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SUBJECT: Forwards safety evaluation from 860421 ltr w/corrected release fraction data re proposal & supporting analysis to delete License Condition 2.C.19 to Operating License NPF-16.

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FPL

APRIL 10 1987

L-87-159

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

Gentlemen:

Re: St. Lucie Unit 2
Docket No. 50-389
NPF-16 License Condition 2.C.19

By letter L-86-173, dated April 21, 1986, Florida Power & Light Company (FPL) submitted a proposal and supporting analysis to delete License Condition 2.C.19 from Facility Operating License NPF-16. This License Condition requires FPL to submit and obtain NRC approval of a new analysis that addresses potential gas-gap release for extended burnup fuel.

A concern was identified during a phone conversation with NRC, NRC's contractor and FPL on March 10, 1987, regarding an underprediction of the release fractions calculated by Combustion Engineering and reported in FPL's L-86-173 submittal. It was subsequently determined that an error had been made in calculating the release fractions for the 52,830 and 60,000 MWD/MTU burnup levels.

Attached is the Safety Evaluation from the FPL submittal of April 21, 1986, with the recalculated release fraction values. The new values are still bounded by the FSAR reported values and, therefore, the conclusions reached in the FPL safety evaluation remain valid.

Also, a typing error made in the original Safety Evaluation has been corrected. In several areas of the Safety Evaluation, the burnup of 52,830 MWD/MTU had been incorrectly typed as 52,380 MWD/MTU.

If there should be any questions, please contact us.

Very truly yours,

C. O. Woody
Group Vice President
Nuclear Energy

COW/MSD/gp
Attachment

cc: Dr. J. Nelson Grace, Regional Administrator, Region II, USNRC
Senior Resident Inspector, USNRC, St. Lucie Plant

A001 11

ATTACHMENT

SAFETY EVALUATION FROM L-86-173

WITH CORRECTED* RELEASE FRACTION DATA

*Bars on right-hand side of page denote corrections

Analysis Methods and Calculated Fuel Rod Gas Gap
Radioactive Fission Product Activity Results
For Burnups in Excess of 38,000 MWD/MTU

The radioactive fission product activity in the fuel rod gas gap has been calculated for St. Lucie 2 fuel rod average burnups out to 60,000 MWD/MTU. These calculated fuel rod gas gap activities are for use in the fuel handling accident. The fission gas release was calculated using the methods described in Reference 1.

The controlling activity as far as the off-site dose from the fuel handling accident is that for I-131. The release fraction assumed in these analyses is based on the peak power rod history for St. Lucie 2 Cycle 3 shown in Figure 1. This rod power history was generated in such a way that it is expected to bound the fuel rod power histories for future cycles of St. Lucie 2. This data was input to C-E's FATES 3A fuel performance code (Reference 2). The fuel rod radial temperature distributions as a function of rod average burnup and local power levels shown in Figures 2 and 3 were generated by FATES 3A.

Since the analysis was aimed at a determinition of the gas gap activities for the fuel assembly as a whole, the peak rod linear heat rate was multiplied by a factor of 0.955 to scale from the peak rod values to the fuel assembly average values. Also, since the rod power history of Figure 1 is for the axially averaged linear heat rate, the average linear heat rates in the central axial regions of the fuel will be higher. To account for these axial variations in the linear heat rates, the average kw/ft for the rod was assumed to be the value which would exist in nodes 4-17 (i.e. the central rod region axially). The resultant linear heat rates are displayed in Table 1. The calculated gas release fraction from these central axial nodes was assumed to exist over the entire length of the rod. This is conservative since the release fraction from the end nodes (1-3 and 18-20) would be much less than the release fraction based on the higher linear heat rate in the central axial nodes.

To perform these gas gap activity calculations the fuel rod was divided into 6 equal volume radial nodes. Release fractions were then calculated at 43,396, 52,830 and 60,000 MWD/MTU. The fuel temperature used to calculate the release fraction between a burnup of 35,849 and 43,396 MWD/MTU was conservatively taken from the breakpoints shown on Figure 2, where the fuel temperature distribution at the end of this burnup range is shown. The temperatures assumed correspond to 8.38 Kw/ft (see Figure 2). Note that 8 kw/ft could have been used in this calculation (i.e., 8.38 kw/ft multiplied by the 0.955 factor). However, a value of 8.38 kw/ft was assumed for conservatism. The release fraction for each of the the radial regions, and for the radial average over the rod, are shown in Table 2.

