Florida
Power
CORPORATION
Crystal River Unit 3
Docket No. 50-302

April 15, 1996
3F0496-18

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555

Subject: Technical Specification Change Request No. 203, Revision 2, Additional Information

Reference: A. FPC to NRC letter, 3F0496-04 dated April 8, 1996
B. FPC to NRC letter, 3F0396-19 dated March 21, 1996

Dear Sir:

The results of in-situ pressure testing performed on Crystal River Unit 3 (CR-3) steam generator tubes during the current Refuel Outage 10 were provided in Reference A. In addition, Florida Power Corporation (FPC) developed a statistical analysis regarding non-leakage under steam line break conditions based on this testing. A summary of this analysis is included as an Attachment to this letter along with an evaluation of bounding leak rates as a function of degradation extent. An evaluation is also provided to show that calculated radiation doses due to the small population of indications not statistically addressed at the 95% confidence level remain less than 10 CFR 100 limits.

FPC believes that the information provided in the Attachment along with References A and B provide assurance of the leak tight integrity of the CR-3 steam generator tubes and that the No-significant Hazards (Sholly) evaluation provided in Reference B remains valid.

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FPC will continue to refine an NDE-based correlation to address leakage integrity of CR-3 first-span IGA indications during the operating cycle. We further plan to perform additional in-situ pressure testing of a statistically meaningful number of indications during our next Refueling Outage currently scheduled for Spring 1998. Both efforts are intended to support a permanent technical specification change for future operating cycles.

Sincerely,

Gary Boldt

G. L. Boldt,
Vice President
Nuclear Production

Attachment

xc: Regional Administrator, Region II
Senior Resident Inspector
NRR Project Manager

Summary of In-situ Test Results

The in-situ pressure testing performed at Crystal River Unit 3 can be used to establish a probability/ confidence statement regarding non-leakage under steam line break conditions. In this testing, there were no observations of leakage in the 74 unique eddy current indications tested at pressures in excess of 3000 psid. This number of observations exceeds the minimum (59) necessary to establish a non-parametric 95/95 probability/ confidence limit for the overall population of CR-3 first-span indications (1136). The bobbin voltage distribution of the indications subjected to in-situ pressure testing (Figure 1) is representative of the total population of indications of interest. From this, it can be concluded from the results of the in-situ testing that non-leakage for the CR-3 defect population is assured at a greater than 95/95 probability/ confidence level.

Utilizing the CR-3 in-situ test results and the database of inservice first-span indications, a number of 50 indications conservatively envelopes the population of inservice indications which cannot be statistically addressed with the results of the in-situ testing. For this small population, FPC continues to have a high confidence that these indications would likewise not experience leakage under steam line break conditions. This confidence is based upon two considerations. The first is an additional statistical evaluation based upon CR-3 pulled tube metallographic results. The second is a qualitative assessment of the conservatism associated with the in-situ test. These are described briefly below.

Statistical Evaluation of CR-3 Pulled Tube Depth Distribution

For the remaining 50 indications not statistically bounded by in-situ testing, a second statistical argument is possible which further reduces the population of interest. CR-3 pulled tube examinations provided a data set of 118 metallurgically measured IGA-related defect depths. An analytical probability distribution function (Weibull) was fitted to this data in order to allow computation of expected behavior in the upper tail region. The selection of this data was not random in the strictest sense. The selection was somewhat conservatively biased toward higher voltages by comparison with the total population of inservice indications due to the method used to select tubes which were pulled. A comparison of the fitted distribution with that of the data set is shown in Figure 2. It should be noted that the fitted distribution is conservative in the upper tail. Also the results of the Kolmogorov-Smirnov goodness-of-fit test show a level of significance exceeding 50%. Usage of this distribution approach gives a probability of exceeding the 87% through wall criteria of 0.004. Applying this probability to the population of inservice indications (1136) reduces the sub-population for which leakage concerns remain to approximately 5 indications.

Conservatism Present in the In-situ Pressure Testing

The actual in-situ test pressure differential was approximately 3100 psid. This value is a factor of 20% higher than an upper bound steam line break pressure differential of 2575 psid. If CR-3 safety analysis, rather than upper bound

steam line break pressure differentials are considered, the test pressure differential, with the temperature correction considered, represents a margin of conservatism of more than 20%.

