UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 234 TO FACILITY OPERATING LICENSE NO. DPR-58

AND AMENDMENT NO. 217 TO FACILITY OPERATING LICENSE NO. DPR-74

INDIANA MICHIGAN POWER COMPANY

DONALD C. COOK NUCLEAR PLANT, UNITS 1 AND 2

DOCKET NOS. 50-315 AND 50-316

1.0 INTRODUCTION

By application dated October 1, 1999, as supplemented November 19, 1999, the Indiana Michigan Power Company (the licensee) requested amendments to the Technical Specifications (TSs) for the Donald C. Cook Nuclear Plant, Units 1 and 2. The proposed amendments involve the resolution of an unreviewed safety question related to certain small-break loss-of-coolant accident (LOCA) scenarios for which there may not be sufficient containment recirculation sump water inventory to support continued operation of the emergency core cooling system (ECCS) and containment spray system pumps during and following switchover to cold leg recirculation. Resolution of this issue consists of a combination of physical plant modifications, new analyses of containment recirculation sump inventory, and resultant changes to the accident analyses to ensure sufficient water inventory in the containment recirculation sump. The amendments would also change the TSs dealing with the refueling water storage tank inventory and temperature, the required amount of ice in each ice basket in the containment, and the delay to start the containment air recirculation/hydrogen skimmer fans.

The proposed TSs involving the removal of the word "Each" in Sections 3.6.5.1.d and 4.6.5.1.b.2 will be evaluated and issued in separate correspondence.

The licensee's November 19, 1999, letter provided information inadvertently left out of the October 1, 1999, application. The November 19, 1999, letter did not alter the scope of the application or the staff's initial proposed no significant hazards determination.

2.0 BACKGROUND

Upon indications of a LOCA in a pressurized water reactor such as Donald C. Cook Nuclear Plant (DC Cook) Unit 1 or Unit 2, water is injected into the reactor vessel to make up for coolant expelled from the break and to cool the core. The source for this water is the refueling water storage tank (RWST). When the RWST water level reaches a specified set point, the water source is transferred to the containment recirculation sump and the emergency core cooling system (ECCS) and containment spray (CTS) pumps continue to supply the reactor vessel and the containment atmosphere from this source. The water inventory for the containment recirculation sump consists of water from the RWST, the reactor vessel, the safety injection accumulators and melted ice from the ice condensers which are designed to absorb the energy released as a result of the LOCA.

On September 8, 1997, the licensee confirmed that there may not be sufficient water in the containment recirculation sump to ensure that the ECCS and CTS pumps would not entrain air by vortexing to the extent that performance of these pumps may be degraded for certain small-break LOCAs. The licensee therefore shutdown both units in compliance with TS requirement 3.0.3.

By letter dated October 21, 1997 (Reference 3), the licensee requested exigent changes to the TSs to ensure adequate water inventory in the containment recirculation sump to preclude vortexing. This was done by increasing the minimum required mass of ice in each ice condenser basket. In addition, the fraction of ice sublimation during a cycle was revised from 10% to 5%. The licensee considered the change to the sublimation fraction to be an unreviewed safety question as defined in 10 CFR 50.59. An analysis of the water inventory in the containment following a limiting small-break LOCA supported this change. An NRC safety evaluation report dated January 2, 1998 (Reference 4), approved these changes to the TSs. These changes were designated as Amendment 220 for Unit 1 and 204 for Unit 2. Both DC Cook units have been shut down since these license amendments were approved and have not operated with the revised TSs.

In a March 17, 1999, (Reference 5) letter from the licensee to the NRC, the licensee identified a potentially nonconservative assumption in the analysis supporting Amendments 220 for Unit 1 and 204 for Unit 2.

By letter dated October 1, 1999 (Reference 1), which is the subject of this review, the licensee requested changes to the TSs with an accompanying new analysis, to correct the earlier deficiencies and ensure that the ECCS and CTS pump vortexing limit is satisfied. This submittal was supplemented by additional proprietary technical information in a letter dated November 19, 1999 (Reference 2).

Attachment 6 of the licensee's October 1, 1999, submittal provides a more detailed chronology of the events which led to the need for the proposed TS changes.

The following TSs and bases changes are proposed in the licensee's October 1, 1999, letter:

(1) The available RWST water inventory will be increased from 350,000 gallons to 375,500 gallons.

