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FACIL:50-315 Donald C. Cook Nuclear Power Plant, Unit 1, Indiana M 05000315
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SUBJECT: LER 97-010-02:on 970808,unit operation w/lake temperature in excess of design basis value,was determined.Caused by failure to recognize UFSAR value & other design aspects. Placed restrictions on plant operation.W/971231 ltr.

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INDIANA MICHIGAN POWER

December 31, 1997

United States Nuclear Regulatory Commission
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Washington, DC 20555

Operating Licenses DPR-58
Docket No. 50-315

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In accordance with the criteria established by 10 CFR 50.73 entitled Licensee Event Report System, the following report is being submitted:

97-010-02

Sincerely,

A. A. Blind
Site Vice President

/mbd

Attachment

c: A. B. Beach, Region III
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IE22

NRC FORM 366 (5-92) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104
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LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	Page 1 of 8
Donald C. Cook Nuclear Plant - Unit 1	50-315	

TITLE (4)
Unit Operation with Lake Temperature In Excess of Design Basis Value Results in Condition Outside the Design Basis

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
08	08	97	97	– 010 –	02	12	31	97	Cook, Unit 2	50-316
									FACILITY NAME	DOCKET NUMBER

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)(3)(I)		50.73(a)(2)(iii)	73.71(b)
20.2203(a)(1)		20.2203(a)(3)(ii)		50.73(a)(2)(iv)	73.71
20.2203(a)(2)(I)		20.2203(a)(4)		50.73(a)(2)(v)	OTHER
20.2203(a)(2)(ii)		50.36(c)(1)		50.73(a)(2)(vii)	(Specify in Abstract below and in Text, NRC Form 366A)
20.2203(a)(2)(iii)		50.36(c)(2)		50.73(a)(2)(viii)(A)	
20.2203(a)(2)(iv)		50.73(a)(2)(I)		50.73(a)(2)(viii)(B)	
20.2203(a)(2)(v)	X	50.73(a)(2)(ii)		50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
Mr. Jeb Kingseed, Nuclear Safety and Analysis Manager	616/697-5106

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	X	NO				

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

On August 8, 1997, with Units 1 and 2 at 100 percent Rated Thermal Power, as a result of questions posed by the NRC AE Design Inspection team, it was determined that both units had operated outside the design basis of 76° Fahrenheit for lake water temperature. An ENS notification was made at 0934 hours the same day under under 10CFR50.72(b)(1)(ii)(B), as a condition outside the design basis. This report is made in accordance with 10CFR50.73(a)(2)(ii), as a condition outside the design basis, and an unanalyzed condition.

The root cause of this event was the failure to recognize a UFSAR value as a design basis parameter and to recognize interrelationships between a UFSAR value and other design aspects. Process changes have been implemented which require that changes to design basis information be handled via the design change process, a corporate directive and policy were written to provide direction on design basis, and additional training on design basis has been provided to those employees involved in handling such information. Restrictions have been placed on plant operation such that the plant will not be operated with lake water temperatures above 76° Fahrenheit. This restriction will remain in effect until all analyses and 10CFR50.59 safety evaluations are complete.

Analysis of this event has been performed, taking into account the effects of the elevated service water temperature on the safety related systems to which it provides cooling. It has been determined that the event did not result in any threat to the health or safety of the public.

Condition Prior to Event
Unit 1 Mode 1, 100 percent Rated Thermal Power
Unit 2 Mode 1, 100 percent Rated Thermal Power

Description of Event
During the AE Design Inspection, conducted August 4 through September 12, 1997 at Cook Nuclear Plant, as a result of questions raised by the inspection team, it was determined that operation of either unit with Lake Michigan water temperature higher than 76° Fahrenheit (F) was contrary to the design basis information contained in the Updated Final Safety Analysis Report (UFSAR). Specifically, Chapter 9, Table 9.5-3, states that the service water inlet temperature to the Component Cooling Water (CCW) heat exchangers is 76°F. Service water inlet temperature is equivalent to Lake Michigan water temperature. Operation with a lake water temperature in excess of this value was determined to be a condition outside the design basis. As the Cook units did operate while lake temperature was greater than 76°F for a period in the summer of 1987 before any evaluation or assessments were performed, this constitutes a condition reportable under 10CFR50.72 and 50.73. Additionally, historical data shows that during July and August of most years since 1987, there were likely to be days when lake temperature exceeded 76°F.

