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SUBJECT: Submits info contained in 30 day 10CFR50.46 rept re
 large break LOCA/ECCS revised analysis.

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L-96-295
10 CFR 50.46

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

Re: St. Lucie Unit 1
Docket No. 50-335
LBLOCA/ECCS Revised Analysis,
30 Day 10 CFR 50.46 Report

- Ref: (1) Letter from Brian W. Sheron (NRC) to T.F. Plunkett (FPL), 10 CFR 50.46 LARGE BREAK LOSS-OF-COOLANT ACCIDENT EVALUATION MODEL FOR ST. LUCIE PLANT, UNIT 1 (TAC NO. M96355); October 11, 1996.
- (2) Letter from W.H. Bohlke (FPL) to NRC/DCD: St. Lucie Unit 1, Docket 50-335, Revised LBLOCA Evaluation Model; Preliminary Assessment of Impact on PCT; L-96-283, October 25, 1996.
- (3) EMF-92-176, St. Lucie Unit 1 Large Break LOCA/ECCS Analysis with 25±7% SGTP: Siemens Power Corporation, February 1993.
- (4) Letter from J.A. Norris (NRC) to J.H. Goldberg (FPL): ST. LUCIE UNIT 1 - ISSUANCE OF AMENDMENT RE: REDUCTION OF REACTOR COOLANT SYSTEM DESIGN FLOWRATE (TAC M86064), November 25, 1994.
- (5) Letter from L.A. Wiens (NRC) to T.F. Plunkett (FPL): ST. LUCIE UNIT 1 - ISSUANCE OF AMENDMENT RE: THERMAL MARGIN AND REACTOR COOLANT SYSTEM FLOW LIMITS (TAC NO. M95472), July 9, 1996.

Reference (1) informed Florida Power and Light Company (FPL) of problems identified by the NRC concerning changes that were made to the large break loss-of-coolant (LBLOCA) evaluation model used by Siemens Power Corporation (SPC) for pressurized water reactors. Reference (2) documented a preliminary assessment of the impact of these problems on the St. Lucie Unit 1 LBLOCA analysis, identified the estimated change in peak cladding temperature (PCT) as significant (115 °F), and provided the basis for FPL's conclusion that the unit is operating in compliance with 10 CFR 50.46. A quality assurance verification of the calculational results reported in the preliminary assessment has been completed by SPC, and final conclusions regarding the limiting emergency core cooling system (ECCS) analysis are provided in this report.

The results of the limiting LOCA/ECCS analysis had previously been reported by Reference (3) in support of St. Lucie Unit 1 License Amendment No. 130 (Reference 4). That analysis was performed by SPC using the Exxon Nuclear Company Large Break ECCS Evaluation Model EXEM/PWR. The problems identified by Reference (1) involve only those calculations performed with SPC's TOODEE2 computer code, which is a code used in EXEM/PWR to calculate fuel rod heatup during the refill and reflood portions of the LOCA transient.

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St. Lucie Unit 1
Docket No. 50-335
Revised LBLOCA Analysis;
30 Day 10 CFR 50.46 Report

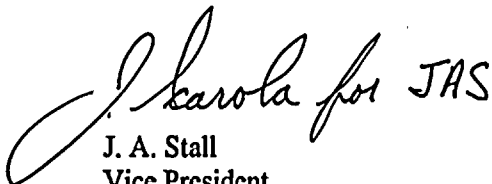
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The nature of the problems discovered in the evaluation model are described in References (1) and (2). Compensatory actions taken by FPL included an analysis of the LBLOCA using the 1986 NRC approved methodology as modified by a change in the TOODEE2 heatup calculation that assumes interpolated values of the heat transfer coefficient for reflood rates between 1.0 and 1.77 inches/second. The results of the compensatory actions are described in Reference (2) and the attachment to this report. In summary: the calculated PCT is 2027 °F, the calculated maximum local metal/water reaction is 3.45%, and the calculated core-wide metal/water reaction is less than 1%.

FPL considers the analysis reported by Reference (3), as modified by the attached SPC letter TMH:96:219, October 25, 1996, "Revised Large Break LOCA Analysis for St. Lucie Unit 1," and attachments thereto, to be the limiting ECCS analysis of record. The calculations demonstrate conformance to the criteria set forth in 10 CFR 50.46(b). Moreover, it has also been determined that this revised analysis will bound operation with up to 30% (avg) of steam generator tubes plugged, and the conclusions reached in support of St. Lucie Unit 1 License Amendment No. 145 (Reference 5) remain valid.

