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SUBJECT: Forwards addl performance test & analysis info & RBCU & LPI cooler operability criteria,per 881104 EC.

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December 15, 1988

U.S. Nuclear Regulatory Commission
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Washington, DC 20555

Subject: **Oconee Nuclear Station**
Docket Nos. 50-269, -270, -287
Inspection Report 50-269, -270, -287/88-28
LER 287/88-03

Gentlemen:

As requested in the November 4, 1988 NRC enforcement conference summary regarding the potential degraded capabilities of the Reactor Building Cooling Units (RBCU), please find attached additional performance test and analysis information. In addition, I have included further information regarding RBCU and Low Pressure Injection (LPI) cooler operability criteria.

Very truly yours,

Hal B. Tucker

PJN/445/mmf

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IE01

Duke Power Company
Oconee Nuclear Station

ATTACHMENT 1

Reactor Building Cooling Units
Performance Testing/analysis

DUKE POWER COMPANY
OCONEE NUCLEAR STATION
REACTOR BUILDING COOLING UNIT PERFORMANCE UPDATE
12/06/88

Since September of this year, Duke Power Company has continued thermal performance testing/analysis on RBCUs in all three Units of Oconee Nuclear Station. Unit 1 has been tested once, Unit 2 once, and Unit 3 twice in that time period. The attached graphs indicate the results of these tests. Since only the "A" and "C" coolers are normally running, they are the only coolers tested at power. The "B" coolers are assumed to be clean (air- and waterside), since the coils are valved out and the fans/isolation dampers are in their off/closed positions. "Clean" in this sense is the level of performance at the most recent startup, when the "B" coolers were last tested.

Performance tests for the RBCUs indicate continued operable status for all, with varying rates of degradation individually. This is to be expected, as data "scatter" and difficult test conditions inside containment may be contributors to "knees" in the degradation curves. The general trend to date is shown for each Unit in the attachments.

Units 1 and 2 show the closest paralleling of degradation over time. The Unit 1 degradation rates are currently being used to assess operability for all RBCUs, since these rates (assumed linear) are the most conservative. However, with the most recent test results, it appears that a more "customized" approach may be possible for each of the three Units. This approach, if taken, would be based on two observations:

1) Data obtained to date (four sets on Unit 1) indicates degradation rates less than the 0.25% per day originally assumed, and in fact may indicate that the degradation will level off at some point. This is consistent with current knowledge of fouling mechanisms where sediment is the primary tubeside contributor.