When originally reported, it was stated that no 10CFR50.59 safety evaluation was performed for operation with the increased lake temperature. It was subsequently discovered that safety evaluations were performed, although the documentation level would not meet today's standards. While analysis has shown that higher temperatures are acceptable for containment heat removal, no single analysis identified and resolved all effects of the change in design basis lake temperatures. Therefore, as the existing analyses did not adequately address the 36 hour cooldown requirement or the Control Room equipment requirements, a condition outside the design basis which represent an unanalyzed condition in regards to the 36 hour cooldown and Control Room equipment, is also being reported under 10CFR50.72 and 50.73. This LER addresses the general issue of lake water temperature and the 36 hour cooldown. Details of the Control Room equipment operability issue are addressed separately in LER 315/97-014-02.

It should be noted that Lake Michigan water temperature, lake temperature, service water inlet temperature, Essential Service Water inlet temperature and the Ultimate Heat Sink (UHS) essentially represent the same parameter, and were used interchangeably in the evaluations and analyses previously conducted.

The historical information necessary for understanding this issue follows, and outlines the evaluations which were performed and the aspects which were considered.

- In the summer of 1987, Lake Michigan water temperature exceeded the UFSAR maximum limit of 76°F during an unusually hot, dry summer. An engineering assessment performed in September, 1987, reviewed the impact of the elevated lake temperature on its associated cooling loads. This evaluation postulated a lake temperature of 81°F and concluded that the cooling provided would still be adequate to meet the design requirements of the safety related systems.

- In July 1988, an internal memorandum was issued to address operation at an elevated Essential Service Water (ESW) temperature of 81°F. This memo contained a safety evaluation, in the then current format, which addressed the impact on containment integrity due to elevated ESW temperature. The memo took credit for the September, 1987, memo, in particular the portions dealing with the malfunctions of equipment important to safety and accidents. However, there was no indication that a calculation was performed to verify the ability to meet Technical Specification (T/S) Action Statement cooldown times.

Description of Event (cont'd)

- In August 1988, another memo was issued to address rising lake water temperatures. This memo addressed operation with a lake temperature up to 85°F. This memo considered the potential impact on CCW, Containment Spray (CTS), Residual Heat Removal (RHR), and containment integrity.
- A memo issued in July 1989, allowed the plant to operate at a UHS temperature of 90°F. This was predicated on operation of Unit 1 at full power and Unit 2 at a reduced thermal power level of 3250 MWt.
- A September 1992, memo discussed revision of the ESW operating procedure to reduce the maximum temperature for continued operation of the units from 90°F to 87.5°F.

In short, the lake temperature design value was originally 76°F, then raised successively to 81°, 85° and 90°F. The temperature limit was reduced in the early 1990s to 87.5°F due to Control Room equipment operability concerns.

UFSAR updates were performed to reflect the increased accident analysis input assumption for ESW temperature. Specifically, Section 14.3.4 of the UFSAR was updated to 81°F to reflect the ESW temperature assumed in the containment integrity analysis submitted for the Reduced Temperature and Pressure (RTP) program. A footnote was added to Section 14.3.4 to address an assessment on the long term containment integrity analysis with an increase in lake temperature of 85°F. The UFSAR was also updated in 1997, following NRC approval of the Steam Generator Tube Plugging Program analysis, to reflect the increase in ESW temperature to 87.5°F.

However, none of the updates addressed all aspects of the lake water temperature effects. As a result of the August 1997 AE Design Inspection, it was concluded that an elevated lake temperature was not adequately addressed in relation to Control Room equipment operability and the 36 hour cooldown analysis. This condition is, therefore, considered to be reportable as a condition outside the design basis while representing an unanalyzed condition in regards to Control Room equipment and the 36 hour cooldown.

Cause of Event

The root cause of this event was the failure to recognize a UFSAR value as a design basis parameter and to recognize interrelationships between a UFSAR value and other design aspects. Personnel conducting reviews to support operation of the plant at higher lake water temperature did not properly consider all the potential impacts.

Contributing causes to this event include:

- Rising standards for UFSAR compliance and design basis definition were not implemented within the organization.
- Design change procedures in place at the time of these events did not require considering a change to design bases values as a design change.