This report is submitted pursuant to 10 CFR 50.46(a)(3)(ii). Please contact us if there are any questions.

Very truly yours,

A handwritten signature in cursive script that reads "J. A. Stall for JAS". The signature is written in black ink and is positioned above the typed name and title.

J. A. Stall
Vice President
St. Lucie Plant

JAS/RLD

Attachment

cc: Stewart D. Ebnetter, Regional Administrator, Region II, USNRC.
Senior Resident Inspector, USNRC, St. Lucie Plant.

St. Lucie Unit 1
Docket No. 50-335
Revised LBLOCA Analysis;
30 Day 10 CFR 50.46 Report

L-96-295
Attachment

THIS ATTACHMENT TO FPL LETTER L-96-295 INCLUDES:

Letter from T.M. Howe (SPC) to R.J. Rodriguez (FPL), Revised Large Break LOCA Analysis for St. Lucie Unit 1; TMH:96:219, October 25, 1996, and attachments thereto, as follows:

TMH:96:219, Attachment 1 (Plots):

Clad Temperature vs. Time
Effective Flooding Rate vs. Time
Collapsed Core Liquid Level vs. Time
Quench Level vs. Time
Coolant Channel Pressure vs. Time
Heat Transfer Coefficient vs. Time

TMH:96:219, Attachment 2:

Summary of LBLOCA Results Using Linear Interpolation of Heat Transfer Correlations (0.8 DECLG Break - MOC Stored Energy, EOC Axial Shape, $X/L = 0.85$).

Input Parameters for Calculation of Heat Transfer Coefficients During Reflood (0.8 DECLG Break - MOC Stored Energy, EOC Axial Shape, $X/L = 0.85$).

SIEMENS

October 25, 1996
TMH:96:219

Mr. R. J. Rodriguez, JPN-JB
Nuclear Fuels Supply Group
Florida Power & Light Company
700 Universe Blvd.
Juno Beach, FL 33408-0420

Dear Mr. Rodriguez:

Revised Large Break LOCA Analysis for St. Lucie Unit 1

In accordance with the agreement reached between FPL and SPC on October 23, 1996, SPC has performed an analysis of the St. Lucie Unit 1 Large Break LOCA (LBLOCA) using the 1986 NRC approved methodology with the exception of linear interpolation of the FCTF heat transfer correlation for reflood rates between 1.0 and 1.77 inch/sec (the interpolated value is never allowed to be greater than the value corresponding to the reflood rate of 1.77 inch/sec). Except for this change in the TOODEE2 heatup calculation, the methodology is the same as that reported in EMF-92-176, "St. Lucie Unit 1 Large Break LOCA/ECCS Analysis with $25 \pm 7\%$ SGTP," dated February 1993. The plant parameters used in the re-analysis are identical to those used in EMF-92-176. Only the limiting break size cases were calculated with the interpolated heat transfer coefficients. A disposition was performed, however, to show that even with the interpolation approach the other LBLOCA cases would remain less severe than reported in this letter.

Using the linear interpolation approach, SPC has assessed that the PCT for St. Lucie Unit 1 will be 2027°F, an increase of 115°F from the current PCT of record. SPC has also reviewed the applicability of the analysis at 25% steam generator tube plugging (SGTP) for 30% SGTP. The conclusion that conservatisms in the 25% SGTP analysis bound operation at 30% SGTP remains valid.

To facilitate FPL's review of the re-analysis of the St. Lucie Unit 1 LBLOCA, SPC is providing the following information:

- In Attachment 1, plots of cladding temperature, effective reflood rate, core collapsed liquid level, quench level, core outlet pressure and heat transfer coefficient at the PCT location versus time for the TOODEE2 analysis of the limiting LBLOCA case using the heat transfer correlations based on the linear interpolation approach.

Siemens Power Corporation

Nuclear Division
Engineering & Manufacturing

2101 Horn Rapids Road
P.O. Box 130
Richland, WA 99352-0130

Tel: (509) 375-8100
Fax: (509) 375-8402

Mr. R. J. Rodriguez
October 25, 1996
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- In Attachment 2, input parameters and a summary of results for the analysis using the linear interpolation approach.

