SAXTON NUCLEAR EXPERIMENTAL CORPORATION

DOCKET NO. 50-146
LICENSE DPR-4

Amendment No. 1 to Change Request No. 32

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1. In support of Change Request No. 32, Applicant hereby submits the additional Core III information requested in Division of Reactor Licensing letter of December 18, 1968.

2. In support of Change Request No. 32, Applicant submitted a report entitled: "Safeguards Report for Saxton Core III", dated August, 1968. Paragraph 3.3 of this report presented an analysis for the loss-of-coolant accident. Applicant hereby submits a report entitled: SAXTON CORE III LOSS-OF-COOLANT ACCIDENT RE-EVALUATION, which revises Paragraph 3.3 of the safeguards report.

SAXTON NUCLEAR EXPERIMENTAL CORPORATION

by R. E. Neidig
R. E. Neidig, President

SAXTON CORE III LOSS-OF-COOLANT ACCIDENT RE-EVALUATION

The loss-of-coolant accident has been re-evaluated since the submission of the Safeguards Report for Saxton Core III. The following are changes in the analysis which resulted in deviations from those results presented in the Safeguards Report.

1. The moderator temperature coefficient has been re-evaluated. A less negative coefficient of -0.5×10^{-4} $(\Delta k/k)/°F$ is now used in the analysis rather than the value of -2.0×10^{-4} $(\Delta k/k)/°F$ previously reported.

2. The heat transfer models in the LOCTA-R2 core thermal analysis code are the same as those described in Section 4 of the report "Saxton Loss-of-Coolant Accident Prevention and Protection" except that stable film boiling immediately following the occurrence of DNB at 0.5 seconds, is no longer assumed. Instead, post DNB heat transfer coefficients during the transition and stable film boiling phases of blowdown are now calculated using an empirical correlation developed by Westinghouse, from steady state heat transfer data. It has been compared with experimentally determined transient data recently obtained as part of the Westinghouse Flashing Heat Transfer research and development program. (1)

   A comparison of the measured heat transfer coefficients obtained from the transient blowdown data and the coefficients calculated with the empirical correlation is presented in Figure 1. It is concluded that the heat transfer coefficients during the transition and stable film boiling phases of blowdown can be conservatively estimated by the recently developed Westinghouse empirical correlation.

3. The two load follow assemblies now contain both Zircaloy and stainless steel clad fuel rods. (2)

The specific cases analyzed and a summary of the results are as follows:

Break Size	Total % Core Clad Melt	Total % Zr-H_2O Reaction
Doubled Ended Severence - 1.28 ft^2	8.9	12.5
Intermediate - 0.173 ft^2	1.6	7.5
Surge Line - 0.0375 ft^2	0.0	1.6

Figures 2 through 4 show the clad temperature transients for the high power density Zircaloy clad rods located in the Loose-Lattice assemblies. Presented in these figures are the clad temperature transients for rods operating at various fraction of the design peak linear heat rate of 24 kw/ft. Figures 5 though 10 show the clad temperature transients for the Zircaloy and stainless steel clad rods located in the load follow assemblies. The design peak linear heat rate in these assemblies is 19.9 kw/ft.

Since the stainless steel clad rods located on the core periphery are operating at approximately 33.1% of the peak linear heat rate of 24 kw/ft, the peak clad temperatures exhibited by these rods would be much lower than those presented in Figures 8 through 10. The clad melt is limited to 8.9% for the double- nded break with no melt occurring for the surge line break. The loss-of-flow analysis re-evaluation gives a negligible change in heat flux response and minimum DNB ratio during the accident.

REFERENCES

1. Farman, R. F., Cermak, J. O., "Post DNB Heat Transfer During Blowdown", WCAP-9005, October, 1968. Westinghouse Proprietary Report.

2. Melehan, J. B., Addendum to Saxton Core III License Application, WCAP-7219, July 16, 1968. Westinghouse Confidential Report.

