NRC FORM 366 U.S. NUCLEAR REGULATORY COMMISSION
(6-1998)

LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

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FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Waterford Steam Electric Station, Unit 3	05000-382	1 of 10

TITLE (4)
Inadequate Pumping Capacity in the Dry Cooling Tower Areas due to Inadequate Design Control

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
									N/A	N/A
7	26	99	99	- 010 -	00	8	26	1999	FACILITY NAME: N/A	DOCKET NUMBER: N/A

OPERATING MODE (9)	1
POWER LEVEL (10)	100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)

	20.2201(b)		20.2203(a)(2)(v)		50.73(a)(2)(i)		50.73(a)(2)(viii)
	20.2203(a)(1)		20.2203(a)(3)(i)		50.73(a)(2)(ii)		50.73(a)(2)(x)
	20.2203(a)(2)(i)		20.2203(a)(3)(ii)		50.73(a)(2)(iii)		73.71
	20.2203(a)(2)(ii)		20.2203(a)(4)		50.73(a)(2)(iv)		OTHER
	20.2203(a)(2)(iii)		50.36(c)(1)	x	50.73(a)(2)(v)		Specify in Abstract below or in NRC Form 366A
	20.2203(a)(2)(iv)		50.36(c)(2)		50.73(a)(2)(vii)		

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
Paul Gropp, Design Engineering Manager	(504) 739-6652

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

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX

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

ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines) (16)

On July 26th, 1999, Entergy Operations Incorporated (EOI) determined that the pumping capacity of the pumps in the dry cooling tower areas was inadequate to preclude flooding of safety related or essential equipment during either a Probable Maximum Precipitation (PMP) event (assuming two of the four installed pumps are unavailable in accordance with the licensing basis). An investigation has determined the root cause to be an inadequate original design. Additionally, the original design of the sump system was not fully implemented. To address this condition, portable pumps were installed in each of the dry cooling tower areas to ensure sufficient pumping capacity.

The above condition could result in safety related equipment associated with the Ultimate Heat Sink becoming inoperable during the PMP or the SPS. However, based on an engineering analysis, it has been determined that with the postulated loss of safety related equipment, the Ultimate Heat Sink and Emergency Feedwater System would be capable of performing its design function of dissipating heat from the reactor and its auxiliaries and safe shutdown could have been achieved. Accordingly, the health and safety of the plant and general public were not compromised during this condition.

REPORTABLE OCCURRENCE

On July 26, 1999, Waterford determined the pumping capacity in the Dry Cooling Tower (DCT) [CTW] as inadequate to preclude flooding of safety-related components during a Probable Maximum Precipitation (PMP) event (assuming two of the four installed pumps are unavailable in accordance with the licensing basis). This condition could adversely impact the capability of the Ultimate Heat Sink [BS] to remove residual heat. Accordingly, this condition is being reported per 10CFR50.73(a)(2)(v)(B), as a condition that alone could have prevented the fulfillment of the safety function of structures or systems that are needed to remove residual heat. On July 26, 1999, a four hour notification was made per 10CFR50.72(b)(2)(iii)(B) requirement.

INITIAL CONDITIONS

Upon discovery of this event, Waterford 3 was at 100% power. There were no systems, structures, or components inoperable relative to this condition.

EVENT DESCRIPTION

Background

Waterford 3's Final Safety Analysis Report (FSAR) Subsection 2.4.2.3, Effects of Local Intense Precipitation, and Table 2.4-6, Probable Maximum Precipitation (PMP) Runoff Accumulation in the Cooling Tower Areas, reflect that 23,131 square feet of ponding area and 35,284.2 square feet of contributing area (open or adjacent roof that drains to the DCT) were used in the current licensing basis analysis for rainwater ponding in the DCT areas. In addition, FSAR Subsection 2.4.2.3.3,d, Effects of PMP on Roofs of Structures, reflects that 1.71 feet is the maximum depth that rainwater can rise before flooding of essential equipment can occur.

Event

In June of 1998, during the Engineering Scoping of Design Change Package (DCP) 3514, Enhancement to Diesel Fuel Oil Storage System [DE], concerns were raised related to the effect the installation of a new diesel fuel oil storage tank would have on the ponding analysis. In February of 1999, after several reviews and surveys of the ponding issues, EOI determined the maximum depth that rainwater can rise before flooding of essential equipment (Sump Pump Motors) can occur is 1.4 feet, rather than 1.7 feet as specified in the FSAR. In June of 1999, a contract was issued to develop a new ponding calculation for the DCT areas. This calculation utilizes new detailed surveys of the ponding areas to more accurately reflect that:

1. The available ponding area is reduced from 23,131 square feet to 20,523 square feet due to reductions for items such as concrete column pedestals, the Liquid Waste Management system tank, a pump room which was added in the west DCT area in 1985, an air-conditioned enclosure, a decontamination curbed area added on the (-) 35.00 elevation of the Fuel Handling Building (FHB), and long term storage of equipment.