The information provided by this letter has received an independent review according to SPC's Quality Assurance Program.

If you have any questions, please call me.

Very truly yours,

T. M. Howe

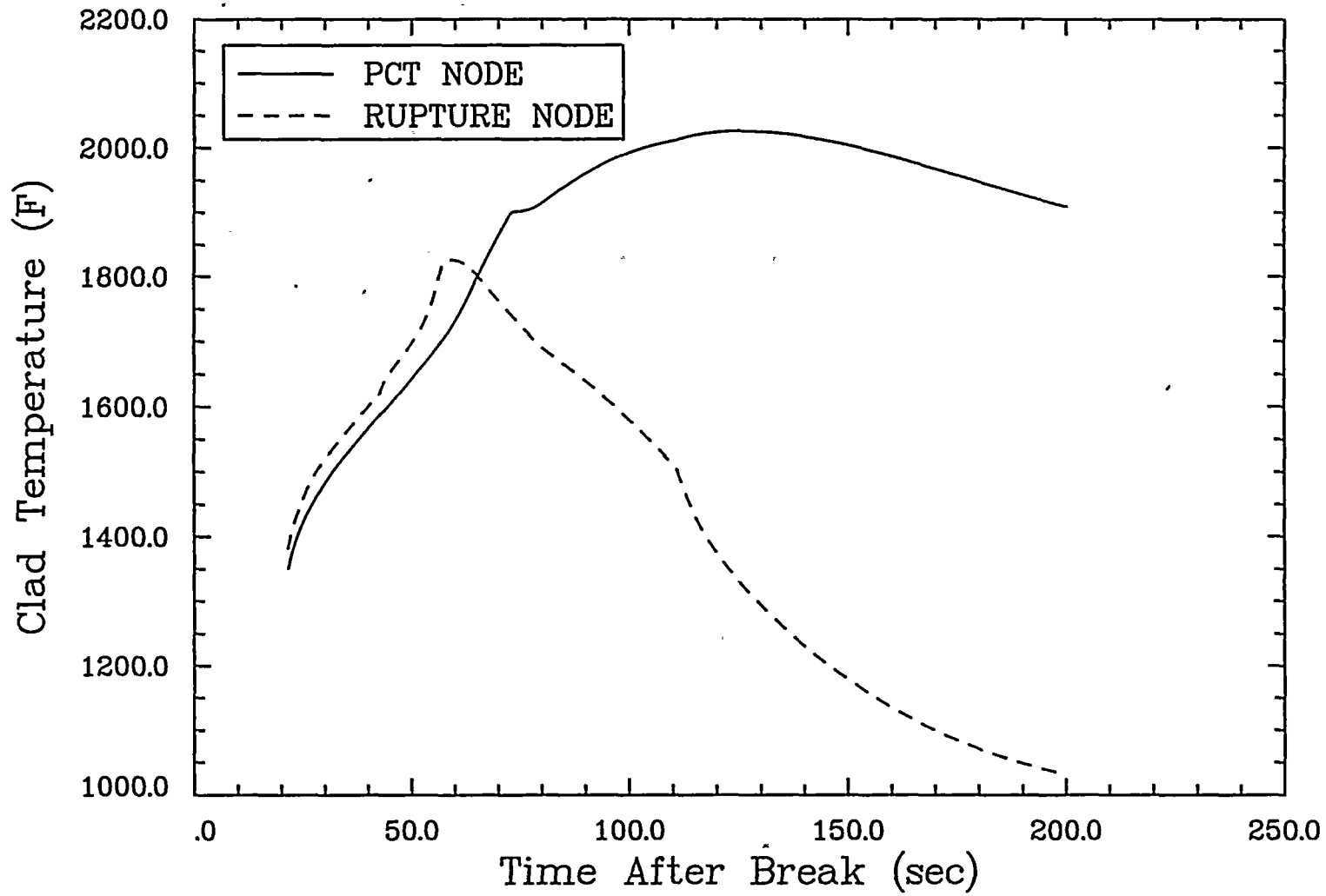
Tim M. Howe
Project Manager