COMPARISON OF CALCULATED AND MEASURED HEAT TRANSFER COEFFICIENTS

Figure 1

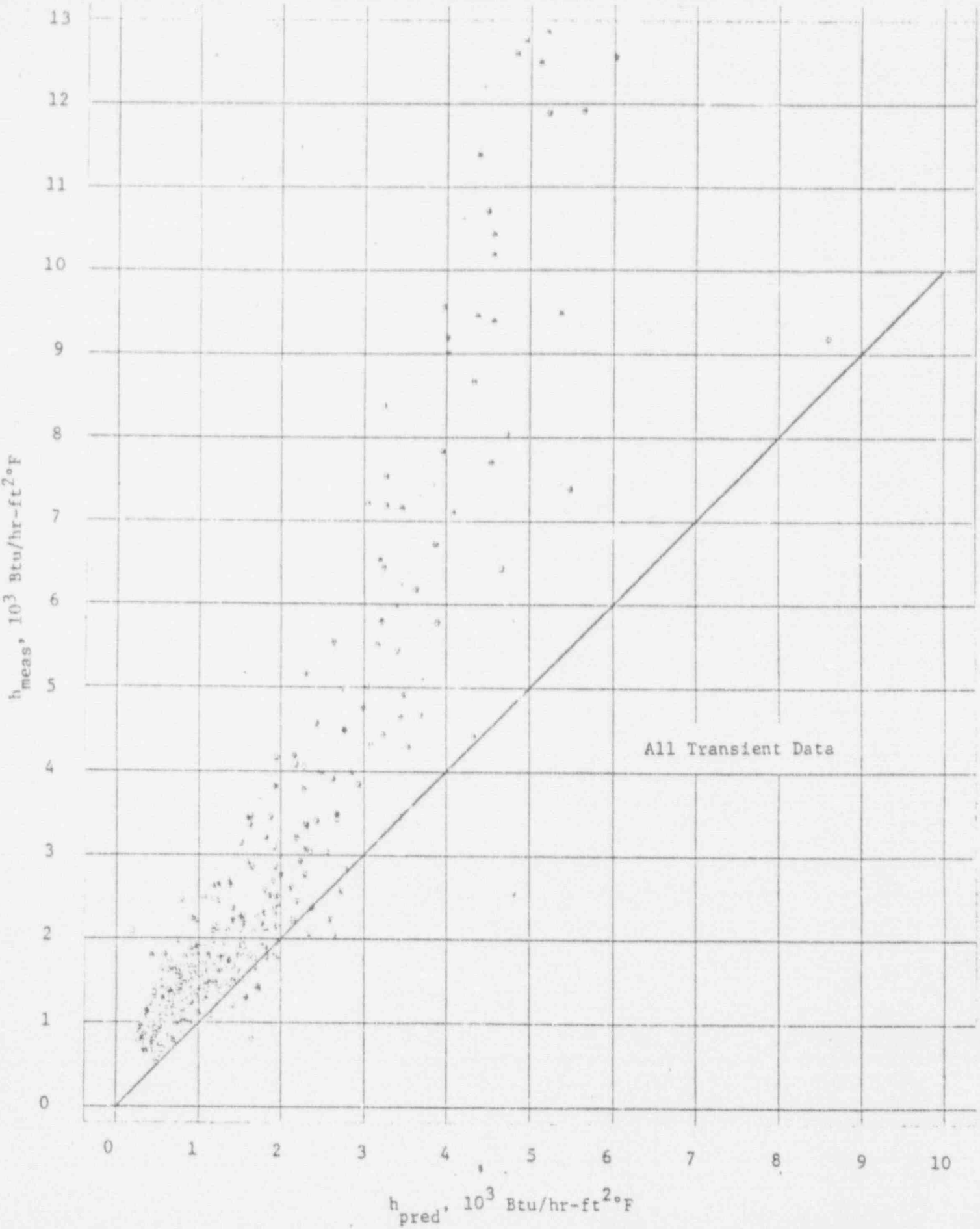


FIGURE 2

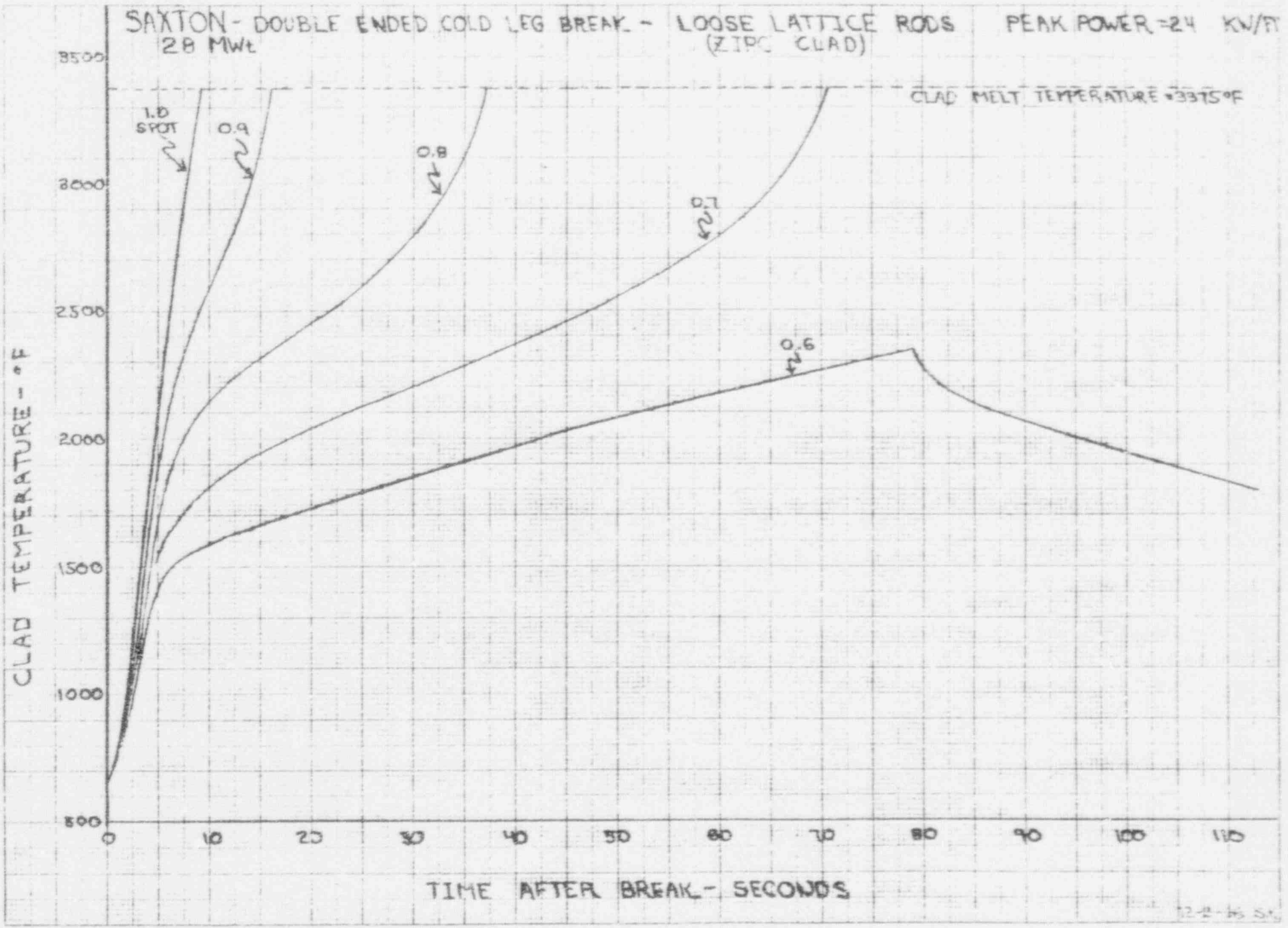

SAXTON - DOUBLE ENDED COLD LEG BREAK - LOOSE LATTICE RODS PEAK POWER = 24 KW/FT
28 MWt
(ZIRC CLAD)
CLAD MELT TEMPERATURE = 3375°F
1.0 SPOT
0.9
0.8
0.7
0.6
CLAD TEMPERATURE - °F
3500
3000
2500
2000
1500
1000
500
0
10
20
30
40
50
60
70
80
90
100
110
TIME AFTER BREAK - SECONDS

