November 13, 2006

MEMORANDUM TO: J. E. Dyer, Director
Office of Nuclear Reactor Regulation

FROM: John A. Grobe, Associate Director/**RA/**
for Engineering and Safety Systems
Office of Nuclear Reactor Regulation

SUBJECT: DIFFERING PROFESSIONAL OPINION (DPO) PANEL RESPONSE TO DPO-2006-002

By memorandum dated June 2, 2006, you established a Differing Professional Opinion (DPO) Ad Hoc Review Panel to review the DPO pertaining to the use of leak-before-break (LBB) technology in the design of a facility modification involving installation of new emergency core cooling systems (ECCS) recirculation sump strainers at Oconee, Units 1 and 2 and report its recommendations to you. The panel has completed its review of the matters raised by the Submitter regarding the application of LBB technology at Oconee. The results of the panel's evaluation of the concerns raised in the DPO are detailed in the enclosed DPO panel report.

Based on its review of concerns raised in the DPO, the panel has made the following conclusions:

- The Submitter's concern regarding inappropriate application of LBB technology in the ECCS recirculation sump strainer modification at Oconee, Units 1 and 2 was based on an incorrect understanding of the Commission's regulations and policy on the use of LBB technology in the design of the ECCS. The regulations and policy support the staff's decision to authorize the application of LBB technology to this modification.

- The NRC staff reviewed and documented the approval of the application of LBB technology for reactor coolant system cold leg breaks that could affect the ECCS recirculation sump strainer for Oconee, Units 1 and 2 pursuant to the draft Standard Review Plan 3.6.3, "Leak-Before-Break Evaluation".

- Had NRR and Regional Division management effectively engaged in resolution of this issue, or had the Task Interface Process been used, the need for a DPO may have been avoided.

During the course of the review of this DPO, one additional issue was raised and resolved as described in the Enclosure. The panel has the following recommendation for consideration:

- The staff should develop a knowledge management document describing the NRC's policy and practice on the application of LBB.

CONTACT: John A. Grobe, ADES/NRR
301-415-1274

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The Office of General Counsel (OGC) has reviewed the discussion of the regulatory history and General Design Criterion 4, and the applicability to the Oconee plant. OGC comments on the Report have been appropriately addressed.

Please do not hesitate to contact me if you have any questions regarding the enclosed report.

Enclosure:
As Stated

The Office of General Counsel (OGC) has reviewed the discussion of the regulatory history and General Design Criterion 4, and the applicability to the Oconee plant. OGC comments on the Report have been appropriately addressed.

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Enclosure:
As Stated

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OFFICE	NRR	RES	RII	NRR:ADES
NAME	MCaruso	ACsontos	JLenahan	JGrobe
DATE	11/13/2006	11/13/2006	11/13/2006	11/13/2006

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ENCLOSURE

Differing Professional Opinion (DPO)
On
Application of Leak-Before-Break Technology at Oconee
DPO-2006-002

DPO Panel Report

John A. Grobe, Panel Chair

Mark A. Caruso, Panel Member

Aladar A. Csontos, Panel Member

Joseph J. Lenahan, Panel Member

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Executive Summary

Differing Professional Opinion (DPO) 2006-002 disagrees with the NRC staff's decision to allow installation of new emergency core cooling system (ECCS) sump strainers in Oconee, Units 1 and 2. The submitter contends that the new ECCS sump strainers at Oconee Units 1 and 2 can be adversely impacted by the dynamic effects of jet impingement from a potential reactor coolant system (RCS) cold leg loss of coolant accident (LOCA) in a way that could disable the ECCS re-circulation function. In approving the installation, the staff allowed dynamic effects to be excluded from the design bases for the strainers based on leak-before-break (LBB) technology. The submitter contends that LBB technology should not have been credited by staff because the licensee has not submitted the information required to justify the application of LBB technology for NRC review and approval. Further, the submitter contends that, even if the required information is submitted, the staff should not permit the application of LBB technology because the NRC does not allow the use LBB technology to exclude dynamic effects such as jet impingement when those effects adversely impact the ECCS or containment.

A DPO panel was formed to review the issues and concluded that the DPO contention was based on a misunderstanding of the Commission's regulations and policy on the use of LBB technology in the design of the ECCS. The panel concluded that both the regulations and policy support the staff's decision to authorize the application of LBB to this modification.

During the review, the panel identified an additional issue associated with the DPO. This secondary issue involves the question of why the central issue raised in the DPO could not have been resolved through effective interaction between division management in the Regional Office and the Office of Nuclear Reactor Regulation (NRR) or through the established process for resolving questions on the application of regulations, i.e., the NRR Task Interface Agreement (TIA) process. The panel concluded that a DPO filing may have been avoided through effective interaction between Regional and NRR management.

