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October 13, 2008

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10 CFR 50.54(f)

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-001

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

Subject: Nine-Month Response to NRC Generic Letter 2008-01, "Managing Gas Accumulation in Emergency Core Cooling, Decay Heat Removal, and Containment Spray Systems"

References:
1. NRC Generic Letter 2008-01, "Managing Gas Accumulation in Emergency Core Cooling, Decay Heat Removal, and Containment Spray Systems" dated January 11, 2008.
2. Letter, R. Anderson (FPL Energy Duane Arnold) to USNRC, "Three-Month Response to NRC Generic Letter 2008-01, 'Managing Gas Accumulation in Emergency Core Cooling, Decay Heat Removal, and Containment Spray Systems'," NG-08-0239, dated May 8, 2008. (ADAMS Accession No. ML081420015)
3. Letter, K. Feintuch (USNRC) to R. Anderson (FPL Energy Duane Arnold), "Duane Arnold Energy Center - re: Generic Letter 2008-01, 'Managing Gas Accumulation In Emergency Core Cooling, Decay Heat Removal, And Containment Spray Systems,' Proposed Alternative Course Of Action (TAC NO. MD7824)," dated August 6, 2008. (ADAMS Accession No. ML081930209)

The Nuclear Regulatory Commission (NRC) issued Generic Letter (GL) 2008-01 (Reference 1) to request that each licensee evaluate the licensing basis, design, testing, and corrective action programs for the Emergency Core Cooling Systems (ECCS), Decay Heat Removal and Containment Spray systems, to ensure that gas accumulation is maintained less than the amount that challenges operability of these systems, and that appropriate action is taken when conditions adverse to quality are identified.

GL 2008-01 requested each licensee to submit a written response in accordance with 10 CFR 50.54(f) within nine months of the date of the GL to provide the information summarized below:

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> "(a) A description of the results of evaluations that were performed pursuant to the requested actions;
>
> (b) A description of all corrective actions, including plant, programmatic, procedure, and licensing basis modifications that were determined to be necessary to assure compliance with the quality assurance criteria in Sections III, V, XI, XVI, and XVII of Appendix B to 10 CFR Part 50 and the licensing basis and operating license as those requirements apply to the subject systems; and,
>
> (c) A statement regarding which corrective actions were completed, the schedule for completing the remaining corrective actions, and the basis for that schedule."

The Enclosure to this letter contains the FPL Energy Duane Arnold, LLC nine-month response to NRC GL 2008-01.

In summary, FPL Energy Duane Arnold has concluded that the subject systems/functions at the DAEC are in compliance with the TS definition of Operability, i.e., capable of performing their intended safety function and that the DAEC is currently in compliance with 10 CFR 50, Appendix B, Criterion III, V, XI, XVI and XVII, with respect to the concerns outlined in GL 2008-01 regarding gas accumulation in these systems/functions, based upon the results of our evaluations of all piping sections and walkdowns of the accessible portions of the piping for these systems/functions.

As committed to in Reference 2, FPL Energy Duane Arnold will complete its evaluations of those inaccessible portions of these systems/functions during the next Refuel Outage and provide a supplement to this report with those results within 90 days from startup of that outage. As requested in Reference 3, FPL Energy Duane Arnold will format this supplemental report similar to this 9 month submittal in description of evaluations and disposition of corrective actions.

This letter contains the following new NRC commitment:

- FPL Energy Duane Arnold commits to submit to the NRC proposed changes to the DAEC Technical Specifications based upon the final, approved version of Technical Specification Task Force (TSTF) Traveler for unacceptable gas accumulation in ECCS, modified, as needed, to account for plant-specific DAEC design and licensing basis, within 180 days following NRC publication of the Notice of Availability of the TSTF Traveler in the Federal Register.

Please contact Steve Catron at (319) 851-7234 if you have further questions regarding this matter.

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

Executed on October 13, 2008.

Richard L. Anderson
Vice President, Duane Arnold Energy Center
FPL Energy Duane Arnold, LLC

Enclosure

cc: Administrator, Region III, USNRC
Project Manager, DAEC, USNRC
Resident Inspector, DAEC, USNRC

FPL Energy Duane Arnold
Nine-Month Response to NRC Generic Letter 2008-01, Managing Gas Accumulation in Emergency Core Cooling, Decay Heat Removal, and Containment Spray Systems

This Enclosure contains the FPL Energy Duane Arnold, LLC (FPL Energy Duane Arnold) nine-month response to NRC Generic Letter (GL) 2008-01 "Managing Gas Accumulation in Emergency Core Cooling, Decay Heat Removal, and Containment Spray Systems," dated January 11, 2008. In GL 2008-01, the NRC requested "that each addressee evaluate its ECCS, DHR system, and Containment Spray system licensing basis, design, testing, and corrective actions to ensure that gas accumulation is maintained less than the amount that challenges operability of these systems, and that appropriate action is taken when conditions adverse to quality are identified."

The following information is provided in this response:

a) A description of the results of evaluations that were performed pursuant to the requested actions (see Section A of this Enclosure),

b) A description of the corrective actions determined necessary to assure compliance with the quality assurance criteria in Sections III, V, XI, XVI, and XVII of Appendix B to 10 CFR Part 50 and the licensing basis and operating license with respect to the subject systems (see Section B of this Enclosure), and

c) A statement regarding which corrective actions have been completed, the schedule for the corrective actions not yet complete, and the basis for that schedule (see Section C of this Enclosure).

For the Duane Arnold Energy Center (DAEC) the GL subject functions correspond to the following plant systems/operating modes:

High Pressure ECCS: High Pressure Coolant Injection (HPCI) – water side.

