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AEP
INDIANA
MICHIGAN
POWER

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C0901-03
10 CFR 50.90

Docket Nos.: 50-315
50-316

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Mail Stop O-P1-17
Washington, DC 20555-0001

Donald C. Cook Nuclear Plant Units 1 and 2
RESPONSE TO NUCLEAR REGULATORY COMMISSION
REQUEST FOR ADDITIONAL INFORMATION REGARDING THE
DECAY TIME LICENSE AMENDMENT REQUEST
(TAC NOS. MB1975 AND MB1976)

References:

1) Letter from M. W. Rencheck (I&M) to Nuclear Regulatory Commission (NRC) Document Control Desk, "Donald C. Cook Nuclear Plant Units 1 and 2, Technical Specification Change Request Refueling Operations Decay Time," C0501-03, dated May 17, 2001.

2) Letter from J. F. Stang, NRC, to R. P. Powers (I&M) "Donald C. Cook Nuclear Plant, Units 1 and 2 – Request for Additional Information, 'License Amendment Request Refueling Operations Decay Time' (TAC Nos. MB1975 and MB1976)," dated August 10, 2001.

3) Letter from M. W. Rencheck (I&M) to NRC Document Control Desk, "Partial Response to Nuclear Regulatory Commission Request for Additional Information Regarding License Amendment Request for Control Room Habitability (TAC Nos. MA9394 and MA9395)," C0601-03, dated June 19, 2001.

This letter provides the information requested to support the NRC review of the analyses associated with the proposed decay times in Reference 1. Attachment 1 to this letter addresses the specific questions transmitted in Reference 2. The responses in this submittal provide only technical information supporting the previously submitted amendment request. Therefore, the responses do not impact the original evaluation of significant hazards consideration provided in

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Reference 1. Additionally, I&M has determined that the environmental assessment provided in Reference 1 is not affected by the information transmitted in this letter. Attachment 2 to this letter contains the commitment made in this letter regarding measurement of lake temperature. No other commitments are made.

Should you have any questions, please contact Mr. Ronald W. Gaston, Manager of Regulatory Affairs, at (616) 697-5020.

Sincerely,

M. W. Rencheck
Vice President Nuclear Engineering

\bjb

Attachment

c: J. E. Dyer
MDEQ - DW & RPD, w/o attachment
NRC Resident Inspector
R. Whale, w/o attachment

AFFIRMATION

I, Michael W. Rencheck, being duly sworn, state that I am Vice President of Indiana Michigan Power Company (I&M), that I am authorized to sign and file this request with the Nuclear Regulatory Commission on behalf of I&M, and that the statements made and the matters set forth herein pertaining to I&M are true and correct to the best of my knowledge, information, and belief.

Indiana Michigan Power Company

M. W. Rencheck
Vice President Nuclear Engineering

SWORN TO AND SUBSCRIBED BEFORE ME

THIS 5th DAY OF September, 2001

Notary Public

My Commission Expires

PATRICIA A. EDDIE
NOTARY PUBLIC-BERRIEN COUNTY, MI
MY COMMISSION EXPIRES
NOVEMBER 5, 2004

ATTACHMENT 1 TO C0901-03

RESPONSE TO NUCLEAR REGULATORY COMMISSION
REQUEST FOR ADDITIONAL INFORMATION REGARDING THE DECAY TIME
LICENSE AMENDMENT REQUEST

Nuclear Regulatory Commission (NRC) Question 1

Justify (with supporting data) that the number of days that it takes for the peak temperature to come down to the licensing basis temperature of 150°F can be classified as "short term," to satisfy the requirements of Section A.4.2 of the American Concrete Institute ACI-349-97, "Code Requirements for Nuclear Safety Related Concrete Structures," code 349-97 Appendix A.

Indiana Michigan Power Company (I&M) Response to Question 1

Based on the worst case scenario (148 hour decay time), the maximum duration that the water temperature remains above 150°F is approximately 788 hours (~33 days) with a peak temperature of 180°F.

ACI 349-97 does not provide an explicit definition of "short-term" nor does there appear to be any widely recognized time period to which "short-term" is typically applied throughout the industry. Section A.4.1 of the code allows prolonged exposure of up to 200°F around penetrations. Section A.4.2 allows temperature excursions of up to 350°F for accidents or any other short-term period and up to 650°F from steam or water jets in the event of a pipe failure. The following discussion is provided to support the conclusion, that the amount of time the spent fuel pool remains above 150°F can be considered "short-term."