Similarly, the fuel temperature used to calculate the release fraction between a burnup of 43,396 and 52,830 MWD/MTU was taken from the break points on Figure 3 and correspond to 6.56 kw/ft (i.e., 6.87 multiplied by the 0.955 factor). The release fractions for the 52,830 MWD/MTU burnup were calculated in the same manner as described for the 43,346 MWD/MTU burnup based on these data. The resultant release fractions are shown in Table 3. The rod radial average release fraction was calculated to be 1.26 x 10^{-2} as shown on Table 3.

To determine the corresponding release fractions over the interval between 52,830 and 60,000 MWD/MTU it was assumed that the fuel temperatures from the 52,830 MWD/MTU time point also apply at 60,000 MWD/MTU. (Note that this sort of extrapolation was necessary to extend the available data.) The 52,830 MWD/MTU time point data is judged to be conservative anyway since the fuel and clad will be in contact by 52,830 MWD/MTU. Therefore, the temperatures at a given kw/ft, and the kw/ft value itself, would not be expected to change significantly between 52,830 and 60,000 MWD/MTU. Based on these engineering judgements, and a kw/ft value of 6.30 (i.e., the assumed kw/ft is the 6.54 kw/ft value shown on Figure 3 multiplied by the 0.955 factor discussed above), the 60,000 MWD/MTU release fractions were calculated. The calculated release fractions at 60,000 MWD/MTU are shown in Table 4. The rod radial average release fraction was calculated to be 1.21 x 10^{-2} as shown in Table 4. It should be noted that this release fraction is not as much lower than the one at 52,830 MWD/MTU as one would expect based on the 0.24 reduction in kw/ft. This is the case because the enhanced fission gas release at the higher burnup essentially negates the benefit of the kw/ft reduction.

The I-131 inventory quoted in the St. Lucie 2 FSAR was calculated based on 10.08 KW/ft rather than the linear heat rates used in these analyses. The lower linear heat rates reduce the inventory for the 8.1 day I-131 to 83 percent of the FSAR values by the 43,396 MWD/MTU burnup. As a result, the I-131 source-term is reduced to an equivalent release fraction of 3.02 x 10^{-2} by 43,396 MWD/MTU. This release fraction is a factor of 3.3 less than in the FSAR source term. The release fractions at the higher burnups are an even smaller fraction of the FSAR value. For instance, at 60,000 MWD/MTU, the I-131 release fraction is about a factor of 8 smaller than the value quoted in the FSAR.

In conclusion, this analysis has demonstrated that the existing St. Lucie 2 FSAR gas gap activities conservatively bound those for fuel assembly burnups out to 60,000 MWD/MTU.

References:

1. "Method for Calculating the Fractional Release of Volatile Fission Products from Oxide Fuel," ANSI/ANS-5.4-1982.

2. CEN-161(B)-P, "Improvements to Fuel Evaluation Model," Combustion Engineering, Inc., July 1981.

TABLE 1

ST. LUCIE 2, CYCLE 3 POWER FALL OFF HISTORY ASSUMED IN THESE GAS GAP ACTIVITY ANALYSES

ROD AVG BURNUP MWD/MTU		LOCAL LINEAR HEAT RATE KW/FT			
	NODES	1,20*	2,19	3,18	4-17
29057		5.47	7.74	8.50	8.92
33962		5.47	7.74	8.50	8.92
35849		5.36	7.58	8.33	8.74
43396		5.14	7.27	7.99	8.38
45283		4.98	7.04	7.73	8.11
47170		4.76	6.73	7.39	7.76
49057		4.54	6.42	7.05	7.40
50943		4.32	6.11	6.71	7.04
52830		4.21	5.96	6.54	6.87
54717		4.16	5.88	6.46	6.78
56604		4.10	5.80	6.37	6.69
60000		4.05	5.73	6.29	6.60

*Nodes 1 and 20 are at the fuel rod ends.