Low Pressure ECCS: Core Spray (CS) and Residual Heat Removal (RHR) – Low Pressure Coolant Injection (LPCI) mode.

Decay Heat Removal: RHR - Shutdown Cooling (SDC) mode, LPCI mode, or Suppression Pool Cooling (SPC) mode. All three (3) modes can utilize the RHR heat exchanger for decay heat removal. Shutdown Cooling mode is the normal means for removing decay heat from the core during planned shutdowns and abnormal operating occurrences/transients that result in a plant trip/scram. Suppression Pool Cooling mode is used if there is transfer of decay heat from the reactor to the suppression pool, such as a transient resulting in safety/relief valve opening or a Loss-of-Coolant Accident (LOCA). LPCI mode can also be used during a LOCA for decay heat removal by routing injection through the RHR heat exchanger as part of the long term core cooling path.

Containment Spray: RHR – Drywell Spray mode and RHR – Suppression Pool Spray mode.

It should be noted that there are related issues that the nuclear industry is currently considering with respect to the overall performance of these systems, specifically Generic Safety Issue (GSI) - 193, "BWR ECCS Suction Concerns." Resolution of these issues will continue to be pursued through the BWR Owners' Group and industry leadership organizations and will not be addressed herein. This is consistent with the NRC's direction in SECY-08-0108[1].

[1] From the Enclosure to SECY-08-0108, page 24: "The initial intent to include this issue in the scope of the GL on the topic of gas accumulation in suction piping of ECCS pumps being developed by NRR proved to be impractical due to fundamental differences and the development status of the GL in relation to the GI." Note: GI means "Generic Issue."

A. EVALUATION RESULTS

Licensing Basis Evaluation

The DAEC licensing basis was reviewed with respect to gas accumulation in the Emergency Core Cooling, Decay Heat Removal, and Containment Spray functions. As noted above, this use of "function" versus "system" as used in the GL context is intentional, as the standard Boiling Water Reactor (BWR) design does not have dedicated systems to some of these functions; they are various operating modes of other systems, such as the Residual Heat Removal (RHR) system. This review included relevant Technical Specifications (TS) and TS Bases, Updated Final Safety Analysis Report (UFSAR), Technical Requirements Manual (TRM) and TRM Bases, responses to NRC generic communications, regulatory commitments, and License Conditions.

1. Results of the licensing document review:

The above documents and regulatory commitments were evaluated for compliance with applicable regulatory requirements. The following is a summary of the DAEC licensing basis for the associated GL functions.

For the ECCS function, the DAEC licensing basis is limited to the discharge portion of these piping systems, with a focus on the specific piping sections between the associated pump discharge valve and the injection valve outboard of the primary containment. The TS, UFSAR and licensing commitments are concerned with precluding unacceptable consequences associated with having voids in these sections of piping, notably waterhammer. The low pressure ECCS systems were originally constructed with a "keep fill" system to maintain this specific section of piping pressurized and "full of water[2]" to preclude such a waterhammer from occurring. The licensing basis does not identify any specific issues or concerns with respect to unacceptable voiding in the suction piping for low pressure ECCS. Thus, the TS Surveillance Requirement (SR) for ECCS "keep fill" does not address the suction piping for these low pressure ECCS systems/functions.

The HPCI system was retrofitted with a low pressure keep fill capability for the discharge piping as added assurance of system Operability during periods when the pump suction is aligned to the Suppression Pool. A high pressure keep fill capability was added to address the "turbulent penetration" concern in the HPCI discharge piping in the vicinity of the injection valve, as noted in the GL (Reference 1). As part of the resolution of that concern, an inverted loop of piping, which created a high point, was found without an installed vent valve. A new vent valve was added to that HPCI suction piping from the Condensate Storage Tank (CST) to assist in fill and vent activities.

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[2] The terminology "full of water" has been historically used in these documents to describe the state of piping systems as being absent of voids of sufficient size that could create unacceptable consequences, such as waterhammer. The Industry recognizes that this phrase is potentially confusing as to its original intent and is working on generic language to properly describe the desired state/condition for these piping systems. In the interim, the phrase "full of water" will continued to be used with that understanding as to its original intent.

In response to NRC-identified concerns during a Component Design Basis Inspection (CDBI), the calculation for the instrument setting that controls the HPCI pump suction transfer from the CST to the Suppression Pool is being revised. While the initial evaluation of this identified concern concluded that it did not impact HPCI Operability, the revised calculation will add analytical margin to address vortexing concerns with entrained air being drawn into that piping. Corrective Action document (CA049348) is tracking the completion of that item. Because this issue was identified as part of the CDBI and not as part of the reviews for this GL, FPL Energy Duane Arnold considers this activity outside the scope of this GL and thus, this Corrective Action is not listed in Section C of this Enclosure.

Although the Decay Heat Removal and Containment Spray functions of the RHR system have common piping sections with the ECCS function (LPCI), which has a keep fill function described above, the DAEC licensing basis has no specific requirements regarding precluding gas accumulation (voiding) in piping systems (suction or discharge) for either the Containment Spray or Decay Heat Removal functions as a condition for Operability. This is principally because these are manually initiated systems, that are generally not vulnerable to waterhammer concerns, and they have no specific timing requirements for initiation in response to any analyzed event in the DAEC UFSAR. Thus, the Operators can take the time necessary to ensure these systems are properly aligned, back-flushed (as needed), and capable of performing their intended functions without the use of a "keep fill" capability similar to that used for ECCS.