1.0 Introduction

Differing Professional Opinion (DPO) 2006-002 disagrees with the NRC staff's decision to allow installation of new emergency core cooling system (ECCS) sump strainers in Oconee, Units 1 and 2. DPO-2006-002 was submitted for consideration on May 3, 2006. A DPO panel ("the panel") was formed on June 2, 2006 by James E. Dyer, Director, Office of Nuclear Reactor Regulation (NRR). The panel's charter is contained in a memorandum from James E. Dyer to the panel members dated June 2, 2006. On July 20, 2006, the panel met with the author of the DPO ("the Submitter") and presented their understanding of the concerns stated in the DPO. At this meeting, the author acknowledged his agreement with the panel's understanding of the concerns.

The panel has reviewed the issues raised in DPO-2006-002 and documents the panel's findings and conclusions in this report. During the review, the panel identified an additional issue associated with the DPO. The issue involves the question of why the central issue raised in the DPO could not have been resolved through effective interaction between division management in the Regional Office and NRR or the established NRR process for resolving questions on the application of regulations. The panel's findings and conclusions regarding this issue are also discussed in the report.

2.0 Background

On August 18, 2005 and supplemented on September 15, 2005, Duke Energy Corporation ("the licensee") submitted a request to modify Oconee Nuclear Station, Units 1 and 2 Technical Specifications (TS) 3.5.2.6 and 3.5.3.6. The requested changes to TS 3.5.2.6 and 3.5.3.6 were related to replacement of the reactor building emergency sump suction inlet trash racks and screens with new sump strainers. The licensee planned to install the new ECCS sump strainers to address issues raised in Generic Safety Issue-191 (GSI-191) and requests made in Generic Letter (GL) 2004-02. In response to GL 2004-02, the licensee provided an engineering evaluation by Stone and Webster (Calculation S-003) to assess the impact of pipe rupture and jet impingement on the design function of the new sump strainers and determine if additional protection, i.e. jet impingement shields, were necessary. Calculation S-003 concluded that the design function of the sump strainers would not be compromised by jet impingement or pipe whip from any lines in the vicinity of the emergency sump. For the RCS cold leg, this conclusion was based on crediting LBB technology. In a safety evaluation dated November 1, 2005, the NRC concurred with the conclusions of the licensee's engineering evaluation and issued Amendments 348 and 350 to modify the technical specifications necessitated by installation the of ECCS sump strainers in Oconee Nuclear Stations, Units 1 and 2.

3.0 Statement of Concerns

The fundamental contention of this DPO is that the ECCS sump strainer modification described above should not have been approved by the NRC nor implemented by the licensee. The submitter contends that the new ECCS sump strainers at Oconee Units 1 and 2 can be adversely impacted by the dynamic effects of jet impingement from a potential RCS cold leg loss of coolant accident (LOCA) in a way that could disable the ECCS re-circulation function. In approving the installation, the staff allowed dynamic effects to be excluded from the design bases for the strainers based on leak-before-break (LBB) technology. The submitter contends

that LBB technology should not have been credited by staff because the licensee has not submitted the information required to justify the application of LBB technology for NRC review and approval. Further, the submitter contends that, even if the required information is submitted, the staff should not permit the application of LBB technology because the NRC does not allow the use LBB technology to exclude dynamic effects such as jet impingement when those effects adversely impact the ECCS or containment. This DPO contention stems in part from the interpretation of Commission policy that LBB technology cannot be used if the dynamic effects of the pipe rupture adversely affect ECCS and containment. In support of this position, the DPO cites sections from the final rule that modified GDC-4 to permit exclusion of dynamic effects of high energy pipe ruptures from the design basis of systems, structures and components (SSC) based on LBB technology (52 FR 41288, October 27, 1987). Since then, the NRC has accepted the concept of LBB for certain large diameter high-quality piping systems such as the RCS cold leg line, thereby, permitting the removal, or non-installation, of various pipe-whip restraint devices and jet-impingement shields originally designed to mitigate the dynamic effects of a postulated instantaneous pipe rupture.