TABLE 2

RELEASE FRACTIONS AT 43396 MWD/MTU

Radial Region	Release Fraction
1	1.53(-1)*
2	5.74(-2)
3	5.92(-3)
4	1.55(-3)
5	2.06(-4)
6	1.63(-4)**
Average	3.64(-2)

* power of ten

** This is the calculated low temperature release which is higher than the calculated diffusion release fraction.

TABLE 3

Release Fractions of 52,830 MWD/MTU

Radial Region	Release Fraction
1	5.90 (-2)*
2	1.19 (-2)
3	3.56 (-3)
4	7.96 (-4)
5	1.63 (-4)**
6	1.63 (-4)**
Average	1.26 (-2)

* Power of ten.
** This is the calculated low temperature release which is higher than the calculated diffusion release fraction.

TABLE 4

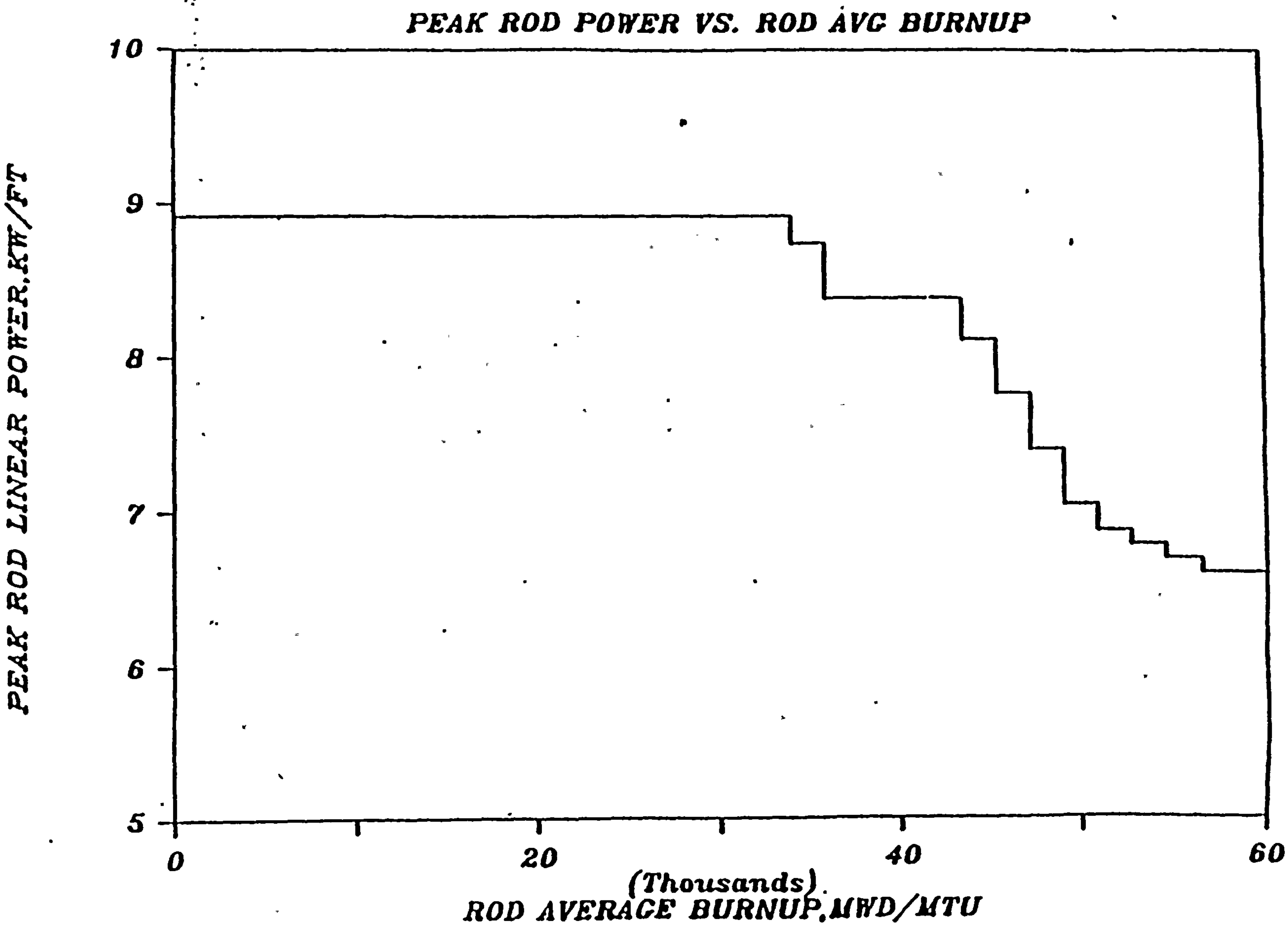
Release Fractions at 60,000 MWD/MTU

Radial Region	Release Fraction
1	5.38 (-2)*
2	1.45 (-2)
3	3.07 (-3)
4	1.14 (-3)
5	1.63 (-4)**
6	1.63 (-4)**
Average	1.21 (-2)

* Power of ten.
** See explanation in Table 1.

