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April 28, 2006

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

SUBJECT: Duke Power Company LLC
d/b/a Duke Energy Carolinas, LLC
Oconee Nuclear Station Units 1, 2 and 3
Docket Nos: 50-269, 270 and 287
High Energy Line Break: Mitigation Strategy

In a letter dated January 31, 2006, Duke Power Company LLC d/b/a Duke Energy Carolinas, LLC (Duke), provided information on the scope and schedule for planned modifications to address licensing basis issues related to tornado and High Energy Line Break (HELB) events outside containment at Oconee Nuclear Station (Oconee). This information was also presented to the Nuclear Regulatory Commission (NRC) Staff, in a meeting held on February 7, 2006, at NRC headquarters.

During the February 7, 2006 meeting, the Staff requested that Duke (1) provide a listing of systems, components, and structures (SSCs) needed to mitigate tornado and HELB events and (2) specify for which SSCs protection from these events can be adequately mitigated. Further, the Staff requested that Duke provide the intended mitigation strategy for both tornado and HELB related events.

The purpose of this letter is to describe the Duke strategy for meeting the reconstituted HELB design basis requirements, as presently developed. A similar letter for tornado events was previously submitted to the Staff on April 12, 2006. The present submittal addresses the integrated strategy regarding the mitigation of HELBs, including key concepts and assumptions and specification of those SSCs needed to mitigate the HELB event(s). This submittal also provides major milestone dates for the actions necessary to resolve the issue.

Since the HELB reconstitution project is not yet complete, certain details regarding the overall HELB mitigation strategy are not yet fully formulated. However, the Attachment presents

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the mitigation strategy based on the current project status. As the HELB reconstitution project progresses, this strategy may be altered. Changes to the strategy will be promptly communicated to the Staff.

Additionally, since the HELB reconstitution project continues, it is possible that additional interactions will be identified that could potentially affect SSC operability. If such interactions are identified, they will be promptly entered into the Oconee corrective action program for resolution. For the duration of the HELB reconstitution project, that is scheduled to be completed by September 2007, Duke Requests that the NRC exercise enforcement discretion in accordance with Section VII of the NRC Enforcement Policy. This will allow Duke to evaluate and correct each identified interaction in an expeditious manner as an integral part of the overall project plan, similar to the process being employed for transition to NFPA-805.

Duke remains committed to an orderly and thorough approach to resolving both HELB and Tornado mitigation issues at Oconee. It is our intention to fully resolve these issues by a strategy that is acceptable to both the Staff and Duke.

If you have any questions or comments regarding this letter, please contact Graham Davenport of the Oconee Nuclear Site Regulatory Compliance Group at 864-885-3044.

Sincerely,

Henry B Barron

Henry B. Barron
Group Vice President Nuclear Generation
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Attachment

Oconee Nuclear Site HELB Mitigation Strategy

Introduction

In order to describe the integrated strategy for HELB mitigation, it is necessary to first discuss the key concepts and assumptions proposed for use in the HELB reconstitution project. These concepts and assumptions are similar to the methodologies first proposed in 2003[1]. Following that discussion, the mitigation functions described in the Giambusso[2] letter, as modified by the Schwencer[3] letter, are described with an explanation of how Duke intends to meet those functions moving forward, considering the reconstituted HELB design basis. These discussions will then provide the basis for the integrated strategy. Following this, a high level project milestone schedule is presented including the proposed dates for NRC review and approval of the license amendment requests (LARs).

Key Concepts and Assumptions

The integrated strategy will be predicated on concepts and assumptions. The first of these concepts/assumptions regards the level of protection provided to systems, structures, and components (SSCs) necessary to reach safe shutdown (SSD)[4] and the level of protection provided to equipment necessary to reach cold shutdown (CSD)[5]. In broad terms, SSCs necessary to reach SSD will be protected from possible effects from a given HELB, including environmental and flooding affects. Damage that may occur to structures will not adversely affect the ability of systems and components necessary to reach SSD and subsequent cool-down to CSD. However, other damage, unrelated to the structural damage, may be permitted to systems and components necessary to reach CSD. Station repair guidelines will be

[1] Letter dated 8/20/03 from Duke Power to Document Control Desk of the NRC, "High Energy Line Break Outside Reactor Building Methodology."
[2] Letter dated 12/15/1972 from the AEC to Duke Power, Attn: Mr. Austin Thies
[3] Letter dated 1/17/1973 from the AEC to Duke Power, Attn: Mr. A.C. Thies
[4] Safe Shutdown is defined as Mode 3 with an average Reactor Coolant System (RCS) temperature > 525F°. Overcooling events can lead to RCS temperatures < 525°F. SSD for these events includes reestablishing and maintaining shutdown margin > 1% $\Delta k / k$ with RCS temperatures and pressures being controlled in accordance with plant emergency procedures.
[5] Cold Shutdown is defined as Mode 5, RCS temperature < 200°F.

credited to repair those systems and components necessary to reach CSD. Inherent in this concept is the maintenance of SSD conditions until the necessary repairs are completed. As described herein, the planned modifications will enable the plant to remain at SSD conditions while repairs are being made to systems and components necessary to reach CSD. The timeline for maintaining SSD and initiating and reaching CSD has not been formulated. It is expected that the timeline will be event specific. Duke will communicate the specifics of the event timeline as details become available.

