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A Duke Energy Company

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U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555

Subject: Oconee Nuclear Station
Docket Nos. 50-269, -270, -287
Licensee Event Report 50-269/1999-01, Revision 01
Problem Investigation Process No.: 0-099-0737

Gentlemen:

Pursuant to 10 CFR 50.73 Sections (a) (1) and (d), attached is Licensee Event Report 50-269/1999-01, Revision 01, concerning a single failure issue that may not meet the current licensing basis of the Emergency Feedwater (EFW) System. The EFW system design relies on alternate sources of emergency feedwater for some feedwater line break accidents. An NRC Staff letter dated February 24, 1999 indicated that this reliance was not approved in the current licensing basis. This supplement provides additional information regarding the results of single failure analysis of the EFW system.

This report is being submitted in accordance with 10 CFR 50.73 (a) (2) (ii) (B). This event is considered to be of no significance with respect to the health and safety of the public.

Very truly yours,

W. R. McCollum, Jr.

Attachment

IE22

cc: Mr. Luis A. Reyes
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Mr. M. C. Shannon
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NRC FORM 366 (4-95) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED OMD NO. 3150-0104
EXPIRES: 04/30/98
ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (MNBB 7714), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Oconee Nuclear Station, Unit 1	05000269	1 of 12

TITLE (4)
Emergency Feedwater Outside Design Basis Due to Deficient Documentation

EVENT DATE (5)			LER NUMBER (6)					REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR		SEQUENTIAL NUMBER		REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER(S)
											Unit 2	05000270
02	24	99	1999	-	01	-	01	03	26	99	Unit 3	05000287

OPERATING MODE (9)	N	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR (Check one or more of the following) (11)			
POWER LEVEL (10)	100	20.402(b)	20.405(c)	50.73(a)(2)(iv)	73.71(b)
		20.405(a)(1)(i)	50.36(c)(1)	50.73(a)(2)(v)	73.71(c)
		20.405(a)(1)(ii)	50.36(c)(2)	50.73(a)(2)(vii)	OTHER (Specify in Abstract below and in Text, NRC Form 366A)
		20.405(a)(1)(iii)	50.73(a)(2)(i)	50.73(a)(2)(viii)(A)	
		20.405(a)(1)(iv)	X 50.73(a)(2)(ii)(B)	50.73(a)(2)(viii)(B)	
		20.405(a)(1)(v)	50.73(a)(2)(iii)	50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER	
	AREA CODE	
L.E. Nicholson, Regulatory Compliance Manager	(864)	885-3292

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	

SUPPLEMENTAL REPORT EXPECTED (14)			EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
	YES (If yes, complete EXPECTED SUBMISSION DATE)	X NO				

ABSTRACT (Limit to 1400 spaces, i.e. approximately fifteen single-space typewritten lines) (16)

On January 26, 1999, a NRC Inspection Report identified that the Oconee Emergency Feedwater (EFW) System design may not meet the current licensing basis due to a single failure issue. On February 8, 1999, a meeting was held in Washington with the NRC staff to discuss the issue. Duke Energy Company (Duke) stated that, for certain event scenarios, single failure protection for the EFW system is provided by EFW from other units and diverse shared Auxiliary Service Water Systems. On February 24, 1999, a NRC Staff letter stated that EFW must be able to withstand a single active failure on an affected unit, with certain approved exceptions. Duke elected to report this issue as a condition outside the design basis of the plant. An ENS notification was made at 1521 hours on February 26, 1999. Units 1 and 3 were at 100% power and Unit 2 was at hot shutdown at the time of the report. The root cause is deficient written communications by Duke concerning the design and licensing requirements for the EFW system following the TMI-2 event. On September 30, 1999, Duke completed a more detailed single failure analysis of the EFW system to assure that the scope of the EFW single failure vulnerability issue is fully documented. Duke has undertaken corrective actions to clarify the licensing basis and assure the plant conforms to the clarified licensing basis.

EVALUATION:

Background

The original (1970) Final Safety Analysis Report (FSAR) for Oconee stated that Emergency Feedwater (EFW) System [EIIS:BA] included only one turbine driven emergency feedwater pump (TDEFWP)[EIIS:P] per unit. Feedwater line breaks were not addressed in the original design of Oconee and are not addressed in Chapter 15 of the Updated FSAR.

The requirements and licensing bases for the EFW system have evolved over time as Oconee and the nuclear industry have recognized and responded to emerging issues, as described below.