4.0 Findings and Conclusions

4.1 Issue #1: Use of LBB Criteria to Eliminate Local Dynamic Effects from the Design Basis of the New ECCS Sump Strainers

4.1.1 Findings

4.1.1.1 Interpretation of the Commission's Policy on the Application of LBB Technology

In order to evaluate the concerns identified in DPO-2006-02, the panel first interviewed the submitter and then reviewed the various documents relevant to the NRC staff's interpretation of the Commission policy regarding the application of LBB technology. The panel then interviewed and questioned several cognizant members of the NRC technical staff in its examination of the use of LBB technology to support the ECCS sump strainer modification. Documents particularly germane to the panel for this interpretation issue included:

- GDC-4 in 10 CFR Part 50, Appendix A, which governs the treatment of dynamic effects of pipe ruptures on systems, structures and components;
- Draft Standard Review Plan (SRP) Section 3.6.3, "Leak-Before-Break Evaluation Procedures", in NUREG-0800;
- Statements of Consideration for final rules that revised GDC-4 for exclusion of dynamic effects of reactor coolant system (RCS) primary loop pipe ruptures from the design basis of SSCs based on LBB technology (51 FR 12502, April 11, 1986), and the follow-on revision that extended the exclusion to all qualified high energy piping (52 FR 41288, October 27, 1987);
- Proposed rulemaking to modify GDC-4 published in the Federal Register (51 FR 26399, July 23, 1986);

- Solicitation of public comments by the NRC on additional applications of LBB technology published in the Federal Register (53 FR 11312, April 6, 1988);

- Commission policy statement on additional applications of LBB technology (54 FR 18649, May 2, 1989);

- NRC Staff technical paper on leak-before-break applications published in the International Journal of Pressure Vessels and Piping (vol. 43, pp 57-65, 1990).

- NRC Memorandum dated April 14, 1988 from James E. Richardson (NRR) to Frederick J. Hebdon (RES), Subject: Ticket 88-10-Issues for SRP 3.6.3 which reiterates the staff's position on the design bases of containment, ECCS, and environmental qualifications when LBB is demonstrated.

The panel found that neither GDC-4 nor SRP Section 3.6.3 make distinction among SSCs as to which ones could or could not have dynamic effects excluded from their design basis. The panel found that the sole determining factor for exclusion is whether or not the piping whose rupture would produce the dynamic effects has an acceptably low likelihood of rupture prior to producing a detectable indication of impending failure, i.e. leakage. SRP Section 3.6.3 provides the specific procedures and acceptance criteria for making this determination.

Prior to April 1986, GDC-4 required all SSCs important to safety be protected against the dynamic effects of pipe rupture LOCAs. It did not permit exclusion of these dynamic effects from the design basis under any circumstances. On April 11, 1986, GDC-4 was revised to allow the use of LBB technology for excluding the dynamic effects of postulated ruptures from the design basis of primary coolant loop piping in pressurized water reactors (PWRs), e.g., RCS cold leg piping. GDC-4 was revised again on October 27, 1987 to its current form. This revision expanded the scope for pipe rupture locations that could be treated with LBB technology. As currently revised, GDC-4 allows the application of LBB technology to exclude dynamic effects of postulated ruptures in high energy piping in currently licensed nuclear power plants and not just primary coolant loop piping in PWRs. High energy piping is defined as those systems having pressures exceeding 275 psig or temperatures exceeding 200 deg F. GDC-4 currently states:

> "Structures, systems, and components important to safety shall be designed to accommodate the effects of and to be compatible with the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents, including loss-of-coolant accidents. These structures, systems, and components shall be appropriately protected against dynamic effects, including the effects of missiles, pipe whipping, and discharging fluids, that may result from equipment failures and from events and conditions outside the nuclear power unit. However, dynamic effects associated with postulated pipe ruptures in nuclear power units may be excluded from the design basis when analyses reviewed and approved by the Commission demonstrate that the probability of fluid system piping rupture is extremely low under conditions consistent with the design basis for the piping."

The last sentence in GDC-4 establishes the LBB conditions which must be met in order to exclude dynamic effects from the design basis. It was added in the April 11, 1986 revision and

modified in the October 27, 1987 revision to broaden the scope for pipe rupture locations that could be treated with LBB technology.

The Commission summarized the basis for the October 27, 1987 revision to GDC-4 in Section II of the Federal Register notice:

> "This proposed amendment to GDC-4 allows exclusion from the design basis of dynamic effects associated with high energy pipe rupture by application of leak-before-break technology. Only high energy piping in nuclear power units that meet rigorous acceptance criteria is covered. High energy piping is defined as those systems having pressures exceeding 275 psig or temperatures exceeding 200 deg F."
>
> "Studies completed by Lawrence Livermore National Laboratory under contract to the NRC indicate that adverse safety implications can result from requiring protective devices to resist the dynamic effects associated with postulated pipe rupture. (See NUREG/CR-4263, Reliability Analysis of Stiff Versus Flexible Piping, Final Project Report, May 1985). The placement of pipe whip restraints degrades plant safety when thermal growth is inadvertently restricted, reduces the accessibility for and effectiveness of inservice inspections, increases inservice inspection radiation dosages and adversely affects construction and maintenance economics."