In the commentary section of the subject code, three types of temperatures are defined: ambient, operating and accident, or abnormal temperatures. The ambient temperatures (ACI 349 – Section A.1.1) are related to meteorological changes; the operating temperatures are defined to produce "linear temperature distributions across structural sections"; and the accident or abnormal temperatures are defined as "short duration or transient temperatures, which usually produce non-linear temperature distributions across structural sections." I&M contends that by tying the temperature limits of Section A.4.2 to "accidents," the framers of the code implicitly accepted the mission time of accident response systems as the definition of "short-term." Thus, the duration of this transient can be considered "short-term." Additionally, the 788 hours is only approximately 0.2% of the 40 year plant life.

Finally, in this case the temperature limits of the code are conservative, as the code is not prescriptive in terms of penetration size relative to concrete mass or any other parameters that may impact temperature distribution (or gradient) resulting from a locally applied or accidental / short-term heat source. This conclusion is supported by the references cited below in the response to NRC Question 2, that suggest appreciable losses in concrete properties due to high temperatures do not occur unless the concrete receives prolonged exposure at temperatures of about 500°F.

NRC Question 2

Provide available test data to show that the reduced concrete strength due to the increased temperature during worst case conditions for the spent fuel pool (SFP) will not cause deterioration of the concrete either with or without load, as required by ACI code 349-97.

I&M Response to Question 2

The following references contain data that support the conclusion that a temperature of 180°F (82.2°C) will have minimal effects on the properties of concrete.

Reference	Relevant Quote
D. Campbell-Allen, E. W. E. Low, and H. Roper, "An Investigation on the Effect of Elevated Temperatures on Concrete for Reactor Vessels," Nuclear Structural Engineering, 1965, p 384.	Up to 250°C (482°F) the loss of compressive strength of concrete cylinders after one thermal cycle is small, in fact at 200°C (392°F) a slight increase in strength is apparent.
"Effect of High Temperature on Hardened Concrete," Concrete Construction Magazine, November 1971, p 477.	The first effects of a slow temperature rise in concrete will occur between 200 and 400°F when evaporation of the free moisture contained in the concrete mass occurs; ... As the temperature approaches 500°F, dehydration or loss of non-evaporable water or water of hydration, begins to take place. The first sizable degradation in compressive strength is usually experienced between 400 and 750°F.
Adam M. Neville, Hardened Concrete: Physical and Mechanical Aspects, American Concrete Institute, Detroit, 1971, pp 204 – 206.	The effect of temperature on the strength of concrete is small and somewhat irregular below 480°F but above about 570°F a definite loss of strength takes place.

NRC Question 3

For the fuel handling accident, the meteorological data set (ARCON96 format) provided by Indiana Michigan Power Company (I & M) as an attachment to the June 19, 2001, letter [cover letter Reference 3], appears to contain data which are questionable. For example:

- *For the year 1996, stability class A was reported for 4912 hours out of the available 8760 hours; 4404 hours in 1997; and 4653 hours in 1998. These appear to be unusually large* *fractions and are inconsistent with historic data reported in Table 2.2-4 of the updated final safety analysis report (UFSAR).*

- *There are periods in the data set in which the reported stability class did not change for numerous hours; 56 hours in one case. Given that this encompasses two diurnal cycles, the constant stability class suggests a potential instrumentation or data processing problem resulting in invalid data that perhaps should have been flagged as such.*

- *Over 25 percent of the observations of stability class A for the three years were reported between the evening hours of 1900 to 0700. This appears to be an untypically large fraction.*

I & M stated in the June 19, 2001, letter, that the data were validated by a meteorologist on your contractor's staff to ensure that the wind speed and direction were within normal operating ranges. The response also states that invalid data were not used. The response does not explicitly state that a similar validation was performed on the stability class data. (The staff did determine that a wind rose prepared using the submitted wind speed and wind direction data showed a good correlation to the 1992 data reported in the UFSAR.)

Although the staff recognizes that local temporal meteorological conditions can often result in observations that appear askew, the large quantity of stability class A observations in the D.C. Cook data set raises a question regarding the representativeness of the reported data. Since stability class A is generally more favorable with regard to dispersion than the other classes, the reported χ/Q values may not be adequately conservative.

Please provide a suitable explanation of the conditions identified above. If the conditions described above cannot be reasonably explained, or are deemed to be the result of instrumentation or processing problems, please provide a justification of why these data are appropriate for use in determining short-term dispersion estimates for design-basis calculations.

I&M Response to Question 3

This response addresses the fuel handling accident (FHA) only. As documented in an NRC letter dated August 16, 2001, I&M has committed to address the remainder of the events, unrelated to this proposed decay time change, in future correspondence.

