seconds. DW-to-RB and WW-to-RB differential pressures remain greater than zero for Case 3.

The results presented in Table 1 demonstrate that all predicted differential pressure values for DW-to-RB differential pressure, WW-to-RB differential pressure and DW-to-WW differential pressure are below the design limit of 2 psid.

3.0 WW-to-DW VB Number Reduction Impact

The following discussion is limited to the change in the number of available WW-to-DW VBs and the changes in WW-to-DW inputs. All the other conditions for a particular analysis remain the same as analysis of record (AOR) to be discussed.

3.1 DAEC EPU NPSH and Overpressure Analysis

The DAEC net positive suction head (NPSH) analysis at extended power uprate (EPU) conditions can be found in Reference 5. [[

]]

Overpressure analysis refers to containment overpressure analyses in Reference 5. Specifically, those analyses refer to containment short-term analysis (using M3CPT) for peak containment pressure and temperature, and long-term design basis accident (DBA) analyses.

<u>Reference 5 Section 2.3.1 M3CPT DAEC Short-Term Analysis:</u>

The Reference 5 M3CPT short-term analysis only lasts ~30 seconds, and ECCS flow is not modeled. [[

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<u>Reference 5 Section 2.3.2 SHEX DAEC Long-Term DBA Analysis:</u>

For the long-term DBA-LOCA analysis in Reference 5 Section 2.3.2, the parameters of interest are peak suppression pool temperature, peak WW temperature and peak containment pressures as shown in Tables 3-3 and 3-4 of Reference 5. Updated Final Safety Analysis Report (UFSAR) Case 3 and Case 4 in Reference 5 are essentially the same (Section 2.3.2.1 A discussion). UFSAR Case 4 used low pressure coolant injection (LPCI) cooling and UFSAR Case 3 used containment spray. Other inputs are the same for those two cases.

[[

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It is therefore concluded that changing the number of available VBs for DAEC from 6 to 4 (or the input changes for those VBs) has no effect on DAEC short-term and long-term containment overpressure analyses.

3.2 Containment Hydrodynamic Loads and PULD

Containment hydrodynamic loads consist of LOCA loads and safety relief valve (SRV) loads. LOCA loads include pool swell, vent thrust, condensation oscillation (CO) and chugging.

[[

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The SRV air-clearing loads include SRV discharge line (SRVDL) loads, suppression pool boundary pressure loads and drag loads on submerged structures. These loads are influenced by the SRV opening setpoint pressure, the initial water leg in the SRVDL, the SRVDL geometry, and the suppression pool geometry. VB operation would not have any effect on those parameters, and therefore, the number of available VBs will have no effect on the SRV loads. For the times when DW pressure is lower than WW (e.g., following DW spray initiation), the smaller number of VBs can slightly increase the WW-to-DW pressure difference for a very short duration immediately after VB opening. This would make the water level in the SRV tailpipe slightly higher at the time of SRV actuation. [[

]]

For example, for LOCA conditions, it is assumed in References 8 and 9 that [[

]]

Therefore, the number of VBs has no effect on the Mark I SRV loads defined for DAEC.

Plant Unique Load Definition (PULD) analyses for intermediate break accidents (IBAs) and small break accidents (SBAs) can be found in Reference 5 Section 3.1.3.5. [[
]] Therefore, there is no effect on those analyses from the VBs.

3.3 Containment Bypass Analysis

The steam bypass analysis is discussed in Section 2.3.2.6 of Reference 5. [[

]] Therefore, the number of available VBs has no effect on the Reference 5 steam bypass capacity analysis.

4.0 Conclusions

The results presented in Table 1 confirm that the size and number of WW-to-DW VBs and RB-to-WW VBs for DAEC, accounting for two (2) WW-to-DW VB OOS, and one (1) WW-to-DW VB failure, are sufficient to adequately mitigate negative DW-to-WW, DW-to-RB and WW-to-RB differential pressures and prevent exceeding the differential pressure design limits of 2 psid.

It is further concluded that the number of available WW-to-DW VB reduction does not have an effect on the containment analysis reported in the DAEC EPU containment system analysis report (Reference 5).