2. The maximum water depth achievable prior to flooding essential and/or safety related equipment is reduced from 1.71 feet to 1.417 feet in WCT basin A and 1.513 feet in WCT basin B. This is because the DCT sump pump motors are lower than the safety related electrical equipment previously assumed to be the critical failure depth.

3. The contribution area is decreased from 35,284.2 square feet to 35,052.8 square feet due to conservatism in the original analysis (FSAR Figure 2.4-8).

Based on a draft calculation, the results indicate that an additional 200 gpm pumping capacity is needed in each of the cooling tower areas during the PMP event. In addition, for the SPS event, the new calculation reflects that a 100 gpm pumping capacity is needed in each of the two cooling tower areas within 3 hours, versus the 6 hours for a single pump currently indicated in FSAR Subsection 2.4.2.3.4.

CAUSAL FACTORS

Entergy conducted an investigation into this condition. The following causal factors were identified:

1. The original design of the cooling tower area sump pump system was inadequate. Although the documented margin provided in the FSAR was only 0.11 feet (1 3/8"), a formal calculation was not provided to document the design inputs and assumptions which were used in this analysis.

2. The original design of the cooling tower area sump pump system was not completely implemented. The ponding analysis in the FSAR is dependent on operation of the sump pumps at water levels that would partially submerge the motors. The sump pump design documentation reflects that diving bells were ordered to cover the pump motors and prevent wetting during brief periods when rainfall exceeds pumping capacity. The diving bells are not presently installed, and plant walkdowns revealed the discharge pipe and electrical conduits would require revision before the diving bells could be installed. Therefore, it appears that the diving bells were ordered but were never installed due to poor work control practices during original plant construction.

   In addition, SMP-84-257 was approved in 1985 to install a new liquid waste storage tank and associated pump room in the west dry cooling tower area. This design change did not address the impact on the ponding analysis in the Safety Evaluation prepared for the Station Modification Package (SMP).

3. Administrative Controls were Incomplete. Procedure UNT-007-006 describes the requirements for storing materials on the (-) 35.00 elevation of the FHB and cooling tower areas but there are no precautions, restrictions, or controls related to maintaining the open area credited in the FSAR ponding analysis. Designated tool and other material storage

areas have been established in the FHB since original plant construction, as well as an air-conditioned office type enclosure and a curbed decontamination type area. These changes have reduced the surface area available for rainwater ponding.

CORRECTIVE ACTIONS

1. Portable pumps with a capacity of at least 200 gpm each were installed in each of the Dry Cooling Tower areas.

2. Calculation EC-M99-010, DCT Basin Basis Ponding Analysis to document the requirements for the dry cooling tower sump pumps will be completed and issued.

3. A Temporary Alteration Request (TAR) will be prepared to authorize short term installation of the additional 200 gpm pumping capacity in each of the DCT areas.

4. Revise the licensing basis for the current configuration or prepare a configuration change to resolve the pumping capacity in the cooling tower area as recommended by calculation EC-M99-010.

5. Revise procedure UNT-007-006, Housekeeping, to identify the ponding concern in the cooling tower areas and the FHB.

SAFETY SIGNIFICANCE

The Ultimate Heat Sink (UHS), which consists of Dry Cooling Towers (DCT), Wet Cooling Towers (WCT), and the water stored in the WCT Basins, dissipates heat removed from the reactor and its auxiliaries during normal operation, refueling and design basis accidents. CR 99-0789 documents that during a Probable Maximum Precipitation (PMP) event, the DCT sump pump system has inadequate pumping capacity (given the unavailability of 2 sump pumps) to prevent submergence of the safety related AC power supply that provides electrical power to the WCT and DCT fans. Therefore, the requirement for the UHS to dissipate plant auxiliary and decay heat requires evaluation to determine if the plant could have achieved safe shutdown and maintained the reactor in a safe shutdown condition.