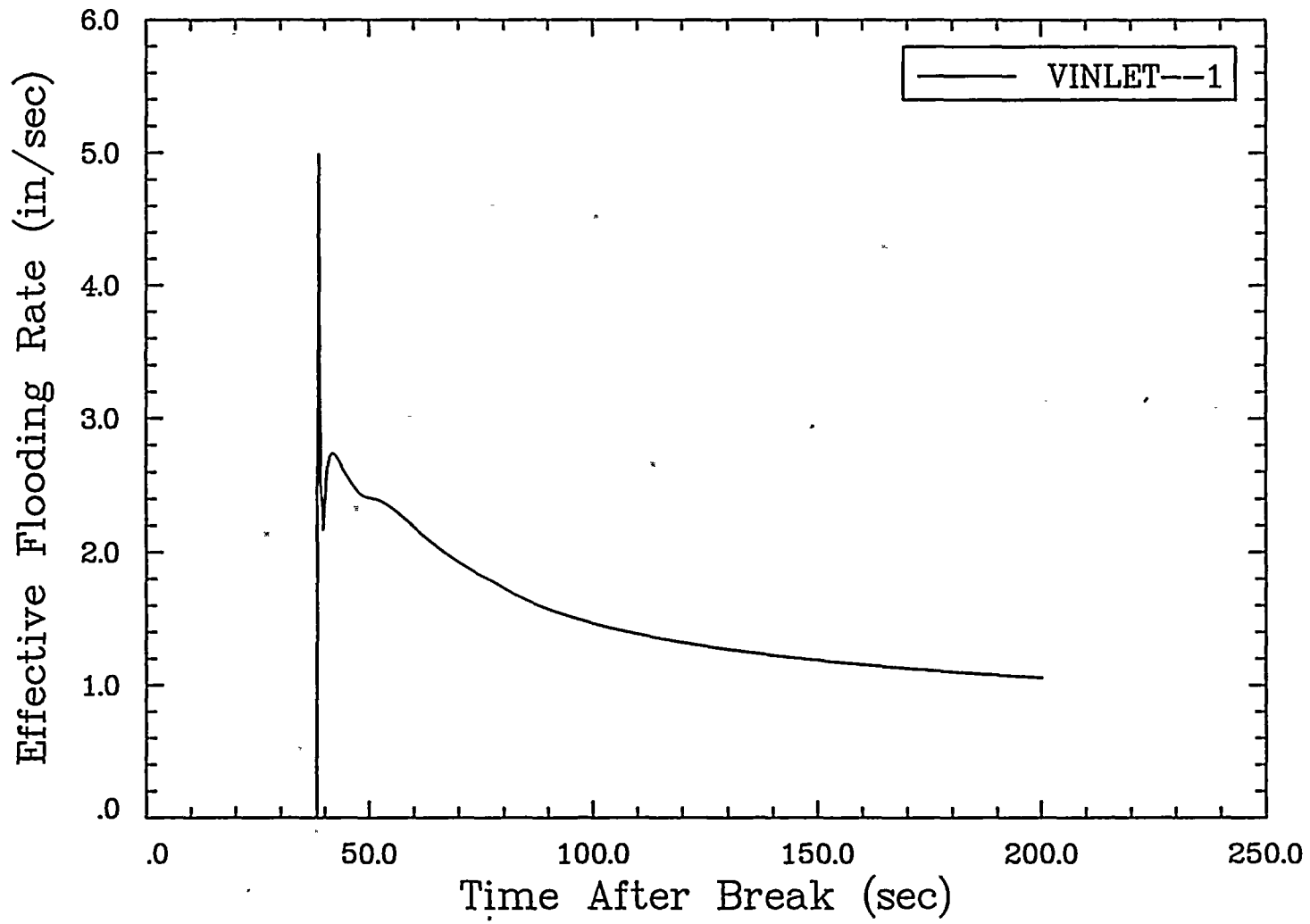
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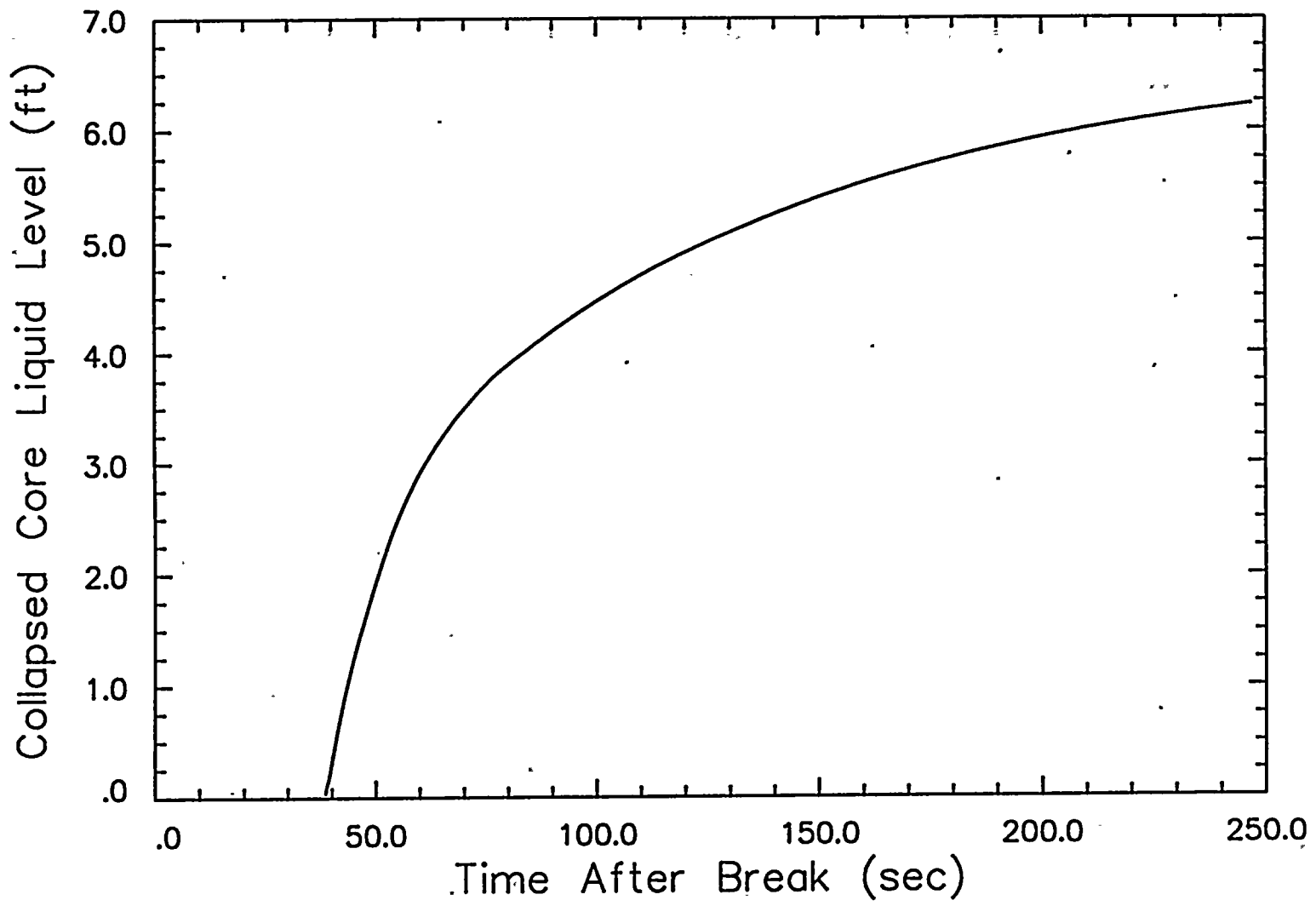