In a letter dated December 15, 1972, the AEC requested information on the effects of a High Energy Line Break (HELB) outside of containment. The AEC granted the Oconee Unit 1 operating license on February 6, 1973, while a HELB analysis was in progress. Duke submitted the HELB analyses for Oconee on April 25, 1973, followed by a supplement on June 22, 1973. These submittals indicated that certain postulated breaks could cause the loss of the Main Feedwater (MFDW) [EIIS:SJ] and EFW systems. In addition, certain breaks could result in the loss of the 4160 volt engineered safeguards switchgear [EIIS:EB]. The EFW system was modified to add an alternate flow path to each steam generator (SG) [EIIS:SG]. The added path was routed to avoid areas that were postulated to be damaged by the identified breaks. The EFW system previously included the ability to cross-connect between Oconee units. This modification also added a second cross-connect header between Oconee units. The NRC subsequently accepted the use of cross-connects to mitigate this event in a safety evaluation dated July 6, 1973.

Several improvements to the system were implemented following the accident at Three Mile Island (TMI) in 1979. For example, Oconee added motor driven emergency feedwater pumps (MDEFWP) (2 per unit), and provided flow paths and controls independent of the Integrated Control System (ICS) [EIIS:JA]. Significant correspondence occurred between Duke and the NRC as a result of the post-TMI upgrades.

Currently, the EFW system consists of two MDEFWPs and one TDEFWP per unit. The EFW Pumps have initiation circuitry that starts the pumps automatically upon certain conditions. Both MDEFWPs and the TDEFWP automatically start on a loss of both MFW pumps. The initial suction

source for the EFW pumps is the Upper Surge Tank (UST) [EIIS:TK]. SG levels are controlled automatically by the EFW Control Valves. All EFW automatic initiation logic and control features are independent of the ICS. The capability exists to manually align the EFW system to cross-feed from one Oconee unit to another, if necessary.

The Standby Shutdown Facility (SSF) [EIIS:NB] consists of an Auxiliary Service Water (ASW) System [EIIS:BA], Reactor Coolant Makeup System [EIIS:CB], associated instrumentation, and support systems such as power generation and distribution, and interfaces with normal plant systems. The SSF augments existing capabilities of the EFW system, and other systems, to mitigate postulated fires, turbine building flooding, and security incidents. The SSF systems can supply all three Oconee units simultaneously.

Whenever an Oconee reactor is above 250F, Technical Specifications (TS) require the EFW and SSF systems to be operable. TS also provide limiting conditions and action statements for inoperable components/trains associated with these systems.

Event Description:

On January 26, 1999, NRC Inspection Report 50-269/99-10, 50-270/99-10, and 50-287/99-10 (IR 99-10) was issued and identified certain issues related to the Emergency Feedwater (EFW) System design basis.

IR 99-10 resulted in a preliminary determination that the Oconee licensing basis requires that the EFW system on the affected unit alone should be capable of mitigating a feedwater line break coincident with a single active failure. IR 99-10 stated that the current design was apparently contrary to the approved licensing basis of the EFW system. Specifically, a single active failure of 1,2,3C-187, Unit 1, 2, or 3 UPPER SURGE TANK MAKEUP TO HOTWELL ISOLATION VALVE, (C-187) [EIIS:V] during certain postulated Main Feedwater (MFDW) line breaks could prevent the EFW system on the affected Oconee unit from performing its safety function of decay heat removal.

The design of C-187 is to open on a low condenser hotwell level during normal operation but close on low Upper Surge Tank (UST) level to preserve minimum UST inventory as a source for the EFW pumps. As a result, in the event of a MFDW line break, the contents of the condenser hotwell would be spilled through the break. Initially C-187

would open to provide makeup from the UST to the hotwell, then, as UST level decreased to the control setpoint, C-187 would receive a signal to close. Although the circuitry to close C-187 on low UST level is single failure proof, a failure of the valve to close on demand could result in a loss of suction inventory to the EFW system. The circuitry to close C-187 and C-176 on low UST level was added via a modification in the 1993 timeframe. Prior to that modification, these valves would have remained open based on low hotwell level.

Duke met with the NRC staff in Washington on February 8, 1999 to communicate the position that the EFW system is not an Engineered Safeguards [EIIS:JE] system and was not designed or licensed to withstand all potential single failures. For HELBs, the design basis of Oconee has always relied on diverse and redundant methods of supplying feedwater to the Steam Generators (SGs) to remove decay heat following various plant transients. The options include the unit's EFW system, cross-connection to another unit's EFW system, and the Standby Shutdown Facility (SSF) Auxiliary Service Water System. Duke considered that the C-187 single failure vulnerability was not a significant safety issue because it required two simultaneous low probability events, emergency operating procedures could mitigate the event using diverse and redundant methods, and the single failure had a minor impact on the reliability of the EFW system.