Analysis of Event

This event was reported via the ENS at 0934 hours on August 8, 1997, EDT under 10CFR50.72(b)(1)(ii)(B), as any event or condition during operation that results in a condition that is outside the design basis of the plant; and represents an unanalyzed condition. This report is therefore made in accordance with 10CFR50.73(a)(2)(ii), as an or event or condition that results in a condition that was outside the design basis of the plant, and which represents an unanalyzed condition in regards to Control Room equipment and the 36 hour cooldown.

The shared service water systems supply cooling water to various heat exchangers in both the primary and secondary systems of each unit. Provisions are made to ensure a continuous flow of cooling water to those systems and components necessary for plant safety both during normal operation and under accident conditions. Sufficient redundancy of piping and components is provided to ensure that cooling is maintained to vital services at all times.

The ESW system provides cooling to the CCW and the CTS heat exchangers, as well as the Emergency Diesel Generators (EDGs) and Control Room Air Conditioners.

The CCW system is designed to:

- Remove residual and sensible heat from the Reactor Coolant System (RCS), via the Residual Heat Removal (RHR) System, during plant shutdown;
- Cool the spent fuel pool water and the letdown flow to the Chemical and Volume Control System during power operation;
- Provide cooling to dissipate waste heat from various primary plant components, and
- Provide cooling for safeguards equipment.

Operations with lake temperature above 76°F can also affect the Circulating Water and Non-Essential Service Water systems. However, these systems are non-safety related and were not considered in this analysis.

In considering the effects of elevated lake temperatures, the effects on ESW and CCW performance parameters are of particular relevance because of their use in the containment integrity analysis after a LOCA. Specifically, the primary effect of a higher ESW temperature is a reduction in cooling of the containment sump water which is used for the lower and upper containment sprays during the recirculation phase of a Loss of Coolant Accident (LOCA). An increase in the spray temperature results in a reduction in the removal of heat and condensation of steam from the containment atmosphere, hence, the net effect of a higher ESW temperature is a higher peak containment pressure during a LOCA. The ESW temperature is not explicitly modeled for the LOCA core response, non-LOCA, and main steam mass and energy release calculations.

The following sections provide a review of the safety parameters and systems relevant to past operations with service water temperatures above 76°F. Each section is prefaced with a statement regarding the adequacy of the safety reviews that were previously discussed since they provided the justification and acceptance to operate at lake water temperatures above 76°F.

Containment Integrity

Containment integrity was adequately addressed and documented in the safety reviews. These reviews referenced analyses from Westinghouse which supported operation up to 87.5°F.

Analysis of Event (cont'd)

Key physical phenomena are considered in the containment pressure response analysis for conditions within containment during a postulated LOCA. In particular, the peak containment pressure transient is calculated based, in part, on the inlet service water temperature. For the CTS heat exchanger and the CCW heat exchangers, the UFSAR Chapter 9 ESW temperature value is 76°F. However, UFSAR Section 14.3.4 lists the assumed ESW temperature as 87.5°F to reflect the current analysis of record for both Units 1 and 2. The original assumed initial ESW inlet temperature was 76°F, which was based on equipment design parameters such as are used for heat exchanger sizing, and is reflected in various UFSAR tables for normal operating heat loads.

Based on the 1988 and 1989 reviews and on the Westinghouse analyses, past operation at service water inlet temperatures up to 87.5°F would not have resulted in unanalyzed accident consequences because sufficient cooling will still be provided to the equipment cooled by ESW. An assumed ESW inlet temperature of 87.5°F bounds the maximum expected lake water temperature.

In addition, operation at temperatures up to 87.5°F would not have impacted any of the fission product barriers. The radiological consequences of a LOCA are determined by the assumed containment leakage rate which is a function of containment pressure. Given a service water inlet temperature of 87.5°F, it was shown that the containment peak pressure will not exceed the 12.0 psig design limit on which the leak rate is based. Therefore, radiological consequences of a LOCA will be bounded by the current UFSAR analysis. At an elevated service water inlet temperature of 87.5°F, the functionality of the containment spray heat exchanger and the CCW heat exchanger during accident mitigation is maintained.

Containment Spray Heat Exchangers

Containment spray heat exchangers were adequately considered in the previous safety reviews and were not found to be adversely affected by lake water temperatures up to 87.5°F.