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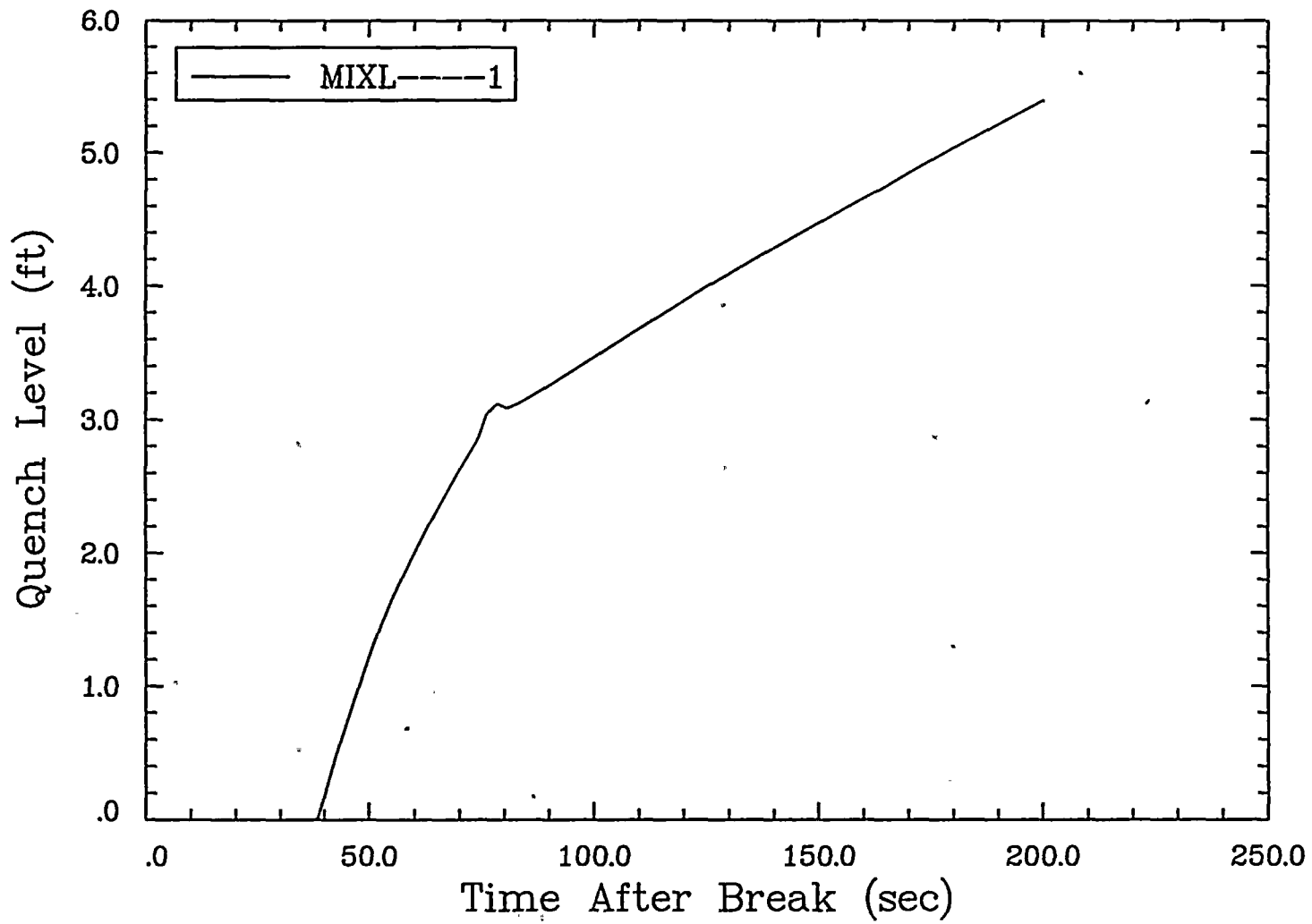
c: C. G. O'Farrill - St. Lucie Plant Site (with attachments)