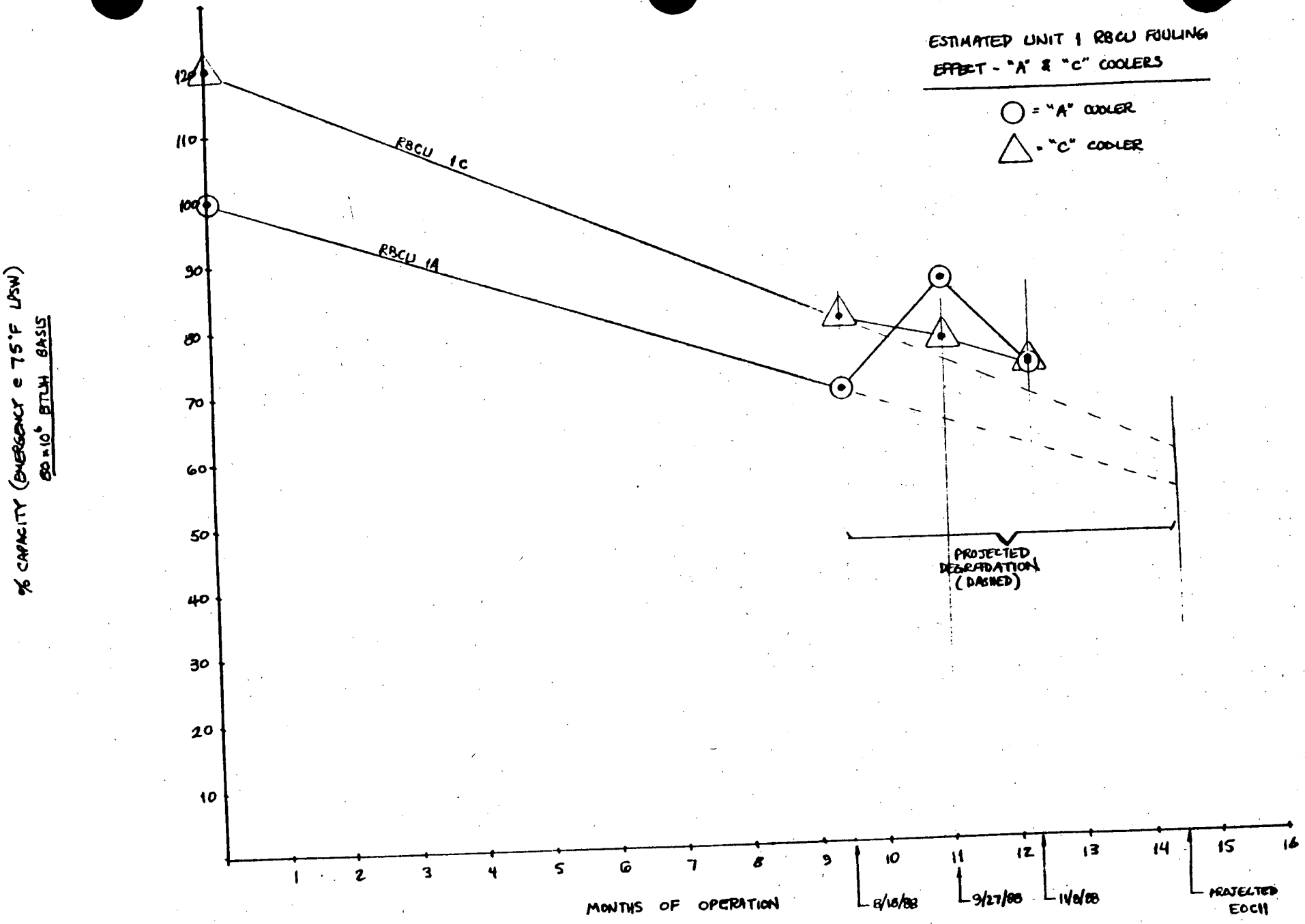
2) The elevated temperature of the lakewater used on the tubeside does not appear to have affected the analysis, as originally theorized. Recent data points, taken with the lake 5 to 10 degrees cooler, indicate that degradation rates do not improve with colder lake temperatures.

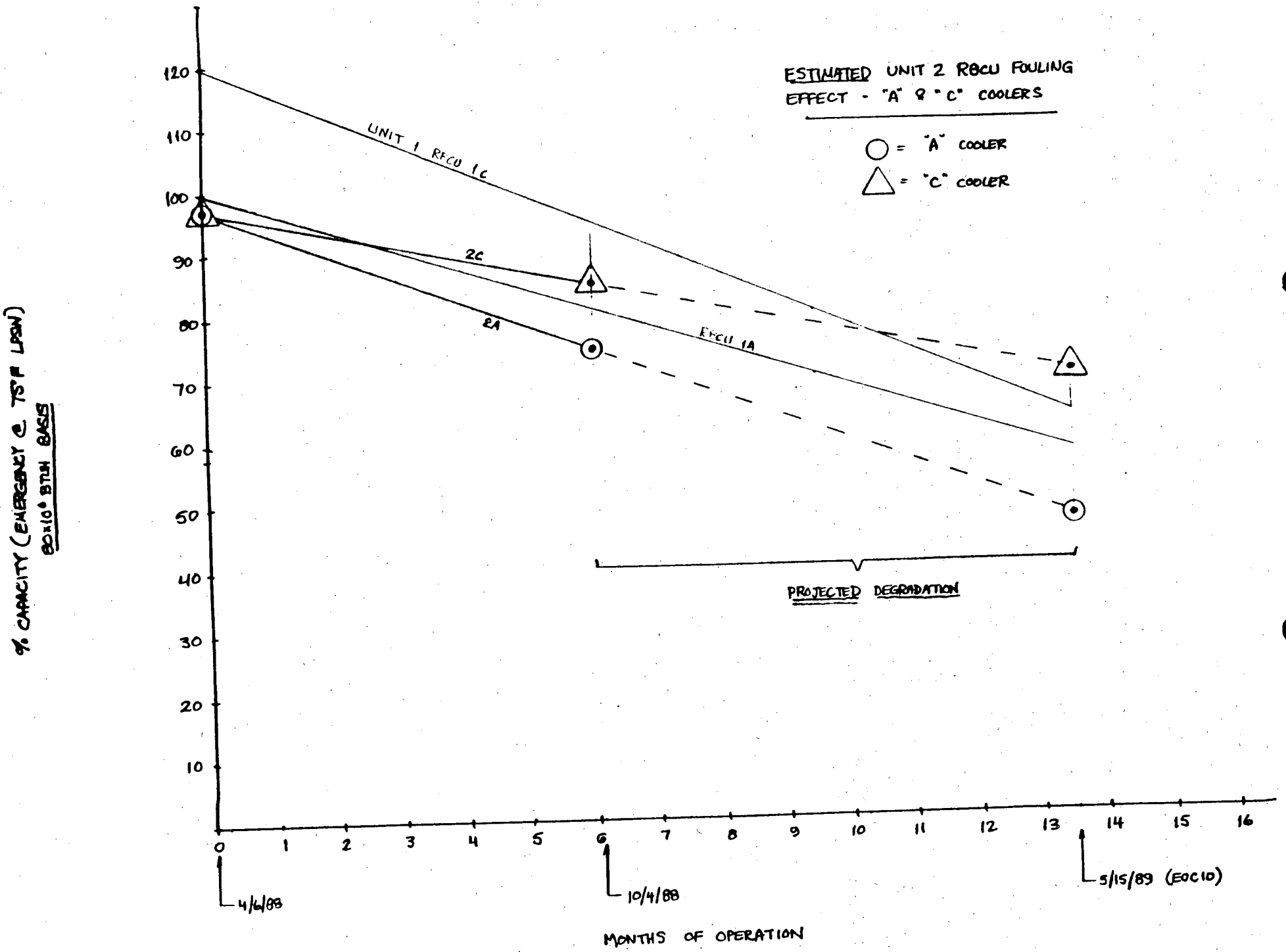
Unit 3's RBCUs continue to operate at a lower post-cleaning capacity than either Units 1 or 2. The cause of this is being investigated; it is suspected that the return bends on the