The second key concept/assumption regards the postulation of single active failures. Single active failures are to be postulated for initial event mitigation, as well as for achieving and maintaining SSD. Once the plant has been stabilized at SSD conditions, a plant cool-down will be initiated, as warranted, to bring the unit to CSD, following completion of repairs, should repairs be necessary. No single active failures are to be postulated during the cool-down phase.

The third key concept/assumption regards the determination of the jet impingement cone geometry and jet impingement effective length from breaks and cracks. Duke intends to define the cone geometry and effective length in accordance with NUREG/CR-2913[6] (NUREG), subject to the pressure and temperature limitations given in the NUREG (i.e. stagnation pressures from 870 psig to 2465 psig, 158°F sub-cooling to 75% steam quality and higher). For jets consisting of steam or sub-cooled liquid falling outside of the NUREG limitations, the effective length of the jet from breaks will be 10 pipe diameters (internal diameter). Effective jet lengths from critical cracks are not explicitly addressed in the NUREG. However, it is Duke's intent to apply the concepts of the NUREG, with the noted limitations, to the determination of effective jet lengths from critical cracks. This application of the NUREG has been approved at other licensee facilities. Duke will seek approval to use the NUREG in this capacity in the LAR scheduled to be submitted by August 31, 2006.

The fourth key concept/assumption regards the identification of high energy systems where protection is

[6] NUREG/CR 2913, "Two Phase Jet Loads"

to be provided. The Giambusso letter required that pipe whip protection be provided to those systems that normally operate at temperatures greater than or equal to 200°F or at pressures greater than or equal to 275 psig. Duke seeks to modify that requirement as follows: No HELB protection will be provided if the operating time of a system at high energy conditions is less than 1% of the total plant time (e.g., Emergency Feedwater), or if the operating time of a system at high energy conditions is less than 2% of the total system operating time (e.g. Low Pressure Injection). For systems meeting these limitations, no breaks or cracks are to be postulated. This is justified based on the very low probability of a HELB occurring during the limited operating time of these systems at high energy conditions.

The fifth key concept/assumption involves the postulation of break and crack locations. Consistent with GL 87-11[7], Duke has postulated circumferential and longitudinal break locations as follows:

A. For piping that is seismically analyzed, i.e. stress analysis information is available and the analysis includes seismic loading, intermediate breaks shall be postulated in Class 2 or 3 piping at axial locations where the calculated stress for the applicable load cases exceed $0.8(S_A + S_h)$. Applicable load cases include internal pressure, dead weight (gravity), thermal, and seismic (defined as operational basis earthquake, OBE). Intermediate breaks will not be postulated at locations where the expansion stress exceeds $0.8S_A$. Thermal stress is a secondary stress, and taken in absence of other stresses, does not cause ruptures in pipe.

B. For piping that is not rigorously analyzed or does not include seismic loadings, intermediate breaks shall be postulated in accordance with BTP MEB 3-1 (Section B.1.c(3)).

C. Terminal ends are vessel/pump nozzles, building penetrations, in-line anchors, and branch to run connections that act as essentially rigid constraints to piping thermal expansion. A branch appropriately modeled in a rigorous stress analysis with the run

[7] Generic Letter 87-11, "Relaxation of Arbitrary Intermediate Pipe Rupture Requirements"

flexibility and applied branch line movements included and where the branch connection stress is accurately known will use the stress criteria noted above for postulating break locations. For unanalyzed branch connections or where the stress at the branch connection is not accurately known, break locations will be postulated in accordance with BTP MEB 3-1(Section B.1.c(3)).

D. The Giambusso letter provided criteria to determine pipe break orientation at break locations and specifies that longitudinal breaks in piping runs and branch runs be postulated for nominal pipe sizes greater than or equal to 4 inches. Circumferential breaks are postulated at all terminal ends. The design of existing and potentially new rupture restraints may be used to mitigate the results from such breaks, including prevention of pipe whip and alteration of the break flow. Longitudinal breaks are not postulated at terminal ends, unless the piping at the terminal end contains longitudinal seam welds. This is consistent with the requirements of BTP MEB 3-1.

For the postulation of critical cracks, the following applies:

E. For piping that is seismically analyzed (i.e. stress analysis information is available and the analysis includes seismic loading), critical cracks shall be postulated in Class 2 or 3 piping at axial locations where the calculated stress for the applicable load cases exceed $0.4(S_A + S_h)$. Applicable load cases include internal pressure, dead weight (gravity), thermal and seismic (defined as operational basis earthquake, OBE).

F. For non-seismically analyzed piping, critical cracks will not be postulated, since the effects of postulated circumferential and longitudinal breaks at these locations will bound the effects from critical cracks (See B above).

Actual stresses used for comparison to the break and crack thresholds noted above shall be calculated in accordance with the Oconee piping code of record, USAS B31.1.0[8]. Allowable stress values S_A and S_h shall be determined in accordance with the USAS B31.1.0 code or the USAS B31.7[9] code as appropriate.

These key concepts/assumptions provide the basis for the HELB mitigation strategy to be employed. As the HELB reconstitution project progresses, additional key concepts/assumptions may be determined. If determined, these issues will be communicated to the NRC Staff as appropriate.