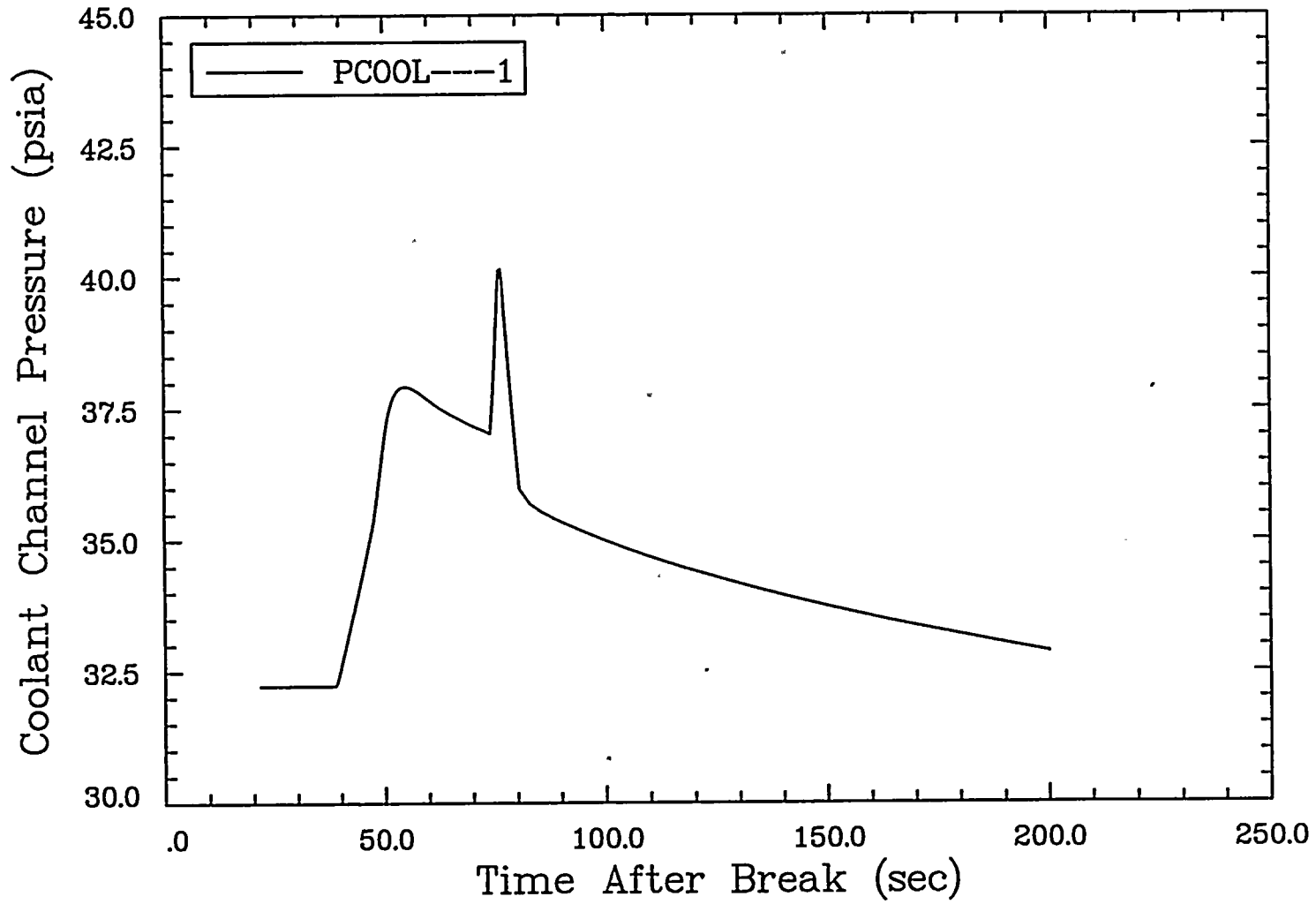
PLOTS OF CLADDING TEMPERATURE, EFFECTIVE REFLOOD RATE, CORE COLLAPSED
LIQUID LEVEL, QUENCH LEVEL, CORE OUTLET PRESSURE AND HEAT TRANSFER
COEFFICIENT FOR TOODEE2 HEATUP CALCULATION WITH LINEAR INTERPOLATION OF
HEAT TRANSFER CORRELATION