During investigation of this Request for Additional Information, it was determined that an error existed in the manner in which the meteorological data was manipulated. The error concerns normalizing meteorological data for differential height and properly identifying invalid data. This error affects the previously submitted stability class information and χ/Q values used in the control room dose analysis for the FHA.

The impact of the error on the FHA dose consequence is expected to be small. The FHA is a short duration release and uses the χ/Q values for the 0 to 2 hour time interval. Since the χ/Q values are at a 95% confidence level, it is unlikely that they will change significantly. Correcting the errors should reduce the frequency of extremely stable or unstable meteorological conditions. Extremely stable conditions are generally less favorable with regard to dispersion and are relatively common for a 2 hour period. Meteorological data for most of these periods are valid and unaffected by the normalization error. Therefore, the ARCON96 analysis is likely to find the most stable conditions for a 2 hour period relatively frequently and predict a similar χ/Q value independent of the errors identified. Additionally, the corrected meteorological data correlates well with the UFSAR.

Since dose is directly proportional to χ/Q in a steady-state situation, the χ/Q value could almost triple without causing the originally reported FHA dose consequence of 1.7 rem to exceed the General Design Criteria (GDC) 19 limit of 5 rem total effective dose equivalent (TEDE). The meteorological errors discussed above are expected to increase the χ/Q values used in the FHA analysis no greater than ten percent. Thus, corrected dose consequence will remain well below the GDC 19 limit of 5 rem TEDE. The original conclusions made with regard to the FHA control room dose remain valid.

NRC Question 4

Describe the process used to determine the peak SFP pool temperature, as a function of heat sink (lake) temperature. Include a discussion of the sensitivity of SFP pool temperature to changes in lake temperature.

I&M Response to Question 4

For a decay time of 148 hours, based on a design lake temperature of 85°F, the peak SFP temperature was calculated to be 180°F. For a reduced decay time of 100 hours, based on a design lake temperature of 85°F, the peak SFP temperature would exceed 180°F. To limit the peak SFP temperature to the same 180°F peak temperature as the 148-hour case, the allowable lake temperature is limited to 77.8°F, to maintain the same peak SFP temperature of 180°F.

The 7.2°F (85 – 77.8 = 7.2°F) reduction in lake temperature results in the same 7.2°F reduction in the essential service water (ESW) temperature, component cooling water (CCW) temperature and the SFP temperature. In the case of ESW, the ESW temperature is 1°F greater than the lake temperature. Therefore, a 7.2°F reduction in lake temperature results in a 7.2°F reduction in ESW temperature.

In the case of CCW and SFP water, the change in temperature is dependent upon the behavior of heat exchangers. The heat load (q), heat exchanger heat transfer coefficient (U), heat exchanger area (A) values and flow rates through the heat exchangers are essentially unchanged. Changes in density and specific heat for a 7.2°F reduction in water temperature are negligible. Since the heat loads and flow rates are the same, the temperature difference between the cold outlet and cold inlet remains the same; and, the temperature difference between the hot outlet and hot inlet remains the same. From the log-mean-temperature-difference heat exchanger equation below, it can be seen that the temperature difference between the hot inlet and cold outlet remains the same; and the temperature difference between the hot outlet and the cold inlet remains the same.

$$q = UA\frac{(T_{hi} - T_{co}) - (T_{ho} - T_{ci})}{\ln[(T_{hi} - T_{co})/(T_{ho} - T_{ci})]}$$

Given this, the hot inlet and hot outlet temperatures are reduced by the same 7.2°F as the lake temperature. Therefore, a 7.2°F reduction in lake temperature results in a 7.2°F reduction in ESW temperature, which results in a 7.2°F reduction in CCW temperature, which results in a 7.2°F reduction in SFP temperature.

NRC Question 5

In the containment cooling water and the spent fuel pit heat exchangers, how have fouling and tube plugging been addressed in your calculations?

I&M Response to Question 5

For the SFP heat exchangers, design values consistent with heat transfer information in UFSAR Table 9.4-2 were used. The shell-side design fouling factor was 0.0005 hr-ft^2-°F/Btu. The tube-side design fouling factor was 0.000575 hr-ft^2-°F/Btu. No tube plugging allowance was provided for the SFP heat exchangers, as the SFP heat exchangers have no history of tube plugging. If tube plugging is required in the future, a 10 CFR 50.59 safety evaluation would be performed to ensure that the overall heat transfer capability of the SFP heat exchanger assumed in the analysis remains valid.