FIGURE 3

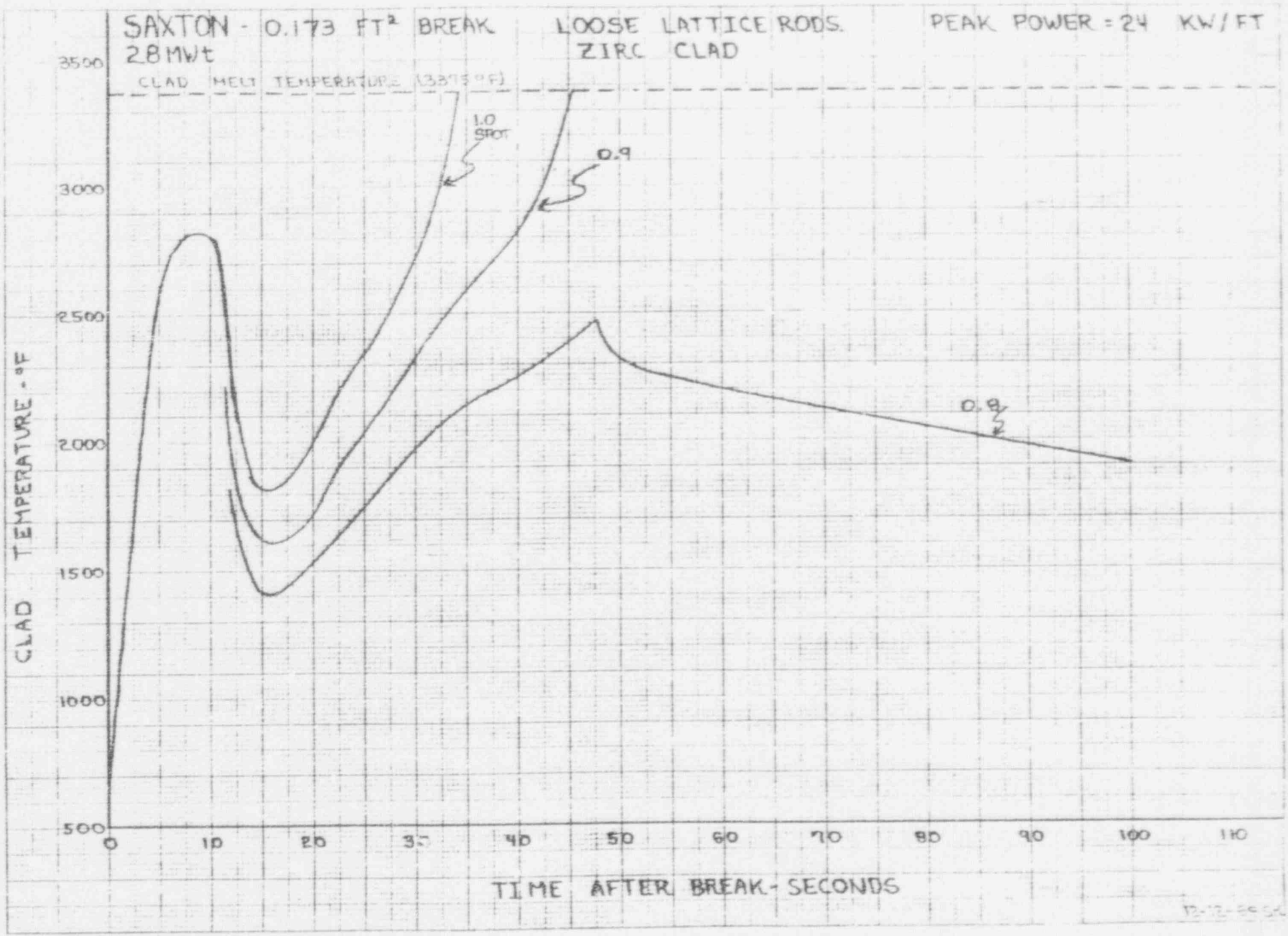

SAXTON - 0.173 FT² BREAK
28 MWt
LOOSE LATTICE RODS.
ZIRC CLAD
PEAK POWER = 24 KW/FT
CLAD MELT TEMPERATURE (3375°F)
1.0 SPOT
0.9
0.9
3500
3000
2500
2000
1500
1000
500
CLAD TEMPERATURE - °F
0
10
20
30
40
50
60
70
80
90
100
110
TIME AFTER BREAK - SECONDS