In Section III of the October 27, 1987 notice in the Federal Register , the Commission acknowledged that the rulemaking created an inconsistency in the design basis for emergency core cooling systems and containment:

> "This rulemaking will introduce an inconsistency into the design basis by excluding the dynamic effects of postulated pipe ruptures while still retaining nonmechanistic pipe rupture for emergency core cooling systems, containments and environmental qualification (see issue 4 below for additional information on potential relaxation with respect to environmental qualification). The Commission recognizes the need to address whether and to what extent leak-before-break analysis techniques may be used to modify present requirements relating to other features of facility design. However, this is a longer term evaluation. For the present the rule allows the removal of plant hardware which it is believed negatively affects plant performance and safety, while not affecting emergency core cooling systems, containments and environmental qualification." [The last sentence means: Functional performance of ECCS and containments, and environmental qualification of SSCs important to safety must continue to be based on a ruptures of pipes in the reactor coolant system up to and including a double ended rupture of the largest pipe].

The panel found that the Statement of Considerations for each of the modifications to GDC-4 contained a number of other statements that suggest that the modifications are not to be applied to ECCS or containment systems, such as this comment in Section III of the October 27, 1987 notice in the Federal Register:

> "To retain high safety margins, the application of leak before break technology to various piping systems should not decrease the capability of containments to perform their function of isolating the outside environment from potential leaks, breaks, or

malfunctions within the containment. Containment will continue to be designed to accommodate loss of coolant accidents resulting from breaks in the reactor coolant pressure boundary up to and including a break equivalent in size to the double-ended rupture of the largest pipe in the reactor coolant system. Also, the functional design for emergency core cooling systems still retains nonmechanistic pipe rupture."

The following quote is a public comment on the October 27, 1987 rule change published in Section VI of the October 27, 1987 notice in the Federal Register:

"Leak-before-break technology should be extended to relax pipe rupture requirements for containment design, emergency core cooling systems and environmental qualification...."

The Commission's response is:

"The Commission does not intend to consider near-term changes to emergency core cooling system and containment design basis as discussed in the Final Rule section...."

The panel discussed this apparent inconsistency between GDC-4, as modified, and the Statements of Consideration with staff who are experienced in the application of LBB. Their understanding of the Commission's position on the application of LBB in the design of ECCS and containment is that while potential damage from local dynamic effects, e.g. pipe whip and jet impingement) may be excluded from the design of ECCS per GDC-4, other important nonmechanistic global effects of pipe ruptures, e.g. reduction in reactor coolant inventory and pressurization of containment, cannot be excluded from the functional design requirements of ECCS and containment under any circumstances. Effects such as the loss of inventory from the RCS and the release of mass and energy globally to the containment, and all other effects explicitly accounted for in approved ECCS and containment performance analysis methods and models[1] need to be based on the most limiting pipe rupture event. In other words, the global functional design requirements of ECCS and containments cannot be reduced or excluded from the design basis by applying LBB technology.

This interpretation is supported by a comprehensive reading of the Statements of Consideration associated with the revisions to GDC-4, the solicitation of public comment by the NRC on additional applications of LBB technology, the NRC staff's technical paper published in the International Journal of Pressure Vessels and Piping, and a NRC staff memorandum between NRR and RES dated April 14, 1988. These documents explain the difference between potential local dynamic effects associated with a pipe rupture such as jet impingement and the effects of hypothesized nonmechanistic pipe ruptures used to define the global functional performance for the ECCS. The "non-dynamic" effects produced by a large pipe rupture simply serve as a convenient and conservative functional design umbrella for the ECCS.

[1] For example, see 10 CFR 50, Appendix K; SRP Sections 6.2.1.1A, 6.2.1.1B, 6.2.1.1C, 6.2.1.3, 6.2.1.4, and 6.2.1.5.