Mitigation Functions

The Giambusso/Schwencer letters describe certain mitigation functions that must be fulfilled in order to meet the overall HELB requirements. Listed below are these functions with a description of how the Oconee integrated strategy will meet those functions.

1. *Verification that failure of any structure, including non seismic Category I structures, caused by the accident, will not cause failure of any other structures in a manner to adversely affect:*
   a) *Mitigation of the consequences of the accidents; and,*
   b) *Capability to bring the unit(s) to a CSD condition.*

As noted earlier, damage that may occur to structures will not adversely affect the ability of systems and components necessary to reach SSD and subsequent cool-down to CSD. The HELB reconstitution project is currently evaluating potential interactions between postulated HELBs and Turbine Building (TB) structural components. Thrust loads calculated for this evaluation will be determined in accordance with ANSI 58.2[10]. An energy approach is used to first determine if the applied thrust loads (with a whip moment arm) exceed the plastic capacity of pipe and

[8] USAS B31.1.0, 1967 Edition, "Power Piping"
[9] USAS B31.7, February 1968 Edition including Errata of June 1968, "Code for Pressure Piping, Nuclear Power Piping"
[10] ANSI/ANS-58.2-1988, "American National Standard, Design Basis for Protection of Light Water Nuclear Power Plants Against the Effects of Postulated Pipe Rupture."

determine if a plastic hinge forms. Should a plastic hinge form and the pipe whip impact the structural component, the response of the component is determined, and a code check performed to the requirements of the structural steel code of record, AISC[11]. Dynamic load and increase factors will be employed to capture the impact response of the structure. Certain structural components may fail to meet the requirements of AISC. In those cases, functionality will be determined based on stability requirements. Modifications will be implemented for those structural components that fail to meet the functionality requirements and whose failure may affect the ability of systems and components necessary to reach SSD, and subsequent cool-down to CSD, as appropriate. Periodic volumetric piping inspections may be implemented in lieu of structural repairs in those cases where structural repairs prove to be unfeasible.

The HELB reconstitution project will likewise evaluate any potential interactions with the Auxiliary Building (AB) structure. These interactions include any internal pressurization effects that may occur in the East and West Penetration Room (EPR and WPR respectively) following pipe ruptures that may occur in those rooms. Pressurization effects will be calculated utilizing the GOTHIC 4.0 code. Since the AB is a reinforced concrete structure with infill un-reinforced masonry partition walls, any identified interactions will be evaluated in accordance with the appropriate concrete code of record, ACI[12]. Certain walls of the AB have been fortified with steel plates and columns. These components will be evaluated to the requirements of the AISC code. Certain exterior walls ('blow-out panels') in the EPR are designed to fail in the aftermath of either a Main Steam (MS) or Main Feedwater (MFW) line break, relieving pressure to the atmosphere. Calculations have been completed that confirm the ability of the blow-out panels to fail. Certain structural components may fail to meet the requirements of the referenced codes. In those cases stability of the structure will be reviewed and confirmed, and the localized effects evaluated. Repairs will be implemented

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[11] American Institute of Steel Construction, Manual of Steel Construction, 6th Edition
[12] American Concrete Institute, ACI 318-63, "Building Code Requirements for Reinforced Concrete, June 1963" and ACI 531-79, "Building Code Requirements for Concrete Masonry Structures, 1979"

for those structural components that fail to meet the functionality requirements and whose failure may affect the ability of systems and components necessary to reach SSD, and subsequent cool-down to CSD as appropriate. Periodic volumetric piping inspections may be implemented in lieu of structural repairs in those cases where structural repairs prove to be unfeasible.

2. *Verification that rupture of a pipe carrying high energy fluid will not directly or indirectly result in:*

a) *Loss of required redundancy in any portion of the protection system (as defined in IEEE-279), Class 1E electric system (as defined in IEEE-308), engineered safety features equipment, cable penetrations, or their interconnecting cables required to mitigate the consequences of that accident and place the reactor(s) in a cold shutdown condition; or*

b) *Environmental induced failures caused by a leak or rupture of the pipe which would not of itself result in protective actions but does disable protection functions. In this regard, a loss of redundancy is permitted but a loss of function is not permitted. For such situations plant shutdown is required.*

The original HELB mitigation strategy, as documented in the MDS Report OS-73.2[13], identified break locations inside the TB that could result in the combined loss of main and emergency feedwater, as well as, the complete loss of 4160V power to Engineering Safeguards equipment. Modifications were implemented to provide an alternate means of providing the decay heat removal function utilizing emergency feedwater from an alternate unit to address the single active failure of the station auxiliary service water pump. However, a single High Pressure Injection (HPI) pump with a single source of electrical power, not vulnerable to HELB effects inside the TB, was credited for the plant cool-down function. In keeping with the original HELB mitigation strategy, two redundant means will be provided to feed either steam generator for the decay heat removal function. One train of HPI will be provided to meet the plant cool-

[13] MDS Report OS-73.2,"Analysis of Effects Resulting from Postulated Piping Breaks Outside Containment for Oconee Nuclear Station, Units 1, 2 & 3"

down function. Noting the vulnerability of systems and components located in the TB to potential HELBs, the new strategy will involve a decreased reliance on systems and components located in the TB. Inherent in this strategy is the reliance on modifications to the Station Auxiliary Service Water System[14] and its associated electrical distribution system. Power to a single HPI pump will be provided from the new electrical power distribution system. Improvements will be made to minimize operator actions outside the control room to align the modified systems. In addition, the strategy will involve the licensing of the Standby Shutdown Facility (SSF) for HELB mitigation. This issue will be addressed in the unit specific HELB LARs.