2. Summary of any required changes to licensing basis documents:

No changes have been made to the licensing basis documents as a result of this GL to date. Opportunities for enhancements have been identified to clarify the language used in various licensing documents to describe the requirement for piping systems to be "full of water" to preclude any Operability concerns. These have been entered into the FPL Energy Duane Arnold Corrective Action Program (COM032036). Such clarifications are pending development of industry consensus language, as applicable to the DAEC design and licensing basis that are being pursued by the BWR Owners' Group (BWROG) and the Technical Specification Task Force (TSTF).

3. Future actions, schedule, and the basis for the schedule:

As noted above, TS improvements are being addressed by the TSTF to provide an approved TSTF Traveler for making changes to individual licensee TS related to the potential for unacceptable gas accumulation. The development of the TSTF Traveler relies on the results of the evaluations of a large number of licensees to address the various plant designs. FPL Energy Duane Arnold is continuing to support the industry and NEI Gas Accumulation Management Team activities regarding the resolution of generic TS changes via the TSTF Traveler process. FPL Energy Duane Arnold will evaluate the resolution of TS issues as contained in the TSTF Traveler for applicability to the DAEC design and licensing basis, and submit a license amendment request based on this evaluation within 180 days following NRC publication of the Notice of Availability of the TSTF Traveler. Any TS Bases changes associated with these TS changes will also be made as part of implementation of the DAEC license

amendment, upon NRC issuance, under the TS BASES Control Program, along with any other licensing basis document changes for consistency, such as UFSAR changes.

Design Evaluation

The DAEC design basis was reviewed with respect to gas accumulation in the Emergency Core Cooling System, and Decay Heat Removal and Containment Spray functions. This review included relevant Design Basis Documents, Calculations, Engineering Evaluations, and Vendor Technical Manuals

1. Results of the design basis document review:

HPCI discharge piping had previously been evaluated (Reference 2) as part of the resolution of the "turbulent penetration" issue described in the GL (Reference 1). This evaluation concluded that the steam bubble created by the turbulent penetration did not compromise Operability of the HPCI system.

The design basis of the low pressure ECCS provides for maintenance of the discharge piping "filled with water." This is accomplished by having pump discharge check valves at an elevation below the Suppression Pool water level and the installation of a "keep fill" pump.

Similar to the licensing basis noted above, the Decay Heat Removal and Containment Spray functions at the DAEC do not have any specified gas accumulation (voiding)/ keep-fill criterion as part of their design basis. Thus, there are no previous analyses for these concerns for these specific functions.

2. Discussion of gas volume acceptance criteria used for each piping segment in each GL subject system/function, summary of any required Corrective Actions, and schedule for completion of those Corrective Actions:

a) Pump Suction Piping

Consistent with Industry guidance, gas volume acceptance criteria for the suction piping for centrifugal pumps is a bounding 2% void fraction for continuous voiding and an average 10% void fraction for up to 5 seconds, given that the DAEC pumps operated below 120% of the best efficiency point (BEP). These conservative criteria have been applied at the DAEC, in support of system Operability determinations, pending continued Industry investigations. These values, when used in conjunction with other factors such as $NPSH_R$, duration of gas flow, and abnormal operational occurrences/transients for which the system is credited, provide a basis for continued system Operability.

b) Pump discharge piping, which could be susceptible to pressure pulsation or waterhammer after a pump start.

A joint PWR/BWR Owner's Group program evaluated pump discharge piping gas accumulation. Gas accumulation in the piping downstream of the pump to the first closed isolation valve can result in amplified pressure pulsations after a pump start. The subsequent pressure pulsation has the potential to cause relief valves in the subject systems to lift, or can result in unacceptable pipe loads, i.e., axial forces that are greater than the design rating of the axial restraint(s). The joint Owner's Group program

established a method that can be used by the member utilities to determine the voiding limit for gas accumulation in discharge piping.

This method uses plant-specific information for piping restraints and relief valve set points in the GL subject systems/functions to determine the acceptable gas volume accumulation such that, relief valve lifting in the subject systems does not occur and pipe loading remains within acceptable limits, i.e., axial forces that are less than the design rating of the axial restraint(s).

Consistent with this Industry developed method, potential for relief valve lifting and unacceptable pipe loads are considered at the DAEC in support of system Operability determinations. These effects, when used in conjunction with other factors, such as potential to delay ECCS injection during accidents and abnormal operational occurrences/transients for which the system is credited, provide a basis for continued system Operability.

c) Downstream ECCS and Containment Spray Piping Analysis

A generic analysis of low pressure ECCS and Containment Spray piping downstream of the normally-closed injection valves has been completed and a determination made that the existence of air voids in this piping will have no adverse consequences related to accident conditions. Even if voids did exist in this piping, the pressure transient would not be greater than the normal injection pressure mainly because of the open ended spargers at their termination (CS and Containment Spray) or injection into larger piping sections before reaching the vessel, e.g., recirculation piping for LPCI.

As noted above, FPL Energy Duane Arnold has performed a plant-specific analysis of high pressure ECCS (HPCI system) discharge piping for the DAEC, as part of the turbulent penetration issue. Thus, no new analysis of HPCI discharge piping was needed as part of the GL response.

d) Affects of Gas Ingestion into the Reactor Coolant System (RCS)

Gas ingestion into the RCS as a result of voids in the ECCS piping has the potential to delay ECCS injection and subsequently impact core cooling.

A conservative generic evaluation for BWRs determined a bounding Loss-of-Coolant Accident (LOCA) peak cladding temperature (PCT) heatup rate of 12 °F/sec. Using this heatup rate, and setting a maximum allowable PCT increase of 50°F (10 CFR 50.46 definition of "significant change")[3], results in an approximate 4 second of additional time delay in the ECCS injection beyond that already assumed in the current DAEC

[3] It should be noted that the LOCA Analysis of Record (AOR) for the DAEC demonstrates that a margin of over 500°F exists to the regulatory limit of 2200°F (10 CFR 50.46). Thus, the above generic assessment of PCT impact results in a very minor impact on regulatory margins for the DAEC.