F\ .RE 1

ST LUCIE 2, CYCLE 3, POWER HISTORY



. ..URE 2

ST LUCIE 2,CY 3 FUEL TEMPERATURE

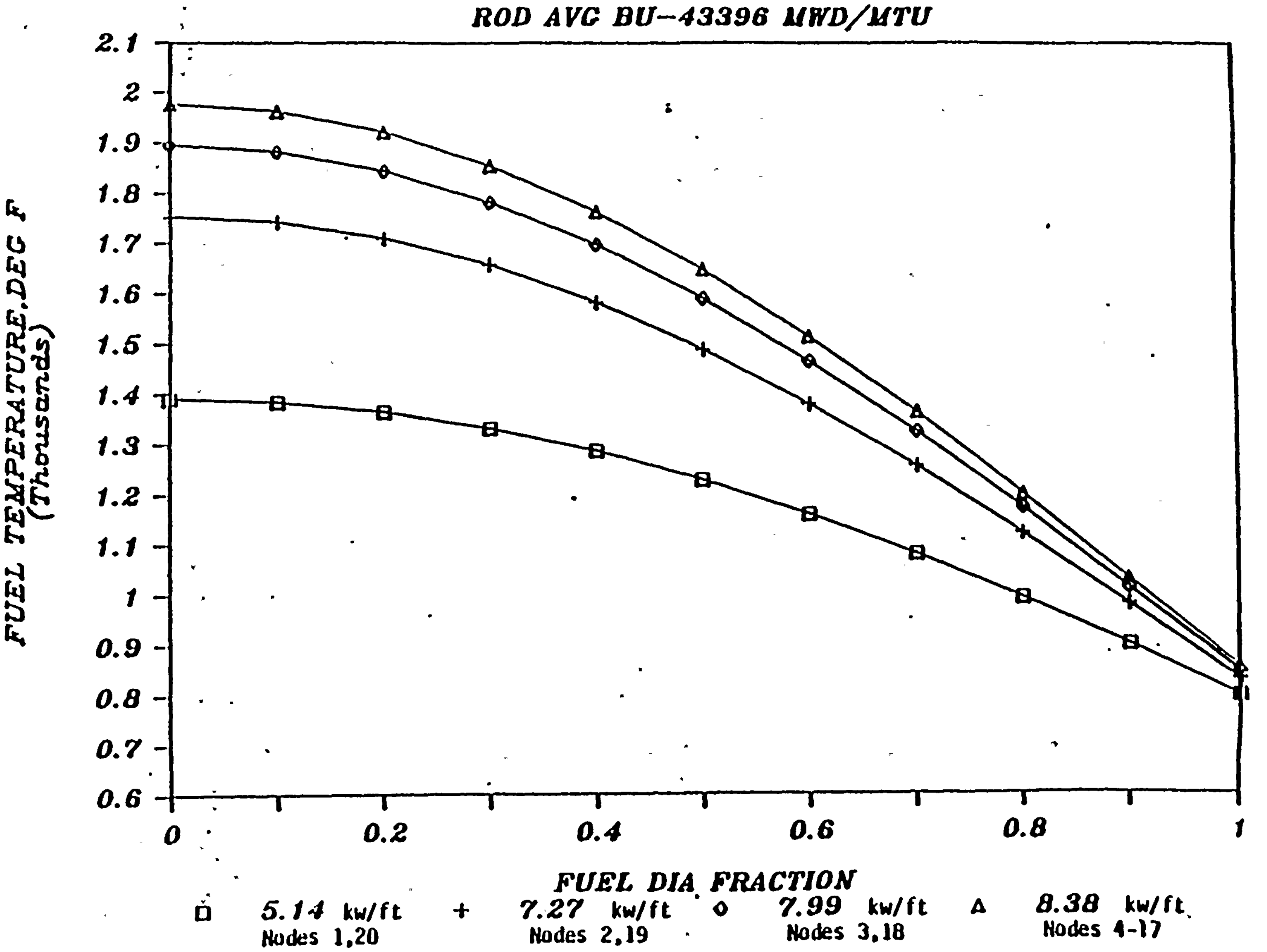
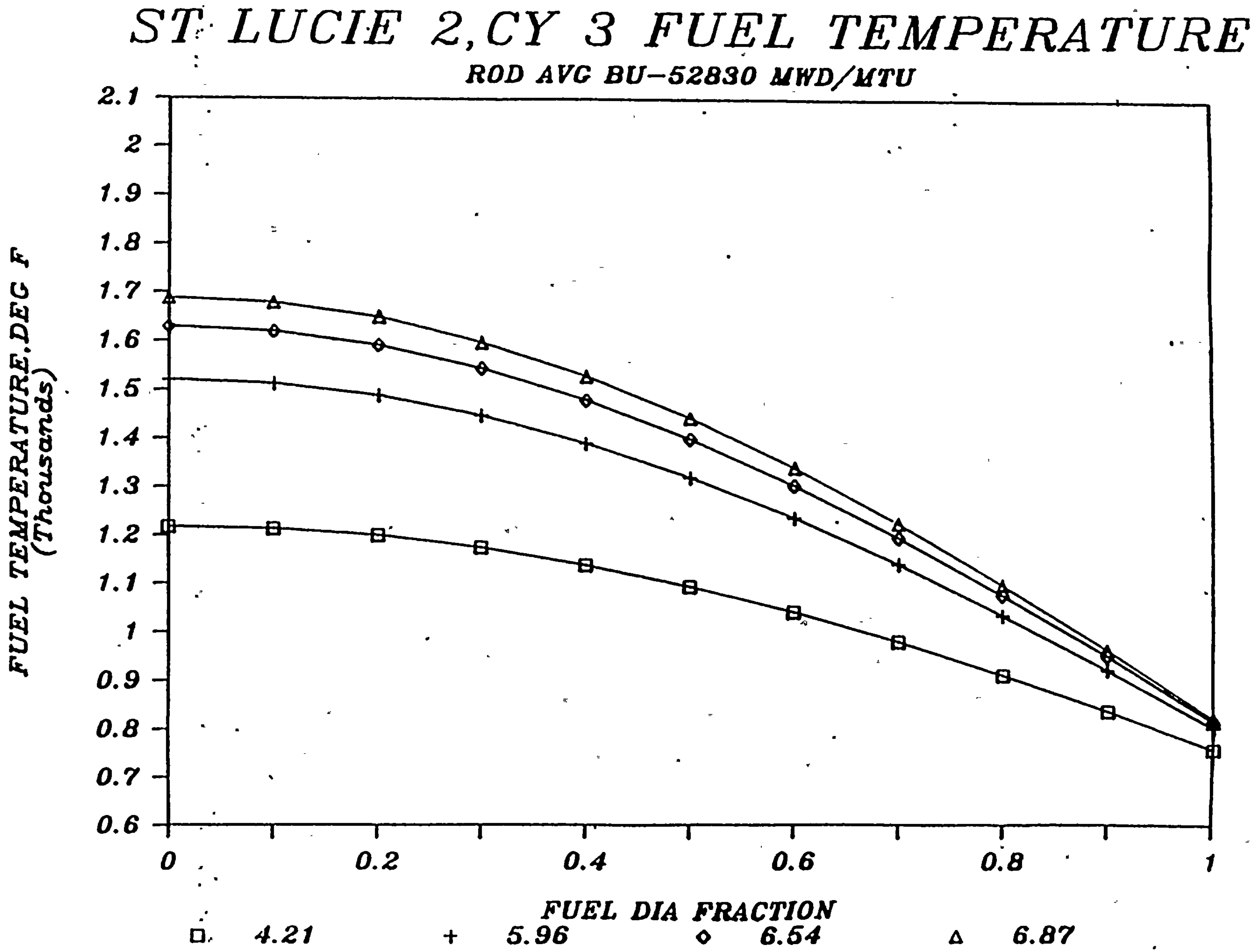


FIGURE 3


ST LUCIE 2,CY 3 FUEL TEMPERATURE
ROD AVG BU-52830 MWD/MTU
FUEL TEMPERATURE,DEG F (Thousands)
2.1
2
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0
0.2
0.4
0.6
0.8
1
FUEL DIA FRACTION
□ 4.21
+ 5.96
◇ 6.54
△ 6.87