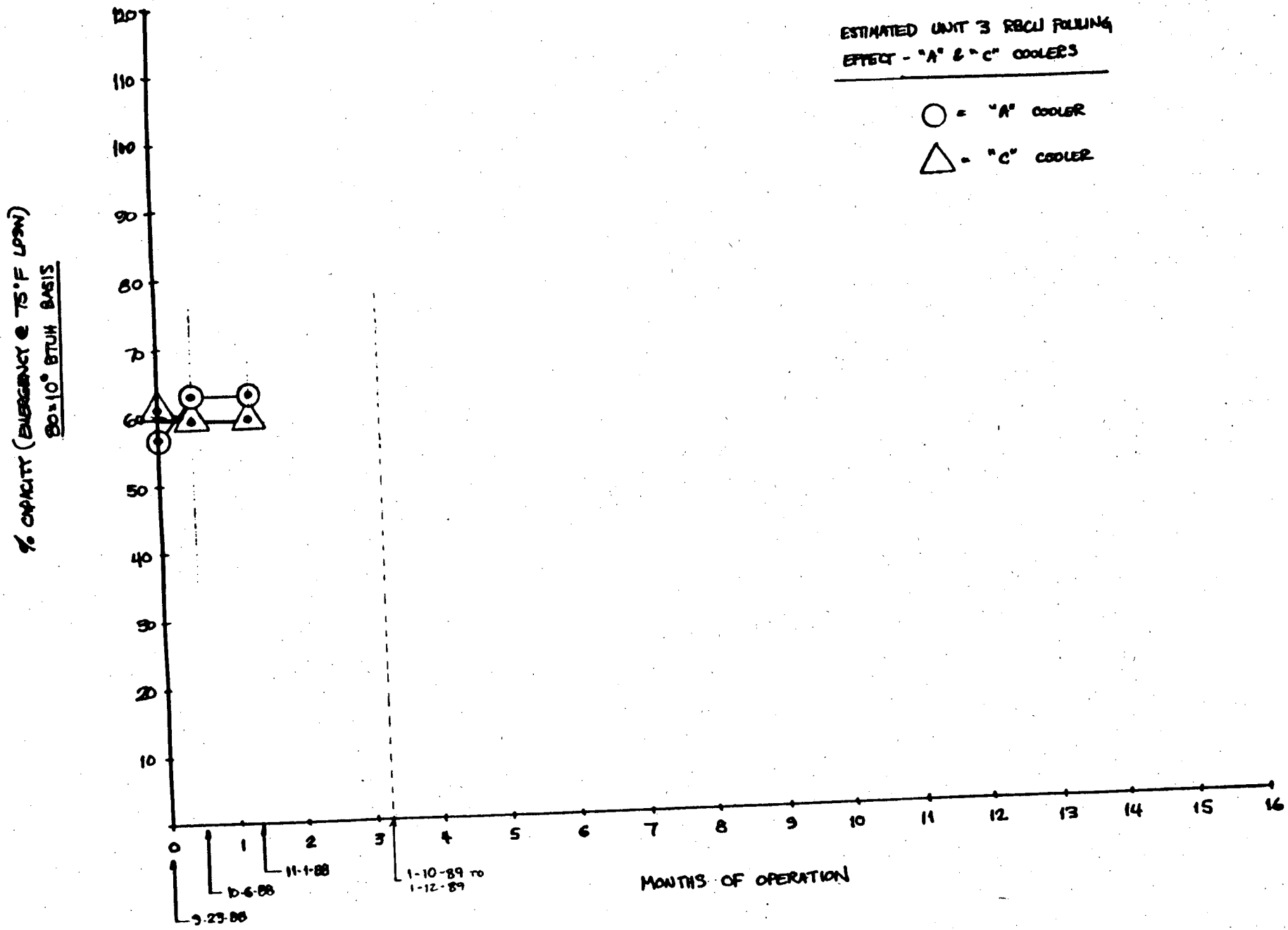
waterside of these coolers may be partially fouled with debris entrained during the "rodding out" process. Inspection of these return bends is planned for the next upcoming Unit refueling outages. In the meantime, operability is still being based on the conservative Unit 1 degradation rate, and testing at power is done approximately once/quarter at this point. As the graph for Unit 3 shows, no significant fouling has occurred in the six weeks since startup in September; the next test is scheduled for early January 1989.