The new Protected Service Water (PSW) system will be capable of mitigating HELB events postulated to occur in the TB that could affect the Main Feedwater (MFW) and Emergency Feedwater (EFW) systems. The system will provide a redundant means, along with the Standby Shutdown Facility Auxiliary Service Water (SSF-ASW) System, to feed all six fully pressurized steam generators and remove core decay through secondary side heat removal.

Since the PSW system will be capable of being aligned and started from the control room, it will eliminate operator actions in the TB needed to align EFW. Also, since the system will be capable of feeding all six fully pressurized steam generators, current operator actions necessary to manually operate the atmospheric dump valves to depressurize the generators following HELBs that could affect MFDW and EFW will be eliminated. An added benefit of the system is the ability to maintain water levels in the steam generators to provide long term SSD capability. After reaching SSD, the upgraded system will be capable of cooling the plant down to the Low Pressure Injection (LPI) system entry conditions.

The PSW system will be capable of being promptly aligned within 15 minutes following the HELB event. This capability will prevent overheating of the Reactor Coolant System (RCS) and minimize challenging the Pressurizer

[14] The Station Auxiliary Service Water System will be renamed the Protected Service Water (PSW) System to distinguish this system from the Standby Shutdown Facility Auxiliary Service Water System.

Relief Valves (PRVs) under saturated water lift and repetitive cycling conditions.

While the PSW system, with the SSF as a back up, will be able to mitigate many of the potential pipe ruptures that could occur in the TB, the system is not designed to mitigate MS breaks that could occur. For that reason, systems and components necessary to protect the pressure boundary of the MS system will be protected from the effects of HELBs that could occur, including environmental and flooding effects. The mitigation strategy for postulated MS breaks has not yet been completed.

As noted, the PSW system will be capable of cooling the RCS down to LPI system entry conditions. Single active failures will not be applied to any systems and components needed during the cool-down phase. Repair guidelines will be credited should any system or component failure occur during the cool-down phase. Structural damage, which may occur following the HELB event, will not prevent these systems from providing the cool-down function.

3. *Assurance should be provided that the control room will be habitable and its equipment functional after a steam line or feedwater line break or that the capability for shutdown and cool-down of the unit(s) will be available in another habitable area.*

The Control Room (CR) by its design and location in the plant is protected from the steam-air environment that may occur following a postulated HELB. Current analysis indicates that the CR will remain habitable and the equipment located there remains functional should there be a loss of CR Ventilation following a postulated HELB. If needed, portable back-up ventilation systems can be provided for long term habitability. As a back up, the SSF CR is fully capable of monitoring and controlling the plant at SSD conditions using the SSF ASW system.

4. *Environmental qualification should be demonstrated by test for that electrical equipment required to function in the steam-air environment resulting from a high energy fluid line break. The information required for our review should include the following:*

a) Identification of all electrical equipment necessary to meet requirements of 11 above. The time after the accident in which they are required to operate should be given.

b) The test conditions and the results of test data showing that the system will perform their intended function in the environment resulting from the postulated accident and the time interval of this accident. Environmental conditions used for the tests should be selected from a conservative evaluation of accident conditions.

c) The results of a study of steam systems identifying locations where barriers will be required to prevent steam jet impingement from disabling a protection system. The design criteria for the barriers should be stated and the capability of the equipment to survive within the protected environment should be described.

d) An evaluation of the capability of safety related electrical equipment in the control room to function in the environment that may exist following a pipe break accident should be provided. Environmental conditions used for the evaluation should be selected from conservative calculations of accident conditions.

e) An evaluation to assure that the onsite power distribution system and onsite sources (diesels and batteries) will remain operable throughout the event.

The mitigation strategy for ensuring that systems and components required to function in the resulting environment following the HELB closely follows the strategy described in (2) above.

HELBs located inside the TB were previously analyzed and found to have negligible effects on the pressure and temperature inside the TB. As such, equipment located inside the TB have no EQ requirements applied to them. Duke will not be re-analyzing the environmental profile for the TB. However, electrical equipment located in the TB required to protect the pressure boundary of the MS systems will either be environmentally qualified to the conditions described in the Environmental Qualification Criteria

Manual (EQCM) for the EPR, including the effects of spray and jet impingement, or shown to fail in a manner to assure isolation of the main steam pressure boundary. The remaining systems and components located inside the TB, that are not relied upon to fulfill this function, will not be environmentally qualified or protected from jet impingement. Those systems and components located in the TB that enable the cool-down to CSD conditions will also not be environmentally qualified nor protected from jet impingement. Since the new PSW system will improve the ability to remain at SSD conditions for long periods of time, damage repair guidelines will be credited to repair those systems and components located in the TB that enable the cool-down to CSD.

Systems and components located in the AB, including those related to the new PSW system, which will be relied upon to reach SSD conditions, will be environmentally qualified for those HELBs that could occur in the AB, including the EPR and WPR. The environmental conditions include the effects from spray and jet impingement. Those systems and components located in the AB that enable the cool-down to CSD conditions will not be environmentally qualified nor protected from jet impingement. Damage repair guidelines will be credited to repair those systems and components located in the AB that enable the cool-down to CSD.

