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SUBJECT:
FORWARDING 19 UPDATED PAGES TO SUBJECT FACILITY"S CYCLE 2 RELOAD SAFETY EVALUATION TO INCLUDE THE EFFECT OF CEA GUIDE TUBE WEAR ON THE CYCLE 2 CORE CONFIGURATION... W/ATT.

PLANT NAME: ST LUCIE #1

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FLORIDA POWER & LIGHT COMPANY

April 24, 1978
L-78-148

Office of Nuclear Reactor Regulation
Attention: Mr. Victor Stello, Director
Division of Operating Reactors
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

RECEIVED
MAY 1 1978
U.S. NUCLEAR REGULATORY COMMISSION
Mail Section

Dear Mr. Stello:

Re: St. Lucie Unit 1
Docket No. 50-335
RSE Revision

Nineteen pages of the St. Lucie Unit 1, Cycle 2, Reload Safety Evaluation (RSE) have been revised to include the effect of CEA guide tube wear on the Cycle 2 core configuration. The attached revised pages can be used to update the RSE which was forwarded to your office as an attachment to letter L-78-99 of March 22, 1978. The revisions are marked by a line in the right hand margin.

Very truly yours,

Robert E. Uhrig
Vice President

REGULATORY DOCKET FILE COPY

REU/MAS/mb

Attachment

cc: Mr. James P. O'Reilly, Region II
Harold F. Reis, Esquire

781220085

A001/S *
3/3

ATTACHMENT

Re: St. Lucie Unit 1
Docket No. 50-335
RSE Revision

The following RSE pages (L-78-99, March 22, 1978) are revised to include the effect of CEA guide tube wear on the Cycle 2 core configuration:

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would significantly reduce the late reflood peaks for both fuel types. Since the low density fuel experiences blowdown rupture, the first and second peak temperatures are higher than that for the high density fuel. Use of the PARCH code (10) would thus result in demonstrating the low density fuel to be the limiting fuel.

The blowdown (CEFLASH-4A)[4], refill (COMPERC-II)[5] and core-wide clad oxidation COMZIRC[5, sup. 1] analyses from the Cycle I analysis[9] remain valid for Cycle II. Accordingly, only the new STRIKIN-II results for the worst break size for the limiting low density fuel and as applied to the high density fuel is being reported in this analysis.

The results of this study supercede those reported in Reference 9 and show that the plant meets the appropriate NRC Acceptance Criteria[1] published in the Federal Register on January 4, 1974. Conformance is summarized as follows:

Criterion (1) PEAK CLAD TEMPERATURE*. "The calculated maximum fuel element cladding temperature shall not exceed 2200°F".

The analysis for the low density fuel yielded a peak clad temperature of 1972°F for the 0.8 DES/PD** break at 14.8 kw/ft. The peak clad temperature for the high density fuel case was 2035°F at 14.8 kw/ft.

Criterion (2) MAXIMUM CLADDING OXIDATION*. "The calculated total oxidation of the cladding shall nowhere exceed 17% of the total cladding thickness before oxidation".

The analysis for the low density fuel yielded a peak local clad oxidation percentage of 11.8% for the 0.8 DES/PD break at 14.8 kw/ft. The high density fuel clad oxidation percentage was 12.0% at 14.8 kw/ft.

* Neither the low nor the high density fuel cases employed the PARCH code[10]. Since the peak clad temperatures occur during late reflood, use of PARCH would result in lower peak clad temperatures, lower local clad oxidation and lower core wide clad oxidation. Use of PARCH would also show that the low density fuel is the more limiting fuel type.

**DES/PD = Double-Ended Slot at Pump Discharge

Criterion (3) MAXIMUM HYDROGEN GENERATION*. "The calculated total amount of hydrogen generated from the chemical reaction of the cladding with water or steam shall not exceed 1% of the hypothetical amount that would be generated if all of the metal in the cladding cylinders surrounding the fuel, excluding the cladding surrounding the plenum volume, were to react".

The analysis for the low density fuel yielded a peak core-wide clad oxidation percentage of <.67% for the 0.8 DES/PD break at 14.8 kw/ft. The core wide clad oxidation percentage for the high density fuel is <.63% at 14.8 kw/ft.

II. Large Break Analysis

A. Method of Calculation

The calculations reported in this section were performed using Combustion Engineering's Large Break Evaluation Model which is described in References 2, 3, and 6.

In the CE model, the CEFLASH-4A[4] computer program is used to determine the primary system flow parameters during the blowdown phase, and the COMPERC-II[5] computer program is used to describe the system behavior during the refill and reflood phases. The core flow and thermodynamic parameters from these two codes are used as input to the STRIKIN-II[6] program which is used to calculate the hot rod clad temperature transient. The peak clad temperature and peak local clad oxidation percentage are therefore obtained from the STRIKIN-II calculation. The STRIKIN-II program has been revised and includes the prevention of a return to nucleate boiling[6, Sup. 4]. The core-wide clad oxidation percentage is obtained from the results of both the STRIKIN-II and COMZIRC[5, Sup. 1] computer programs.

B. Emergency Core Cooling System Assumptions

The ECCS assumptions are the same as those stated in Reference 9.

C. Core, System and Containment Parameters

Those parameters which differ from the previous analysis[9] are shown in Table 8-1.

D. Break Spectrum

Only the worst break as identified in the Cycle I ECCS performance analysis[9] was analyzed for Cycle II. This break was the 0.8 DES/PD (the worst break identified in the Cycle I spectrum for the low density fuel) and was used for the high density fuel also. Analyses of this break for Cycle II resulted in peak clad temperatures of 1972 °F and 2035 °F respectively. The substantially low peak clad temperatures for these breaks are due to the fact that the Cycle II fuel stored energy at the time in life of the minimum gap conductance is appreciably lower than that for Cycle I. Furthermore, since the peak clad temperatures for Cycle II show an appreciable margin relative to the criterion limits, a re-analysis of the full break spectrum is not warranted since it is expected that the performance for the remaining break sizes will also display these margins.

E. Results

A re-analysis of only the worst break identified as the 0.8 DES/PD from the previous Cycle I ECCS performance report[9] was performed.

Table 8-2 identifies the breaks analyzed in this study for the low and high density fuels along with the figure number presenting the pertinent transient data for each analysis.

As noted in Table 8-2 the results for each of the cases analyzed are displayed graphically in Figures 8.1 and 8.2. For each case, the variables listed in Table 8-3 are plotted as a function of time.

Times of interest for the various breaks are shown in Table 8-4, while Table 8-5 summarizes peak clad temperatures and clad oxidation percentages.

As shown in Table 8 -1, the Cycle II analysis represents a reduction in initial fuel average temperature stored energy for the low density fuel of 134.5°F when compared to the Cycle I analysis. The initial high density fuel stored energy was even lower. The analysis yielded low peak clad temperatures of 1972 °F for the low density fuel and 2035°F for the high density fuel which are directly attributable to the reduction in stored energy. These results clearly identify the temperature margin relative to the Acceptance Criteria limit. Since the ECCS performance for this break for Cycle II represents performance results well below the Acceptance Criteria[1] limits, a complete spectrum analysis is not warranted as the remaining breaks in the large break spectrum would also display these large margins.

Mass and energy release to the containment during blowdown has not changed from those values presented in the Cycle I analysis[9].