For example, the NRC staff's publication in the International Journal of Pressure Vessels and Piping clearly states the staff's understanding of the Commission's position on the application of LBB in the design of ECCS and containment:

> "Effects resulting from postulated pipe ruptures can be generally divided into local dynamic effects and global effects. Local dynamic effects of a pipe rupture are uniquely associated with that particular pipe rupture. These specific effects are not caused by any other source or even a postulated pipe rupture at a different location. Examples of local dynamic effects are pipe whip, jet impingement, missiles, local pressurizations, pipe break reaction forces, and decompression waves in the intact portions of that piping or communicating piping. Global effects of a pipe rupture need not be associated with a particular pipe rupture. Similar effects can be caused by failures from sources such as pump seals, leaking valve packings, flanged connections, bellows, manways, rupture disks, and pipe ruptures of other piping. Examples of global effects are gross pressurizations, temperatures, humidity, flooding, loss of fluid inventory, radiation, and chemical condition.
>
> The application of LBB technology eliminates the local dynamic effects of postulated pipe ruptures from the design basis because a LBB pipe does not rupture. However, global effects may still result from a source other than a postulated pipe rupture. Since the global effects from a postulated pipe rupture provide a convenient and conservative design umbrella, and the NRC staff is not prepared at this time to propose alternative criteria, the functional and performance requirements of containment, ECCS, and EQ are not affected by LBB applications."

The panel also found that the April 6, 1988 notice in the Federal Register (53 FR 11312) soliciting comments on additional applications of leak-before-break technology is specific about what can and cannot be excluded from the design basis.

> "The specific functional and performance requirements retained when leak-before-break is accepted under the recent modification to GDC-4 are as follows:
>
> 1. *For Containments.* Global loads and environments associated with postulated pipe ruptures, including pressurization, internal flooding, and elevated temperature.
> 2. *For ECCS.* Heat removal and mass replacement capacity needed because of postulated pipe ruptures.
> 3. *For EQ.* Pressure, temperature, flooding level, humidity, chemical environment, and radiation resulting from postulated pipe ruptures.
>
> However, under the recent [October 27, 1987] modification of GDC-4 local dynamic effects uniquely associated with pipe rupture may be deleted from the design basis of containment systems, structures and boundaries, from the design basis of ECCS hardware (such as pumps, valves, accumulators, and instrumentation). And from the design basis of safety related electrical and mechanical equipment when leak-before-break is accepted."

"...Thus, while functional and performance requirements for containments, ECCS and EQ remain unchanged under the now effective modification [October 27, 1987] of GDC-4, the design bases for these aspects of facility design have been modified in that local dynamic effects uniquely associated with ruptures in piping which qualified for leak-before-break may be excluded from consideration."

4.1.1.2 NRC LBB Approval for Oconee's RCS Cold Leg Line

DPO-2006-002 contends that the licensee for Oconee has not justified the application of LBB technology to the ECCS sump stainer modification in accordance with Commission regulations and guidance. In order to complete our evaluation of this concern identified in DPO-2006-02, the panel interviewed cognizant NRC staff and performed a review of historical documents to construct a sequence of regulatory activities regarding the approval and use of LBB technology for Oconee's RCS cold leg piping system. Key events in the sequence are shown in Table 1.

The panel determined that a safety evaluation completed in 1985 was forwarded to the licensee in 1986 indicating that a satisfactory technical basis had been provided for crediting LBB technology to exclude consideration of local dynamic effects of RCS primary loop pipe ruptures which included the RCS cold leg lines. The 1985 SE addresses BAW-1847 Rev. 1, submitted by the Babcock and Wilcox (B&W) Owners Group on behalf of several licensees, including the licensee for Oconee. The SE includes a generic bounding analysis that supports the use of LBB technology. The SE states that the analysis provides an acceptable basis for application of LBB technology to qualified piping at the facilities covered by the topical report. However, statements in the letter transmitting the SE to Oconee suggest that Oconee should submit additional supporting information with respect to the adequacy of leakage detection systems. Further, the SE concludes that the leakage detection systems at Oconee and the other facilities were acceptable for purposes of crediting LBB technology, i.e. that they were designed and implemented consistent with the guidelines of Regulatory Guide 1.45. The panel reviewed an internal document prepared by the licensee following receipt of the SE which indicates that the licensee believed the review was complete and no additional action to support NRC review and approval was required in order to apply LBB to primary loop piping.

Table 1

Date	Event
Dec. 1985	Staff approves B&W Topical Report (BAW-1847, Rev. 1) which justifies use of LBB in RCS primary loop piping for several B&W plants.
Feb. 1986	Staff transmits SE on BAW-1847, Rev. 1 to DPC indicating that the report provides an adequate basis for eliminating dynamic effects of large ruptures in RCS primary loop piping as a design basis at Oconee. Staff requests information demonstrating that leakage detection systems installed at Oconee comply with Regulatory Guide 1.45. Staff indicates that an exemption to GDC-4 is required in order to apply the methodology.
April 1986	NRC revises GDC-4 such that staff approved LBB technology may be used as a basis for eliminating dynamic effects of large ruptures in RCS primary loop piping from the design basis for SSCs.