(2) The maximum temperature for the RWST water will be limited to 100°F.

(3) The actuation signal for the containment air recirculation/hydrogen skimmer (CEQ) fans will be changed from containment pressure-high-high to containment pressure-high and the time delay for the CEQ fan start will be reduced from 9±1 minutes to 120±12 seconds.

(4) The weight of ice is decreased from 1333 pounds to 1144 pounds per basket. (This includes a 1% uncertainty for weight measurement.)

(5) The ice weight (both per basket and total) will be required to be within specified limits at the end of the cycle rather than at the beginning of the cycle as currently required.

(6) The sublimation fraction will be increased from 5% to 10%. This is a change to the TS Bases. The staff considers this to be an unreviewed safety question, as defined in 10 CFR 50.59. This is consistent with the licensee's treatment of a similar change in the licensee's October 21, 1997, submittal (Reference 3).

These changes are supported by analyses which demonstrate that the water level in the containment recirculation sump will remain above the vortexing limit and analyses which demonstrate that the other relevant criteria of the DC Cook licensing basis are satisfied.

The water level analyses were performed by the licensee using the Modular Accident Analysis Program (MAAP) 4.0.4 computer program. MAAP was originally developed as part of the Industry Degraded Core Rulemaking (IDCOR) program to study damaged core, primary system and containment failure scenarios. The licensee stated that this code was chosen because of its ability to model the reactor and containment systems together in an integrated way.

MAAP has not been previously approved by the NRC and has not been reviewed for acceptability for use in licensing calculations as part of this review. Instead, the staff has relied on comparisons supplied by the licensee of MAAP with experimental data and with other computer codes to demonstrate the capability of MAAP to predict ice condenser behavior. In addition, the NRC staff requested the Los Alamos National Laboratory (LANL) to perform some independent calculations to assess the licensee's results.

The licensee provided WCAP-15302, "Donald C. Cook Nuclear Plant Units 1 and 2 Modifications to the Containment Systems Westinghouse Safety Evaluation," dated September 1999 as Attachment 10 to the licensee's October 1, 1999, letter to demonstrate compliance with other criteria related to accident and transient analysis in the DC Cook licensing basis.

In addition to these TS changes, the licensee's October 1, 1999, submittal discussed several other changes that will be made to the plant. These include:

(1) Containment water level instrumentation will be improved to provide operators with more accurate level indication during the switchover from injection (pump suction from the RWST) to recirculation (pump suction from the containment recirculation sump).

(2) Penetrations will be made in a wall separating the pipe annulus region from the reactor coolant system (RCS) loop compartment to allow water to flow freely between these areas (see Figure 1 of Attachment 6 to the October 1, 1999, letter).

(3) Elbows and a vertical section of pipe will be added to the RWST to increase the RWST overflow height.

(4) The drain lines in the CEQ fan room will be rerouted and the check valves in the lines will be replaced.

As stated above, the purpose of the changes proposed by the licensee to the TSs is to ensure that the containment water level following a LOCA is high enough so that vortexing and concomitant ingestion of air by the ECCS and CTS pumps can be prevented. This level is 602 feet 10 inches, which is approximately 4 feet above the containment floor. This level was shown to be adequate by hydraulic testing sponsored by the licensee and conducted at Alden Research Laboratory. Reference 6 describes the tests that were performed and their results. These tests were performed to satisfy Unit 2 License Condition 2.c.(3)(H). By letter dated July 2, 1982, the NRC concluded that the license adequately responded to this license condition and found the sump testing performed by the licensee to be acceptable.

3.0 EVALUATION

3.1 Changes to the TSs

3.1.1 TS 3/4.1.2.8 "Borated Water Sources-Operating" TS 3/4.5.5 "Refueling Water Storage Tank"

The minimum RWST inventory requirement will be increased from 350,000 gallons to 375,500 gallons. The licensee stated that the change will be implemented by modifying the RWST overflow line. Increasing the RWST water inventory results in more water being available to the containment recirculation sump to prevent vortexing and air entrainment in the ECCS and CTS pumps. The licensee's calculation of water level in containment following LOCAs of various sizes and locations, discussed in Attachment 7 of the October 1, 1999, submittal, demonstrates that the increase in RWST water inventory (together with other changes) is sufficient to ensure that the vortexing limit of 602-feet 10-inches is met or exceeded.