For the CCW heat exchangers, design fouling factors consistent with heat transfer information in UFSAR Table 9.5-3 were used. The shell-side design fouling factor was 0.0005 hr-ft^2-°F/Btu. The tube-side design fouling factor was 0.001 hr-ft^2-°F/Btu. In addition, a 5% tube plugging allowance was provided for the CCW heat exchangers.

NRC Question 6

Indicate why 5.8 hours, before SFP boiling begins, is acceptable. [Additional clarification regarding the level of detail expected in response to this question was verbally provided in a telecon between the NRC and I&M licensing staff.]

I&M Response to Question 6

The 5.8 hours to boiling comes from Case 2 in Reference 1, the abnormal heat load case. The abnormal case is where a full-core discharge of 193 assemblies after 100 hours of decay time is considered. The previously discharged refueling load of 88 assemblies was assumed to have been discharged 30 days earlier. The design basis lake temperature of 85°F is assumed. Both SFP cooling trains are assumed to be lost at a time when the peak SFP temperature (142.3°F) with both SFP pumps operating exists so as to minimize SFP time to boil. This is the limiting case from a heat load perspective.

With the normal case, the heat load is lower than the abnormal case. The peak SFP temperature achieved is 180°F. However, a time-to-boil is not determined by assuming the second pump fails at the 180°F peak temperature. This is because with the temperature in the SFP rising, the operators would enter the abnormal operating procedure for high SFP temperature. As the temperature in the pool heats up, the operators would take action to place the non-operating SFP pump in service. If that train could not be placed in service and temperatures continued to rise, the operators would already be in the abnormal procedure that aligns make-up paths. Heightened awareness would exist because the operators would be aware of the degraded nature of the SFP cooling system. Since the operators would be in the abnormal operating procedure for high SFP temperature, with a recognized degraded SFP cooling system, they would have additional time until the second SFP failed to brief and prepare SFP make-up flow paths. With one pump in-service, the time it takes to heat-up to 180°F, from the time the 193rd fuel assembly has been offloaded or from the time the temperature exceeds the 142.3°F for the time-to-boil case (Case 2, Reference 1), is much greater than 5.8 hours. Thus, these cases afford the operator more time in the abnormal operating procedure that directs the actions to align make-up sources to the SFP.

As discussed above, the operators would be aware of the degraded SFP cooling situation in the case of the 180°F peak SFP temperature. However, over 2.6 hours exists from the time the 180°F peak is reached and the time the SFP would boil. The 2.6 hours is a conservative estimate, simply taken from the Case 2 (time-to-boil) results in the original submittal. In Case 2, the SFP temperature rises from 180.5°F to 210.9°F in 2.6 hours. This occurs with a 53.98 MBtu/hr heat source in the SFP at the time the temperature is 180.5°F. In Cases 1a and 1b, the maximum heat load that exists at 180°F is 49.09 MBtu/hr. This heat load is approximately nine percent lower than the 53.98 MBtu/hr, and thus, it would take longer to boil the SFP. In this time frame, as discussed below, sufficient make-up capability could be aligned to the SFP.

The 5.8 hours is conservative with respect to the current licensing basis 5.74 hour time to boil approved in the NRC safety evaluation report on the SFP rerack submittal. This 5.8 hours is acceptable from an operational standpoint. The discussion below covers the operator requirements, procedures and estimated action times associated with SFP temperature and level.

SFP level and temperature readings are recorded by operators once per shift per procedure. Each day, SFP level and temperature readings are also recorded by operators. Senior Reactor Operators review this data.

During a core offload, an annunciator alarm alerts the operators when SFP temperature increases above its 98°F setpoint. This annunciator alarms at the SFP local subpanel and in both control rooms. The annunciator response procedure directs the operators to increase SFP cooling. During a core offload, the alarm may remain standing due to the high heat load in the SFP.

For a standing alarm, the annunciator response procedure directs operators to a procedure, which directs increased monitoring of the SFP temperature. SFP temperature is monitored every four hours if SFP temperature is between 98°F and 120°F, and hourly if SFP temperature exceeds 120°F.

If the SFP temperature increase is unable to be stopped by maximizing available SFP cooling or the SFP cooling system has failed, the annunciator response procedure further directs the operators to the abnormal procedure for loss of SFP cooling.

The abnormal operating procedure first checks for loss of SFP level. Then, if level is not decreasing, it maximizes available SFP cooling. If SFP cooling is inadequate, water level in the SFP will decrease due to evaporation. If SFP level is decreasing, the abnormal operating procedure directs operators to add water to the SFP to restore level. The procedure lists five possible sources of water for maintaining SFP level and contains steps to align each system. The five sources and the estimated times for alignment of each are listed below.