III. Computer Code Version Identification

The following versions of the Combustion Engineering ECCS Evaluation Model computer codes were used for this analysis:

CEFLASH-4A:	Version No. 76041
STRIKIN-II:	Version No. 76234
COMPERC-II:	Version No. 75097
COMZIRC :	Version No. 75055

Table 8 -1

St. Lucie I Cycle II
General System Parameters

Quantity	Value Cycle I	Value Cycle II	
Reactor Power Level (102% of Nominal)	2611	2611	MWt
Average Linear Heat Rate (102% of Nominal)	6.2126	6.2126	kw/ft
Moderator Temperature Coefficient at Initial Density	$+0.2\times10^{-4}$	$+0.2\times10^{-4}$	$\Delta\rho/^{o}F$
System Flow Rate (Total)	139.44×10^{6}	139.44×10^{6}	lbs/hr
Core Flow Rate	134.6×10^{6}	134.6×10^{6}	lbs/hr
Initial System Pressure	2250	2250	psia
Core Inlet Temperature	548	548	^{o}F
Core Outlet Temperature	598	598	^{o}F
Active Core Height	11.39	11.39	Ft
Fuel Rod OD	0.44	0.44	In
Number of Cold Legs	4	4	
Number of Hot Legs	2	2	
Cold Leg Diameter	30	30	In
Hot Leg Diameter	42	42	In
Safety Injection Tank Pressure	215	215	psia
Safety Injection Tank Gas/Water Volume	930/1090	930/1090	Ft^3
Peak Linear Heat Generation Rate (PLHGR)	14.8	14.8	kw/ft
Gap Conductance at PLHGR	714*	947.2* 1552 **	$BTU/hr\text{-}ft^2\text{-}^{o}F$
Fuel Centerline Temperature at PLHGR	3835*	3751.1* 3484 **	^{o}F
Fuel Average Temperature at PLHGR	2563*	2428.5* 2181 **	^{o}F
Hot Rod Gas Pressure	1115.5*	1297.4* 1047.8**	psia
Hot Rod Burnup	3791.*	10081 820.**	MWD/MTU

*For low density fuel, when gap conductance is minimum.

**For high density fuel, when gap conductance is minimum.

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Table 8-4

St. Lucie I - Cycle II
Times of Interest
(Seconds)

Break	Hot Rod Rupture	SI Tanks On	Start of Reflood	SI Tanks Empty
Low Density Residual Fuel (14.8 kw/ft)				
0.8 x DES/PD	9.92	17.6	35.84	70.33
High Density Fuel (14.8 kw/ft)				
0.8 x DES/PD	54.91	17.6	35.84	70.33

Table 8-5

St. Lucie I -- Cycle II --
Peak Clad Temperatures and Oxidation Percentages
for the 0.8 DES/PD Break

Low Density Residual Fuel (14.8 kw/ft)

Break	Peak Clad Temperature (°F)	Clad Oxidation (%) Local	Clad Oxidation (%) Core-Wide
0.8 x DES/PD	1972	11.8	<.67

High Density Fuel (14.8 kw/ft)

Break	Peak Clad Temperature (°F)	Clad Oxidation (%) Local	Clad Oxidation (%) Core-Wide
0.8 x DES/PD	2035	12.0	<.63