In response to IR 99-10 and the February 8, 1999 meeting, the NRC Staff communicated a position that the EFW system on the affected unit must be able to withstand a single active failure, with certain approved exceptions. Therefore, the current design represented a nonconforming condition. This position was documented in a letter from the staff, dated February 24, 1999.

Upon receipt of the letter, Duke placed this issue in the corrective action program, by initiation of Problem Investigation Process (PIP) 0-O99-0737. In accordance with the corrective action program, Duke promptly initiated operability and reportability determinations to address the non-conforming condition.

Duke considers the EFW systems on all three Oconee units to be Operable with a nonconforming condition. However, Duke management determined that, based on the NRC Staff's interpretation, it was prudent and appropriate to report this issue under 10CFR50.72(b)(1)(ii)(B) and 50.73(a)(2)(ii)(B) as a condition outside the design basis

of the plant. An ENS notification was made at 1521 hours on February 26, 1999.

The Oconee design to mitigate certain events includes the capability to provide flow to the affected Oconee unit from alternate sources of emergency feedwater for secondary decay heat removal. These alternate sources are other Oconee units and other systems such as the Auxiliary Service Water System. The specific issue covered in this LER is the Staff's position that the Staff had not considered and approved reliance on these alternate sources of emergency feedwater for some feedwater line break accident scenarios.

A related issue was included in Inspection Report 50-269/98-15. In November 1998, Duke issued a revision to the UFSAR to reflect our understanding of the single failure requirements of the EFW system. However, the information included in this revision is inconsistent with the position given in the Staff's letter of February 24, 1999. Therefore, Duke has withdrawn that revision and removed it from the UFSAR annual update.

In order to assure that any single failure vulnerabilities of the system are fully characterized, Duke performed a more detailed single failure analysis of the EFW system for the full scope of events covered in Updated Final Safety Analysis Report 10.4.7. Based on the results of this analysis, Duke is assessing various options to clarify the EFW licensing basis

This action plan was discussed with the NRC staff via a conference call on March 16, 1999. As part of that conference call, Duke indicated that this LER would provide information related to the EFW cross connection flow paths. This information is provided in the Safety Evaluation at the end of this report.

The detailed single failure analysis of the EFW system, discussed above, was completed. This analysis, completed without regard to the redundant and diverse capabilities of the Oconee EFW system, identified 37 vulnerabilities (which included the previously identified issue associated with C-187). These 37 vulnerabilities can be grouped into four categories plus 7 miscellaneous issues: UST inventory issues (9 issues), single failures that can affect both EFW flow control valves (5 issues), single failures that can affect a single EFW flow path (5 issues) and condenser hotwell inventory issues (11 issues). A subsequent analysis of the 37 items confirmed that the

Oconee design would be able to successfully mitigate these vulnerabilities using the diverse and redundant methods of supplying EFW that had previously been discussed with the NRC. The corresponding risk assessment determined that most of the failures contribute to cut sets with a core damage frequency (CDF) of less than 1E-8. The aggregate effect of all these issues results in a CDF increase of approximately 4E-7.

Conclusions:

The root cause of this condition is deficient written communications. The major contributor to this discrepancy was the absence of robust, precise control of licensing correspondence during the immediate Post-TMI era.

Documents prepared and submitted by Duke to the NRC to meet NUREG 0737, Item II.E.1, following the 1979 TMI-2 event, addressed the ability of the Emergency Feedwater (EFW) System to mitigate a variety of events. In a few isolated cases, wording that related to the ability to meet specific scenarios was inappropriately applied to other scenarios. Also, some documents did not appropriately reflect the original licensing basis when responding on the capability of the modified system to mitigate certain events.

Subsequently, in 1982, sentences were taken out of context and incorporated into the first update of the Oconee Final Safety Analysis Report (FSAR). These statements were promulgated into additional documents, including the current Updated FSAR (UFSAR) and Design Basis Documents, resulting in a current licensing basis that conflicts with the design of the EFW system.

Due to the historical nature of this event, no corrective action from more recent events could have prevented the occurrence of this event. Therefore, this event is not considered recurring.

However, as part of an overall program to improve the quality and accuracy of the UFSAR, Duke is performing a review of the current UFSAR to identify statements related to the EFW system that are not supported by design documents. Such statements will be reviewed and action taken to provide reasonable assurance that the design basis of the EFW system is accurately reflected in the UFSAR.