WATER SOURCE	ALIGNMENT TIME
• Demineralized Water via SFP Demineralizer outlet	1 hour or less
• Refueling Water from either unit's refueling water storage tank	1 hour or less
• Chemical & Volume Control System Hold Up Tank via Transfer Canal Dewatering system	3 hours or less
• Demineralized water from demineralized water hose stations	1 hour or less
• Fire water via hose reel stations (if other sources not available)	30 minutes or less

The times listed above are based on a procedure walk-through performed by operations personnel.

These sources provide both borated and unborated water to the pool. This is acceptable and does not pose a problem with respect to maintaining the SFP subcritical. Section 5.6.1.1 of the D. C. Cook Nuclear Plant Unit 1 and 2 Technical Specifications requires that the spent fuel storage racks are designed and shall be maintained with a Keff less than or equal to 0.95 when flooded with unborated water.

Therefore it is reasonable to assume that the operators would be able to align make-up water to the SFP in the 5.8 hours required.

NRC Question 7

Describe the makeup sources, their flow capacities, and any special operator actions that may be needed to start delivery of makeup water to the SFP.

I&M Response to Question 7

The makeup sources are listed in the response to Question 6. The required actions to align the sources are proceduralized and have been evaluated as also stated in the response to Question 6. There are no special operator actions required to start delivery of makeup water to the SFP. Required actions, such as connecting a spool piece, are proceduralized and have been considered in the time estimates provided.

Each source was evaluated as to whether it alone could provide 120 gpm, which bounds the conservatively calculated maximum boil-off rate of 119 gpm. The 119 gpm is calculated for the peak transient heat load in the SFP of 55.38E6 Btu/hr. A conservative boil-off rate is calculated by taking the peak transient heat load and dividing it by the latent heat of vaporization and by the density of water. At an atmospheric pressure of 14.4 psia, the latent heat of vaporization is 970.9 Btu/lbm and the density of water is 59.84 lbm/ft^3.

$$\text{Boil-off Rate} = \frac{55.38E6 Btu/hr * 7.48 gal/ft3}{970.9 Btu/lbm * 59.84 lbm/ft3 * 60 \min/hr} = 119 \text{ gpm}$$

The flow capacities for each of the sources listed in the response to Question 6 are described below.

- Demineralized Water via SFP Demineralizer outlet $\geq$ 100 gpm
- Refueling Water from either unit's RWST $\geq$ 120 gpm
- CVCS Hold Up Tank via Transfer Canal Dewatering system $\geq$ 120 gpm
- Demineralized water from three DW hose stations $\simeq$ 120 gpm
- Fire water via hose reel stations (if other sources not available) $\geq$ 120 gpm

Three of the sources alone can provide at least the 120 gpm required peak make-up capability. One flow path can provide approximately 120 gpm. The other flow path will provide at least 100 gpm. This flow path may be aligned in combination with one or more of the other paths listed to ensure the required make-up flow is provided. Overall, sufficient make-up flow capability exists and is proceduralized to provide make-up water in excess of the 120 gpm required to bound the worst case boil-off rate.

NRC Question 8

Indicate how the inlet temperature will not be permitted to exceed the maximum lake temperature of 77.8°F, considering effects such as measurement uncertainties and lake temperature distribution.

I&M Response to Question 8

Since the lake temperature cannot be controlled, it must be monitored to ensure that offloading the core will not violate the design basis assumptions. For lake temperature, procedural controls will be put in place to ensure that the lake temperature is monitored in Mode 6 to ensure core offload does not occur outside of the design basis assumptions. Thirty years of historical lake temperature data demonstrates that the maximum lake temperature, during the proposed time frame (September 15 – June 15) for a 100-hour offload, has remained below 77.8°F. Therefore, meeting the design basis temperature is not expected to be a problem.

ATTACHMENT 2 TO C0901-03

COMMITMENT

The following table identifies those actions committed to by Indiana Michigan Power Company (I&M) in this document. Any other actions discussed in this submittal represent intended or planned actions by I&M. They are described to the Nuclear Regulatory Commission (NRC) for the NRC's information and are not regulatory commitments.

Commitment	Due Date
For lake temperature, procedural controls will be put in place to ensure that the lake temperature is monitored in Mode 6 to ensure core offload does not occur outside of the design basis assumptions.	Upon implementation of the proposed license amendment
I&M will update the χ/Q calculations to address the errors noted in the response to Question #3, and will document the impact on the FHA dose consequences.	No later than October 31, 2001.