FIGURE 4

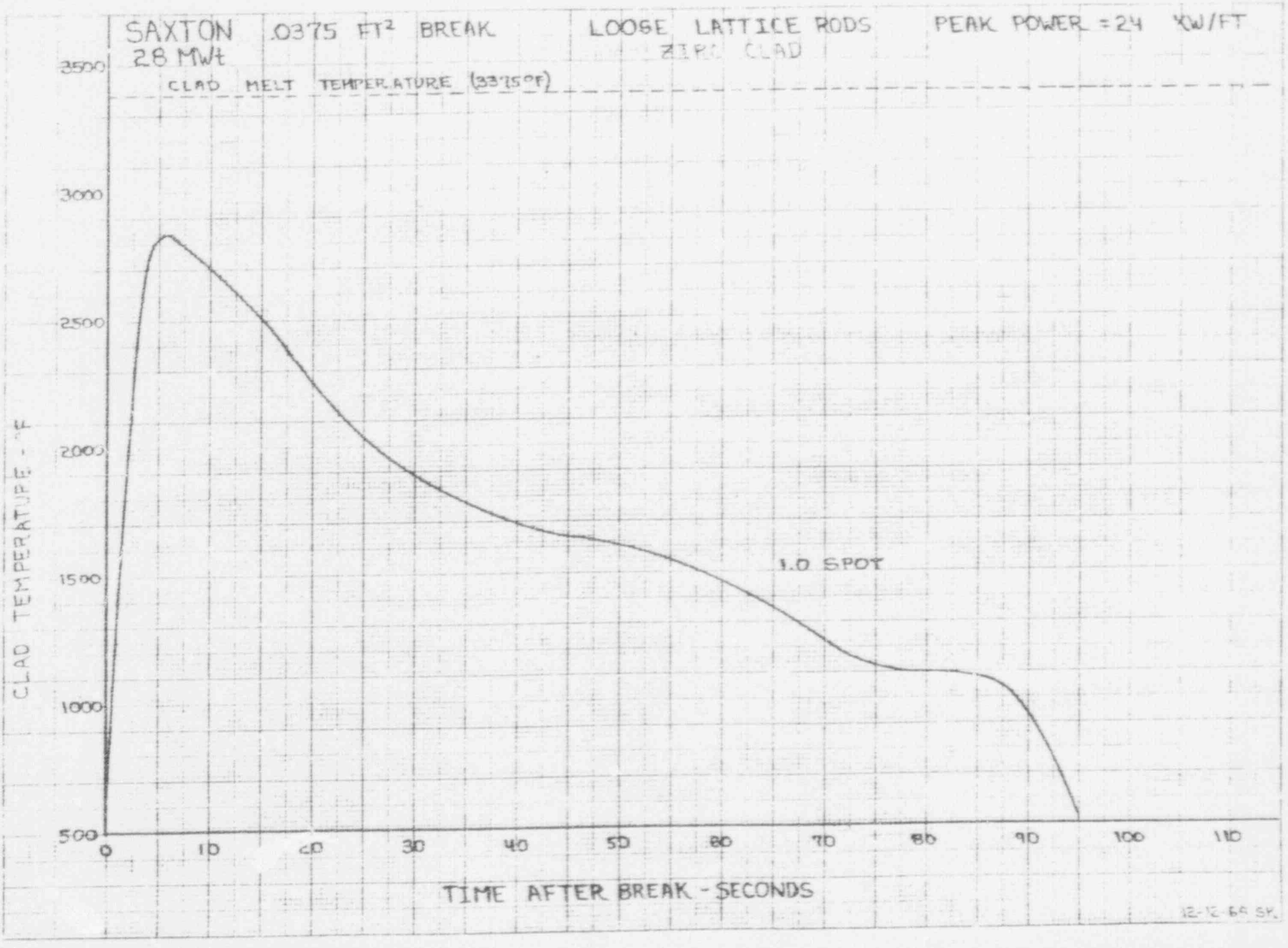

SAXTON .0375 FT² BREAK
28 MWt
LOOSE LATTICE RODS
ZIRC CLAD
PEAK POWER = 24 KW/FT
CLAD MELT TEMPERATURE (3375°F)
3500
3000
2500
2000
1500
1000
500
CLAD TEMPERATURE - °F
1.0 SPOT
0
10
20
30
40
50
60
70
80
90
100
110
TIME AFTER BREAK - SECONDS
12-12-64 SK