5.0 References

1. GE Company, "Mark I Containment Program Mark I Wetwell-to-Drywell Vacuum Breaker Functional Requirements, Task 9.4.3," NEDE-24802, April 1980.
2. Letter to G. L. Sozzi (GE) from A. Thadani (NRC), "Use of SHEX Computer Program and ANSI/ANS 5.1-1979 Decay Heat Source Term for Containment Long-Term Pressure and Temperature Analysis," MFN-117-93, July 13, 1993.
3. GE Nuclear Energy, "Constant Pressure Power Uprate," NEDC-33004P-A, Revision 4, July 2003.
4. Letter from R. McGee (IES) to W. F. Farrel (GE), "DAEC EPU OPL-4A," NG-00-1653, September 28, 2000.
5. GE Nuclear Energy, "Project Task Report Duane Arnold Energy Center Asset Enhancement Program Task T0400: Containment System Response," GE-NE-A22-00100-23-01-R2, Revision 2, December 2002.
6. GE Company, "Mark I Containment Program Load Definition Report," NEDO-21888, Revision 2, November 1981.
7. GE Company, "Mark I Containment Program Application Guide 3 Safety Relief Valve Discharge Line Clearing Transient," NEDE-24555-P, Volume I, Revision 2, September 1980.
8. GE Company, "Mark I Containment Program Application Guide 9 Safety Relief Valve Discharge Line Reflood Transient," NEDE-24555-P, Volume III, Revision 2, September 1980.
9. GE Company, "Mark I Containment Program, Analytical Model for Computing Water Rise in a Safety/Relief Valve Discharge Line Following Valve Closure Task 7.1.2.2," NEDE-23898-P, October 1978.
10. GE Company, "Evaluation of Mark I S/RV Load Cases C3.1, C3.2, and C3.3 for the Duane Arnold Energy Center," NEDC-22204, September 1982.
11. CAL-M01-152, "Drywell Torus Vacuum Breaker System," February 26, 2002.

Table 1 Summary of DAEC Vacuum Breaker Sizing Analysis Results

Case No.	1	2	3
Case Description	Inadvertent Actuation of DW Spray during Normal Operation	DW Spray During Small Steam Line Break	ECCS Reflood Following DBA-LOCA
Single Failure	Failure of one WW-DW VB to open and two OOS	Failure of one WW-DW VB to open and two OOS	Failure of one WW-DW VB to open and two OOS
Number of WW-DW VBs	4	4	4
Number of RB-WW VB System Branch Lines Open	1	1	1
Spray or ECCS Reflood Temp (°F)	[[		]]
Number of Spray Headers	1	2	N/A
Peak Negative[1,2] DW-to-RB Differential Pressure (psid)	[[		
Peak Negative[1,2] WW-to-RB Differential Pressure (psid)			
Peak Negative[2] DW-to-WW Differential Pressure (psid)			]]

Notes:

1. DW-to-RB and WW-to-RB differential pressures are based on a RB pressure of 14.7 psia.
2. Times shown are relative to the start time of DW spray for Cases 1 and 2 and relative to start of ECCS reflood for Case 3.
3. [[

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Figure 1 Case 1 Containment Differential Pressure Responses

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Figure 2 Case 2 Containment Differential Pressure Responses

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Figure 3 Case 3 Containment Differential Pressure Responses

Appendix A Summary of Case Input Parameters

Item No.	Case	Case 1 Inadvertent Spray Operation	Case 2 Drywell Spray After LOCA	Case 3 Vessel Reflood Through Break
1	**CONTAIMENT GEOMETRY PARAMETERS**			
1.a.	**DW Volume (ft^3)**	130,000	130,000	130,000
1.b.	**WW Airspace Volume (ft^3)**	94,070	94,070	94,070
1.c.	**Initial Suppression Pool Volume - (HWL) (ft^3)**	61,500	61,500	61,500
2	**INITIAL CONDITIONS**			
2.a.	**Initial DW Temperature (°F)**	135	266.93	266.93
2.b.	**Initial DW Pressure (psia)**	15.2 minimum 15.7 maximum (Note 1)	39.8	39.8
2.c.	**Initial DW Relative Humidity (%)**	100	---	---
2.d.	**Initial DW Quality**	---	1.0	1.0
2.e.	**Initial WW Airspace Temperature (°F)**	95	143	143.3
2.f.	**Initial Suppression Pool (SP) Temperature (°F)**	95	143	143
2.g.	**Initial WW Pressure (psia)**	15.2 minimum 15.7 maximum (Note 1)	38.5	38.5
2.h.	**Initial WW Relative Humidity (%)**	100	100	100
3	**VESSEL STEAM BREAKFLOW PARAMETERS**			
3.a.	**Vessel Steaming Rate (lbm/sec)**	N/A	0	N/A
3.b.	**Vessel Steam Enthalpy (Btu/lbm)**	N/A	N/A	N/A
4	**WETWELL-DRYWELL VACCUM BREAKER PARAMETERS**			
4.a.	**WW-DW VB Loss Coefficient (K)**	2.41	2.41	2.41
4.b.	**Number of Installed WW-DW VBs (Note 2)**	7	7	7
4.c.	**WW-to-DW VB Area per Valve (ft^2)**	1.396	1.396	1.396
4.d.	**WW-to-DW VB Opening Pressure Differential (psid)**	0.35	0.35	0.35
4.e.	**WW-to-DW VB Full Open Pressure Differential (psid)**	0.5	0.5	0.5

