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

ENCLOSURE 1

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION
USE OF ICC INSTRUMENTATION IN OCONEE EMERGENCY PROCEDURE GUIDELINES
DUKE POWER COMPANY
OCONEE UNITS 1, 2, AND 3
DOCKET NOS. 50-269, 50-270, 50-287

1.0 INTRODUCTION

Reference 1 provides a description of how the inadequate core cooling monitoring (ICCM) instrumentation at Oconee Units 1, 2 and 3 will be used in the plants' emergency procedure guidelines (EPGs). The Oconee ICCM system includes the following for detecting and monitoring inadequate core cooling (ICC) conditions:

1. Subcooling margin monitoring
2. Reactor vessel and hot leg level measurement
3. Core exit thermocouple (CETC) measurement
4. Reactor cooling pump current indication.

The final design description of this system was provided in Reference 2 and has been approved by the NRC in Reference 3.

2.0 EVALUATION

2.1 Approach and Recovery from ICC Conditions

The subcooling margin monitoring system is used to indicate the approach to ICC conditions. All plant transients which lead to ICC conditions will result in a loss of subcooled margin, regardless of the initiating event. The EPGs therefore treat this symptom with absolute priority, and second only to CETC indications that ICC conditions already exist. Subcooled margin indications

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are available to the operator from a variety of sources including digital meters, P/T display, operator aid computer, and the new safety related ICCM plasma displays. The subcooled margin is provided for each hot leg as well as the core exit with the appropriate instrument errors corrections included in each indication. The operator is instructed to transfer to the EPG Loss of Subcooled Margin procedure anytime subcooling indications decrease to 0° F. The most significant actions in this procedure are the tripping of the reactor coolant pumps (RCPs) and the maximizing of emergency core cooling system (ECCS) injection flows.

Once the primary coolant becomes saturated, the operator may trend changes in coolant inventory by observing the ICCM plasma display. This display includes instrumentation which will indicate and trend coolant levels in both hot legs and in the reactor vessel head. This trending is also used to indicate the approach to an ICC condition and should indicate to the operator the extent that his actions are mitigating the transient. The criteria for transfer to the ICC section of the EPG was enhanced by including low reactor vessel head level in addition to superheated CETC temperatures. These parameters will indicate the approach to ICC conditions and the actual onset of ICC conditions. A reactor vessel head level setpoint equivalent to the bottom of the hot leg (instrument errors included) was chosen to initiate a transfer to the ICC section. Below the setpoint, reliable coolant level indications will no longer be available to the operator to ensure that the core remains covered.

After the ICC section of the EPGs are entered successive RCPs are restarted, as necessary, until the ICC condition is mitigated. All RCPs which may have been restarted during ICC mitigation are secured prior to transferring out of the ICC section. This is accomplished once the core exit thermocouples (CETCs) are less than 400°F and the core exit subcooled margin is saturated or subcooled. RCP current must be stable and greater than the nominal current at full power operation prior to securing a RCP.

Once all RCPs (if any) have been secured, reactor vessel head level is observed to ensure that the core remains covered. A transfer out of the ICC section is made only after the core exit subcooled margin is verified greater than or equal to 0°F and reactor vessel head level is on scale. The bottom of the hot leg (instrument errors included) is the setpoint chosen for this level since it is the same setpoint used to transfer into the ICC section.

2.2 Loss of Natural Circulation

The interruption of natural circulation is identified by loss of heat transfer symptoms and is confirmed with the ICCM hot leg level instrumentation. The EPG prescribes how to condense or vent hot leg voids and restore heat transfer.

If the core exit is saturated and hot leg level is below the U-bend spillover elevation (instrument errors considered), then the hot leg high point vents are opened in each loop with low level. This level will confirm that voids have formed in the hot legs and are blocking natural circulation flow. By opening the high point vents, the operator will lessen the RCS pressure increase due to coolant heatup. ECCS injection flow will therefore be maximized and the void will be vented as injection flow refills the hot legs.

The EPG uses RCP pump bumps to help restore natural circulation flow since they are an effective means of condensing steam voids. Hot leg level indications are used to help determine which RCP to bump and assist in evaluating the effectiveness of each bump. RCPs are bumped in the loop with the lowest hot leg level and level is trended to determine if the pump bump was effective. This process is repeated until the voids have been condensed or the RCP successive restart limit is reached.

2.3 Void Identification and Mitigation

The ICCM level instrumentation is included in the EPGs as a direct indication of void formation and is used to determine when the void has been removed. The

ICCM level instrumentation is also utilized to prepare the operator for the consequences of a RCP restart. Whenever a unusual transient has resulted in primary coolant saturation and subcooling is subsequently recovered, steam voids may still exist in the reactor vessel head and/or the hot legs. These voids will be rapidly condensed when a RCP is restarted. As a result, a drop in both pressurizer level and RCS pressure will be observed which is proportional to the void size. The EPG cautions the operator about this phenomenon and instructs him to increase pressurizer level prior to the restart if the level instrumentation indicates a void.

The final application of the ICCM level instrumentation is to assist the operator in identifying and removing voids when the primary coolant is subcooled and no RCPs are operating. The setpoint below which a head void is indicated with certainty is chosen as the top of the vessel (instrument errors included). The corresponding hot leg level setpoint is the top of the hot leg (instrument errors included). When a void external to the pressurizer is indicated, one of several options are exercised to remove the void. These options include RCS repressurization, high point venting, and RCP restart. In all instances, pressurizer level is increased to accommodate the liquid volume required to refill the void volume. Level instrumentation is then used to verify that the void has been successfully removed.

3.0 STAFF POSITION

The staff has reviewed Reference 1 which describes how the ICCM instrumentation will be used in Oconee 1, 2 and 3 EPGs. A summary of the major uses of the ICCM instrumentation is given in Table 1. The staff finds that the approach proposed by Duke Power is prudent and reasonable and finds Reference 1 to be an acceptable method for using ICCM instrumentation in the EPGs of Oconee 1, 2 and 3.

4.0 REFERENCES

1. Letter, H. B. Tucker (Duke) to H. R. Denton, dated June 27, 1986.
2. Letter, H. B. Tucker (Duke) to H. R. Denton, dated July 1, 1985.
3. Letter, H. N. Pastis (NRC) to H. B. Tucker (Duke), "Evaluation of Duke Power Company's Inadequate Core Cooling Instrumentation System for Oconee, Units 1, 2 and 3," dated May 1, 1987.

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Table 1

Summary of EPG ICCM Related Guidance

Instrument	Application
Subcooled Margin Monitors	-Trip all RCPs when saturated -Maximize ECCS injection flow -Increase SG levels to saturated setpoint at saturation -Indicate recovery from ICC conditions
Reactor Vessel & Hot Leg Levels	-Transfer to ICC section on low vessel head level -Ensure recovery from ICC conditions -Operate high point vents to restore heat transfer -Establish appropriate pressurizer level prior to RCP restart -Identify and mitigate voiding when subcooled -Identify and mitigate a head void during a natural circulation cooldown
CETC Temperatures	-Transfer to ICC section when superheated -Determine the severity of actions performed during ICC mitigation -Ensure recovery from ICC conditions
RCP Current	-Indicates no significant RCS voiding during saturated RCP operation -Used to secure RCPs during ICC recovery