There were no equipment failures, radiation releases, personnel overexposures, or injuries associated with this event.

Corrective Actions:

Immediate

1. Problem Investigation Process (PIP) 0-O99-0737 was initiated to begin the corrective action process. This included the performance of an operability evaluation.

Subsequent

1. A related issue was included in Inspection Report 50-269/98-15. In November 1998, Duke issued a revision to the UFSAR to reflect our understanding of the single failure requirements of the EFW system. However, the information included in this revision is inconsistent with the position given in the Staff's letter of February 24, 1999. Therefore, Duke has withdrawn that revision and removed it from the UFSAR annual update.

2. Duke has issued interim guidance to Operations in the form of an "Operations Guide" to administratively control the operability of the EFW cross connections between units.

3. A Selected Licensee Commitment (SLC) has been implemented to address operability of the EFW cross connections between units. This SLC was implemented on April 29, 1999.

4. Duke has performed a more detailed single failure analysis of the EFW system for design basis events listed in UFSAR 10.4.7 in order to assure that the scope of the EFW single failure vulnerability issue is fully characterized. This analysis was completed on September 30, 1999.

5. Duke has completed a review of the current UFSAR to identify statements related to the EFW system that are not supported by design documents. The results of this review have been incorporated into the UFSAR revision and will be resolved through licensing activities in Planned Corrective Action #1.

Planned

1. Based upon the results of Subsequent Corrective Action 4 above, Duke is assessing potential options and implementing corrective actions to clarify the EFW licensing basis and assure the plant conforms to the clarified licensing basis. These options may include implementation of plant modifications to resolve the conflict with the Staff's position or submission of requests to revise the licensing basis, including the UFSAR, so that specific single failure modes would be approved exceptions.

Subsequent corrections 3, 4 and 5, and planned corrective action 1 are considered to be NRC Commitments. These are the only NRC Commitment items contained in this LER.

Safety Analysis

The issue relevant to this report is the degree of licensing approval for single failure modes which exist and potentially might prevent the Emergency Feedwater (EFW) System on an affected Oconee Unit from performing its intended safety function. The applicable accident scenarios and equipment failures have not occurred. Duke considers that the nonconforming issues addressed in this report do not represent a significant safety concern. The wording of Inspection Report 50-269, 270, 287/99-10 and the NRC letter of February 24, 1999 indicates that the NRC shares this conclusion.

The EFW system has multiple injection flow paths (one to each Steam Generator (SG) that is automatic and separated from the Integrated Control System (ICS), and one that requires operator action, uses components that are part of the Main Feedwater System, and is controlled using the ICS). These flow paths are served by two Motor Driven EFW pumps (MDEFWPs) (one per SG) and one Turbine Driven EFW pump (TDEFWP) (serves both SG). Suction is taken from either the Upper Surge Tank (UST) or condenser Hotwell, with make-up from the UST to the Hotwell. Thus, the system is protected from a number of potential single failures.

However, both Duke and the NRC agree that some EFW single failure modes exist and have been approved by the NRC. For example, the Stand-by Shutdown Facility (SSF) was specifically constructed and

licensed to function during certain fire, flood, or security events which might cause the EFW system to become unavailable. Oconee's design basis has been that any existing EFW single failure modes are compensated for by a high degree of redundancy and diversity. The redundancy and diversity are provided by the number of pumps and trains in an Oconee Unit's EFW system, the ability to cross-feed from another Unit's EFW systems, and/or the ability to use the SSF Auxiliary Service Water System (SSF-ASW).

Overall, the number of pumps and trains provided by an Oconee Unit's EFW system greatly reduces the probability of single failures for that EFW system. In addition, the availability of the EFW system on other units and the redundant systems that may be used further reduces the probability of a total loss of safety function. Therefore, the existing degree of redundancy and diversity provides adequate assurance that the decay heat removal safety function can be met.

However, it was observed that Technical Specifications and other administrative controls did not provide guidance to control the ability to cross-feed between units. The existing TS action statements address the impact of removal from service of EFW components on the associated unit only. Removal from service of the crossover paths was not addressed. On April 29, 1999, Duke implemented a Selected Licensee Commitment which provided guidance and compensatory actions for removal of the crossover path from service.

The components in the EFW, EFW crossover, and SSF ASW systems are included in the Inservice Test (IST) program. The TDEFWP, MDEFWPs, and SSF-Auxiliary Service Water Pump are all tested quarterly per ASME Section XI, Subsection IWP. System valves are tested as appropriate under Subsection IWV.