FIGURE 8-1A

ST. LUCIE UNIT I

0.8 x DOUBLE ENDED SLOT BREAK IN PUMP DISCHARGE LEG

PEAK CLAD TEMPERATURE

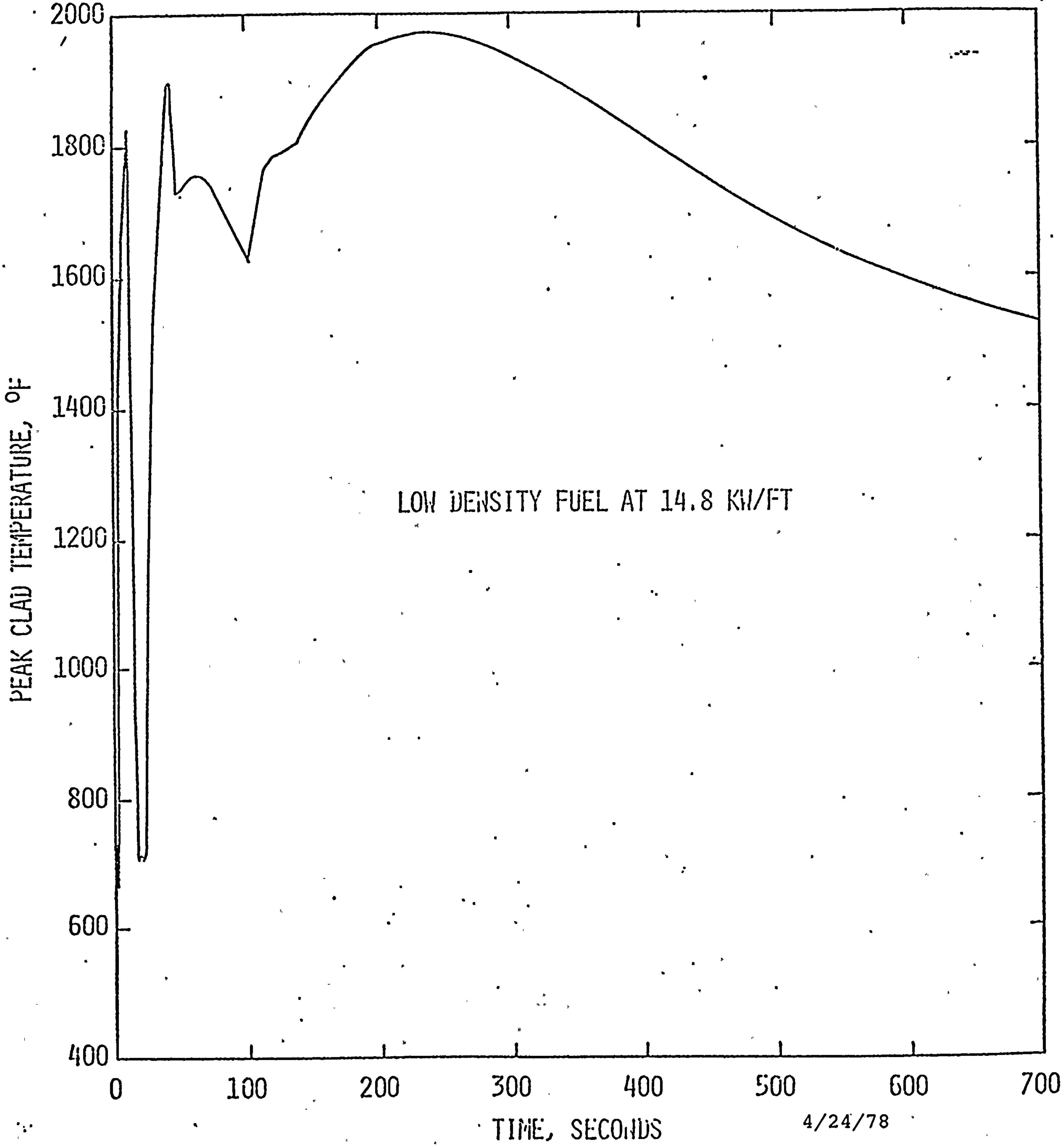

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FIGURE 8-1B

ST. LUCIE UNIT I

0.8 x DOUBLE ENDED SLOT BREAK IN PUMP DISCHARGE LEG

HOT SPOT GAP CONDUCTANCE

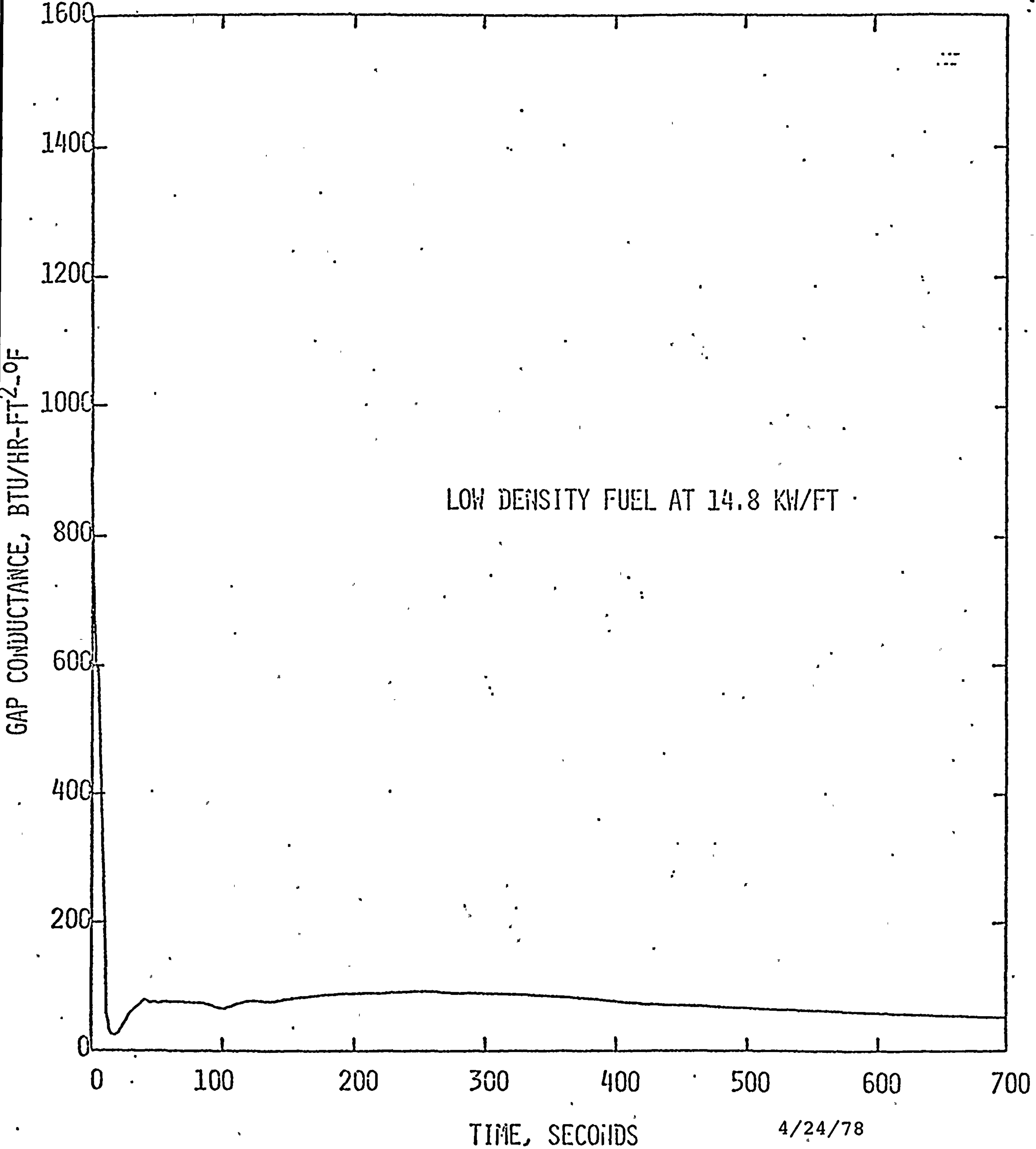

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FIGURE 8-1C

ST. LUCIE UNIT I

0.8 x DOUBLE ENDED SLOT BREAK IN PUMP DISCHARGE LEG

PEAK LOCAL CLAD OXIDATION

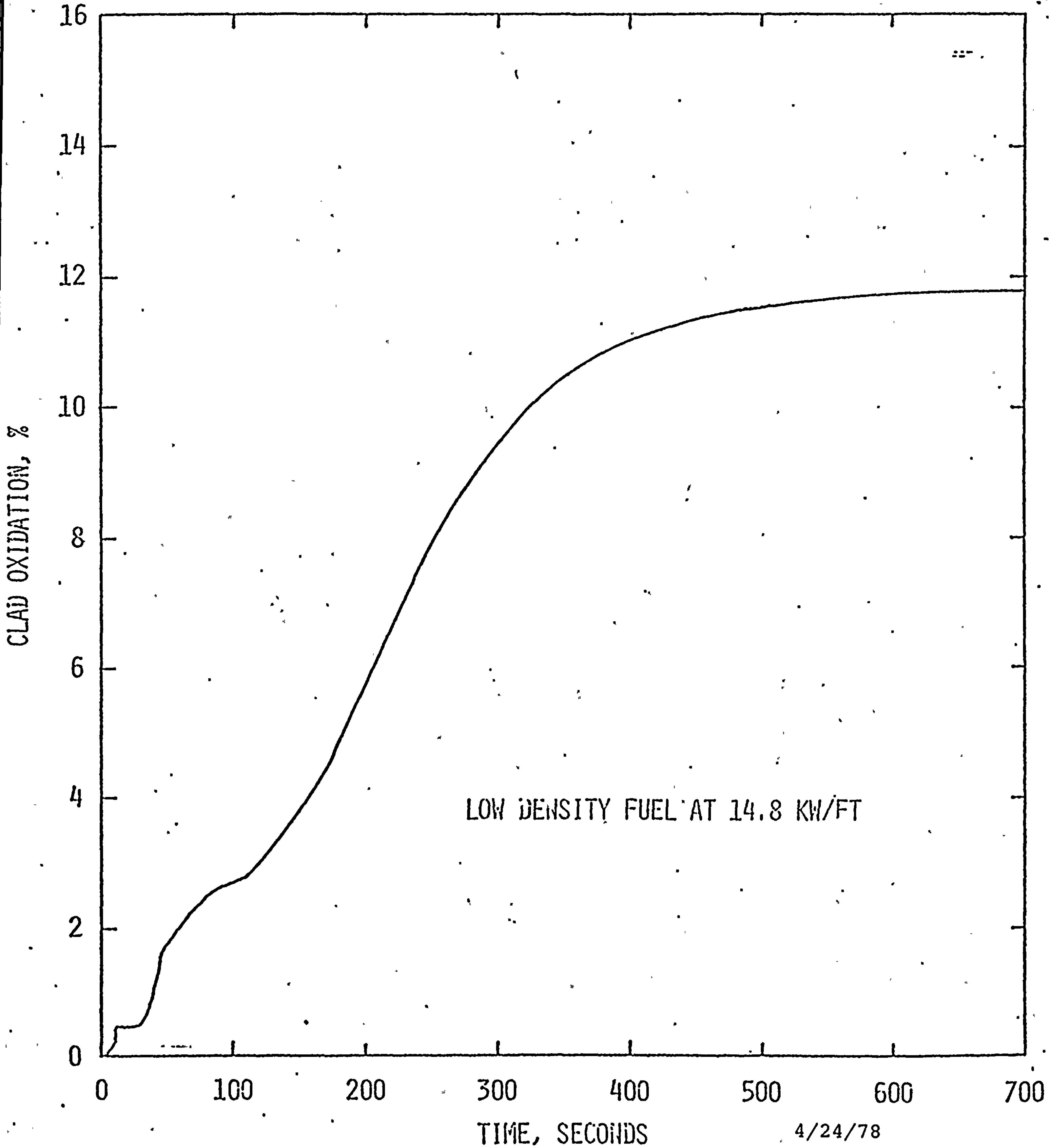

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FIGURE 8-1D

ST. LUCIE UNIT I

0.8 x DOUBLE ENDED SLOT BREAK IN PUMP DISCHARGE LEG
CLAD TEMPERATURE, CENTERLINE FUEL TEMPERATURE, AVERAGE
FUEL TEMPERATURE AND COOLANT TEMPERATURE FOR HOTTEST NODE