The licensee has also proposed adding a requirement to the TSs to limit the maximum allowable RWST water temperature of 100°F. The licensee has performed design basis LOCA calculations as well as containment integrity (maximum containment pressure and temperature) calculations using a water temperature of 105°F. Therefore, the 100°F RWST water temperature is bounded. For the water inventory calculations, the lower RWST water temperature limit of 70°F is conservative since it increases the containment spray's ability to remove heat and thereby reduces the amount of ice that is melted during a LOCA.

The licensee performed LOCA calculations in order to demonstrate that the different conditions at switchover to recirculation due to the increased RWST inventory (water temperature, boron concentration) and the timing of the switchover do not adversely affect other safety limits such as the ECCS criteria of 10 CFR 50.46 and pH concentration of the coolant in the sump.

The licensee also reported the results of RWST drain down calculations which demonstrate that the timing of the switchover from injection to recirculation is adequate to ensure a sufficient water source for adequate flow for both the ECCS and CTS pumps. The licensee indicated that the calculations also demonstrate that adequate injection will continue during the switchover from the injection phase to the recirculation phase of the LOCA. The staff finds this to be acceptable.

3.1.2 TS Table 3.3-3 "Engineered Safety Feature Actuation System Instrumentation"
TS Table 3.3-4 "Engineered Safety Feature Actuation System Instrumentation Trip Set Points"
TS Table 4.3-2 "Engineered Safety Feature Actuation System Instrumentation Surveillance Requirements"
TS 3/4.6.5.6, "Containment Air Recirculation Systems"

The current TSs do not specify automatic actuation of the CEQ fans and valves. Instead, they are actuated automatically with a delay time of 9±1 minutes after receipt of a containment spray automatic actuation signal (on Containment Pressure-High-High in MODES 1,2, and 3 at 2.9 psig). The licensee proposes to change the initiating signal and timing so that the CEQ fans will start and the hydrogen skimmer valves will start to open 120±12 seconds after a containment pressure-high signal (at a containment pressure equal to 1.1 psig).

The purpose of this change is to start the CEQ fans in order to increase the rate of ice melting in the containment. Increasing the rate of ice melting in containment is conservative for the water inventory calculations since it increases the steam flow into the ice condenser bays which promotes more rapid ice melting. However, it is nonconservative from the perspective of design basis peak containment pressure and temperature calculations. The licensee has performed new calculations (described in Attachment 10 of the licensee's October 1, 1999, letter) of peak containment pressure and temperature following the most conservative large break LOCA and has demonstrated that the peak containment pressure and temperatures remain below the containment design values. Therefore, the staff finds this change to the initiating signals and timing of the CEQ fans and hydrogen skimmer valves to be acceptable.

The current TSs specify that manual actuation of the CEQ fans is accomplished as part of the containment spray manual actuation requirements which are applicable in MODES 1 through 4. The proposed changes to the TS Table 3.3-4 and TS Table 4.3-2 specify that manual actuation of the CEQ fans and valves is separate from the containment spray manual actuation requirements. This is acceptable since suitable controls are provided in the control room to operate the CEQ fans independent of the containment spray controls. The surveillance requirements for manual actuation have been changed to be consistent with the new method of CEQ fan actuation.

3.1.3 TS 3/4.6.5.1 Ice Condenser

The purpose of this TS is to ensure that the amount of ice available will provide sufficient pressure suppression to maintain the peak containment pressure following a design basis accident below the containment design pressure. In addition, the water from the melting of all or part of this ice, when combined with water from the reactor coolant system, safety injection accumulators, and the RWST will be sufficient to ensure that the ECCS and CTS pumps will operate above the vortexing level criterion during recirculation following a LOCA.

The current weight of ice specified in this TS for each basket is 1333 pounds. Since there are 1944 baskets in the DC Cook design, this is a total of 2.59 million pounds of ice. This weight is the beginning-of-cycle (BOC) or "as-left" value, and includes a 1% uncertainty for weighing and a 5% factor for sublimation during the 18-month cycle which decreases the ice weight.