LOCA analysis. This 4 second time delay can be translated into an equivalent void size, using the actual plant piping geometry (length of piping and nominal cross-sectional area) and required pump flowrate.

For example, the DAEC CS system discharge piping is 10-inch, Schedule 40 (nominal cross-sectional area = 0.548 ft^2). The TS required CS pump flowrate is 2718 gpm (6.056 ft^3/sec). Using the above 4 second time delay would yield an equivalent void size of 24.22 ft^3, which translates to over 44 feet of 10-inch, Schedule 40 piping that would be completely voided. A void of this size would be bounded by the allowable void size based upon waterhammer considerations. Consequently, the permissible voiding size in CS discharge piping has no significant impact on PCT. Using similar evaluations, the same conclusion would be reached for the remaining ECCS systems/functions.

Another generic assessment of BWRs concludes that large gas voids passing through the core do not pose an additional safety concern (impact on core cooling) mainly because high void conditions are already present in the core during the LOCA. These voided conditions are conservatively modeled per the requirements of 10 CFR 50.46 and Part 50, Appendix K.

A generic assessment of BWRs for the Loss-of-Feedwater (LOFW) abnormal operating transient and Anticipated Transients without SCRAM (ATWS) events concluded that a time delay of 5 seconds in ECCS injection would have an insignificant impact on the analysis results and the acceptance criteria in the UFSAR for these events would continue to be met. This same generic assessment included an evaluation for Station Blackout (SBO) events which concluded that an injection time delay of 10 seconds would not impact the ability of the water makeup system to maintain the vessel water level above the top of active fuel, the UFSAR acceptance criterion. Similarly, this evaluation concluded that a injection time delay of 10 seconds would have an insignificant impact on meeting the UFSAR acceptance criteria for core cooling in the 10 CFR 50, Appendix R fire safe shutdown analysis.

Again, as with the LOCA results, the above generic assessment for time delays in ECCS injection translate into an equivalent gas void size well in excess of what could be tolerated for waterhammer.

3. Summary of any required changes to design basis documents:

No changes to any ECCS design basis documents have been made and none have been identified to date.

4. Results of the system P&ID and isometric drawing reviews to identify all GL subject system/function vents and high points:

Plant drawings for the GL subject systems/functions were used to prepare simplified one-line diagrams of the suction and discharge piping sections of these systems/functions, including vent locations and piping elevations. Plant isometric

drawings were used in the field to conduct the validation walkdowns for vent locations and other piping high point locations.

The review of plant drawings confirmed that piping high points either had vent valves at those locations or were capable of being dynamically vented during system operation (e.g., inverted piping loops would be flushed during system operation, such as during post-maintenance testing prior to return to service.)

5. **Identification of any new or modified vent valves, or utilization of existing vent valves that were previously considered to be in inaccessible areas, based on the drawing review, and any resulting Corrective Actions, and their schedule for completion:**

No new or modified vent locations have been identified to date, based upon the review of DAEC drawings. In addition, no modifications to existing vents have been identified. Consequently, no items have been entered into the Corrective Action Program.

6. **Results (including the scope and acceptance criteria used) of the GL subject system/function confirmation walkdowns that have been completed:**

Plant walkdowns of the accessible piping sections were conducted at the DAEC as part of this GL. As described in the FPL Energy Duane Arnold 3-month response to the GL (Reference 3), some portions of the piping within the scope of this GL were previously identified as being inaccessible during power operations. The walkdowns of those sections of piping will be conducted during the upcoming Refuel Outage, currently scheduled for early 2009.

The initial scoping walkdowns were conducted to confirm the physical location and orientation of the vents and piping layout, per the DAEC drawings. Laser scans of the accessible GL subject piping were conducted to gather information that would be used to plan the detailed examinations, specifically to identify target areas where voids might accumulate and would be subjected to ultrasonic testing (UT) examinations to confirm the absence of voids in those locations.

The initial scoping walkdown did not identify any vents that were not on the plant drawings, nor did they identify any vents not in the proper location per the drawings. The scoping walkdown did identify one new plant area to be added to the "inaccessible piping" list previously identified in the FPL Energy Duane Arnold 3-month response letter (Reference 3). A section of discharge piping in the "A" CS subsystem (approximately 24 feet in length) is located in the Reactor Water Clean Up (RWCU) Heat Exchanger Room, which is a high radiation dose area. Based upon the review of plant drawings, this section of piping, which is between the inboard and outboard CS injection valves, is part of a horizontal run of piping that has a vent valve installed (outside the RWCU Heat Exchanger Room). This vent is used during the TS Surveillance for maintaining the system "filled with water." Thus, FPL Energy Duane Arnold has confidence that this piping is not voided and consequently, deferral of the confirmatory walkdown until the Refuel Outage is justified.

Except for one location, the vent connections are installed on horizontal piping runs at the top center of the GL subject piping. This one exception is a vent installed near the inlet of the "B" CS inboard injection valve (MO2137), which utilizes an elbolet connection. Configuration of an elbolet connection results in a very small volume at the inlet of MO2137 that will not be directly vented by opening the vent valve, but any remaining accumulated gas will not degrade system performance as discussed below in the results of the UT examination.

The second set of walkdowns was performed to map the accessible areas of subject piping using a laser scanning technique to determine pipe elevations for each horizontal pipe segment. The purpose of the laser scanning was to confirm the slope of piping by referencing piping elevations relative to known fixed plant elevations. This technique was used to alleviate the need to build scaffolding in numerous plant areas to reach the piping sections not within reach from the floor, remove insulation from significant portions of piping, and to minimize dose to the workers by not having to be in close physical proximity to the piping and other radiation/contamination sources in those areas. Even though the piping insulation was not removed, the laser scans provided sufficient data points such that any local imperfections in the insulation would not affect the ability to obtain a good measurement of pipe slope.