Impact on EFW inventory:

Because Emergency Feedwater (EFW) is available to remove decay heat and cool the Reactor Coolant System (RCS), the UHS would only be required to dissipate the plant auxiliary heat loads in the natural draft mode. During a design basis tornado event, the plant is designed to stay in hot stand-by for the first 24 hours using the Emergency Feedwater (EFW) system and the atmospheric dump valves (ADVs). Secondary side makeup water is supplied from the Condensate Storage Pool (CSP) and emergency makeup can be provided from the WCT basins, which together contain enough inventory to cool the RCS for 24 hours. Since the design basis tornado event assumes a loss of an emergency diesel generator (EDG) concurrent with a Loss of offsite Power (LOOP), the failure modes during the PMP (which is not required to assume any single failures) are bounded by the design basis tornado event, except restoration of the DCT and WCT fans are required for SDC initiation prior to losing EFW inventory. Additional EFW inventory, beyond 24 hours, is available in the Circulating Water (CW) system piping that can be gravity fed into the WCT basins, or the rain water that resides in the DCT area from the PMP that could be pumped into the WCT basins using the portable pump. The impact of the Component Cooling Water (CCW) makeup system design deficiency described in CR 97-2551 was also considered. This makeup scenario could result in a continuous demand for water from the CSP to the CCW system for a period up to 30 minutes before operator action is credited. This CCW makeup demand could reduce the amount of water available in the CSP which is credited for EFW usage. However, as discussed previously, adequate amounts of EFW inventory remain due to the numerous sources of makeup water which would be available. Thus, there is more than enough EFW inventory to cool the RCS well beyond 24 hours. This would allow ample time to restore electrical power to the DCT and WCT fans in order for the UHS to dissipate both the plant auxiliary and SDC heat load.

Ultimate Heat Sink Impact:

To determine if the UHS can dissipate plant auxiliary heat loads in natural draft mode (i.e. assuming the failure of the DCT and WCT fan motors), the capability of the UHS was evaluated by assuming the maximum plant auxiliary heat load on the system. Using manufacturer's design information for the WCT and an empirical analysis for the DCT, the UHS, in natural draft mode assuming the 24 hour worst case meteorological condition, is capable of maintaining cooling water temperatures within design limits with adequate margin. To validate the empirical analysis used on the DCT, historical data was gathered when the DCT was operating in natural draft mode. The predicted DCT performance and actual DCT performance results were comparable. Therefore, the UHS is capable of removing the plant auxiliary heat load, without any fans available, while the EFW system is maintaining the RCS at hot standby conditions.

Conclusion:

The EFW analysis reflects that adequate water inventory would be available to remove decay heat and the UHS analysis reflects that natural draft cooling is capable of removing the plant auxiliary heat load. It is anticipated that a partial restoration of the fan Motor Control Center (MCC) would occur shortly after the water level is lowered below the bottom of the MCCs. Eight DCT fans and four WCT fans could be restored to operation quickly, as their breakers would not have been submerged. After the eight DCT fans and four WCT fans are restored to operation, the UHS has adequate capacity to remove the plant decay heat and auxiliary loads after 24 hours.

Probabilistic Argument:

The Probable Maximum Precipitation (PMP) event is described in FSAR section 2.4.2.3 as being calculated by a method which uses a combination of a physical model and several estimated meteorological parameters to yield the theoretically greatest depth of precipitation for a given duration physically possible over a particular area. As stated, this value is purely theoretical, and historical data shows no occurrences of *his scale in the area of Waterford 3. However, multiple methods were used to estimate a probability of , unlikely occurrence.

Historical data was gathe.ed from the National Climatic Data Center at http://www.ncdc.noaa.gov/ol/ncdc.html on 24 hour rainfall depths over the last 50 years at the New Orleans International Airport. Several methods and data groupings were used to calculate PMP probability, based on this data, and the results ranged from 1.68E-13 to 3.08E-5 per year. The range was due to the curvature of the data at high rainfall points, causing the projected frequency to be less and less likely. Due to information found in the Handbook of Applied Hydrology, by Dr. Ven Te Chow, which indicated PMP events have occurred in other parts of the U.S., it was determined the occurrence of a PMP, although unlikely, is not an incredible event. Based on the above information, the PMP frequency used for this safety significance determination is the most conservative developed using the Log – Pearson equations at 3.08E-5, since PMP depths have occurred in other parts of the U.S.