EFW HEADER TRAIN & UNIT CROSSOVER ISOLATION VALVES, 1,2,3FDW-313 and 1,2,3FDW-314, provide the ability to cross feed from any Oconee Unit to any other Oconee unit. These manual valves are located in the turbine building basement. The ability to pass flow through the cross-connect has been verified by testing.

These valves were stroke tested at cold shutdown until mid-1998, when the IST program was revised to test them quarterly at power. These valves had not shown any operating problems when tested at cold shutdown or during prior tests at power.

During recent testing on the morning of January 29, 1999, valve 1FDW-313 was stuck on its seat and the assigned operator needed assistance to initiate movement. Additional personnel were able to open the valve. The entire evolution was completed within the required time. As a result of this difficulty, valves 1,2,3FDW-313 and 1,2,3FDW-314 were retested that same afternoon and it was verified that one operator could open the valves. It was observed that pump tests had recently been performed. As a result, calculations were performed which indicated that pressure binding was possible after operating one of the EFW pumps in test alignment. Interim compensatory measures were taken to assure that each valve could be opened by a single operator in the future. Additional actions are being evaluated for permanent resolution of this issue. An operability evaluation found the EFW system to be operable because a stuck valve could be opened in a timely manner by use of more than one operator, if needed. Additionally, only one of the two valves would be required to operate in order to establish EFW flow to one steam generator for decay heat removal. Therefore, the EFW cross connect flow paths are capable of providing flow to alternate units. These flow paths, along with the SSF ASW System, assure that the intended safety function of secondary side heat removal can be accomplished following a feedwater line break with a single failure of the EFW system on the affected unit.

Concerning the 37 issues identified by the single failure analysis, these were categorized and the results are as follows:

UST Inventory Issues (9 issues)
These issues deal with depletion of the inventory of the UST. The majority of these issues involve a normally closed manual isolation valve, consequently the safety significance of this issue is low. In all cases, it has been shown that adequate feedwater can be delivered to the steam generators from the affected unit, or from diverse sources, to mitigate the event.

Single Failures That Can Affect Both EFW Flow Control Valves (5 issues)
These issues deal with failures that can render both EFW Flow Control Valves inoperable. In all cases, these failures can be mitigated by the use of the non-safety main feedwater startup flow path. In the event that the main feedwater startup flow path is unavailable, these failures can be mitigated by use of SSF Auxiliary Service Water. Consequently, the safety significance of these failures is low.

Single Failures That Can Affect A Single EFW Flow Path (5 issues)
These five issues are concerned with failures that can cause the inoperability of one of the EFW flow paths. These failures can be mitigated by the use of the main feedwater startup flow path, with the exception of one failure that results in only the loss of remote manual control of the affected valve. As with the failures affecting both EFW flow paths, the SSF Auxiliary Service Water system continues to be available for event mitigation. Consequently, the safety significance of these failures is low.

Hotwell Inventory (11 issues)
These eleven issues are concerned with failures that have the potential to affect hotwell inventory. Ten of these failures have low safety significance as long term EFW inventory can be achieved by makeup to the UST, or the use of the SSF Auxiliary Service Water system. The eleventh issue is of low safety significance as the failure deals with the loss of hotwell temperature indication which is not used by the operators for indication of EFW operational requirements.

Other Issues (7 issues)
These remaining six issues deal with failures of EFW pumps in the on position, a valve switch mispositioning, and failures of UST level and temperature indication. In all cases, these have been determined to have no safety significance. With the pump failures, the EFW flow control valves continue to function allowing the operator to control delivery of feedwater to the steam generators. Procedures check valve position periodically to assure the component is not mispositioned. With the UST level indication failure, the failure will be readily apparent to the operator as this is a two channel instrument of which only one channel will have failed. With the failure of the UST temperature indication, this temperature is not used as a basis for operator actions for accident mitigation.

A PRA evaluation was performed in support of the Oconee EFW single failure vulnerability study. This report indicated that most failures contribute to cut sets that are less than 1E-8 (including C-187, which contributes negligibly). Also, the FWLB is assumed to fail the hotwell, resulting in a CDF of 5E-8 .

As is indicated by the PRA evaluation, the safety significance of the aforementioned 37 failures is very low. The combined effect of these 37 issues increased the CDF by approximately 4E-7. Additionally, the

redundant and diverse design of the Oconee EFW system (which includes unit cross connects, the SSF-ASW and the Station ASW) affords a reliable method or providing water to the steam generators during any of the previously mentioned single failure scenarios.

Therefore, the health and safety of the public is not affected by this event.