To reach SSD and subsequent cool-down to CSD, certain electrical penetrations in the EPR must be protected from the effects of potential MFDW breaks and cracks, as well as other postulated system breaks and cracks that may occur in the room. The original report on HELB, MDS Report No., OS-73.2, considered critical crack locations. However, certain locations were subsequently eliminated based on a stress criterion. To improve the robustness of the future HELB licensing basis, the HELB reconstitution project will submit a LAR to clarify the rules that Duke will follow when determining the susceptibility of certain electrical penetrations to the effects from jet impingement and spray from critical cracks. The LAR will seek approval to employ certain portions of BTP MEB 3-1 as it applies to selecting critical crack locations based on the prevailing stress analysis of the MFDW lines and other piping lines located in the EPR. The LAR will also seek approval to employ NUREG/CR-2913 for the determination of jet lengths emanating from critical cracks, subject to the limitations on pressure and temperature of the process fluid stipulated by the NUREG. Critical crack jet lengths for systems that do not meet the limitations imposed by the NUREG will likewise be proposed in the LAR.

The inclusion of these methodologies in the Oconee licensing basis will allow Duke to determine those crack locations that could pose a challenge to electrical circuits, necessary to reach SSD, routed through the EPR electrical penetrations. Following establishment of those locations, detailed analysis will follow regarding the ability of jets and spray to reach the electrical penetrations housing circuits necessary to reach SSD. Modifications, including jet shields and equipment upgrades will be installed as necessary for any jet impingement/spray interactions determined from the analysis. Duke has previously committed, in a letter dated November 21, 2005[15], to perform periodic inspections of all the girth welds, attachment welds, and critical base metal locations on the MFDW system located in the AB. These inspections may be credited to demonstrate the integrity of the piping and eliminate the postulation of breaks and cracks in lieu of the erection of jet shields/equipment upgrades.

The onsite emergency power distribution system necessary to reach SSD will be protected from the environment that could result from a HELB, including the effects of spray and jet impingement. The power distribution system located in the TB will not be protected.

To insure the availability of emergency onsite power following the HELB event, a new set of switchgear will be added as part of the PSW system. This new set of switchgear will replace the current ASW switchgear currently located in the AB with stand alone switchgear located in a tornado and HELB protected structure outside of the power block. The new switchgear will be fed from an alternate, protected power path from the Keowee Hydro Station via an underground feeder path. Since the power path to the new switchgear will be located outside of the TB, the system will be fully capable of providing power to the new PSW system and the HPI system, should a HELB

[15] Letter dated 11/21/2005 from Duke Power to Document Control Desk of the NRC, "High Energy Line Break and Tornado Mitigation Strategy."

occurring in the TB, affect the 4160V switchgear. The design will eliminate current operator actions in the TB and AB necessary to align the current ASW switchgear. Since the upgraded system can be aligned quickly from the control room, the previous manual operator actions to physically align HPI and throttle seal cooling will no longer be necessary. This design improves the capability to provide Reactor Coolant Pump (RCP) seal cooling and thus preserve RCP seal integrity.

The modifications will also allow the capability to maintain charger power to the Vital Instrumentation and Control (I&C) batteries should a HELB interaction affect the normal recharging power path. This capability ensures the availability of required instrumentation to reach SSD, and later CSD.

The upgraded system will provide a protected power source to the RCS high point vents and Reactor Vessel (RV) head vents, and thus will improve RCS inventory control and provides a bleed path for boration should a HELB interaction affect the normal letdown path in the AB. Also, the ability to control the RCS vents preserves the ability for a natural circulation cool-down should a HELB interaction affect the 6900V power path to the RCPs.

The upgraded system will provide a protected power source to a sufficient number of pressurizer heaters in order to maintain a steam bubble in the pressurizer, should the normal power path be affected by a HELB. This design will improve RCS pressure control and allow the station to remain at safe shutdown conditions should repairs be needed to proceed to cold shutdown.

5. *A discussion should be provided of the potential for flooding of safety related equipment in the event of a failure of a feedwater line or any other line carrying high energy fluid.*

No flood protection will be provided for systems and components located in the TB with the exception of systems and components required to protect the MS system pressure boundary. Flood protection will be provided for all SSD systems and components located in the AB, including the new PSW system. No flood protection will be provided for systems and components necessary to reach CSD. Damage repair guidelines will be credited to repair those systems and components necessary to reach CSD.

The AB HELB flood prevention modifications will allow water from a MFDW break or crack in the East Penetration Room (EPR) to be collected and directed outside of the AB, thus preventing water from reaching the lower levels of the AB, and challenging the ability of important safety related systems and components to function.

The first series of modifications includes the installation of a passive flow outlet device on the west wall of the EPR of each unit that will utilize a rupture disc design to release water outside of the EPR and AB. A second series of modifications will improve the structural capability of certain un-reinforced masonry walls surrounding the EPR and entry doors into the room. This improvement will provide the capability to impound water released into the room and direct the water to the flood outlet device noted above. A third and final series of modifications will improve exterior doors of the AB to prevent the water released through the flow outlet device from flowing back into the AB.