Date	Event
Oct. 1987	NRC revises GDC-4 such that staff approved LBB technology may be used as a basis for eliminating dynamic effects of large ruptures in all qualified high energy piping from the design basis for SSCs.
March 1997	B&WOG submits topical report BAW-2292 which justifies use of LBB technology in establishing impact loads for Framatome Mark-B fuel assembly spacer grids installed at Oconee and other B&W plants.
Aug. 1997	Staff approves BAW-2292. SE references the staff's Dec. 1985 approval of BAW-1847, Rev. 1 as the basis for accepting the use of LBB technology.
July 1998	Oconee USAR updated to reflect that (1) LBB technology was approved for use at Oconee per the Dec. 1985 SE and (2) the Framatome Mark-B fuel design is consistent with assumptions in the approved LOCA analysis of record.
May 2000	Staff approves License renewal application which relies in part on the application LBB technology. In the process, staff reviews July 1998 update to UFSAR pertaining to LBB and raises no objection.
Sept. 2001	Staff approves application of LBB to steam generator replacement. SE states that NRC accepted LBB with approval of BAW-1847, Rev. 1 in 1985.
March 2003	DPC submits application for LPI cross-connect modification including complete analysis of LBB applied to core flood line (high energy pipe) per GDC-4 and SRP 3.6.3.
Sept. 2003	Staff approves LPI cross-connect modification for unit 1, including LBB analysis for core flood line.
Feb. 2004	Staff approves LPI cross-connect modification for unit 2, including LBB analysis for core flood line.
Sept 2004	Staff approves LPI cross-connect modification for unit 3, including LBB analysis for core flood line.
Nov. 2005	Staff issues Amendments 348 and 350 which allow installation of new ECCS sump screens in Oconee, Units 1 and 2. Staff's safety evaluation addresses licensee calculation that credits LBB technology.

The panel also reviewed the staff's evaluations of topical reports providing generic bounding analyses supporting use of LBB in plants designed by Westinghouse and Combustion Engineering. The panel found that the SE for the Westinghouse topical report was issued to each licensee for a plant designed by Westinghouse, similar to the approach taken for licensees with plants designed by B&W. The transmittal letter and the SE for the Westinghouse facilities included statements clearly indicating that the adequacy of plant-specific leak detection systems had not been covered by the staff's evaluation and would need to be addressed by individual licensees in order for the staff to approve the use of LBB technology. For plants designed by Combustion Engineering, the staff forwarded the SE only to the Combustion Engineering Owners Group organization with guidance that it could be referenced in plant-specific licensing submittals. The SE included statements clearly indicating that the adequacy of plant-specific leak detection systems had not been covered by the staff's evaluation and would need to be addressed in plant-specific submittals in order for the staff to approve the use of LBB technology.

Oconee received additional documents from the NRC indicating that the use of LBB technology for primary loop piping had been approved in the 1985 safety evaluation. This includes the staff's approval of the report BAW-2292, "Framatome Mark-B Spacer Grid Deformation in B&W Designed 177 Fuel Assembly Plants", in August 1997, the staff's approval of the Oconee license renewal application in May 2000 and the staff's approval of the Oconee steam generator replacement in September 2001. In late 1997, the licensee modified the Oconee Updated Safety Analysis report in accordance with 10 CFR 50.59 to reflect the LBB methodology in the NRC approved topical report, BAW-2292P-A, Rev. 0. [The panel notes that the licensee was not required to submit a request for an exemption to GDC-4 in order to incorporate the methodology into the licensing basis for the Oconee Units (contrary to guidance in the NRC's February 18,1986 letter to the licensee) because GDC-4 had been modified in April, 1986 and October, 1987 to allow for the use of approved LBB technology to exclude dynamic effects of pipe ruptures from the design basis for SSCs.]

In its review of the LPI cross-connect modification for DPO-2006-003, the panel identified that an Oconee plant-specific review of the leakage detection systems was also performed by the staff in March 2003 as part of its review of the LBB analyses provided in support of the LPI cross-connect modification. The staff confirmed that the leakage detection system satisfied the requirements of Regulatory Guide 1.45, and therefore, adequately supports the application of LBB technology.

In response to GL 2004-02, which deals with potential blockage of ECCS sump strainers, the licensee provided an engineering evaluation by Stone and Webster (Calculation S-003) to assess the impact of pipe rupture and jet impingement on the design function of the new sump strainers and determine if additional protection, i.e. jet impingement shields, were necessary. Calculation S-003 concluded that the design function of the sump strainers would not be compromised by jet impingement or pipe whip from any lines in the vicinity of the emergency sump. For the RCS cold leg, this conclusion was based on crediting LBB technology. In a safety evaluation dated November 1, 2005, the NRC concurred with the conclusions of the licensee's engineering evaluation and issued Amendments 348 and 350 to allow the licensee to install the ECCS sump strainers in Oconee Nuclear Stations, Units 1 and 2.