FIGURE 5

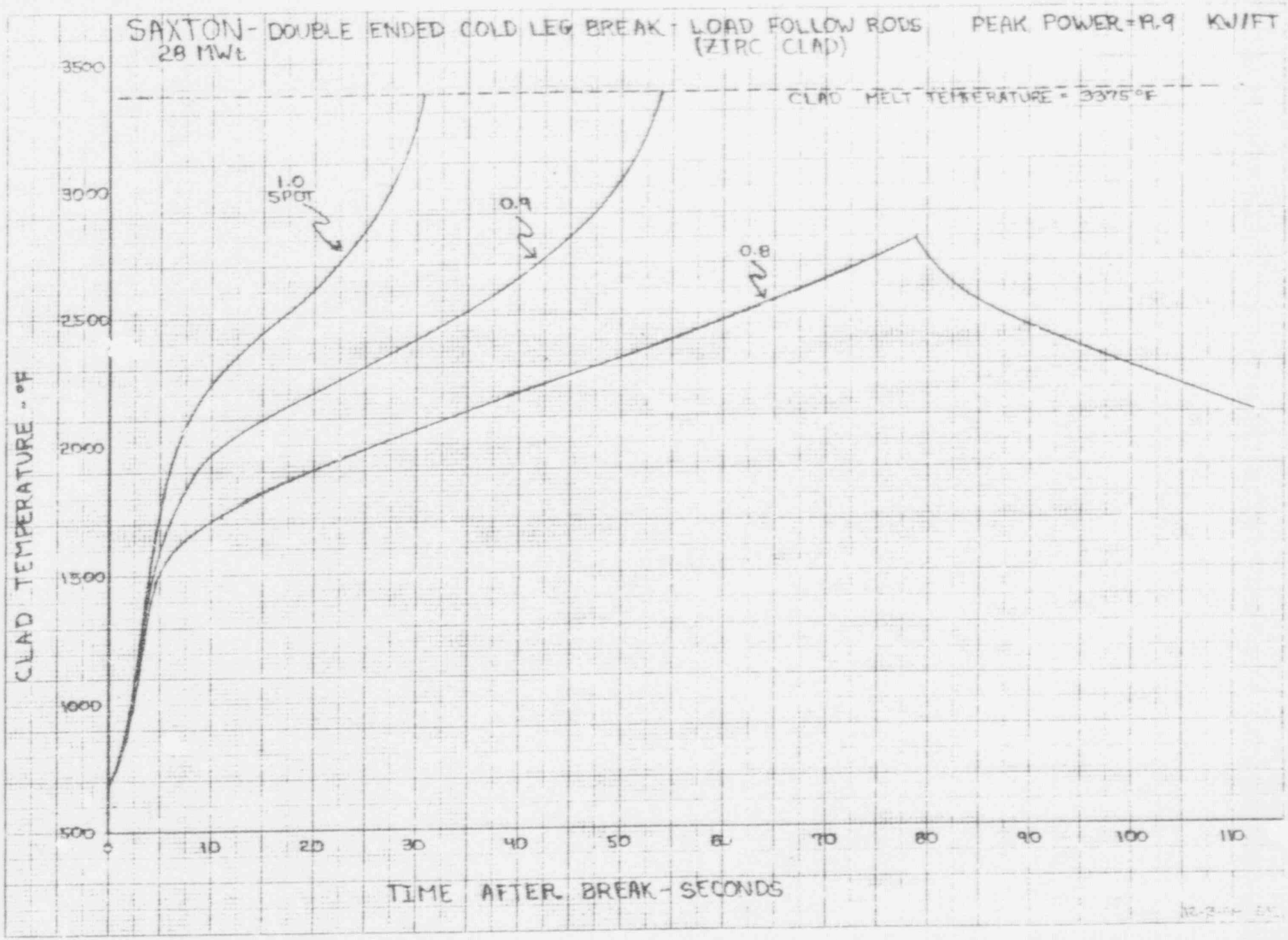

SAXTON- DOUBLE ENDED COLD LEG BREAK, LOAD FOLLOW RODS (ZIRC CLAD)
28 MWt
PEAK POWER = 18.9 KW/FT
CLAD MELT TEMPERATURE = 3375°F
1.0 SPOT
0.9
0.8
CLAD TEMPERATURE - °F
3500
3000
2500
2000
1500
1000
500
0
10
20
30
40
50
60
70
80
90
100
110
TIME AFTER BREAK - SECONDS