6. *A description should be provided of the quality control and inspection programs that will be required or have been utilized for piping outside containment.*

The new PSW system will be designed and constructed to meet Duke's standards for a safety related system (QA-1). The EPR flood prevention modifications will also be designed and constructed to QA-1 requirements. Additional modifications that may be required as the HELB reconstitution project is completed will be designed and constructed to QA-1 requirements.

As noted throughout this submittal, in cases where repairs or the implementation of protection devices (rupture restraints, jet shields, etc.) prove to be unfeasible, periodic piping volumetric inspections may be implemented to demonstrate the integrity of the subject piping at the postulated break/crack location. These volumetric inspections will determine the piping wall thickness, to a suitable distance, on either side of the subject weld and determine the integrity of the weld, i.e. meet ASME Section

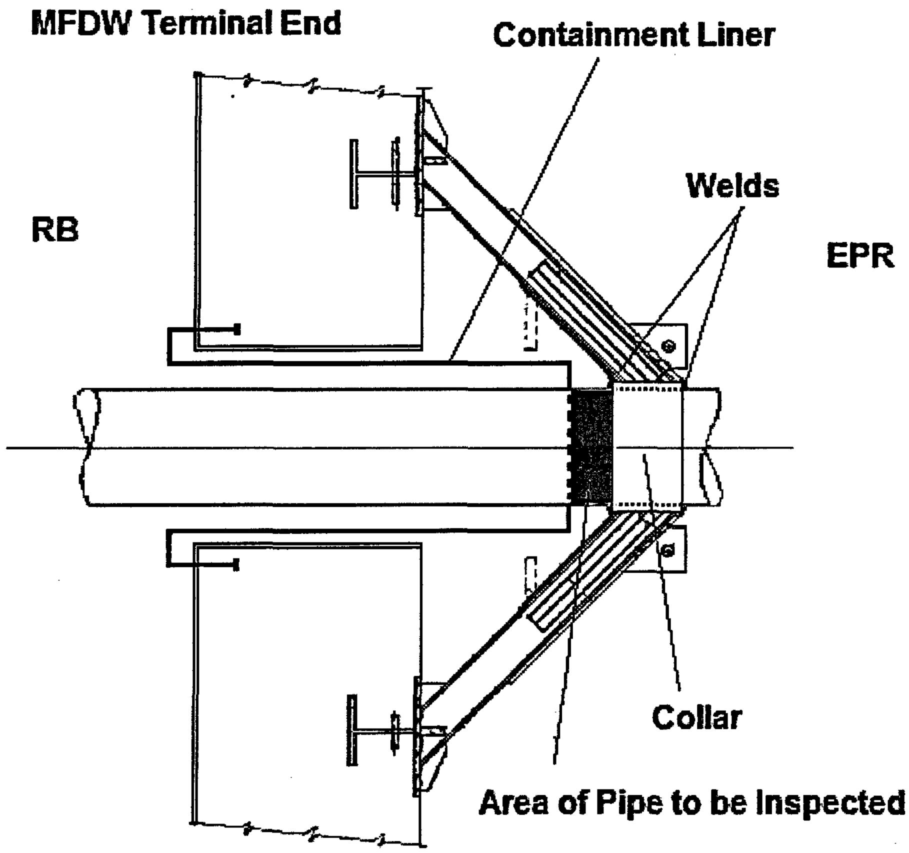
XI[16] requirements. These inspections will be used to eliminate postulation of the particular break and crack location(s). Prompt repairs will be made should any inspection discover thinning of the pipe wall below acceptable standards, or weld indications that do not meet the standards of ASME Section XI. Repairs will be made to the applicable quality standards of the piping system.

7. *A description should be provided of the methods or analyses performed to demonstrate that there will be no adverse effects on the primary and/or secondary containment structures due to a pipe rupture outside these structures.*

In general the RB penetrations represent terminal ends in the piping analyses. These RB penetrations are designed to withstand the forces and moments applied to the terminal end that could occur from postulated breaks located either inside or outside of containment.

The design of the MS and MFDW RB penetrations differ from the other RB penetrations. For these lines, structural anchors have been installed adjacent to the RB penetrations. The MS anchors are located inside the RB, while the MFDW anchors are located in the EPR. These anchors are designed to absorb the large forces and moments that could occur in the aftermath of either a postulated MS or MFDW break. The MS and MFDW anchors consist of a collar wrapped around the outside diameter of the piping. The collar is connected at both ends to the piping via two circumferential fillet welds. The collar is in turn welded to a series of structural wide flange members that span back to the RB wall. The wide flange members are then welded to embedded structural tees located in the RB wall. A simplified sketch of the MFDW anchor follows:

[16] American Society of Mechanical Engineers Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components"



There has been some disagreement between the NRC Staff and Duke regarding the location of the terminal end and the postulation of the terminal end break for the MFDW lines. It has been Duke's position that the terminal break occurs either in between the two welds that connect the collar to the pipe or at the weld on the outboard (AB side) of the collar. To address this issue, Duke has previously committed to institute periodic volumetric inspection of the piping between the collar welds and the containment liner[17] (as indicated in the dark area on the sketch above). These inspections will be used as justification to not postulate breaks at these locations.