Duke Power Company has also engaged a consultant to help model the "staggered-bank" coil arrangement in the RBCUs. It is believed that this configuration, while not limiting at post-LOCA conditions, at normal operating (test) conditions actually renders a portion of the airside of the lower coil bank ineffective. This would mean that the RBCUs, as tested, would be capable of the same duty with essentially less surface area available. Fouling factors computed under this condition would necessarily be lower. A diagram is attached illustrating the theory.

As the winter months progress, more RBCU testing will take place and with it more data analyzed. Both the Design Engineering and Nuclear Production Departments have agreed to a once/quarter testing frequency for all Units, and testing will also be done at end-of-cycle shutdown, startup, and at appropriate intervals determined by previous operability assessments. This frequency should provide data necessary to "customize" the degradation rates for each RBCU, to be used in lieu of the current worst-case linear rate. As more is learned about the fouling rates on these coolers, the testing frequencies will be adjusted as necessary.


ESTIMATED UNIT 1 RBCU FOULING EFFECT - "A" & "C" COOLERS
○ = "A" COOLER
△ = "C" COOLER
% CAPACITY (EMERGENCY @ 75°F LSW)
80 x 10⁶ BTUH BASIS
RBCU 1C
RBCU 1A
PROJECTED DEGRADATION (DASHED)
120
110
100
90
80
70
60
50
40
30
20
10
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
MONTHS OF OPERATION
8/10/88
9/27/88
11/6/88
PROJECTED EOC11