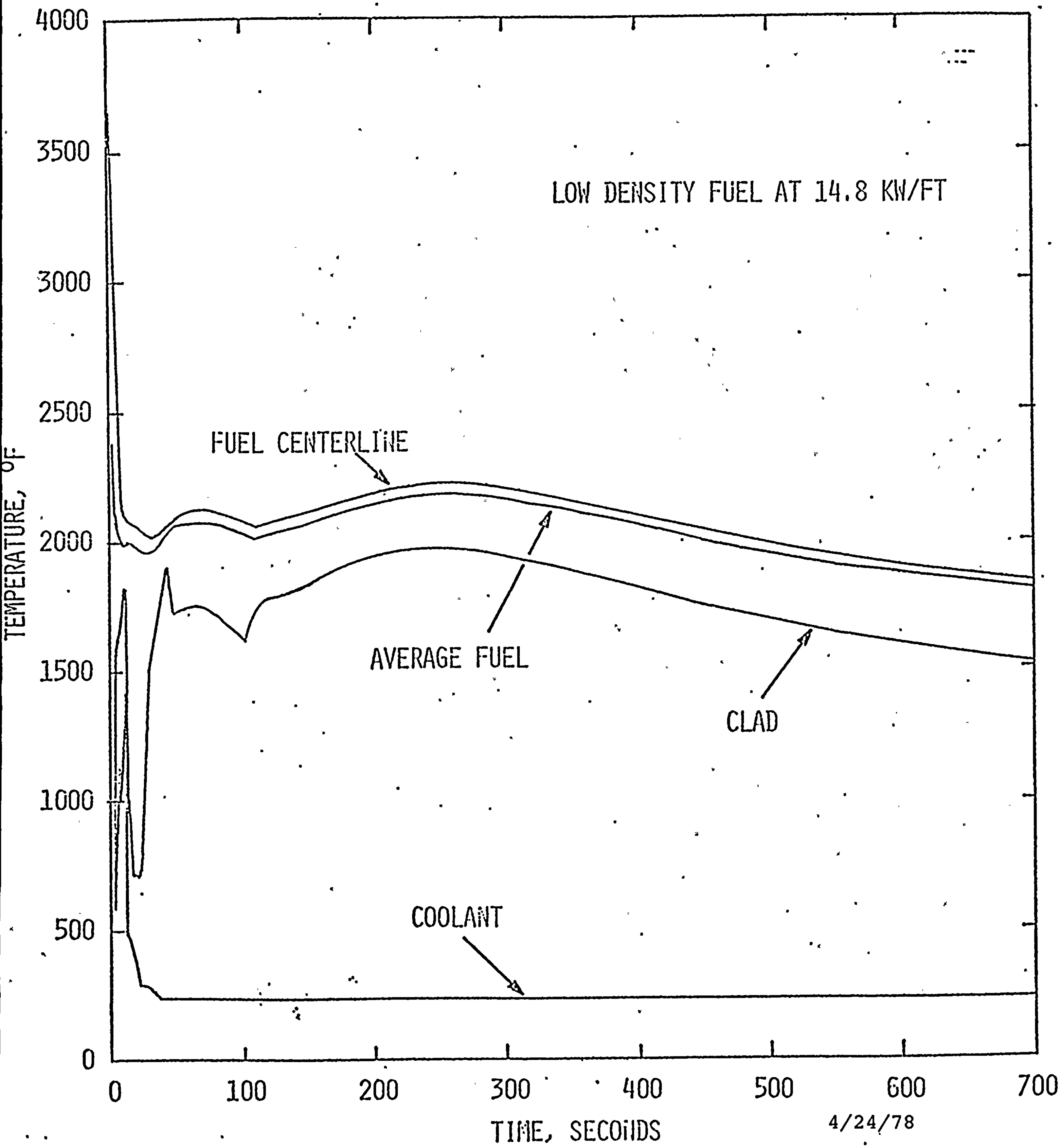

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FIGURE 8-1E

ST. LUCIE UNIT I

0.8 x DOUBLE ENDED SLOT BREAK IN PUMP DISCHARGE LEG

HOT SPOT HEAT TRANSFER COEFFICIENT

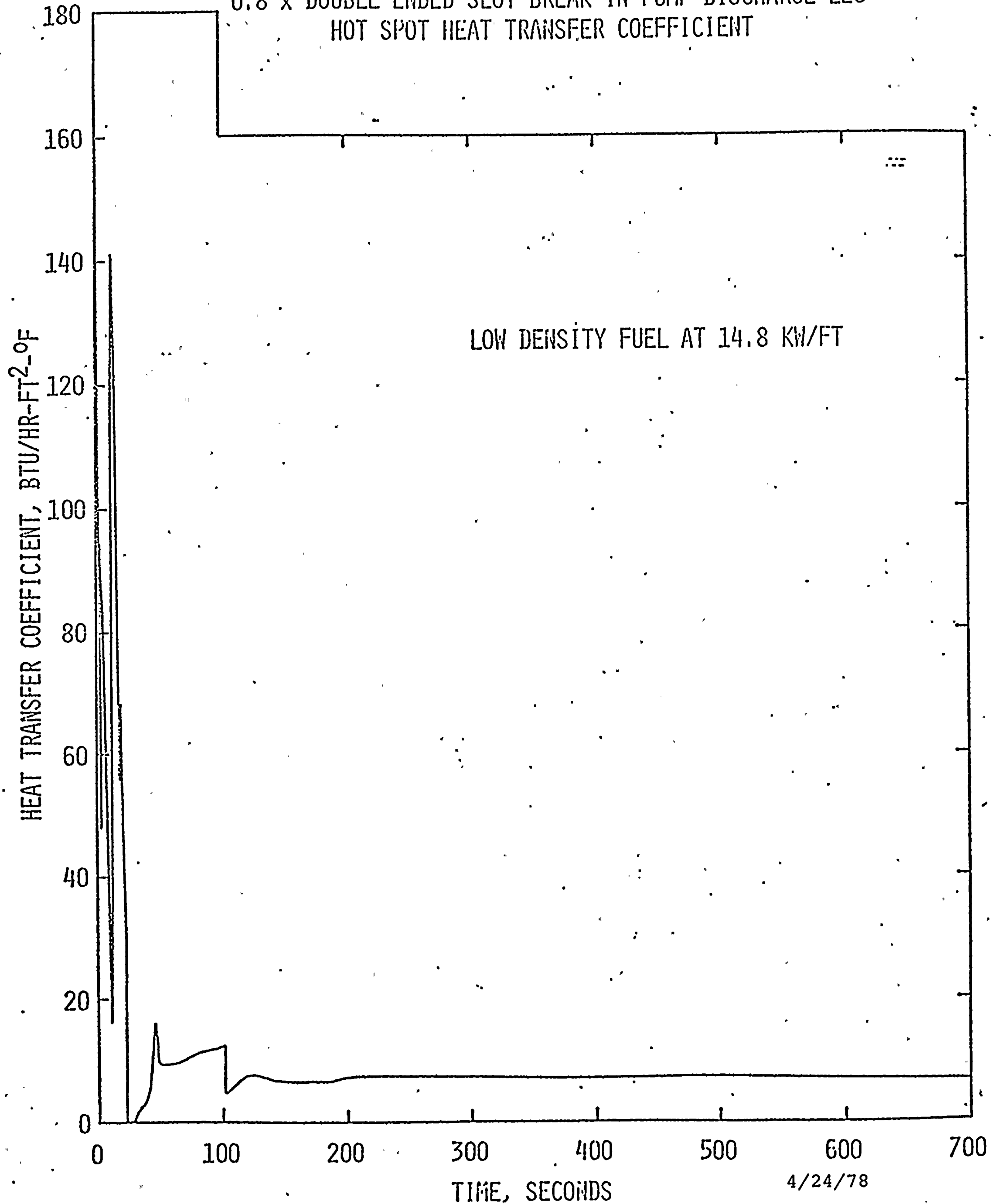

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FIGURE 8?-1F 94

ST. LUCIE UNIT I
0.8 x DOUBLE ENDED SLOT BREAK IN PUMP DISCHARGE LEG