During the UT examinations described below, it was necessary to remove the insulation from certain sections of piping. This provided an opportunity to validate the laser scanning results of the piping slopes with physical measurements. The results of these physical measurements confirmed the results of the laser scans.

From the two sets of walkdowns, a target set of locations was identified for UT examinations. This target set of piping segments was selected with consideration of the following criteria:

- not sloped in the proper direction, an indication that a horizontal (nominal) run of pipe that may contain a potential local highpoint,
- pipe tees where gas that might be contained in the main flow stream could pass into a stagnant pipe section, where it would then accumulate,
- pipe diameter transitions in horizontal sections (e.g., orifice plates), that could create void traps at the top of the larger piping,
- high points created by closed valves in vertical piping runs.

Based upon the above, 47 UT locations were identified in the HPCI, CS and RHR system piping (21 suction and 26 discharge). These UT examinations were performed with the following results.

- One small gas bubble (void) was identified in the "B" CS subsystem discharge piping adjacent to injection valve MO2137. The measured volume of the gas bubble was conservatively estimated to be less than 1 E-05 cubic feet. This is equivalent to a spherical bubble less than 0.33 inches in diameter. A Corrective Action Program document (CAP060038) was generated to evaluate the impact on system Operability. This evaluation concluded that this small finite volume of non

condensable gas was likely trapped during fill/vent activities due to the piping configuration. Routine system operation in the interim had not swept it from this location. Because there are no credible sources of additional gas intrusion during standby readiness conditions (e.g., positive pressure maintained in the system by the keep fill pump and no potential interface with high pressure gas sources), further accumulation of gas, in quantities that could degrade system performance, will not occur. Based upon this evaluation, system Operability was assured. Noteworthy is that this demonstrates FPL Energy Duane Arnold's capability to discern gas bubbles of very small size.

- One gas bubble (void) was identified in the "A" RHR subsystem discharge piping adjacent to control valve (CV2037). This is a 4 inch line that is part of the RHR Steam Condensing Mode, which has been abandoned in place, i.e., this is a dead leg of piping. The bubble was conservatively estimated at 0.01 cubic feet at the 240 psig system pressure. This is equivalent to a spherical bubble less than 3.25 inches in diameter. A Corrective Action Program document (CAP060106) was generated to evaluate the impact on system Operability. This evaluation concluded that this small finite volume of non condensable gas was likely trapped during fill/vent activities due to the piping configuration. Routine system operation in the interim had not swept it from this location. Because there are no credible sources of additional gas intrusion during standby readiness conditions (e.g., positive pressure maintained in the system by the keep fill pump and no potential interface with high pressure gas sources), further accumulation of gas, in quantities that could degrade system performance, will not occur. Based upon this evaluation, system Operability was assured.

It should be noted that no voids were found in any suction side piping and the apparent cause of both of the voids found in the discharge piping was attributed to incomplete fill and vent due to piping configuration, when returning these systems to service following maintenance.

7. **Identification of any new or modified vent valves, or utilization of existing vent valves that were previously considered to be in inaccessible areas, that resulted from the confirmatory walkdowns, and any resulting Corrective Actions, and their schedule for completion:**

No new vents have been identified to be added, no existing vents were identified to be modified, nor was any new utilization of any previously existing vent valves in inaccessible areas identified, as necessary to ensure gas voiding remains within acceptable limits. However, as an enhancement to the existing system configuration, FPL Energy Duane Arnold is evaluating the addition of a new vent in the section of RHR piping where the small void was found, as described above. Corrective Action Program document (OTH032629) is tracking this evaluation, which has a due date of prior to startup from the next Refuel Outage, currently scheduled for early 2009. As noted above, the existing void size has been evaluated as not impacting system Operability, with no potential for additional accumulation, as this section of piping is no longer actively in service (i.e., abandoned in place). Consequently, FPL Energy Duane Arnold considers this schedule to be acceptable.

As noted above, a section of CS discharge piping was identified as being inaccessible during power operation due to radiation dose considerations. This deferral is deemed acceptable, given that the drawings indicate this section of piping is horizontal, with a vent valve installed. Based upon high fidelity of drawings, as validated by walkdown results to date, FPL Energy Duane Arnold has high confidence that this section of piping will not accumulate a gas void that could contribute to CS system inoperability.

Corrective Action Program document (COM030103) is tracking the completion of the walkdowns for the inaccessible piping sections as committed in the FPL Energy Duane Arnold 3-month response letter (Reference 3).

8. Results of the procedure reviews for fill and vent activities in each GL subject system/function:

A review was performed of relevant administrative control procedures (ACPs), system operating instructions (OIs), annunciator response procedures (ARPs), maintenance procedures, surveillance test procedures (STPs), and equipment monitoring procedures (EMPs) to determine their adequacy for maintaining the HPCI, Core Spray, and RHR systems sufficiently filled and vented. These documents were reviewed in conjunction with piping and instrumentation diagrams (P&IDs), piping isometrics, and single line diagrams showing relative pipe elevations. Piping isometrics and field sketches of small bore piping were also referenced as needed to augment the information provided in the P&IDs and single line elevation drawings.

No instances were identified where procedural controls for the filling and venting of HPCI, CS, and RHR systems, following maintenance, would leave the systems in an inoperable condition.