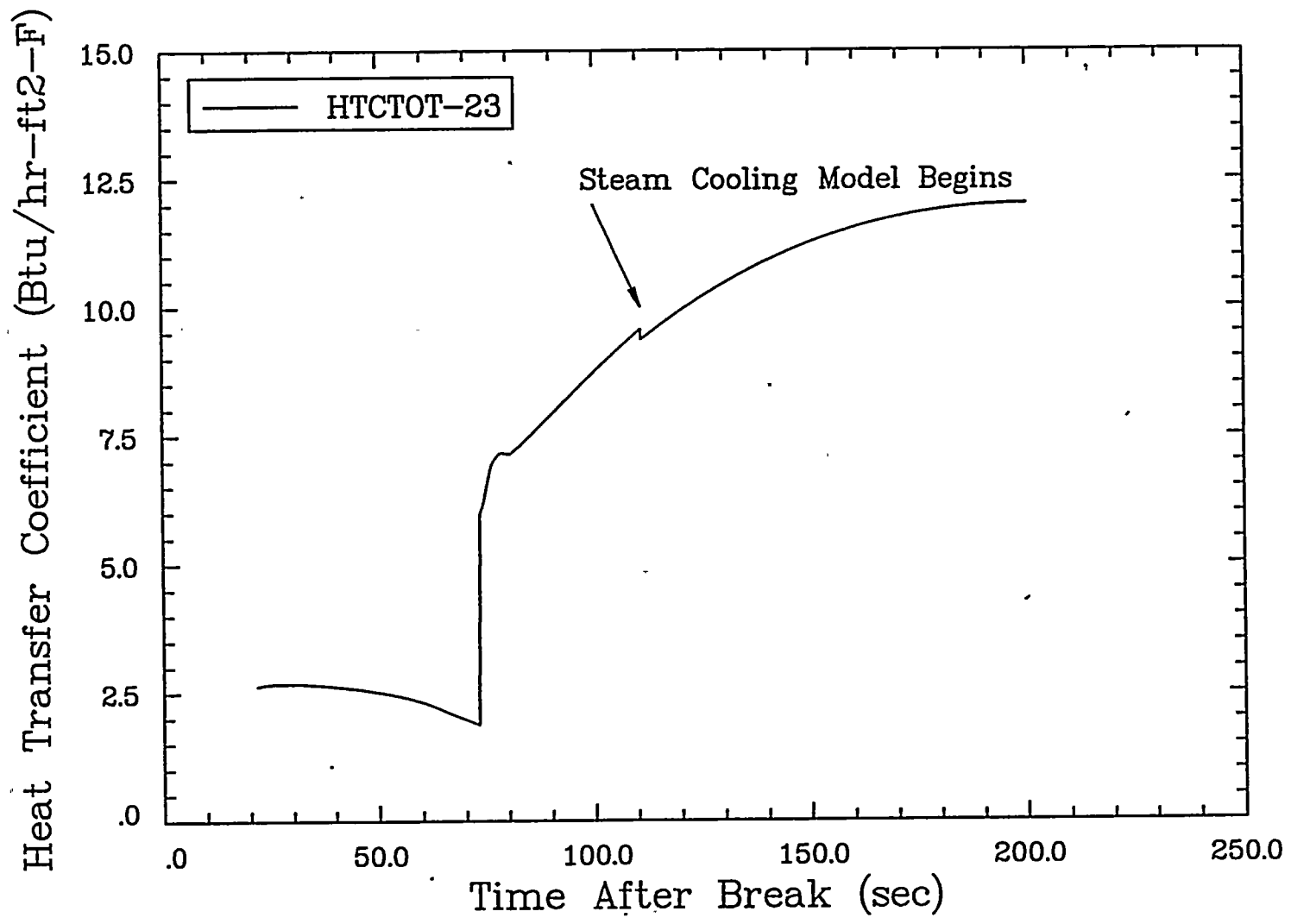












SUMMARY OF LBLOCA RESULTS USING LINEAR INTERPOLATION
OF
HEAT TRANSFER CORRELATIONS

(0.8 DECLG BREAK - MOC STORED ENERGY, EOC AXIAL SHAPE, X/L = 0.85)

<u>Parameter</u>	<u>Value</u>
Hot Rod Burst	
-Time (sec)	42.86
-Elevation (ft)	9.97
-Channel Blockage Fraction	0.494
Peak Cladding Temperature	
-Temperature (°F)	2027
-Time (sec)	125.6
-Elevation (ft)	10.47
Metal-Water Reaction	
-Local Maximum (%)	3.45
-Elevation of Local Maximum (ft)	10.47
-Hot Pin Average (%)	0.53
-Core Wide Maximum (%)	<<1.0
Time Effective Reflood Rate Drops below 1.77 inch/sec (sec)	78.20

INPUT PARAMETERS FOR CALCULATION OF HEAT TRANSFER COEFFICIENTS
DURING REFLOOD

(0.8 DECLG BREAK - MOC STORED ENERGY, EOC AXIAL SHAPE, X/L = 0.85)

<u>Parameter</u>	<u>Value</u>
Radial Peaking Factor	1.89 ⁽¹⁾
Total Peaking Factor	2.37
Hot Rod Peak Node LHGR (kW/ft)	0.747 ⁽²⁾
Hot Rod Peak Node Cladding Surface Temperature (°F)	1588 ⁽²⁾
Core Inlet Subcooling (°F)	122.1 ^{(2),(3)}

⁽¹⁾ The Technical Specification value of 1.75 was increased by a 2% rod insertion augmentation and a 6% measurement uncertainty.

⁽²⁾ These values are provided at the time of the beginning of reflood.

⁽³⁾ This value is used in the FCTF correlations throughout the reflood period.