HOT ROD INTERNAL GAS PRESSURE
LOW DENSITY FUEL

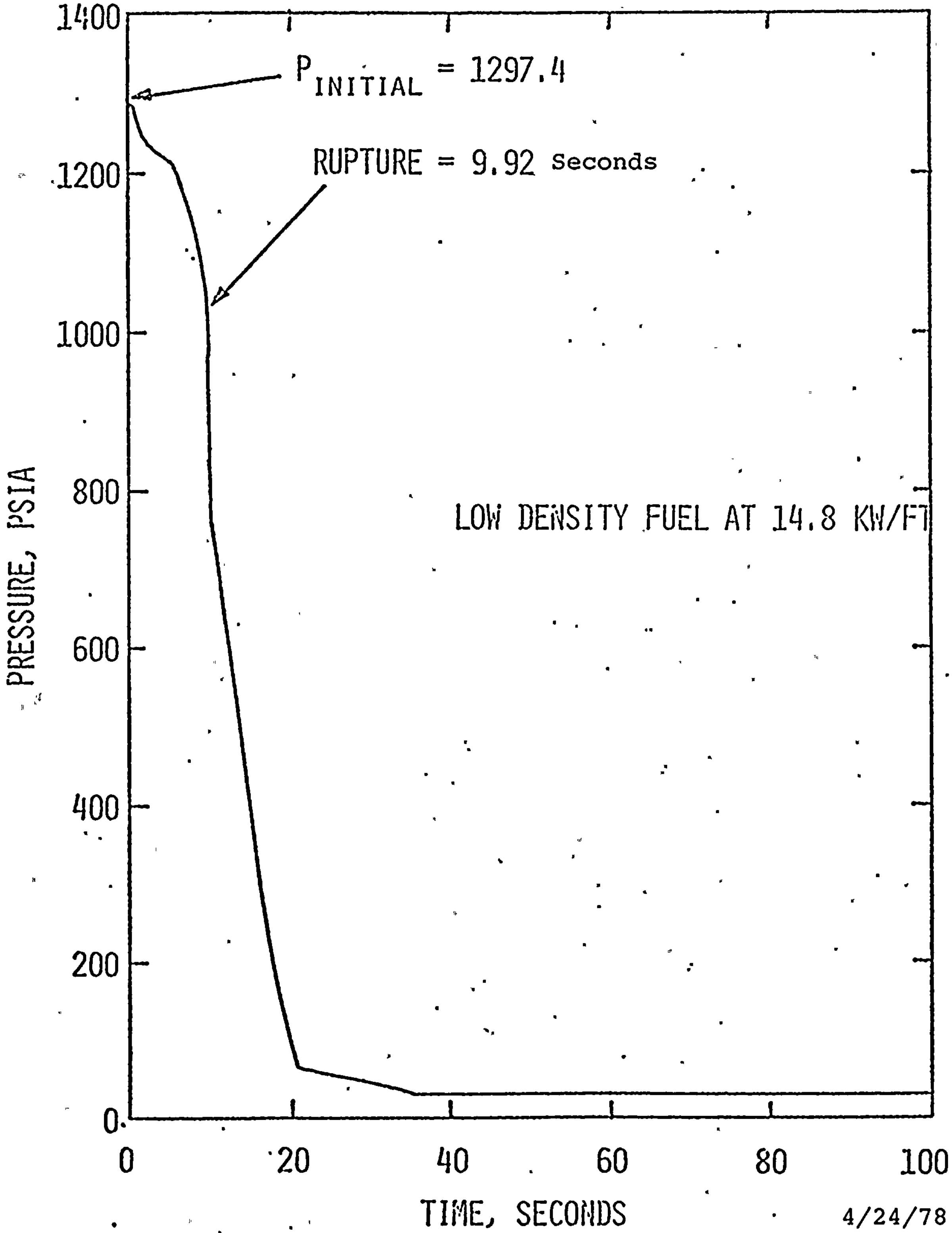

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FIGURE 8-2A

ST. LUCIE UNIT I

0.8 x DOUBLE ENDED SLOT BREAK IN PUMP DISCHARGE LEG

PEAK CLAD TEMPERATURE

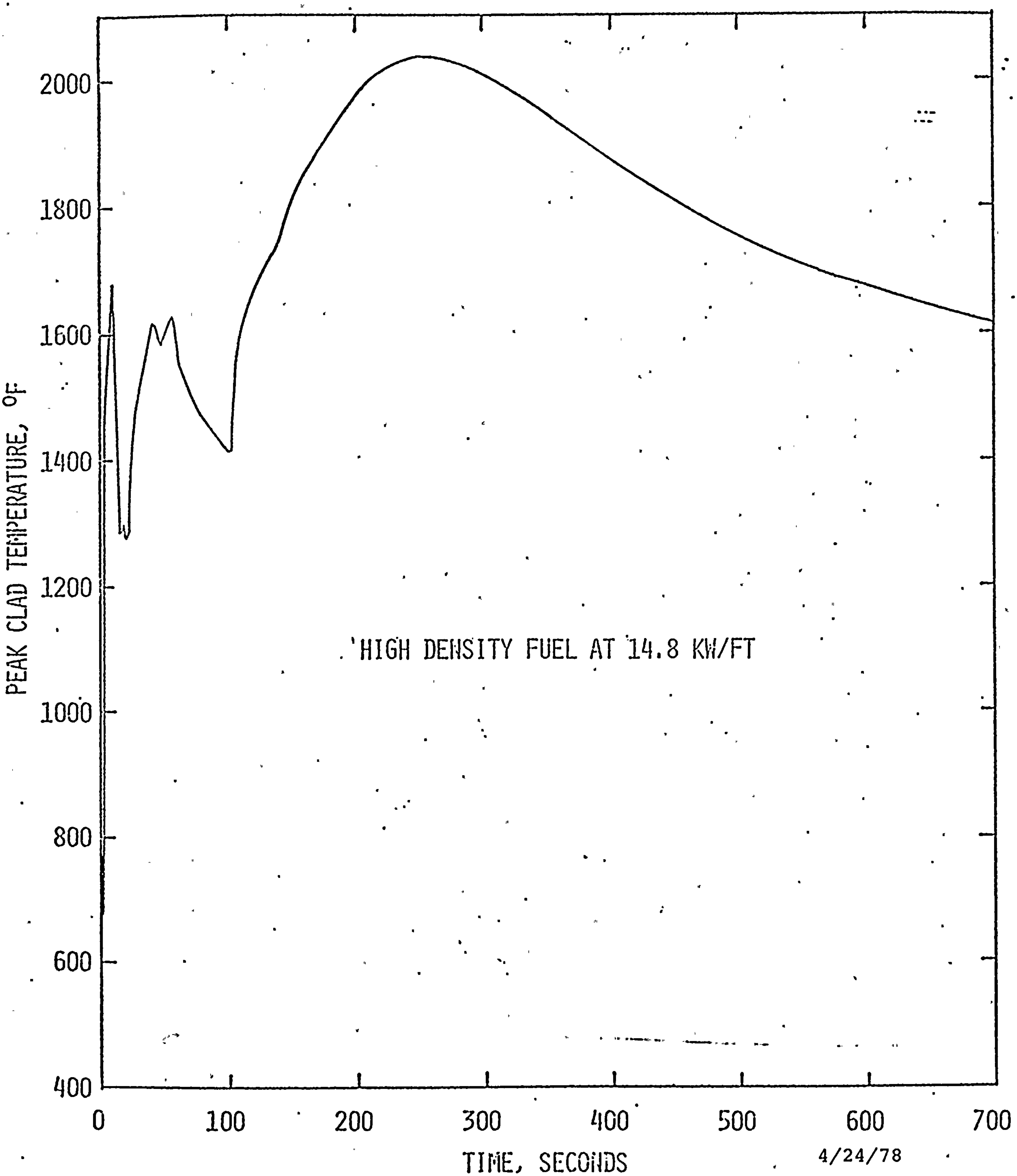

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FIGURE 8.-2B 96