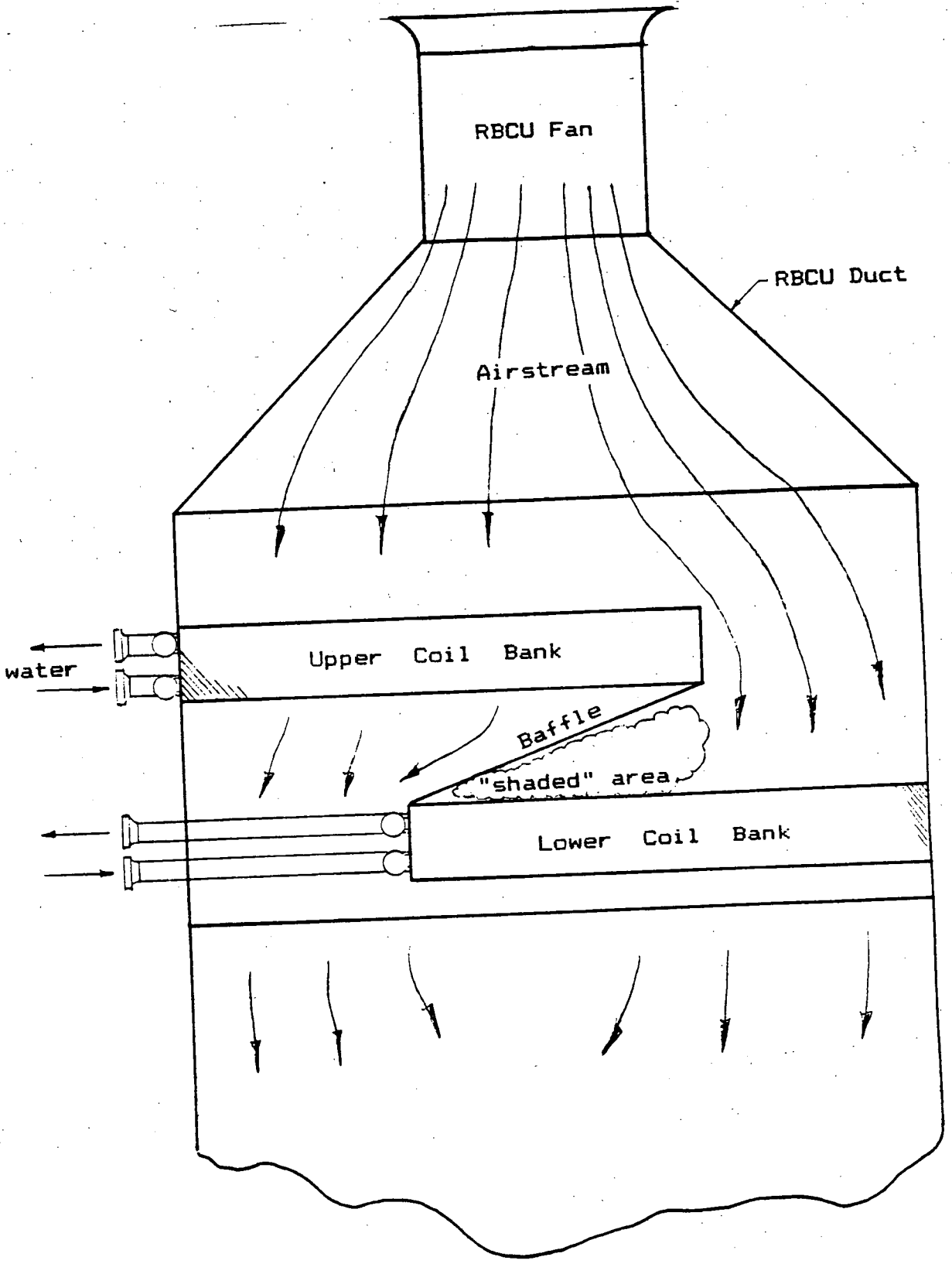

ESTIMATED UNIT 2 RBCU FOULING EFFECT - "A" & "C" COOLERS
○ = "A" COOLER
△ = "C" COOLER
UNIT 1 RECU 1C
2C
2A
RECU 1A
PROJECTED DEGRADATION
% CAPACITY (EMERGENCY @ TS'd LSW)
80x10⁶ BTUH BASIS
120
110
100
90
80
70
60
50
40
30
20
10
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
4/6/88
10/4/88
5/15/89 (EOC10)
MONTHS OF OPERATION


ESTIMATED UNIT 3 RBCU FOULING EFFECT - "A" & "C" COOLERS
○ = "A" COOLER
△ = "C" COOLER
% CAPACITY (EMERGENCY @ 75°F LSW)
80x10⁶ BTUH BASIS
120
110
100
90
80
70
60
50
40
30
20
10
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
9-23-88
10-6-88
11-1-88
1-10-89 TO 1-12-89
MONTHS OF OPERATION

DUKE POWER COMPANY

OCONEE NUCLEAR STATION

REACTOR BUILDING COOLING UNITS COIL ARRANGEMENT



Side Elevation
(no scale)

Duke Power Company
Oconee Nuclear Station

ATTACHMENT 2

Reactor Building Cooling Unit and Low Pressure Injection Coolers

Operability Criteria

LPI COOLER & RBCU OPERABILITY CRITERIA

Testing over the past years has indicated that the performance of certain safety-related heat exchangers, specifically the Reactor Building Cooling Units (RBCUs) and the Low Pressure Injection (LPI) coolers, may be significantly degraded from the nominal performance assumed under accident conditions. The LPI coolers and RBCUs are periodically cleaned and tested. The actual capacities of these coolers under accident conditions are determined by analysis of the test data. Currently, the operability of these heat exchangers is determined based on the following criteria:

1. Unit Cooldown: Both LPI coolers can cool the unit from 250 degrees-F to 140 degrees-F in 14 hours.

2. Loss of Coolant Accident (LOCA): The combined performance of the LPI coolers and the RBCUs can remove decay heat 30 minutes after a loss of coolant accident (LOCA), assuming a single failure in each system (i.e., only the worst LPI cooler and the two worst RBCUs are available for decay heat removal).