Item No.	Case	Case 1 Inadvertent Spray Operation	Case 2 Drywell Spray After LOCA	Case 3 Vessel Reflood Through Break
4.f.	**WW-to-DW VB Opening Time from Starting Opening to Full Open (seconds)**	2	2	2
5	**REACTOR BUILDING-TO-WETWELL VACUUM BREAKER PARAMETERS**			
5.a.	**Number of RB-to-WW VBs**	1	1	1
5.b.	**RB-to-WW VB Area per Valve (ft^2)**	1.623	1.623	1.623
5.c.	**RB-to-WW VB Opening Setpoint Pressure Differential (psid)**	0.35	0.35	0.35
5.d.	**RB-to-WW VB Full Open Pressure Differential (psid)**	0.5	0.5	0.5
5.e.	**RB-to-WW VB Opening Time from Starting Opening to Full Open (seconds)**	2	2	2
5.f.	**RB-DW VB Loss Coefficient (K)**	2.86	2.86	2.86
6	**CONTAINMENT SPRAY PARAMETERS**			
6.a.	**Number of RHR DW Spray Headers**	1	2	N/A
6.b.	**Maximum RHR DW Spray Flow Rate per Header, (gpm)**	4,560	4,560	N/A
6.c.	**RHR DW Spray Temperature (°F)**	[[ ]] (Note 3) Minimum Service Water Temperature 35°F Minimum Torus Water Temperature 55°F Heat Exchanger k-value: 141 Btu/sec-°F	[[ ]] (Note 4) Minimum Service Water Temperature 35°F Minimum Torus Water Temperature 55°F Heat Exchanger k-value: 141 Btu/sec-°F	N/A
6.d.	**Number of RHR WW Spray Headers**	N/A	N/A	N/A
6.e.	**RHR WW Spray Flow Rate, (lbm/sec)**	N/A	N/A	N/A
6.f.	**Distance WW Spray Header to DW Floor (ft)**	N/A	N/A	N/A
6.g.	**RHR WW Spray Temperature (°F)**	N/A	N/A	N/A

Item No.	Case	Case 1 Inadvertent Spray Operation	Case 2 Drywell Spray After LOCA	Case 3 Vessel Reflood Through Break
6.h.	**DW and WW Spray Efficiency**	100%	100%	N/A
6.i.	**Average DW and WW Spray Droplet Diameter (ft)**	[[	]]	N/A
7	**ECCS VESSEL REFLOOD PARAMETERS**			
7.a.	**ECCS Vessel Reflood Flow Through Break (gpm)**	N/A	N/A	35,000
7.b.	**ECCS Reflood Vessel Break Flow Temperature (°F)**	N/A	N/A	[[ ]]
7.c.	**ECCS Reflood Vessel Break Flow Mixing Efficiency**	N/A	N/A	100%
8	**REACTOR BUILDING INITIAL CONDITIONS (NOTE 5)**			
8.a.	**Pressure**	0.87 to 0.32 inch water gauge (wg) vacuum	0.87 to 0.32 inch wg vacuum	0.87 to 0.32 inch wg vacuum
8.b.	**Temperature (°F)**	68 to 100	68 to 100	68 to 100
8.c.	**Relative Humidity (-)**	90% - 20%	90% - 20%	90% - 20%

Notes:

1. [[ ]]
2. Four (4) WW-to-DW VBs are used for all cases in this report (See Table 1).
3. The spray liquid temperature is determined by assuming that one heat exchanger is in operation. With one heat exchanger running, the minimum liquid temperature would be

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4. The spray liquid temperature is determined by assuming that two heat exchangers are in operation. It is estimated in Reference 11 and also by GEH that [[

]] Therefore the pool temperature would be [[ ]] when containment spray is initiated. With two heat exchangers running, the minimum liquid spray temperature would be

[[

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5. Some iterations are made and the following RB initial conditions are used for the analysis. It is worth to note that the RB-to-WW VB is only used for Case 1. For Cases 2 and 3, the RB-to-WW VB does not open during the transient.

   a. [[

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ATTACHMENT 5

GE-Hitachi Affidavit for Withholding of Proprietary Information

GE-Hitachi Nuclear Energy Americas LLC

AFFIDAVIT

I, Lisa K. Schichlein, state as follows:

(1) I am a Senior Project Manager, NPP/Services Licensing, Regulatory Affairs, 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 GEH proprietary report 003N7091-P, "NextEra Energy Duane Arnold (DAEC) Vacuum Breaker Sizing Analysis," Revision 1, dated September 2017. GEH proprietary information in 003N7091-P Revision 1 is identified by a dotted underline placed within double square brackets. [[This sentence is an example.{3}]] GEH proprietary information in figures and large objects is identified by double square brackets before and after the object. In all cases, 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 U.S.C. §552(b)(4), and the *Trade Secrets Act*, 18 U.S.C. §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 F.2d 871 (D.C. Cir. 1992), and Public Citizen Health Research Group v. FDA, 704 F.2d 1280 (D.C. 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 a license from GEH constitutes a competitive economic advantage over other companies;

b. Information that, if used by a competitor, would reduce its expenditure of resources or improve its 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 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 for proprietary or confidentiality agreements or both 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.

(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) is classified as proprietary because it contains details of GEH's design and licensing methodology for the GEH Boiling Water Reactor (BWR). The development of this methodology, along with the testing, development, and approval, was achieved at a significant cost to GEH.

The development of the design and licensing methodology along with the interpretation and application of the analytical results is derived from the extensive experience databases that constitute a 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 is true and correct.

Executed on this 15th day of September 2017.

Lisa K. Schichlein

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