The licensee is proposing to reduce the minimum required weight of ice in the DC Cook ice condensers. The licensee states that the decrease in ice weight will "facilitate effective management of the ice inventory for the ice condenser and ...facilitate ice condenser maintenance."

The total ice condenser ice weight will be reduced to a nominal 2.2 million pounds or 1132 pounds of ice per basket. This value was used in the DC Cook safety analyses discussed in the October 1, 1999 letter. The licensee further proposes that this value be an end-of-cycle (EOC) value or an "as found" value. It therefore must be increased by the 1% weighing uncertainty to the proposed TS limit of 1144 pounds per basket. The sublimation factor is not included in this value since the sublimation process would be complete at the time of the surveillance.

TS Bases Section 3/4.6.5.1 discusses adjusting the ice weight or the number of baskets to be weighed depending on accumulated data from several cycles. However, since the value in the TSs cannot be changed without NRC approval, this provision is moot and the licensee proposes to eliminate it from the bases. The staff concurs.

The licensee has proposed modifying the Bases to increase the sublimation uncertainty from 5% to 10%. The staff considers this change to be an unreviewed safety question as defined in 10 CFR 50.59 which is consistent with the licensee's handling of this issue in the October 27, 1997, submittal to the NRC. Although some other ice condenser plants have larger values for the allowance for sublimation, a review of industry data shows that actual overall sublimation does not exceed the 10% value. The staff therefore finds the 10% allowance to be acceptable.

The licensee proposed changing TS 3.6.5.1.d to state that the ice bed shall be OPERABLE with:

> <u>ice baskets</u> containing at least 1144 lbs of ice (end-of-cycle)

rather than

> <u>each ice basket</u> containing at least 1144 lbs of ice (end-of-cycle)

The licensee states that the purpose of this change is to clarify that the as-found weight applies to all of the ice baskets weighed. However, a similar change to the ice condenser TSs was proposed to the NRC by TVA for Sequoyah Units 1 and 2 as the lead plant for generic changes to the ice condenser TSs and the NRC staff has questioned the implications of this wording. The proposed TSs involving the removal of the word "Each" in Sections 3.6.5.1.d and 4.6.5.1.b.2 will be evaluated and issued in separate correspondence.

For both the calculation of water inventory in the containment recirculation sump following a LOCA and the peak pressure and temperature in containment following a LOCA, it is conservative to use the minimum ice weight. The licensee has done this. Based on the results of the licensee's calculations showing that (1) the water level in the containment recirculation sump is above the vortexing limit of 602 feet 10 inches, and (2) the containment peak pressure and temperature are below the containment design limits, the staff finds the ice weight proposed by the licensee to be acceptable.

The licensee's change to an end-of-cycle surveillance of the ice weight is acceptable since it is in compliance with the definition of a limiting condition for operation defined in 10 CFR 50.36 as "the lowest functional capabilities or performance levels of equipment." The licensee will, by procedure, begin the cycle with a nominal ice weight which will be increased by the weighing uncertainty of 1% and the sublimation allowance of 10%. This does not change the process from the current procedure.

3.2 Analysis

The licensee has demonstrated that the TS changes described above are acceptable based on analyses of design basis accidents, in particular, the LOCA and the main steam line break. All relevant safety criteria of the DC Cook licensing basis will be satisfied if the reactor is operated within these limits.

3.2.1 Containment Water Level

In order to demonstrate that the ECCS and CTS pumps will operate acceptably with respect to the vortex limit, the licensee has calculated the containment water level following the most limiting LOCA and shown that this level is greater than the vortex limit of 602 feet 10 inches (see Section 2.0 of this safety evaluation).

The calculations were performed with the MAAP 4.0.4 computer program. The NRC has not reviewed the MAAP code. However, the MAAP code has been used previously by the licensee to support the October 27, 1997, request for TS changes related to ice weight. In that case, the staff approved the licensee's proposed TS changes based on comparisons between MAAP and experimental data, as well as staff calculations performed with the MELCOR computer code using input data supplied by the licensee (Reference 7). The staff used the same method in reviewing this submittal.

The MAAP code was selected by the licensee since it provides an integral calculation tool and it is not necessary to transfer data from one computer program to another. Calculations of water inventory depend on modeling of the containment as well as flows into and out of the reactor vessel, that is, the water inventory in the reactor coolant system, the amount of melted ice, the amount of water injected from the safety injection accumulators and the ECCS, the containment spray taking suction from the RWST or the recirculation sump, and the flow of water between different compartments in the containment.