Procedures for controlling alternate system line-ups and restorations were reviewed, for example CS suction transfer from the Suppression Pool to the CST during reactor vessel and refueling cavity flood-up, or returning RHR to LPCI mode from SPC. Such procedures were confirmed to have proper venting instructions as part of system restoration to their normal line-up.

9. Results of the procedures review, summary of any Corrective Actions, and schedule for completion of those Corrective Actions:

FPL Energy Duane Arnold had previously reviewed the pertinent procedures as part of its review of Institute of Nuclear Power Operation (INPO) Significant Event Report (SER) 2-05 and Operating Experience (OE) 5410 and made any required changes at that time. Thus, no new procedures or required changes to the existing procedures were identified as a result of this GL. However, FPL Energy Duane Arnold has identified a number of procedural enhancements that it is currently evaluating for adoption in those procedures utilized for fill and vent activities as part of system restoration after maintenance or testing. For example, clearer guidance as to when dynamic venting is appropriate versus the current procedure language of "as deemed necessary" or "as needed." Corrective Action Program documents (PCR032697 and PCR032628) are being used to track the evaluation of those enhancements with a due date of December 1, 2008 and prior to startup from the next Refuel Outage, respectively. This schedule is deemed acceptable, as the due dates are associated with the next planned

maintenance requiring the GL subject systems to be drained and associated procedures for fill and vent processes to be used for return to service.

As the Industry develops its long-term actions in response to this GL, specifically the TSTF Traveler for revising the TS Surveillances previously discussed, it may be necessary to augment or revise the existing DAEC procedures for periodically verifying these piping systems remain "filled with water." However, any such procedure changes (or new programs) will be implemented as part of that future TS change. Thus, no separate Corrective Action Program document is needed.

10. Discussion of potential gas intrusion mechanisms in each system:

Based upon DAEC's operating experience, FPL Energy Duane Arnold believes that the primary mechanisms for potential gas intrusion in the GL subject systems/functions are: incomplete post-maintenance fill and vent activities; and conditions where local temperatures are at or above saturation temperature (so called, turbulent penetration). The latter condition being applicable only to the HPCI discharge piping in the vicinity of the interconnection with the Feedwater System.

Suction piping is not connected to any pressurized gas sources that could introduce voids into the piping and flow stream for any of the GL subject systems/functions. For HPCI, the instrumentation setpoint calculations for the automatic transfer account for the potential for vortexing during the transfer from the CST to the Suppression Pool.

Containment Spray piping (discharge side) is not vulnerable to gas intrusion, even though the Primary Containment is inerted with nitrogen and slightly pressurized during power operation. Because, the outboard sections of the discharge piping are maintained at a higher pressure than the Primary Containment during power operation by the keep fill pump. Thus, it is not likely that gas (nitrogen) will accumulate in the Containment Spray discharge piping in those areas that are intended to contain water, i.e., outboard of the Containment Spray isolation valves[4].

[4] The Containment Spray discharge piping inboard of the isolation valves to the spargers is open to the Primary Containment atmosphere and is intentionally not filled with water by design.

11. Ongoing Industry Programs:

Ongoing industry programs relative to gas accumulation may influence the conclusions reached during the Design Evaluation of the DAEC. These industry activities will be monitored by FPL Energy Duane Arnold, as a member of those groups, to determine if additional changes to the DAEC design and/or procedures may be required or desired to provide additional margin.

Based upon the above, FPL Energy Duane Arnold has concluded that DAEC is in conformance with its commitments to 10 CFR 50, Appendix B, Criterion III for Design Control, as described in the FPL Quality Assurance Topical Report (QATR) – FPL-1, Rev. 2.

Testing Evaluation

The DAEC testing practices were reviewed with respect to gas accumulation in the Emergency Core Cooling Systems and Decay Heat Removal and Containment Spray functions. This review included system OIs, EMPs, STPs and maintenance instructions.

1. **Results of the procedure review of periodic venting or gas accumulation surveillances.**

   STPs for the HPCI, CS, and RHR Systems were reviewed, with emphasis on those that perform the TS-required Surveillance for maintaining the discharge piping in these systems "filled with water."

   These procedures require venting at high point locations in the respective systems and ensure adequate pressure is available to perform the venting. They were determined to have no other acceptance criteria than to ensure that a "steady stream of water is observed" when venting. This is consistent with meeting the specific requirement of the SRs to verify that the piping system "is filled with water."

   Because the HPCI System utilizes CST water level to maintain the piping from the HPCI pump discharge to the HPCI pump discharge check valve "filled with water," those procedures that ensure this keep fill function were reviewed and found to be acceptable with regard to system lineups. Clarifications in those procedures have been implemented recently to explicitly state that the lineups with the CST provide the keep fill function for this portion of the HPCI discharge piping to remove previous ambiguity between the primary and back-up means for the keep fill function.

   Because the low pressure ECCS systems at the DAEC (CS and RHR) utilize a keep-fill pump and alarm system for notifying the Operators of a potential draining in those sections of piping, which could introduce voids, those procedures that ensure this keep fill function were also reviewed and found to be adequate.

2. **Results of the procedures review of periodic surveillances, summary of any Corrective Actions, and schedule for completion of those Corrective Actions:**

   No new procedure or revisions to existing procedure were identified as being required by this review. As noted earlier, as part of the long-term industry programs associated with this GL, in particular the development of the TSTF Traveler, it may be necessary to augment or revise the existing DAEC procedures for periodically verifying these piping systems remain "filled with water." However, any such procedure changes (or new programs) will be implemented as part of that future TS change. Thus, no separate Corrective Action Program document is needed.