Integrated Mitigation Strategy

As noted the HELB reconstitution project continues to make progress toward the creation of a comprehensive HELB mitigation strategy. While that strategy is in its

[17] Letter from Duke to NRC dated 11/21/2005, "High Energy Line Break and Tornado Mitigation Strategy."

formative stages, an integrated strategy is emerging as follows:

- SSCs necessary to reach SSD will be protected from the possible direct effects from a given HELB event.
- Systems and components necessary to reach CSD will not be protected. Station repair guidelines will be credited to effect repairs as necessary to those systems and components necessary to reach CSD. The affected unit will remain at SSD conditions while those necessary repairs are completed.
- Structural damage will not preclude reaching SSD or CSD.
- Single active failures will be postulated for the initial event mitigation as well as achieving and maintaining SSD. Single active failures will not be postulated during plant cool-down to CSD.
- Jet geometry from breaks and cracks will be based on NUREG/CR-2913 pending approval from the NRC. Jet lengths for system temperatures and pressures not addressed by the NUREG will be limited to 10 pipe diameters.
- High Energy systems are defined as those systems with operating temperatures greater than or equal to 200°F or pressures greater than or equal to 275 psig. For those systems that operate at high energy conditions less than 1% of the total plant operating time or at high energy conditions less than 2% of the total system operating time, no breaks or cracks will be postulated.
- Breaks for rigorously analyzed piping with seismically applied loading will be postulated at those locations where the total primary + secondary stress exceeds $.8(S_A + S_h)$.
- For non-rigorously analyzed piping or for analyzed piping that does not include seismically applied loading, break locations will be postulated in accordance with BTP MEB 3-1.
- Circumferential breaks will be postulated at terminal ends. Potential breaks at branch connections will not be postulated if the stresses are known and meet the stress break threshold given above. If the stresses at the branch connection are

not known, breaks will be postulated in accordance with BTP MEB 3-1.

- Critical cracks are to be postulated for rigorously analyzed piping at locations where the total primary + secondary stress exceeds $.4(S_A + S_h)$.
- Critical cracks will not be postulated for non-analyzed piping or for those systems that do not include seismic loading.
- Periodic volumetric inspections (UT) may be used to demonstrate the integrity of the piping at critical locations. These inspections will be used to eliminate the postulation of breaks and cracks at these locations.
- The new PSW system and the SSF will be credited for restoration of secondary side heat removal following the HELB event.
- The SSF will be licensed as a back-up HELB mitigation system to the new PSW system.
- No systems and components located in the TB will be credited for initial HELB event mitigation or for reaching SSD, except for those systems and components necessary to protect the MS pressure boundary. Those systems and components necessary to protect the MS pressure boundary will be protected from the effects of a given HELB event, including, jet impingement, environmental effects, spray, and flooding.
- The CR will remain habitable and the equipment located there will remain functional following a HELB event.
- Systems and components located in the AB, including the new PSW system, necessary to reach SSD will be protected from a given HELB event, including jet impingement, environmental effects, and flooding.
- Electrical components necessary to reach SSD located in the AB, including RB cable penetrations will be protected from the effects of jet impingement and spray as necessary pending approval from the NRC to employ BTP MEB 3-1 for determining critical crack locations and NUREG/CR-2913 for determining jet lengths from postulated break and critical crack locations in the AB. As stated earlier periodic

volumetric inspections (UT) may be used to demonstrate the integrity of the piping at critical locations. These inspections will be used to eliminate the postulation of breaks and cracks at these locations.

- Onsite emergency power distribution systems located in the TB will not be credited for mitigation of HELBs that could occur in the TB. New switchgear, to be installed as part of the new PSW system, along with the SSF, will be credited for mitigation of HELBs that could occur in the TB.
- The new PSW system and the EPR flood prevention modifications will be designed and constructed to the quality standards applicable to a safety related system.
- Containment integrity will be protected from the effects of a postulated HELB. Periodic volumetric inspections (UT) may be used to demonstrate the integrity of the piping at critical locations. These inspections will be used to eliminate the postulation of breaks and cracks at these locations.

Schedule

In order to proceed expeditiously with the HELB reconstitution project, Duke proposes a review and approval schedule for the LARs previously mentioned in this attachment. The three-unit specific LARs will provide the new Oconee licensing basis for HELB.

The fourth LAR mentioned herein concerns the approval to use certain portions of BTP MEB 3-1 and NUREG/CR-2913. Following approval to incorporate these methodologies into the Oconee licensing basis, analyses will be completed evaluating potential interactions between postulated crack locations and the electrical penetrations located in the EPR. The completion of these analyses is scheduled nine months after NRC approval to use BTP MEB 3-1 and NUREG/CR-2913.

The schedule for conclusion of the project will depend on the timing of these LARs and subsequent NRC review and approval. Duke will request that the NRC follow an initial six month review period for each LAR. Following the initial review period, Duke proposes a two month period in which to respond to anticipated Request for Additional Information (RAI). Following that, Duke proposes that the NRC follow a two month final review period. Listed below is table that gives the proposed submittal and review schedule:

Pending License Amendment Requests (LAR)		
Item No.	Description of Activity	Anticipated Complete Date
1	**Incorporate certain portions of BTP MEB 3-1 and NUREG/CR-2913 in LB.**	**August 2007**
♦	Duke/NRC agreement on direction based on NRC response to this letter	May 2006
♦	Draft LAR, solicit comments from Tornado/HELB Design Basis Group supervision & senior management - incorporate comments	June 2006
♦	Circulate LAR for site review and incorporate comments	June 2006
♦	Complete LAR verification package	June 2006
♦	Complete Plant Operating Review Committee (PORC) review and incorporate comments	July 2006
♦	Complete Nuclear Oversight Review Committee review (NSRB) and incorporate comments	July 2006
♦	Transmit LAR	August 2006