ST. LUCIE UNIT I

0.8 x DOUBLE ENDED SLOT BREAK IN PUMP DISCHARGE LEG

HOT SPOT GAP CONDUCTANCE

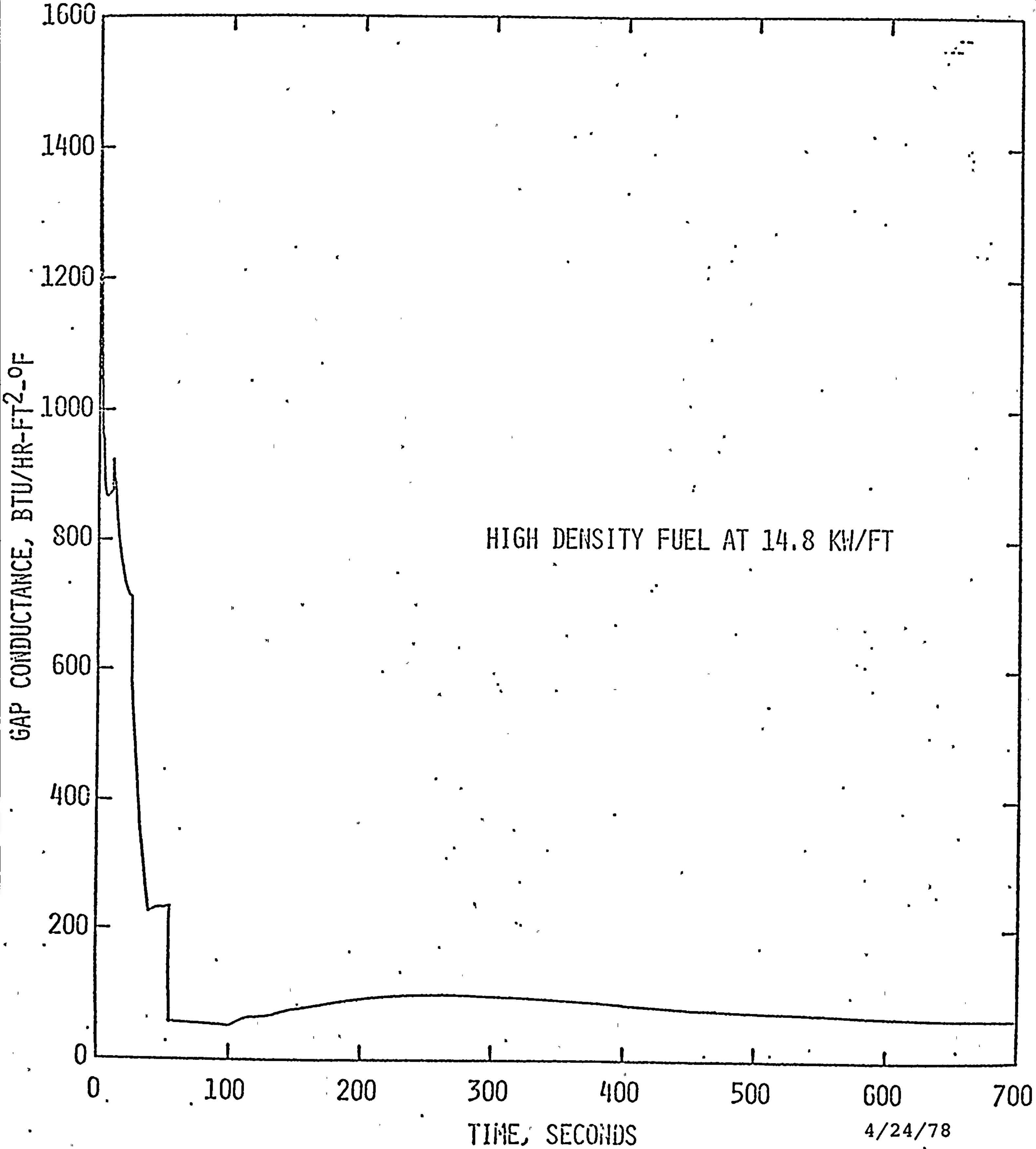

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FIGURE 8-2C

ST. LUCIE UNIT I
0.8 x DOUBLE ENDED SLOT BREAK IN PUMP DISCHARGE LEG
PEAK LOCAL CLAD OXIDATION

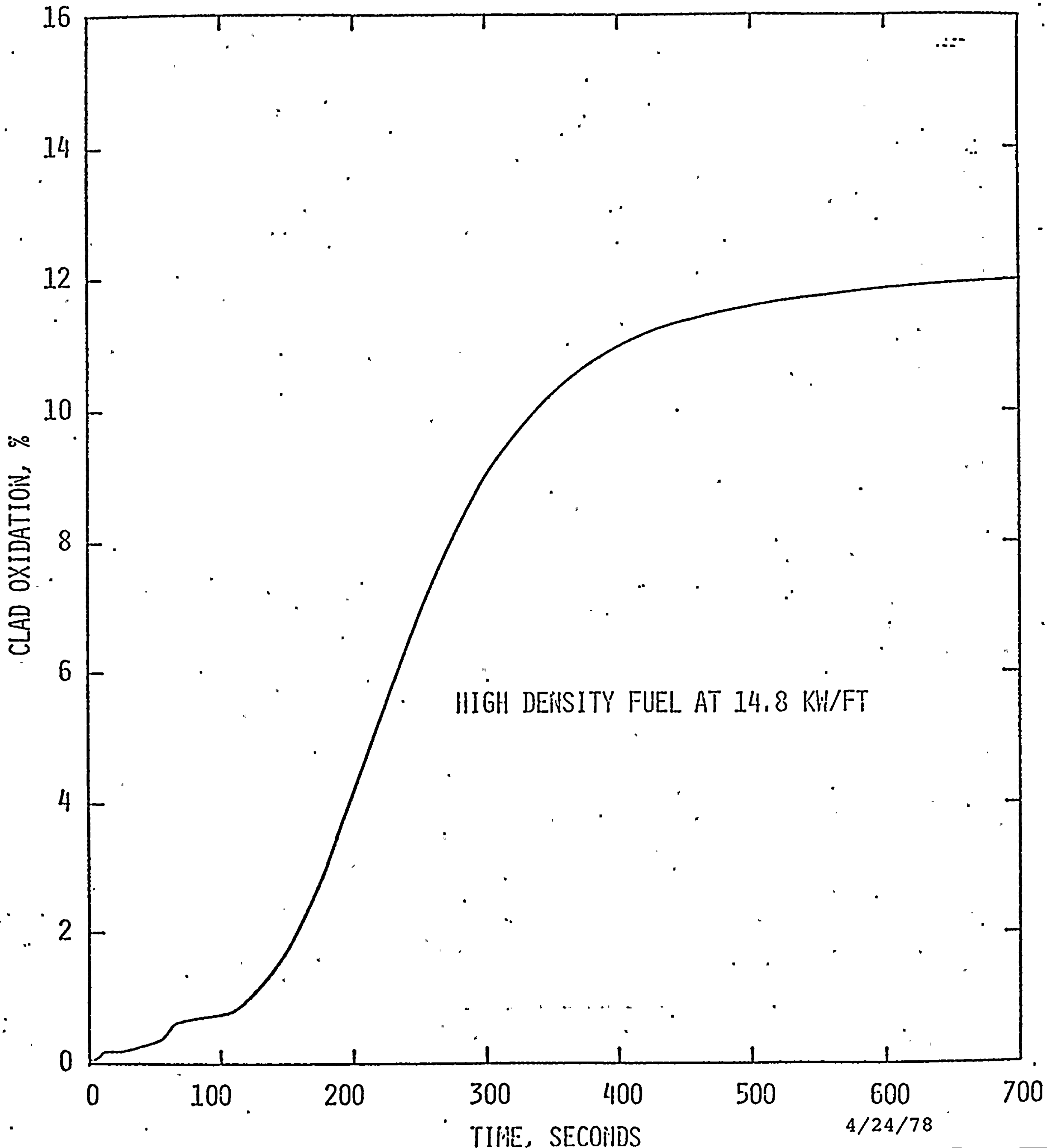