3. **Results of the procedure review for the manual operation of the RHR System in its decay heat removal (Shutdown Cooling) mode of operation:**

The OI for the RHR system was reviewed for placing the system into Shutdown Cooling mode and for restoration back into the primary ECCS function (LPCI mode). When being aligned for SDC mode, the suction piping, pump(s), and a portion of the discharge piping are back-flushed and warmed prior to placing it into service. This evolution should remove any potential voids that might have accumulated since the last use of the SDC mode. The discharge section of piping is common with the ECCS function, thus, it is part of the piping connected to the keep fill system, which precludes unacceptable gas voiding, in conjunction with a proper initial fill and vent. Restoration from SDC mode to standby readiness includes direction to pressurize RHR piping with Condensate Service Water, which precludes unacceptable gas voiding, in conjunction with a proper initial fill and vent.

4. **Results of the procedures review to verify that gas intrusion does not occur as a result of inadvertent draining due to valve manipulations specified in the procedures, system realignments, or incorrect maintenance procedures:**

In addition to the routine test procedures that check for "keep fill" status in the subject piping described above, other periodic system testing procedures (such as ASME pump and valve testing and Simulated Automatic Actuation testing) were also reviewed to ensure that discharge piping was verified "full" at the conclusion of those tests.

During the full load sequence test of the Emergency Diesel Generators (EDG) response during a simultaneous LOCA and loss-of-offsite power (LOOP), the actual ECCS injection valves for CS and RHR are precluded from opening. Thus this test does not introduce the potential for gas voids into the discharge sections of piping. These pumps discharge back to the Suppression Pool during this test, which is the same as other periodic on-line full-flow tests.

During routine surveillance testing of the HPCI and Reactor Core Isolation Cooling (RCIC) systems, the RHR Suppression Pool Cooling mode is utilized to maintain suppression pool temperatures within TS allowable limits during power operation. Procedures for this testing were reviewed and confirmed that the RHR system is returned to its standby readiness condition for ECCS at the conclusion of these tests. This restoration includes a check of the keep fill status of the discharge piping.

Procedures for operating CS with suction from the Condensate Storage Tank (e.g., vessel flood for refuel, full flow testing of the injection check valves) provide direction to vent per the system OI when the suction is re-aligned back to the Suppression Pool.

Procedures for operating RHR in Fuel Pool Cooling Assist mode provide direction for filling and venting prior to placing the system into service.

The Instrument Channel Functional Tests/Calibration and Logic System Functional Test (LSFT) procedures for those instrumentation channels that perform the HPCI suction transfer from CST to Suppression Pool did not identify any potential for introducing gas voids, nor did the review of similar procedures for testing the instrumentation for LPCI Loop-Select Logic identify any potential for introducing gas voids in the RHR piping.

Administrative procedures that control maintenance were reviewed to ensure that proper controls are in place for filling and venting instrument lines as part of system restorations. No deficiencies were identified.

Based upon the review of DAEC procedures, as outlined above, no vulnerabilities for introducing gas voids were identified.

5. **Description of how gas voids are identified, documented, dispositioned, and trended, if found in any of the GL subject systems/functions:**

STPs mark steps required by Technical Specifications with a "TS" immediately to the right of the step signoff line. Each STP contains a general instruction that if a "TS" marked step does not meet its acceptance criteria or cannot be performed an NRC reportable condition may exist and shall be reported to the Control Room Supervisor immediately." A second general instruction requires that an Action Request (i.e., CAP) shall be completed for problems associated with "TS" marked items encountered during the test. In the case of STPs for "keep fill" surveillances, the step to vent until a solid stream of water is observed is a "TS" marked step. Failure to meet this step's acceptance criteria will result in a CAP being generated and notification of the Control Room Supervisor for determination of appropriate action.

As discussed earlier, the CAP document would generate the evaluation of Operability, necessary corrective actions and/or trending that would be needed to resolve the problem.

6. **Provide a detailed list of items that have not been completed, a schedule for their completion, and the basis for that schedule.**

As noted above, no new procedures or changes to existing procedures have been identified to date as being required to satisfy the actions of this GL. Thus, there are no open items for the DAEC. However, as noted earlier, several potential enhancements are being considered and are being tracked by Corrective Action Program documents (see Section C of this Enclosure).

Based upon the above, FPL Energy Duane Arnold has concluded that DAEC is in conformance with its commitments to 10 CFR 50, Appendix B, Criterion V for Instructions, Procedures, and Drawings, Criterion XI for Test Control, as described in the FPL Quality Assurance Topical Report (QATR) – FPL-1, Rev. 2. In addition, FPL Energy Duane Arnold has established the appropriate controls per Criterion XVII for Quality Assurance Records, as described in the FPL Quality Assurance Topical Report (QATR) – FPL-1, Rev. 2.

Corrective Actions Evaluation

1. **Discussion of how gas accumulation issues have been addressed in the Corrective Action Program as part of the GL reviews:**

   As part of the initial validation efforts for this GL, FPL Energy Duane Arnold created appropriate guidelines for assessing voiding in the GL subject piping during the walkdowns and UT examinations. The criterion used was that any identified void, regardless of size, would be entered into the Corrective Action Program for Operability determinations and for reportability evaluations. This included prompt notification of the Control Room Supervisor.

   The Operability criteria were developed prior to the UT examinations using Industry guidelines on acceptable void sizes (e.g., a generic 2% voiding in suction piping) and plant-specific evaluations of void sizes in the discharge piping to preclude unacceptable consequences, such as waterhammer. Part of the Operability determination is an evaluation for potential further degradation that could impact Operability and the need for periodic monitoring.

   Because the threshold used by FPL Energy Duane Arnold was any identified void, regardless of size, (i.e., all identified voids) was entered into the Corrective Action Program for evaluation, there was no need to document and trend results for further degradation for subsequent entry into the Corrective Action Program.