As discussed above in the previous section, the long term containment integrity analysis demonstrates that the CTS heat exchangers will provide adequate heat removal to limit the containment pressure to less than the design pressure of 12 psig, using 87.5°F essential service water. This is based on Westinghouse analyses and demonstrates that the CTS heat exchangers would have performed their safety function at the elevated lake temperature.

Spent Fuel Pool Cooling

The previous safety reviews did not consider spent fuel pool cooling because spent fuel pool cooling is not considered in the accident analysis, and these reviews focused on the impacts of the higher lake water temperatures on the accident analysis. This is considered to be an inadequacy in these previous reviews.

The Spent Fuel Pool Cooling system (SFPCS) has two heat exchangers that are cooled by the CCW system. One of the SFPCS heat exchangers is supplied CCW from one unit, the other heat exchanger is supplied by the other unit. An analysis performed by Holtec Corporation verified that for a normal refueling in Cycle 20, scheduled to occur in 2009, spent fuel pool design limits would be maintained with a CCW temperature of 108.4°F, which corresponds to an ESW inlet temperature of 90°F. This analysis assumed one train of spent fuel pool cooling and a vessel hold time of 100 hours prior to fuel movement. The assumption of a 100 hour vessel hold time is conservative, as the T/S requires 168 hours. Removal of the fuel after 100 hours as opposed to 168 hours would result in a heat load that is approximately 1.5 times as great in the spent fuel pool.

Analysis of Event (cont'd)

The assumed 36 hour cooldown requirement of 120°F CCW heat exchanger outlet temperature will not affect the SFPCS analysis since the CCW to the SFPCS is currently assumed to be taken from the opposite unit, that is, the unit that is not undergoing a rapid cooldown. Specifically, a single train of spent fuel pool cooling is provided using 95°F CCW supplied by the unit undergoing the core offload. Therefore, the CCW cooling water, at 120°F, from the unit that is postulated to be in a rapid cooldown mode, is not needed to provide heat removal for the opposite unit. This is consistent with the footnote #3 in Table 9.5-2 of the UFSAR which lists the CCW flow to the SFPCS heat exchangers for normal operation only, and not for LOCA or cooldown modes. Therefore, it is assumed that the unit that is in a rapid cooldown mode does not supply CCW to the associated SFPCS heat exchanger.

In addition, previous Westinghouse analyses indicate that the CCW/ESW heat exchanger heat removal capability is sufficient assuming a lake water temperature of 87.5°F during LOCA conditions. Therefore, CCW/ESW heat exchanger heat removal capability is also expected to be sufficient under the lower heat loads associated with spent fuel pool heat loads and non-accident conditions with service water inlet temperature elevated to 87.5°F.

Component Cooling Water

Component cooling water was discussed in the previous safety reviews and it was determined that CCW equipment would not be degraded. In 1997, errors were discovered in the modeling of the CCW heat exchangers. However, these errors were later proven to be insignificant to accident analysis.

The accident analysis for LOCA and containment integrity assume a lake temperature of 87.5°F, and result in adequate decay heat removal and containment pressure response, respectively. However, the original safety evaluations performed for the elevated lake temperatures did not explicitly address the affect of a higher lake temperature on the other components cooled by the CCW system during normal operation. Under normal operating conditions, the CCW heat exchanger outlet is limited to a maximum temperature of 95°F. Normal equipment heat loads cooled by the CCW system are not affected by the increased lake temperature, provided that this temperature limit is maintained. A calculation has been performed to show that with an ESW inlet temperature of 90°F, CCW temperature may increase to 108.4°F. In response to an accident such as a LOCA, or a rapid cooldown, the maximum CCW heat exchanger temperature may increase to 120°F.

Recently, a design change package was performed to evaluate the temporary operation of the CCW system at a temperature of 120°F during post-LOCA or emergency cooldown conditions. It was determined that some minor pipe support modifications and slight increases in CCW flow to coolers for the RHR, Safety Injection, and Centrifugal Charging pumps were required. These changes were made to bring the CCW system into full compliance with its design specifications. The operability determination for the CCW and associated systems determined that the system was still capable of performing its safety functions, even before these minor modifications were made. Therefore, even at a temporary elevated lake temperature, the CCW system was capable of performing its safety functions.