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FIGURE 8-2D

ST. LUCIE UNIT I

0.8 x DOUBLE ENDED SLOT BREAK IN PUMP DISCHARGE LEG

CLAD TEMPERATURE, CENTERLINE FUEL TEMPERATURE, AVERAGE FUEL TEMPERATURE AND COOLANT TEMPERATURE FOR HOTTEST NODE

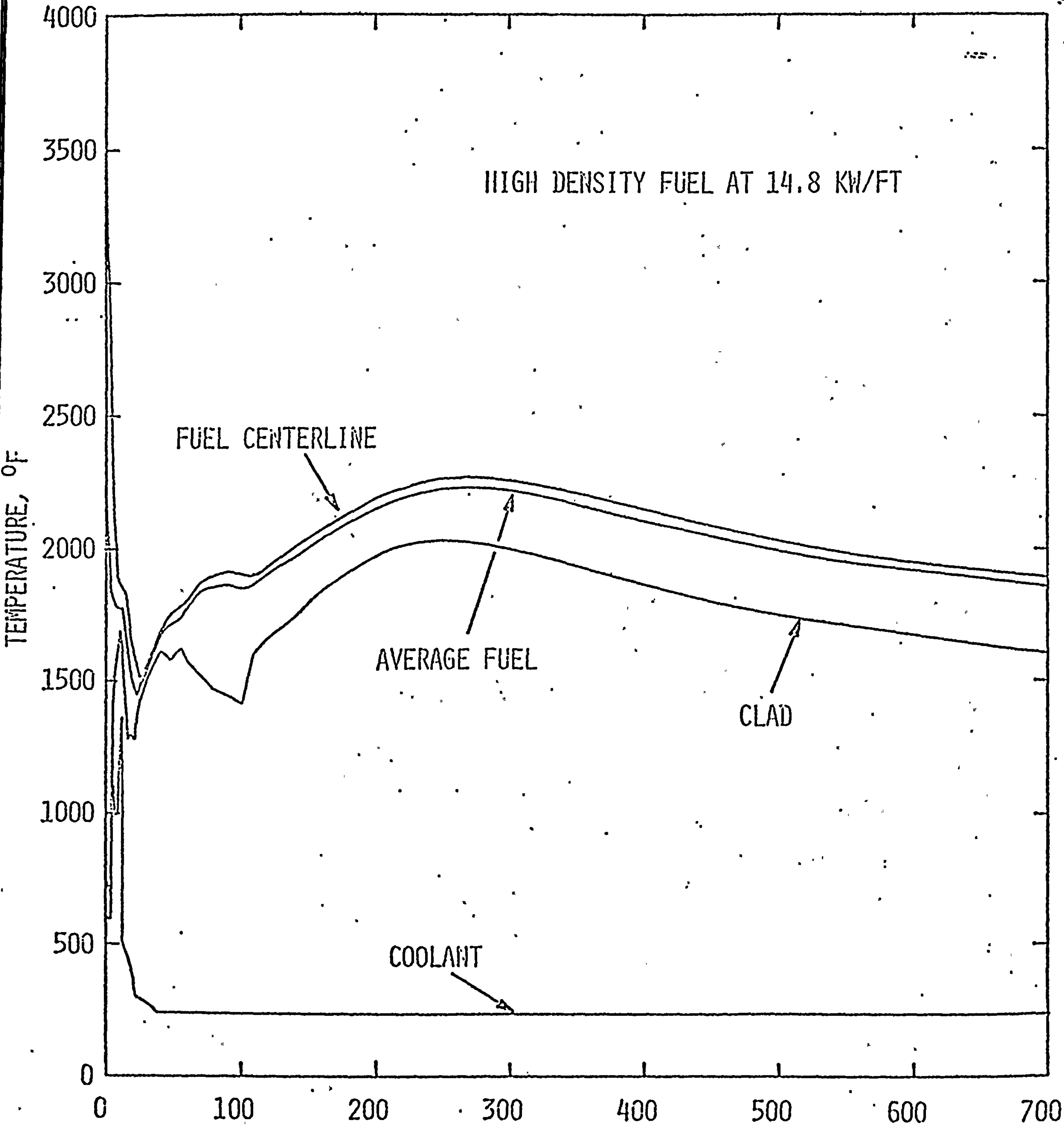

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FIGURE 8-2E

ST. LUCIE UNIT I
0.8 x DOUBLE ENDED SLOT BREAK IN PUMP DISHARGE LEG