The sump configuration includes two 325 gpm sump pumps per side and one 100 gpm diesel driven pump. Because 525 gpm is needed for mitigating a PMP, both motor driven pumps would need to operate. Therefore, both sumps would flood through either a single failure of one EDG with a LOOP (since the two pumps in each sump are powered from separate sources), two individual sump pump failures (one on each train), or failure of operations to align the motor driven sump pumps to the EDGs with a LOOP. The probability of a LOOP, given a PMP, is expected to be higher than the average LOOP yearly frequency, and is assumed to be approximately 32%. When combining the likelihood that a PMP event would occur simultaneously with a LOOP, the resultant probability is approximately 3.08E-5 x 0.32 = 9.8E-6. With a failure of an operator to align the sump pump to the EDG, which is the dominant failure at a probability of 0.037, the resulting frequency of CCW loss given a PMP, is 9.8E-6 x 0.037 = 3.6E-7, which is of low risk significance.

However, flooding in the tower sumps does not lead directly to core damage. The flooding only affects the MCCs for the WCT and DCT fans, and does not affect the CCW or Auxiliary Component Cooling Water (ACCW) pumps. Therefore, ACCW and CCW would remain available. The current logic in the Probabilistic Safety Assessment (PSA) model is that a loss of all fans causes an immediate and complete loss of CCW. However, as discussed previously, a complete loss of CCW does not occur for this condition. Loss of the fans would cause a decrease in CCW/ACCW capacity, but some cooling would still be provided. As stated previously in this LER, it has been determined that the Ultimate Heat Sink will be able to cool its auxiliary loads without operation of the WCT and DCT fans, but would not be able to remove decay heat loads. However, there are sufficient EFW water sources to allow decay heat removal for at least 24 hours (the standard PRA mission time) following event initiation, at which time further recovery actions can occur. These actions may include the alignment of Circulating Water or the Demineralized water storage tank (DWST) to EFW, or the recovery and restoration of the tower fan MCCs. Therefore, the probability of core damage should be based only on events which cause EFW failures.

Because the UHS can cool its auxiliaries, and the EFW failures are independent of sump activities, the operator's failure to align the sumps to the EDG is irrelevant and not a failure which leads to core damage. If all three EFW pumps failed to provide sufficient flow, however, core damage would be imminent. The probability of this loss of feedwater flow was determined by manipulating the "Loss of All Feedwater" portion of the PRA model results. First, the Reactor Trip probability was conservatively set to 1.0. Then, the LOOP probability was set to 0.32, which is the assumed probability of a LOOP given a PMP. Finally, all other potential transient initiators were set to "false", to ensure only equipment failures were counted in the calculation. The resulting probability was 2.4E-5, which is the conditional Core Damage Probability (CDP) given a PMP. The total Core Damage Frequency (CDF) is then the calculated PMP frequency multiplied by the probability of a loss of all feedwater: 3.08E-5 x 2.4E-5 = 7.4E-10, which is negligible.

SIMILAR EVENTS

LER-99-007-00 - It was discovered that Waterford 3's licensing basis did not adequately describe the Waterford 3 plant design for tornado missile protection for the turbine-driven emergency feedwater (EFW) pump and steam supply piping.

LER-97-032-00 and LER-97-032-01 - It was discovered, as a result of an inadequate design. the Hydrogen Analyzer piping penetrating containment did not meet the requirements of General Design Criteria 54.

ADDITIONAL INFORMATION

Energy Industry Identification System (EIIS) codes are identified in the text within brackets [ ].

COMMITMENT IDENTIFICATION/VOLUNTARY ENHANCEMENT FORM

Attachment 2 to W3F1-99-0136
Reporting of Licensee Event Report
August 26, 1999
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COMMITMENT(S)	ONE-TIME ACTION*	CONTINUING COMPLIANCE*	SCHEDULED COMPLETION DATE (IF REQUIRED)	ASSOCIATED CR OR ER
Calculation EC-M99-010, DCT Basin Basis Ponding Analysis to document the requirements for the dry cooling tower sump pumps will be completed and issued.	x			CR 99-0789
A Temporary Alteration Request (TAR) will be prepared to authorize short term installation of the additional 200 gpm pumping capacity in each of the DCT areas.	x			99-0789
Revise the licensing basis for the current configuration or prepare a configuration change to resolve the pumping capacity in the cooling tower area as recommended by calculation EC-M99-010.	x			ER-W3-99-0763-00-00
Revise procedure UNT-007-006, Housekeeping, to identify the ponding Concern in the cooling tower areas and the FHB.		X		CR99-0789

VOLUNTARY ENHANCEMENT(S)	ASSOCIATED CR OR ER