FIGURE 6

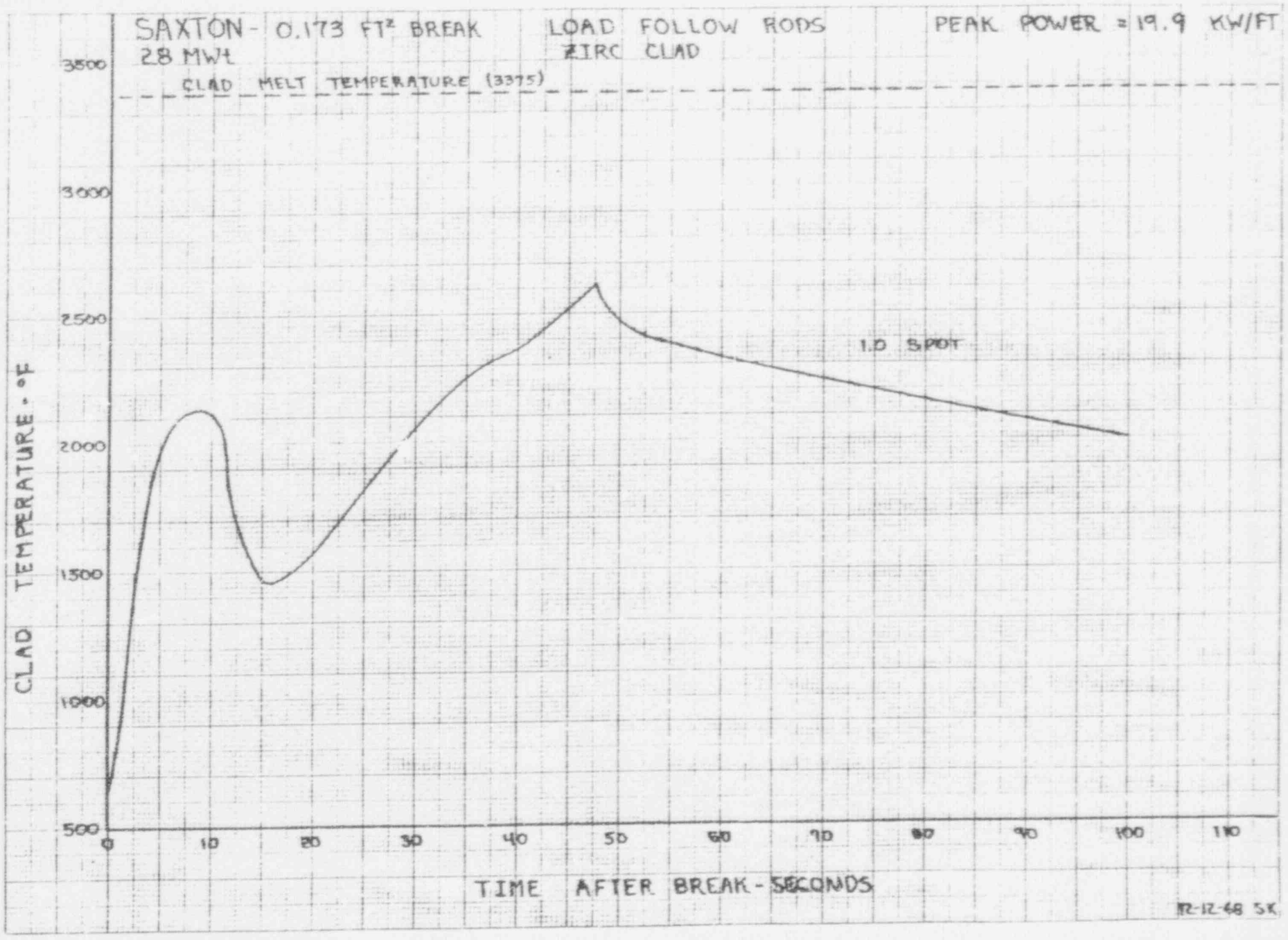

SAXTON - 0.173 FT² BREAK
28 MWt
LOAD FOLLOW RODS
ZIRC CLAD
PEAK POWER = 19.9 KW/FT
CLAD MELT TEMPERATURE (3375)
1.0 SPOT
CLAD TEMPERATURE - °F
3500
3000
2500
2000
1500
1000
500
0
10
20
30
40
50
60
70
80
90
100
110
TIME AFTER BREAK - SECONDS