The licensee compared MAAP calculations with data from three experimental studies relevant to ice condenser containments. These are described in Reference 1, Attachment 7, and Reference 2. The licensee also compared MAAP with calculations done with the licensing codes used for design basis accident analysis. This is also reported in Attachment 7 to Reference 1.

The first experimental program was the Westinghouse Waltz Mill experiments (Reference 8). Eight 36-foot long ice baskets were used to obtain data for various sized LOCAs at scaled steam delivery rates representing a large-break LOCA blowdown, a medium-break LOCA blowdown, and a small-break LOCA blowdown. A large LOCA blowdown followed by a steam flow rate through the inlet doors representative of a post-blowdown energy release (due to decay heat) was also included. MAAP predictions of these data provide an important test of the ability of the code to predict important ice condenser phenomena such as ice melt rate and the displacement of air from the lower to the upper compartment. Of particular interest for the water inventory calculations is the small break blowdown comparison (Test F) since the limiting break for water inventory concerns is the small break. For Test F, MAAP provided reasonable agreement with the experimental results for pressure and mass of melted ice. Also of interest is the large break blowdown with decay heat steaming rate (Test K) since it provides an opportunity to model long term energy transfer in the experimental assembly. In both of these tests the comparisons with measured data were good, demonstrating that MAAP adequately modeled the energy exchange processes in the experiment.

The second experimental program was a 1991 NRC program (Reference 9) to study the behavior of aerosols in ice condensers. While the behavior of aerosols is not of concern for the DC Cook proposed TS changes, the tests also provided data from a test assembly which modeled many features of the ice condenser containment and provided useful data on ice melt and exit gas temperature. Exit gas temperature is important because it is a good indication of the exchange of energy during the tests. Some computer calculations assume a constant exit temperature based on experiment, which is satisfactory for large breaks but not suitable for smaller breaks. This program was limited since it did not model the inlet doors and was limited to behavior after blowdown. Another important feature of these experiments is that an air flow typical of one train of air recirculation fans was included in the tests. Because of the absence of inlet doors, countercurrent natural circulation occurred in tests with lower flow rates. Since this was not a concern for the DC Cook work, the licensee modeled only those tests with a higher gas flow. The higher gas flow prevented this counter current natural circulation flow by "gas flooding" (that is hold-up of what otherwise would have been a downward flow). The licensee provided comparisons with exit temperature data with a heat transfer coefficient representing natural convection and radiation as a parameter. For reasonable values of this heat transfer coefficient, the licensee predicted temperatures between the lowest and highest measured exit temperatures.

The third experimental program was an Electric Power Research Institute (EPRI) program to study the mixing of hydrogen in ice condenser containments (Reference 10). Subcompartments modeling the lower and upper compartments of an ice condenser containment were installed in a large vessel (at a scale factor of 0.3 to an ice condenser containment). This mock-up of an ice condenser containment did not contain ice. It did simulate air recirculation from the upper to the lower compartment. The experiments served as a test of the ability of the MAAP code to calculate gas and temperature distributions in different portions of the containment. The licensee's comparisons of data from these tests with MAAP showed reasonable agreement.

In addition to comparisons with experimental data, the licensee provided comparisons of MAAP with calculations performed with the LOTIC-3 (Reference 11) and NOTRUMP (Reference 12) computer programs. LOTIC-3 is a Westinghouse design basis containment code for predicting ice condenser behavior. NOTRUMP provides the mass and energy input for LOTIC-3 (that is, the mass and energy flow rates from the reactor coolant system break to the containment). Comparisons of LOTIC-3 and MAAP were made for 2-inch and 6-inch cold leg breaks. In general, the comparisons between LOTIC-3 and MAAP were as expected and the differences were explainable in terms of the differences in models between the two codes. In particular, the prediction of ice melt as a function of time was less for MAAP than for LOTIC-3. Since LOTIC-3 is used for design basis containment pressure and temperature analyses, the faster rate of ice melt in LOTIC-3 is conservative.