From either the perspective of volumetric or crack-like degradation, bobbin coil signal amplitude has been shown to be a "measure" of the extent of the degradation. Due to the wide range of morphology differences in either category of degradation, volumetric or crack-like, there is no unique, narrow band, one-to-one correspondence between burst pressure or leak rate with bobbin voltage. A broad range of leak rate or burst pressure values will be observed at a given bobbin voltage, reflecting the varying morphologies. However, the general trend of increasing extent of degradation as bobbin voltage increases is clear. Consequently, burst pressure and leak rate issues become more of a concern at higher voltages. The converse is true as well. While specific correlations are arguably based on the nature and extent of the databases, the overall trends are clear. Therefore, biasing the CR-3 in-situ test sample toward those indications with higher bobbin coil voltages adds further conservatism with respect to those additional indications which cannot be statistically bounded with the in-situ results.

Evaluation of the Consequences of Leakage

In addition to the rationale provided above, an upper limit bound on the consequences of potential leakage was developed for the small population of indications which could not be statistically bounded. This evaluation involved an analysis of the hypothetical leak rate from these indications against the applicable FSAR Chapter 14 safety analysis.

Leak Rate Estimate

Bounding leak rates as a function of degradation extent were examined considering two extreme cases; an axial crack and a volumetric, pinhole type of wall penetration. A 0.25 inch long axial crack, if throughwall along its entire length, is expected to leak at about two (2) gpm at accident differential pressures (expressed in terms of operating temperature). As the throughwall crack length decreases, the leak rate rapidly decreases. A decrease in crack length by a factor of two (2) reduces the leak rate by two orders of magnitude. The observed axial extents of the pulled tube first-span IGA degradation has been consistently measured at less than 0.1 inches. Thus, assuming a crack-like wall penetration, a conservative average leak rate of 0.2 gpm per indication is projected.

Small diameter, pinhole type wall penetrations from a volumetric pit-like degradation may also be postulated. In this scenario, the significance of increased loading due to accident conditions is considered to be small. A pinhole wall penetration which would leak at 1 gpm under accident conditions, would be expected to leak at 0.5 gpm under normal operating conditions. Hence, wall penetration would just as likely occur under normal operating conditions and be easily detected. This is considered highly unlikely based upon previous CR-3 operating history. If a leak were to occur, appropriate plant action would be

taken at this time, including shutting down the unit should leak rate exceed the proposed 150 gallons per day. Given there are a small fraction of indications whose projected behavior cannot be statistically shown from the present in-situ test results, consideration of different modes of wall penetration lead to conservatively postulated leak rates which are manageable.

10 CFR Part 100 Analysis

An evaluation of the CR-3 safety analysis was performed assuming the uppermost limit on the number of indications not bounded by in-situ testing alone (50) would leak under steam line break conditions. The analysis was performed based on the following assumptions:

1. Leak rate associated with each of the 50 indications was conservatively assumed to be 2 gpm. This results in 100 gpm total primary to secondary leakage.

2. A main steam line break occurs with a concurrent 100 gpm primary to secondary flow. It is assumed that this flow rate persists throughout the entire accident.

3. CR-3 FSAR Section 14.2.2.1.6 (Environmental Consequences of a Main Steam Line Break) assumptions apply.

4. Dose was calculated based on the fact that EAB dose is directly proportional to the total amount of primary coolant released. The Cycle 11 reload report was used to obtain the dose due to FSAR assumptions.

Evaluating the steam line break accident in light of these assumptions predicts a resulting thyroid dose of 84.5 REM and whole body dose of 0.32 REM at two hours. These results are significantly below the 10 CFR 100 limits of 300 REM thyroid, and 25 REM whole body which are the current licensing basis criteria for Crystal River Unit 3.

Conclusion

FPC concludes that the statistical conclusions reached through in-situ testing and analysis of the CR-3 pulled tube results, provide a high confidence that no CR-3 in-service first-span pit-like IGA indications will leak under accident conditions. In this regard, the results of this evaluation support previous leakage integrity evaluations. The results of this review also show that, even in the remote event that leakage were to occur, it would not result in post-accident doses in excess of CR-3 current licensing basis limits (10 CFR 100).