12-12-68 SK

FIGURE 7

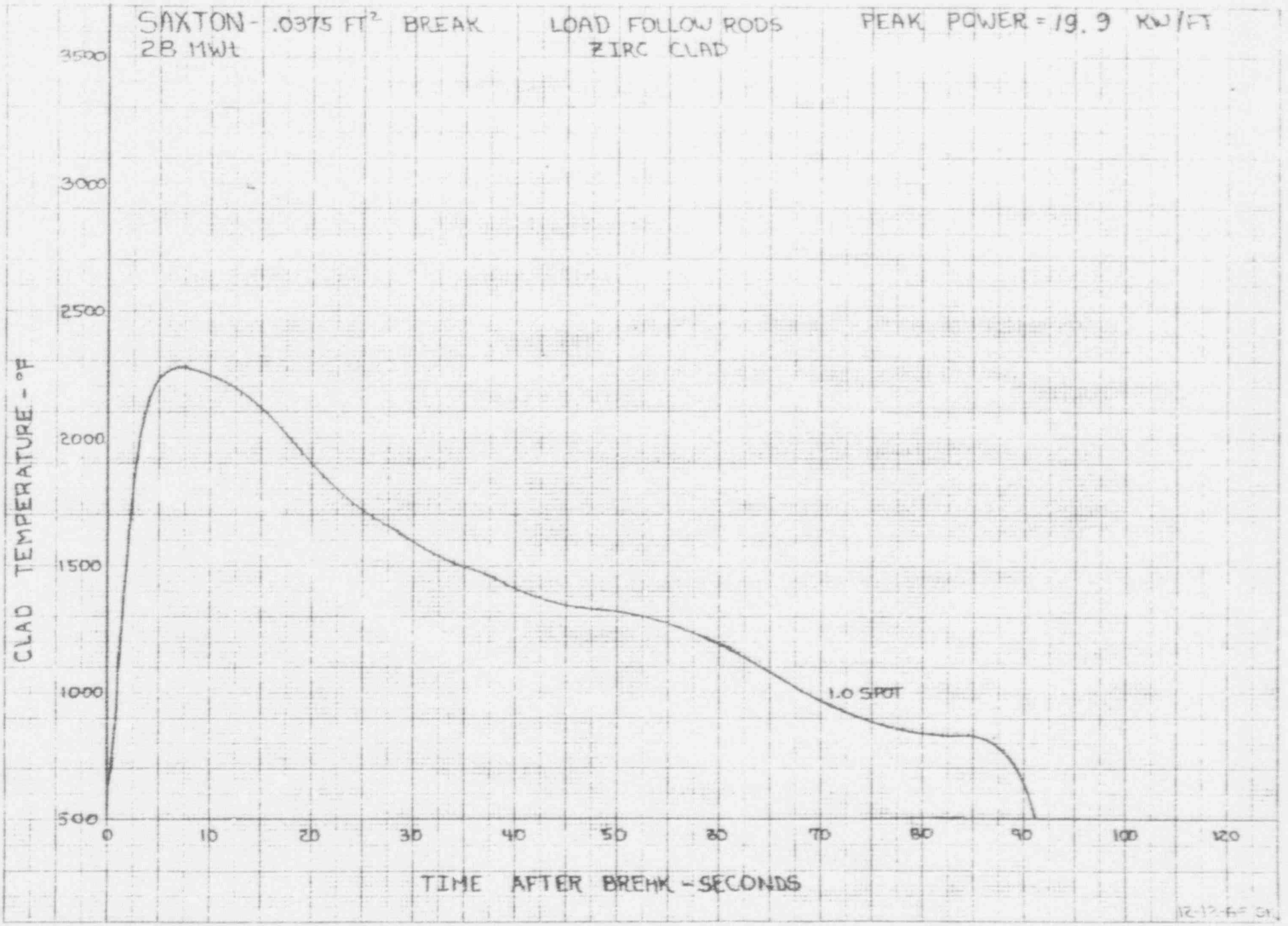

SAXTON - .0375 FT² BREAK
2B MWt
LOAD FOLLOW RODS
ZIRC CLAD
PEAK POWER = 19.9 KW/FT
3500
3000
2500
2000
1500
1000
500
CLAD TEMPERATURE - °F
1.0 SPOT
0
10
20
30
40
50
60
70
80
90
100
120
TIME AFTER BREAK - SECONDS