Table 5-1 of Attachment 7 of Reference 1 lists the break locations and sizes considered by the licensee. In all cases, the break was located in the cold leg. The location was either in the lower compartment or the reactor cavity. Section 5.1 of Reference 1 discusses the choice of these two locations. Cold leg breaks release more mass into the containment, but the energy release is less than for a hot leg or crossover leg break and consequently, the amount of melted ice is less. The staff finds the licensee's choice of break locations to be acceptable. The results of the licensee's calculations are shown in Figure 5-18 of Attachment 7, which is a plot of minimum sump level during recirculation as a function of the effective break diameter. The 1-inch break with 50% flow to the reactor cavity and 50% flow to the sump is the limiting break. (A break at the cold leg nozzle in the reactor cavity results in a flow split between the reactor cavity and the lower compartment.) The worst single failure was determined to be the loss of one CEQ fan. This results in the lowest flow of gas through the ice condenser and, therefore, the lowest rate of ice melt. On the other hand, both trains of containment spray are considered to be in operation since this minimizes the rate of ice melting.

The licensee also analyzed postulated breaks from hot standby condition, MODE 3 of the TSs. The lower range average reactor coolant system temperature of 350°F was used for the analyses since this results in minimum steam production due to flashing and therefore minimum ice melting. The break sizes analyzed were sufficient to actuate the containment sprays and CEQ fans. For some split flow breaks in MODE 3 there is insufficient inventory in the sump to remain above 602 feet 10 inches. The time below this limit is short. However, since the ECCS pump flow rates are reduced for these breaks, air entrainment in the pumps is not a problem. The licensee addressed this issue in Attachment 9 of Reference 1.

The licensee listed several conservatisms in the analyses done to determine the minimum water level in the lower compartment of the containment. These include:

(1) The volume of internal equipment in the lower compartment was neglected. The licensee estimates that if this equipment were included in the calculation sump water level, the level would be increased by approximately 2.2 inches.

(2) A maximum cool down rate of 100° F/hr was assumed following the initiation of the accident. A slower cool down rate would increase the energy discharged to the containment and, hence, more ice would melt. The licensee did not quantify the increase in ice melt which would result from a slower cool down rate.

(3) MAAP uses the assumption that the steam and water discharged from the analyzed breaks are in equilibrium. This results in the maximum water enthalpy and therefore the minimum steam mass is produced as the mixture flashes in the containment. The licensee did not quantify this effect.

(4) The licensee has assumed that the vortex limit, 602 feet 10 inches, remains constant, even as the break flow, and consequently the demand for ECCS pump flow decreases as the break size decreases. The licensee states that for the limiting break sizes, the flow is significantly less than that used in the hydraulic tests used to determine the vortex limit.

3.2.2 Containment Integrity Analyses

The licensee's previous analysis of record for containment integrity analyses is Reference 13. This was approved by the staff in a safety evaluation dated March 13, 1997 (Reference 14).

Section 3.4.2 of the Reference 15 lists several changes to the plant and the input assumptions to the analyses of Reference 13 which affect the containment integrity calculations. Some of these changes increased the peak containment pressure and others tended to decrease the peak containment pressure. Changes made which improve the heat removal capability of the containment deal with increasing the heat transfer from the containment. These include increasing the UA of heat exchangers and decreasing the emergency service water system temperature. The licensee performed new calculations using these assumptions. The result of these calculations is that the peak containment pressure following the most limiting design basis LOCA is calculated to be 11.6 psig. This includes a 0.1 psi pressure increase due to noncondensible hydrogen and a 0.1 psi increase due to leakage from the control air system.

The peak containment temperature following a design basis main steam line break is 324.7°F.

The staff has reviewed the changes made by the licensee to both the LOCA and main steam line break containment integrity analyses and finds them acceptable since they are consistent with planned plant operation and design or provide conservative assumptions for the analyses.

3.2.3 LOCA Analysis

10 CFR 50.46 requires that the containment pressure be minimized in the calculation of peak cladding temperature. The licensee examined the change in the starting of the CEQ fans following a large break LOCA, and concluded that the effect on the peak cladding temperature is negligible.