3. Equipment Qualification (EQ): The Reactor Building cooling capacity must be sufficient to prevent post-LOCA conditions from exceeding the qualifications of equipment required to mitigate a LOCA, again assuming a worst case single failure in both the LPI and RBCU system.

The techniques used to assess measured heat exchanger capacity against these three criteria are discussed in Attachment 4 to an April 6, 1987 letter from Duke Power Company to the NRC. Based on the analyses presented in the Duke LPI cooler and RBCU operability methodology, the operability criteria for the RBCUs and LPI coolers are being revised.

Figure 6.2-3 of the Oconee FSAR gives the design heat removal capacity of the RBCUs as a function of Reactor Building temperature. Figure 6.3-4 of the Oconee FSAR gives the design heat removal capacity of the LPI coolers as a function of primary side inlet temperature. Both of these figures are based on nominal shellside flow, tubeside flow, and low pressure service water (LPSW) inlet temperature. The heat removal capacities of these heat exchangers are less than the design capacities. However, the performance specifications (i.e., FSAR Figures 6.2-3 and 6.3-4) for these heat exchangers are not critical in determining operability.

The Oconee Technical Specifications state that a component "shall be considered operable when it is capable of performing its intended safety functions". Therefore, as long as the capacities of these degraded heat exchangers are such that they can perform their intended safety functions, of the RBCUs and LPI coolers are as follows:

1. 10CFR50.46 states that "after any calculated successful initial operation of the ECCS, the calculated core temperature shall be maintained at an acceptably low value and decay heat shall be

removed from the extended period of time required by the long-lived radioactivity remaining in the core". Therefore, one safety function for these heat exchangers is to provide long-term core cooling following an accident.

2. General Design Criterion 38 states that the intended safety function for containment heat removal systems "shall be to reduce rapidly, consistent with the functioning of other associated systems, the containment pressure and temperature following any loss-of-coolant accident and maintain them at acceptably low levels". Section 6.2 of the Oconee FSAR states that the containment heat removal systems prevent building pressure from exceeding its design limit of 59 psig. In addition, as is implied in 10CFR50.49, the containment heat removal system should be capable of maintaining building temperature below the EQ envelop following the most severe design basis accident. Therefore, another safety function of these heat exchangers is to maintain containment pressure and temperature below the above described limits following an accident.

Although the current operability criteria assure that the above described safety functions can be satisfied, they are not specifically written to address these safety functions. As has been stated previously, the critical point in determining operability is to verify that a component can perform its intended safety function. Therefore, the present operability criteria are considered overly restrictive. Thus, the following operability criteria have been established for the RBCUs and LPI coolers:

1. Long Term Core Cooling: This criterion assures core cooling by demonstrating that at least one train of LPI will be capable of injecting 3000 gpm into the reactor vessel downcomer. Assuming the worst single failure, one LPI cooler must be capable of maintaining conditions in the sump such that no NPSH problems to the LPI pumps occur.

2. Equipment Qualification: The Reactor Building cooling capacity must be sufficient to prevent post-LOCA conditions from exceeding the qualifications of equipment required to mitigate a LOCA, again assuming a worst case single failure in both the LPI and RBCU systems. Compliance with this criterion also implicitly assures that the containment design pressure will not be exceeded.

The impact of the actual heat exchanger capacities on the design basis 5.0 sq. ft hot leg break LOCA is evaluated in assessing operability. This LOCA is used because the FSAR design basis long-term LOCA analyses are based on the 5.0 sq. ft hot leg break. These FSAR analyses assume no Reactor Building spray. Containment pressure and temperature responses are provided for 0, 1, 2, or 3 RBCUs. The long-term containment response associated with different break sizes or locations will deviate somewhat from the 5.0 sq. ft hot leg break analyses stop at 100,000 seconds. Conservative analysis has determined that a fraction of the capacity of one RBCU is needed to reduce the containment temperature to 125 degrees-F within 10 days. In order to account for these effects, the 1 RBCU curve is used in evaluating the EQ criterion even though the zero RBCU curve would appear to be justified.