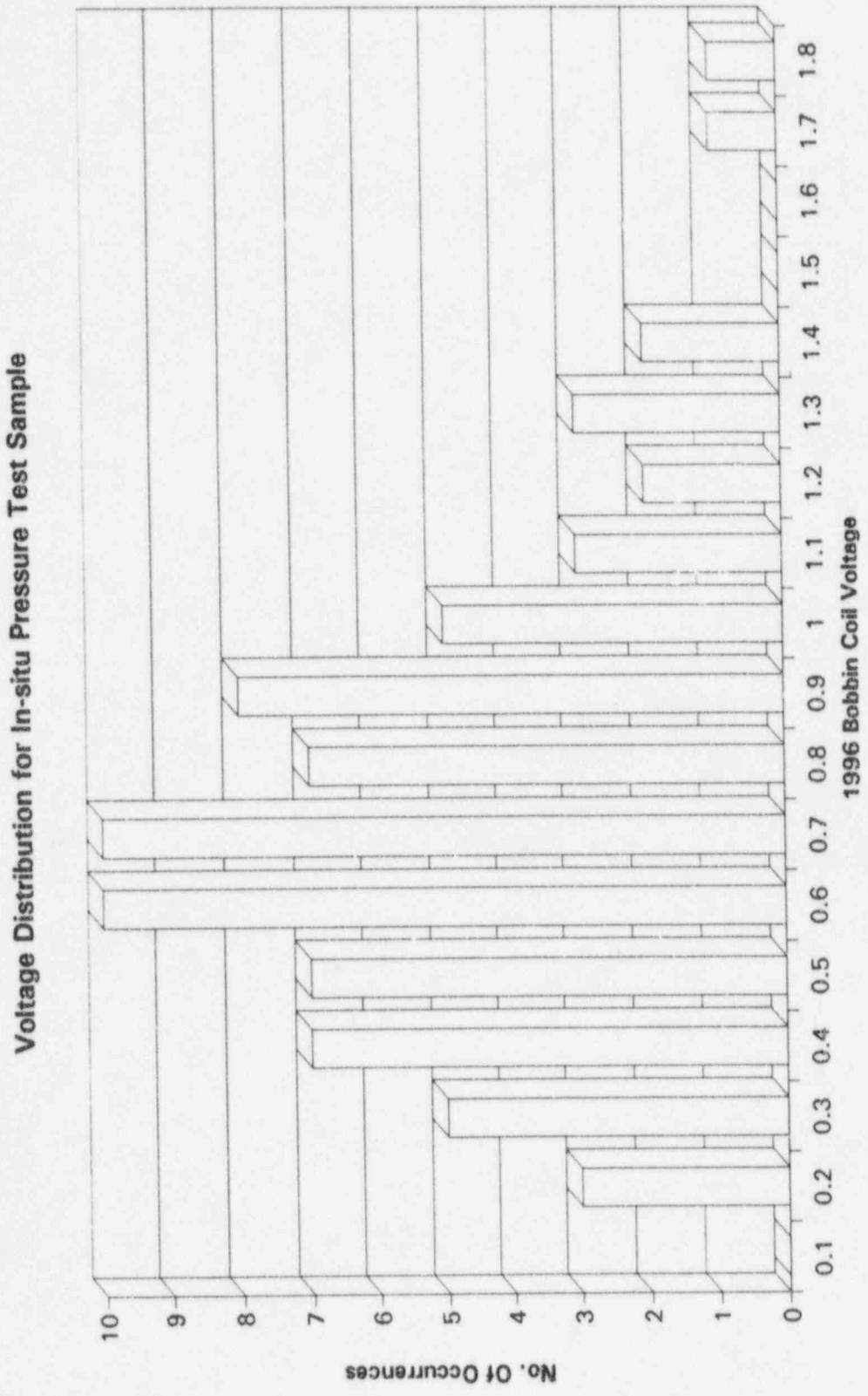
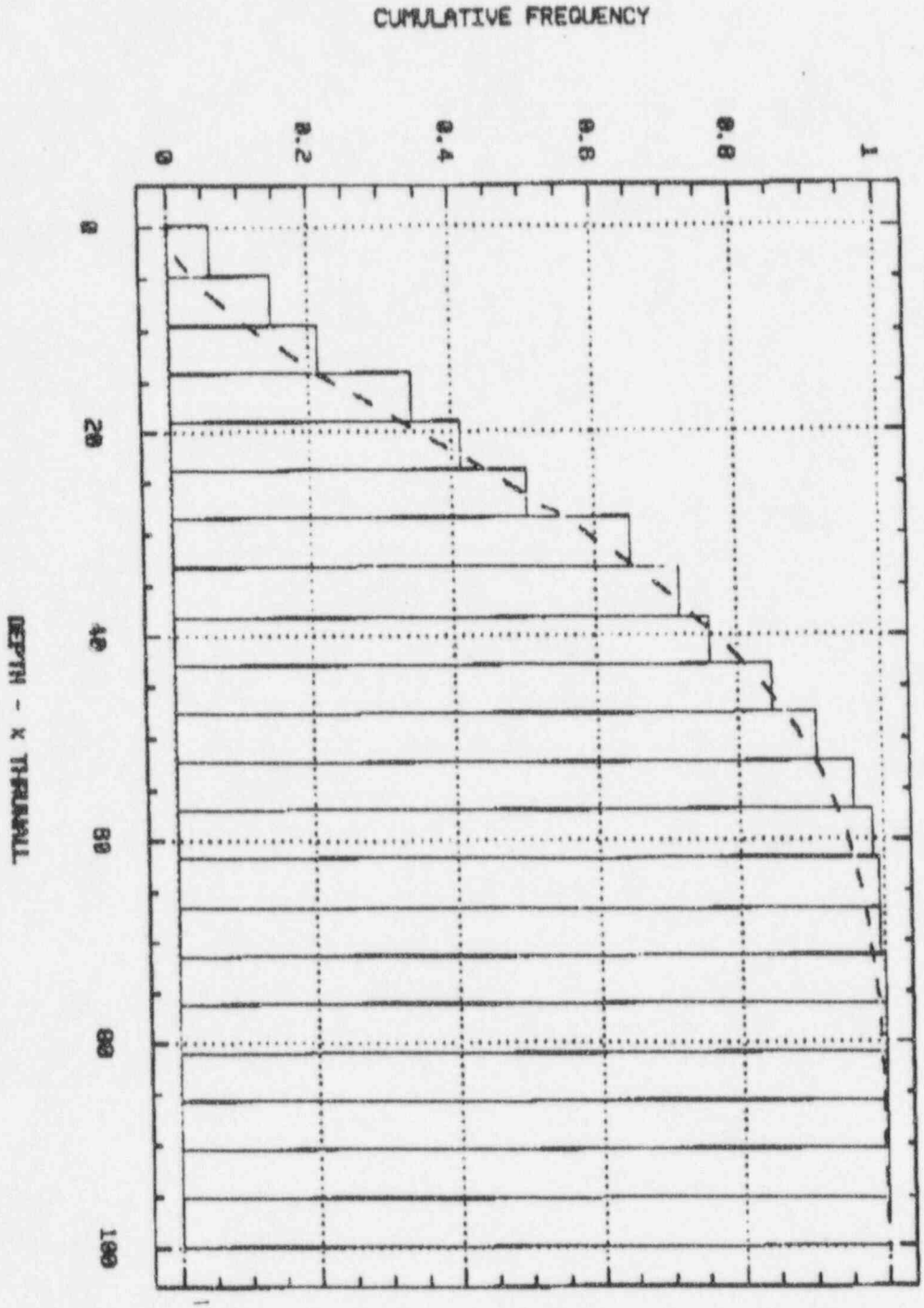

Voltage Distribution for In-situ Pressure Test Sample
No. Of Occurrences
0
1
2
3
4
5
6
7
8
9
10
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1996 Bobbin Coil Voltage

Figure 1



COMPARISON OF CRYSTAL RIVER 3 DEPTH DATA
CDF WITH FITTED WEIBULL DISTRIBUTION

Figure 2