3.2.4 Staff Independent Analysis

The staff requested Los Alamos National Laboratory (LANL) to perform independent analyses using the MELCOR computer program (Reference 16) to model the containment response and RELAP5 (Reference 17) to model the mass and energy addition to the containment as a result of the LOCA. One-inch, 2-inch, and 6-inch breaks in the lower compartment were modeled. The input was derived from input developed by the licensee and provided to the staff during the staff review of the previous TS change to the ice mass (Reference 7). The staff calculations are documented in Reference 18. While the input for these calculations does not have a one-to-one correspondence with the input used by the licensee, the containment pressure, pool temperatures, fraction of ice remaining, the level above the lower compartment floor, and the timing of some key events such as RWST switchover and ice melt compare favorably with the containment response described in Attachment 7 to Reference 1 and Reference 19. In addition, LANL performed a "cold" calculation, meaning that the conditions were assumed for different parameters (such as lower power, lower RWST water temperature, lower RHR heat exchanger secondary side temperature) which tended to minimize the amount of ice melt. Even for this more extreme case, the calculations show that the water level criterion of 602 feet 10 inches is not violated. LANL has also pointed out that an ice melt of 25% is needed to provide sufficient water to meet the 602-foot 10-inch limit. LANL calculations show that this amount of ice melt is reached early in the transient.

The agreement with the licensee's calculations is favorable and adds confidence that the licensee's modeling is reasonable.

4.0 SUMMARY

The staff finds the proposed changes to the TSs for the Donald C. Cook Nuclear Plant, Units 1 and 2, to be acceptable. This approval is based on the licensee's analyses which show that all licensing criteria are satisfied. Analyses of water level in containment, performed with the MAAP code, are acceptable, based on comparisons of the MAAP code with relevant experimental data and approved computer codes and independent analyses performed by the LANL for the staff.

The results of other analyses demonstrate that other relevant licensing criteria (such as containment peak temperature and pressure and the criteria of 10 CFR 50.46) remain satisfied, even with some assumptions different from those used previously. The calculations were done with NRC-approved methods.

5.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Michigan State official was notified of the proposed issuance of the amendments. The State official had no comments.

6.0 ENVIRONMENTAL CONSIDERATION

These amendments change the requirements with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20 or change the surveillance requirements. The staff has determined that the amendments involve no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendments involve no significant hazards consideration and there has been no public comment on such finding (64 FR 58458). Accordingly, the amendments meet the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendments.

7.0 CONCLUSION

The staff has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendments will not be inimical to the common defense and security or to the health and safety of the public.

8.0 REFERENCES

1. Letter to U.S. Nuclear Regulatory Commission from R. P. Powers, Vice President, American Electric Power, Technical Specification Change Request Containment Recirculation Sump Water Inventory, October 1, 1999.

2. Letter from M.W. Rencheck, Vice President, Indiana Michigan Power Company, to U.S. Nuclear Regulatory Commission, "Response to Request for Additional Information Technical Specification Change Request Containment Recirculation Sump Water Inventory," November 19, 1999.

3. Letter to U.S. Nuclear Regulatory Commission from E.E. Fitzpatrick, Indiana Michigan Power Company, "Request for Exigent Technical Specification Amendment Technical Specification 3/4.6.5 Ice Weight and Surveillance Requirement and Technical Specification 3/4.5.5 Basis Refueling Water Storage Tank Change," October 21, 1997.

4. Letter to E.E. Fitzpatrick, Indiana Michigan Power Company from John B. Hickman, U.S. Nuclear Regulatory Commission, January 2, 1998.

5. Letter to U.S. Nuclear Regulatory Commission from Michael W. Rencheck, Indiana Michigan Power Company, March 17, 1999.

6. "Hydraulic Model Investigation of Vortexing and Swirl Within a Reactor Containment Recirculation Sump, Donald C. Cook Nuclear Power Station," Alden Research Laboratory, September 1978.

7. "MAAP Input Parameters and Results Used for Donald C. Cook Nuclear Power Plant Units 1 and 2 Analyses," prepared for American Electric Power Company by Fauske and Associates, Inc., Burr Ridge, Illinois, Attached to AEP Memorandum to USNRC, October 13, 1997.

8. Salvatori, R., "Final Report: Ice Condenser Full Scale Section Test at the Waltz Mill Facility," Westinghouse Proprietary Class 2 Report, WCAP-8282, February 1974.

9. Ligotke, M.W., "Ice Condenser Aerosol Test," NUREG/CR-5768, 1991.