Pending License Amendment Requests (LAR)		
Item No.	Description of Activity	Anticipated Complete Date
♦	NRC acceptance review received	September 2006
♦	RAI response target date	November 2006
♦	Receive NRC approval of LAR	August 2007
♦	Follow-up Analysis Completion Date	April 2008 (1)
2	**Unit 1 - New HELB LB**	**March 2008**
♦	Draft LAR, solicit comments from Tornado/HELB Design Basis Group and Oconee Major Projects supervision & senior management	November 2006
♦	Incorporate supervision/management comments into draft LAR	November 2006
♦	Circulate LAR for site review	November 2006
♦	Incorporate site comments into LAR	December 2006
♦	Complete LAR verification package	December 2006
♦	Complete Plant Operating Review Committee (PORC) review / Incorporate PORC comments	January 2007

Pending License Amendment Requests (LAR)		
Item No.	Description of Activity	Anticipated Complete Date
♦	Complete Nuclear Oversight Review Committee review (NSRB)/ Incorporate NSRB comments	February 2007
♦	Transmit LAR	March 2007
♦	NRC acceptance review received	April 2007
♦	RAI response target date	June 2007
♦	Receive NRC approval of LAR	March 2008
3	**Unit 2 - New HELB LB**	**June 2008**
♦	Draft LAR, solicit comments from Tornado/HELB Design Basis Group and Oconee Major Projects supervision & senior management	March 2007
♦	Incorporate supervision/management comments into draft LAR	March 2007
♦	Circulate LAR for site review	March 2007
♦	Incorporate site comments into LAR	April 2007
♦	Complete LAR verification package	April 2007

Pending License Amendment Requests (LAR)		
Item No.	Description of Activity	Anticipated Complete Date
♦	Complete Plant Operating Review Committee (PORC) review / Incorporate PORC comments	May 2007
♦	Complete Nuclear Oversight Review Committee review (NSRB)/ Incorporate NSRB comments	June 2007
♦	Transmit LAR	June 2007
♦	NRC acceptance review received	July 2007
♦	RAI response target date	September 2007
♦	Receive NRC approval of LAR	June 2008
4	**Unit 3 - New HELB LB**	**September 2008**
♦	Draft LAR, solicit comments from Tornado/HELB Design Basis Group and Oconee Major Projects supervision & senior management	May 2007
♦	Incorporate supervision/management comments into draft LAR	May 2007
♦	Circulate LAR for site review	May 2007
♦	Incorporate site comments into LAR	June 2007

Pending License Amendment Requests (LAR)		
Item No.	Description of Activity	Anticipated Complete Date
◆	Complete LAR verification package	June 2007
◆	Complete Plant Operating Review Committee (PORC) review / Incorporate PORC comments	July 2007
◆	Complete Nuclear Oversight Review Committee review (NSRB)/ Incorporate NSRB comments	August 2007
◆	Transmit LAR	September 2007
◆	NRC acceptance review received	October 2007
◆	RAI response target date	November 2007
◆	Receive NRC approval of LAR	September 2008

Note:

(1) Scheduled completion date of analysis of critical cracks in the AB.

Summary

At a high level, the HELB mitigation strategy recognizes the vulnerability of systems and components located in the TB and the electrical penetrations located in the EPR. The strategy seeks to lessen the reliance on systems and components located in the TB and to protect those systems and components located in the AB necessary to reach and maintain SSD conditions, including certain RB electrical penetrations.

The new PSW system will fulfill the requirement to reduce reliance on systems and components located in the TB. The new system will be capable of mitigating non-MS related breaks in the TB. Its mission is to effect safe shutdown following the TB HELB by providing a redundant and diverse means of removing core decay heat. Reliance on power and control power necessary to reach safe shutdown, currently located in the TB, will be eliminated by the new system. The system will allow the plant to remain at safe shutdown conditions to allow repairs to systems and equipment located in the TB needed to reach cold shutdown, should those repairs be necessary.

Inherent in the HELB mitigation strategy is the recognition of the importance of the SSF-ASW system and its potential role in HELB mitigation. It is Duke's intent to license the SSF for HELB mitigation. This licensing action will be included in the unit-specific LARs. These requests will include justification to use the SSF in this capacity and include a discussion on the increased dependence on the SSF.

Finally, the strategy is based on the concept that while the ability to reach SSD needs to be protected, limited damage will be allowed to those systems and components necessary to reach CSD. While no repair timeline has been determined for these systems and components necessary to reach CSD, the new PSW system will allow maintaining SSD conditions for as long as is required to complete these repairs.

As noted, the Duke thorough and comprehensive reconstitution of the HELB design basis is in progress. The project entails determining all potential break locations, the potential interactions resulting from each break location, and its effect on the ability of the plant to initially reach SSD, and pending repairs, to reach CSD. To date the potential break locations have been determined and the resulting interactions have been identified. The analysis of those interactions and their effect on the ability of the plant to initially reach SSD, and then CSD is in progress. Should any interactions be identified that merit revising the strategy included herein, the NRC Staff will be appropriately advised.