   As noted earlier, the two identified gas bubbles (voids) were entered into the Corrective Action Program and promptly evaluated, including the potential for further degradation, with a conclusion of no impact on system Operability.

   Therefore, FPL Energy Duane Arnold has concluded that issues involving gas intrusion/accumulation were properly prioritized and evaluated under its Corrective Action Program.

Based upon the above, FPL Energy Duane Arnold has concluded that DAEC is in conformance with its commitments to 10 CFR 50, Appendix B, Criterion XVI for Corrective Action, as described in the FPL Quality Assurance Topical Report (QATR) – FPL-1, Rev. 2.

B. DESCRIPTION OF NECESSARY CORRECTIVE ACTIONS

The following corrective actions were identified during the above-described evaluations to be necessary to evaluate system Operability, as defined in the Technical Specifications, and to assure compliance with the applicable regulations and previous regulatory commitments:

1. CAP060038 was written to document the gas bubble (void) discovered in the "B" CS subsystem discharge piping. As noted earlier, the identified void did not impact CS system Operability.

2. CAP060106 was written to document the gas bubble (void) discovered in the "A" RHR subsystem discharge piping. As noted earlier, the identified void did not impact RHR system Operability.

C. CORRECTIVE ACTION SCHEDULE

1. Identify the corrective actions that have been completed as a result of the evaluations discussed above:

Operability determinations and reportability evaluations for the identified gas bubbles (voids) have been completed under CAP060038 and CAP060106. There are no open actions from those evaluations.

2. Identify any open corrective actions yet to be completed, including the scope, schedule, and a basis for that schedule:

As committed in FPL Energy Duane Arnold's original "3-month" response to the GL (Reference 3), those portions of subject piping that were determined to be inaccessible during power operation will have their walkdowns completed prior to startup from the next DAEC Refuel Outage, currently scheduled for early 2009. This is being tracked within the Corrective Action Program by COM030103. The NRC has accepted this schedule in Reference 4. The basis for that acceptance has not changed, based upon the results of the DAEC inspections and evaluations completed to date.

COM030104 is tracking the follow-up report to the NRC, which is due 90 days after startup from this next Refuel Outage. As requested in Reference 4, FPL Energy Duane Arnold will format this supplemental report similar to this 9 month submittal in description of evaluations and disposition of corrective actions.

As discussed earlier, an enhancement to the existing RHR system configuration is being evaluated for the addition of a new vent in the section of RHR Steam Condensing mode piping where a small void was found. Corrective Action Program documents (OTH032629) is tracking this evaluation, which has a due date of prior to startup from the next Refuel Outage. As noted previously, the existing void size has been evaluated as not impacting system Operability, with no potential for additional accumulation. In addition, this section of RHR piping is part of the system that is no longer in active service (i.e., abandoned in place). Consequently, FPL Energy Duane Arnold considers this schedule to be acceptable.

FPL Energy Duane Arnold has identified a number of procedural enhancements that it is currently evaluating for adoption in those procedures utilized for fill and vent activities as part of system restoration after maintenance or testing. Corrective Action Program documents (PCR032697 and PCR032628) are being used to track the evaluation of those enhancements with a due date of December 1, 2008 and prior to startup from the next Refuel Outage, respectively. This schedule is deemed acceptable, as the due dates are associated with the next planned maintenance requiring the GL subject systems to be drained and associated procedures for fill and vent processes to be used for return to service.

Long-term Industry Programs

As noted earlier, FPL Energy Duane Arnold will work with the Industry to develop the necessary changes to the subject TS and Bases under the TSTF process. COM32036 is tracking this commitment to evaluate the Traveler and submit changes to the DAEC TS, consistent with the DAEC design and licensing basis, within 180 days of publication of the NRC approved version of the Traveler in the Federal Register.

Conclusion

FPL Energy Duane Arnold has evaluated the accessible portions of those DAEC systems that perform the functions described in this GL and has concluded that these systems are Operable, as defined in the DAEC TS and are in conformance to our commitments to the applicable General Design Criteria (GDC), as stated in the DAEC UFSAR.

For those portions of GL subject piping that were determined to be inaccessible, FPL Energy Duane Arnold has continued confidence in the Operability of the subject systems/functions, based upon the review of the plant drawings of those piping sections coupled with the fidelity of those drawings to the as-built status of the plant from the walkdowns and laser scans performed on the accessible portions of piping in those same systems, as well as the lack of identified deficiencies in the procedures for filling and venting those inaccessible sections of piping.

References

1. NRC Generic Letter 2008-01, "Managing Gas Accumulation in Emergency Core Cooling, Decay Heat Removal, and Containment Spray Systems" dated January 11, 2008.

2. Letter, G. Van Middlesworth (NMC) to USNRC, "Licensee Event Report #2005-004-00," NG-05-2161, dated November 28, 2005. (ADAMS Accession No. ML053360261)

3. Letter, R. Anderson (FPL Energy Duane Arnold) to USNRC, "Three-Month Response to NRC Generic Letter 2008-01, 'Managing Gas Accumulation in Emergency Core Cooling, Decay Heat Removal, and Containment Spray Systems'," NG-08-0239, dated May 8, 2008. (ADAMS Accession No. ML081420015)

4. Letter, K. Feintuch (USNRC) to R. Anderson (FPL Energy Duane Arnold), "Duane Arnold Energy Center - re: Generic Letter 2008-01, 'Managing Gas Accumulation In Emergency Core Cooling, Decay Heat Removal, And Containment Spray Systems,' Proposed Alternative Course Of Action (TAC NO. MD7824)," dated August 6, 2008. (ADAMS Accession No. ML081930209)