4.1.2 Conclusions

Based on its review, the panel concludes that GDC-4 permits the application of LBB technology to exclude local dynamic effects associated with postulated pipe ruptures from the design bases of SSCs in the ECCS and the containment when analyses reviewed and approved by the Commission demonstrate that the probability of fluid system piping rupture is extremely low. In addition, other parts of 10 CFR Part 50 require that nonmechanistic global effects associated with pipe ruptures, such as loss of cooling capacity in the RCS, be included in the design basis, with no exception.

The panel also concludes, based on its review of the documents and interviews with NRC technical staff, that the revision of the Oconee USAR to reflect the approved methodology for applying LBB technology to RCS piping was performed in accordance with the Commission's regulations and the application of that methodology to the ECCS sump strainer modification was performed in accordance with GDC-4 and NRC guidance for applying LBB technology.

The panel acknowledges that the Commission's intent on the use of LBB technology in the design of ECCS and containment is not clearly articulated in individual Statements of Consideration associated with changes to GDC-4; and, unless reviewed in their entirety, these documents can be misleading. However, clear explanations of the Commission's regulations have been documented which fully support the conclusion that neither the Commission's regulations nor Commission policy preclude the application of LBB technology in the Oconee ECCS sump strainer modification, as approved by the staff. Nevertheless, the panel believes that additional information could be developed and made available to the staff through the NRC knowledge management process that clarifies the relationship between GDC-4 and regulations that govern the design and operation of ECCS and containment. This could help prevent potential misunderstandings in the future on the part of NRC staff.

4.2 Issue #2: Process for Resolving Concerns without a DPO

4.2.1 Findings

The panel reviewed efforts to resolve the concerns raised in the DPO that took place before the DPO was submitted. The panel found that a substantial amount of communication took place between the submitter and NRR staff and management on the issues raised in the DPO. For example, the panel reviewed a number of email exchanges between the Submitter and cognizant staff in the NRR Division of Component Integrity (DCI) and records of several telephone conferences coordinated by the NRR Project Manager for Oconee. The panel also reviewed an informal response prepared by NRR staff that addresses the concerns raised by the submitter adequately. These efforts were substantial; but, they were not effective in resolving the issues.

The panel found that division management in the Region and NRR did not engage in the issues raised in the DPO and the Task Interface Agreement (TIA) process was not used to address the issues raised in the DPO. The TIA process is a management tool used by NRR to address requests for assistance by other NRC Offices, including questions on proper application of regulations or Commission policy. The TIA process is set forth in NRR Office Instruction COM-106, Rev. 2, dated November 30, 2005. As discussed in COM-106, the process was created to ensure that (1) questions related to potential safety and compliance concerns are appropriately discussed with the requesting organization, (2) the resolutions of the questions are appropriately planned, (3) the issues are adequately evaluated, and (4) the conclusions are reviewed by the appropriate level of management, communicated and documented. The panel reviewed the COM-106, Rev. 2 and confirmed that the issues raised in the DPO fell well within the scope of issues for which the TIA process was created.

4.2.2 Conclusions

Effective interaction between Regional and NRR Division management or the TIA process could have been utilized to address the issues raised in the DPO when they were first raised. A DPO filing may have been avoided.

5.0 Recommendations

The panel has the following recommendation for consideration: The staff should develop a knowledge management document describing the NRC's policy and practice on the application of LBB.

Appendix A
List of Documents Reviewed

NRC Draft Regulatory Guide 1.45; May 1973.

NRC Safety Evaluation of Westinghouse Topical Reports Dealing with Elimination of Postulated Pipe Breaks in PWR Primary Main Loops (Generic Letter 84-04, dated February 1, 1984).

NRC Safety Evaluation of B&W Owners Group Reports Dealing with Elimination of Postulated Pipe Breaks in PWR Primary Main Loops (Letter dated December 12, 1985).

Letter from John F. Stolz (NRC) to Hal B. Tucker (Duke Power Co.); February 18, 1986.

Oconee Station Memorandum to File: OS-196.4, "Oconee Nuclear Station RCL Leak-Before-Break NRC Modification of GDC-4"; June 2, 1986.

"Modification of General Design Criterion 4 Requirements for Protection Against Dynamic Effects of Postulated Pipe Ruptures"; Federal Register; 51 FR 12502; April 11, 1986.

"Modification of General Design Criterion 4 Requirements for Protection Against Dynamic Effects of Postulated Pipe Ruptures"; Federal Register; 51 FR 26399; July 23, 1986.