HOT SPOT HEAT TRANSFER COEFFICIENT

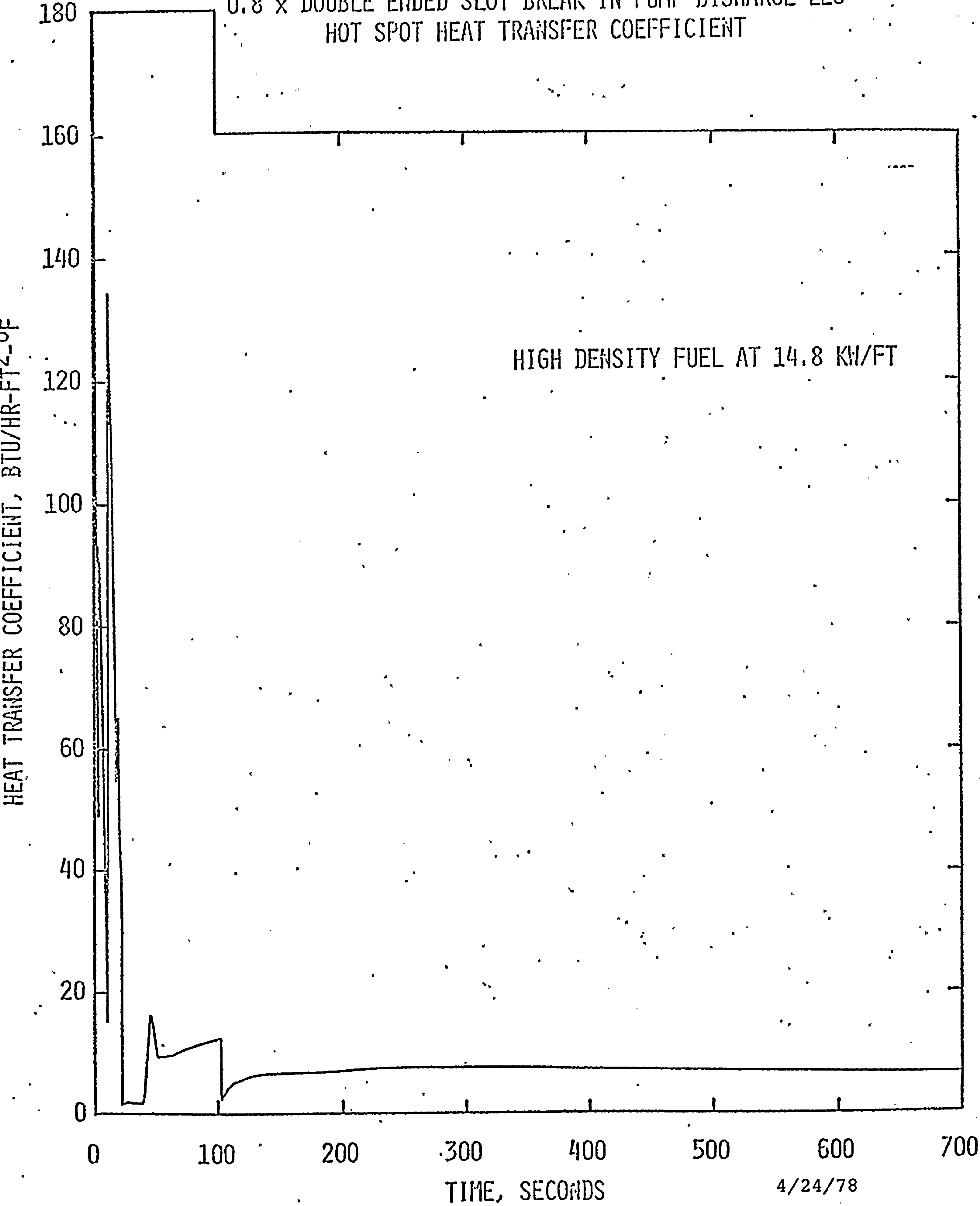

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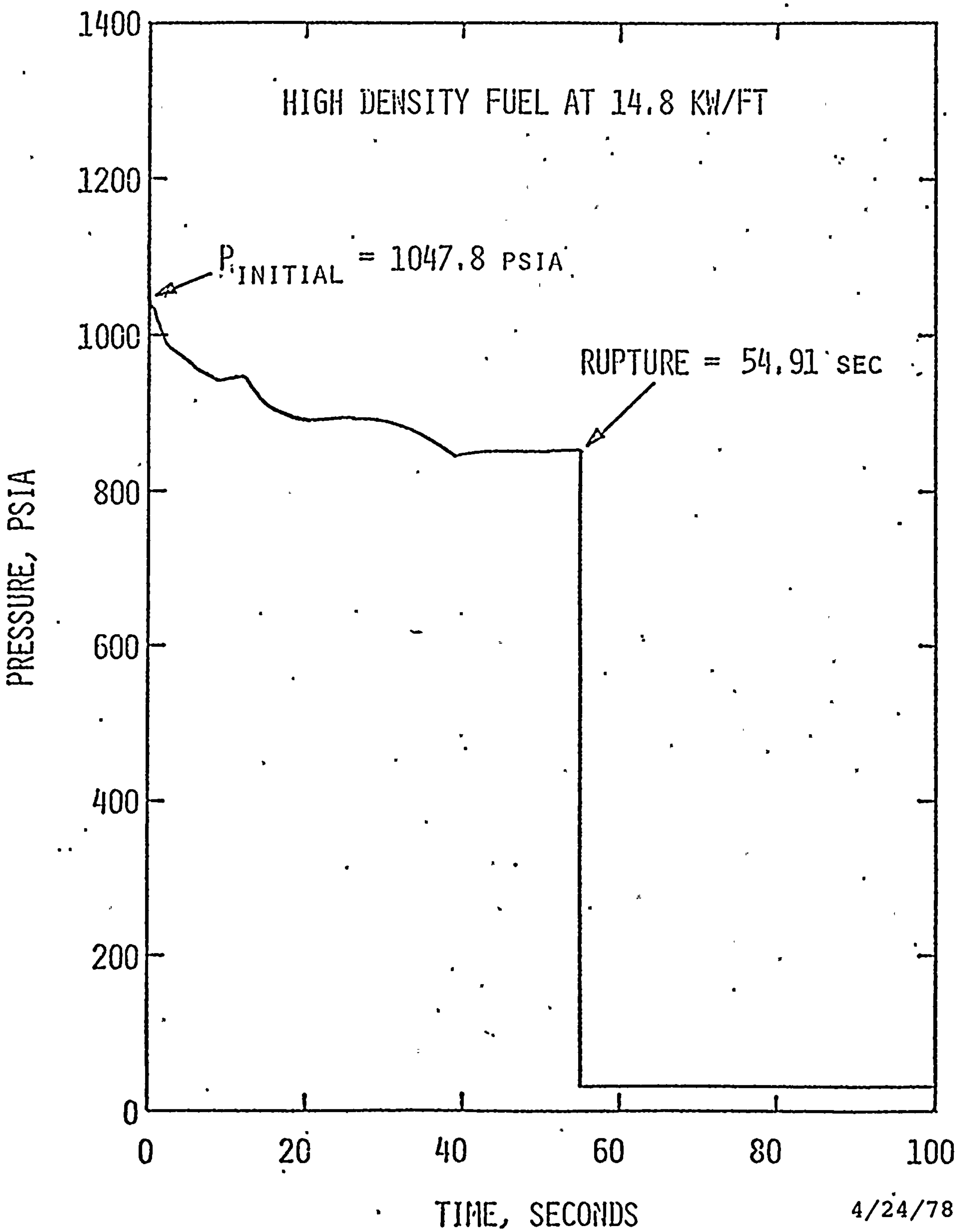
FIGURE 8-2F

ST. LUCIE UNIT I
0.8 x DOUBLE ENDED SLOT BREAK IN PUMP DISCHARGE LEG
HOT ROD INTERNAL GAS PRESSURE
HIGH DENSITY FUEL



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