Analysis of Event (cont'd)

Cooldown Analysis

The previous safety reviews did not provide adequate consideration of T/S Limiting Condition for Operation (LCO) Action Statement cooldown times with respect to elevated lake water temperature, although one review noted that "...impact would be an increase in time to reach the cold condition...". These times do not apply to the accident analysis assumptions since accident analyses assume that the LCOs are met at the initiation of any design basis accident. Further, LCO times are intended to provide a "window" for the plant to transition from a state of higher risk to a lower risk state in an orderly manner. Therefore, the lack of consideration of LCO Action Statement times in the previous safety reviews did not represent a significant safety consequence. However, the completeness of these previous reviews was found to be inadequate since calculations were not performed to demonstrate cooldown capability at a UHS temperature of 87.5°F.

The most recent cooldown analysis was performed by Westinghouse in 1997 to demonstrate RHR cooldown capability. The analysis concluded that the RCS can be cooled to 140°F in less than 20 hours following reactor shutdown for normal two train cooldown and to 200°F in less than 36 hours following reactor shutdown with single train cooldown, although the CCW heat exchanger outlet temperature will be increased to 120°F. The calculation input parameters assumed a maximum service water temperature of 76°F. Analyses have not been completed to determine cooldown times with 87.5°F lake water. Although an increase in the ESW inlet temperature to the CCW Heat exchanger will result in a longer time to cooldown, the RHR and CCW systems will continue to provide for the removal of decay heat from the RCS, even if cold shutdown is not achieved within 36 hours.

The current cooldown analysis demonstrates that the plant can be cooled down in less than 36 hours using a single train of CCW/RHR. As discussed above, this analysis assumes an ESW temperature to the CCW heat exchanger of 76°F. An increase in the ESW inlet temperature above 76°F to the CCW heat exchanger will result in a longer time to cooldown, and may exceed the 36 hour technical specification time for a rapid cooldown using a single train of CCW/RHR. However, the safety function of controlled decay heat removal by the RHR/CCW systems will continue to be fulfilled.

Emergency Diesel Generators

The previous safety reviews adequately considered the impact on EDG cooling due to lake water temperature increases up to 87.5°F.

Review of the impact of the 87.5°F lake temperature on the diesel generator coolers indicates that the EDGs would continue to function within their design limits. The EDG design cooler inlet temperature limit is 90°F.

Control Room Ventilation System

The impact of the lake water temperature on the Control Room ventilation system has been analyzed and reported separately under LER 315/97-014-02.

In conclusion, analysis of this event has been performed, taking into account the effects of the elevated service water temperature on the safety related systems to which it provides cooling. It has been determined that the event did not result in any threat to the health or safety of the public.

Corrective Action

Restrictions have been placed on plant operation such that the plant will not be operated with service water inlet temperatures above 76°F, until proper evaluations are performed. If any unreviewed safety questions result from the review, these will be submitted to the NRC.

A design change package has been opened and will be completed to ensure documentation completeness for the change to the ESW inlet temperature.

A corporate directive and policy were written to provide direction on design basis and single failure criteria. Lower level existing procedures were revised, where necessary, to reference and incorporate the information provided in the directive and policy. Training was conducted on the directive and policy to provide the information on dealing with design bases and licensing bases information to the appropriate personnel, as well as the need for improved documentation and literal compliance with the UFSAR.

A process change has been made which requires changes to design basis information, such as lake water temperature, to be handled via the design change process. This requirement will effect a more thorough and detailed review of the impact of such changes on the design, operation and maintenance of the plant.

The UFSAR will be revised to indicate that the applicability of the 76°F service water temperature in Chapters 6 and 9 represents equipment design values, and are independent of accident analysis input assumptions on lake water temperature.

As discussed in the NRC's Confirmatory Action Letter (CAL) to the Cook Nuclear Plant, dated September 19, 1997, we have assessed the problems identified during the AE Design Inspection to determine whether these types of engineering problems exist in other safety related systems and whether they affect system operation. The results of that short-term assessment have provided reasonable assurance that the kinds of engineering problems found during the design inspection do not affect the operability of other safety systems. In the longer term, we will evaluate our programs for improvements to assure these kinds of engineering problems are promptly identified, thoroughly evaluated and resolved. The results of our reviews and assessments, as well as any necessary preventive actions, will be communicated separately to the NRC.

Failed Component Identification

Not applicable

Previous Similar Events

None