Draft Standard Review Plan (SRP) Section 3.6.3, "Leak-Before-Break Evaluation"; NUREG-0800; March 1987.

"Modification of General Design Criterion 4 Requirements for Protection Against Dynamic Effects of Postulated Pipe Ruptures"; Federal Register; 52 FR 41294; October 27, 1987.

Memorandum from Robert J. Bosnak (USNRC) to Frederick J. Hebdon (USNRC); Subject: Issues for SRP 3.6.3; February 1, 1988.

"Leak-Before-Break Technology; Solicitation of Public Comment on Additional Applications"; Federal Register; 53 FR 11312; April 6,1988.

Memorandum from James E. Richardson (USNRC) to Frederick J. Hebdon (USNRC), Subject: Ticket 88-10-Issues for SRP 3.6.3; April 14, 1988.

"Policy Statement on Additional Applications of Leak-Before-Break Technology"; Federal Register; 54 FR 18649; May 2, 1989.

Wichman, K; Lee, S; "Development of USNRC Standard Review Plan 3.6.3 for leak-before-break applications to nuclear power plants"; International Journal of Pressure Vessels and Piping (UK); 43 (1-3) : 57-65; 1990.

Letter from James E. Richardson (NRC) to Edward C. Sterling, III (Combustion Engineering Owners Group); Subject: Acceptance for referencing of topical Report CEN-367 , "Leak-Before-

Break Evaluation of Primary Coolant Loop Piping in Combustion Engineering Designed Nuclear Steam Supply Systems"; dated October 30, 1990.

McCollum W.R.; Duke Power Co.; "Oconee Nuclear Station, Units 1, 2 & 3 1997 Annual 10CFR50.59 Report"; dated December 12, 1997; submitted to NRC with Letter dated June 30, 1998.

Letter from R.A. Jones (Duke Power Co.) to USNRC, Subject: License Amendment Request associated with the Passive Low Pressure Injection Cross Connect Modification, March 20, 2003.

Letter from R.A. Jones (Duke Power Co.) to USNRC, Subject: Supplement to License Amendment Request associated with the Passive Low Pressure Injection Cross Connect Modification, July 22, 2003.

Letter from Leonard N. Olshan (USNRC) to Ronald A. Jones (Duke Power Co.): Subject: Oconee Nuclear Station , Units 1, 2 and 3 RE: Issuance of Amendments (TAC NOS. MB8083, MB8084, AND MB8085); September 29, 2003.

Letter from Leonard N. Olshan (USNRC) to Ronald A. Jones (Duke Power Co.); Subject: Oconee Nuclear Station , Units 1, 2 and 3 RE: Issuance of Amendments (TAC NOS. MC3334, MC3335, AND MC3336); September 2, 2004.

Letter from Leonard N. Olshan (USNRC) to Ronald A. Jones (Duke Power Co.); Subject: Oconee Nuclear Station , Units 1 and 2 RE: Issuance of Amendments (TAC NOS. MC8125 AND MC8126); November 1, 2005.

Electronic Mail from Mel Shannon to Michael Ernstes and Robert Carroll; Subject: LBB potential issue; January 24, 2006.

Electronic Mail from Mel Shannon to Kimberly A. Gruss and John Taso; Subject: LBB potential issue; January 25, 2006.

Electronic Mail from Mel Shannon to Kimberly Gruss and Leonard Olshan; Subject: LBB at Oconee; January 26, 2006.

Electronic Mail from Kimberly Gruss to Michael Ernstes; Subject: response to Mel Shannon's questions; January 30, 2006.

NRR Office Instruction "Control of Task Interface Agreements"; COM-106, Rev. 2; November 30, 2005.

Appendix B
List of Individuals Interviewed

July 20, DPO Panel Meeting

Melvin Shannon	NRC Region II
Edmund Sullivan	NRC Office of Nuclear Reactor Regulation

August 15, 2006 Panel Meeting

Edmund Sullivan	NRC Office of Nuclear Reactor Regulation
Timothy Steingass	NRC Office of Nuclear Reactor Regulation
Leonard Olshan	NRC Office of Nuclear Reactor Regulation
Kulin Desai	NRC Office of Nuclear Reactor Regulation
Chang-Yang Li	NRC Office of Nuclear Reactor Regulation
Chia-Fu Sheng	NRC Office of Nuclear Reactor Regulation
Sujit Samaddar	NRC Office of Nuclear Reactor Regulation
Leon Whitney	NRC Office of Nuclear Reactor Regulation
Ralph Architzel	NRC Office of Nuclear Reactor Regulation