FIGURE 8

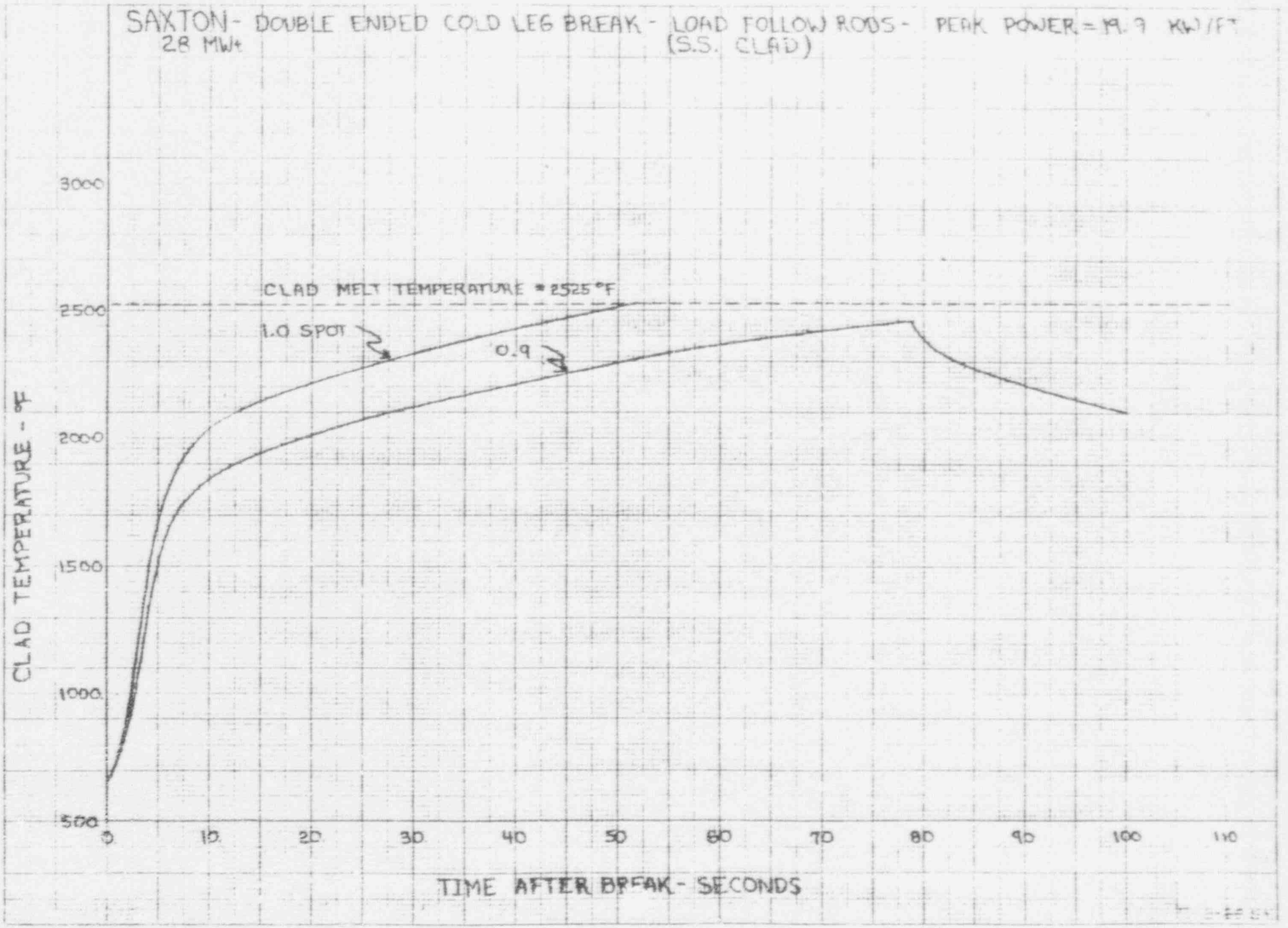

SAXTON - DOUBLE ENDED COLD LEG BREAK - LOAD FOLLOW RODS - PEAK POWER = 19.9 KW/FT
28 MWt
(S.S. CLAD)
CLAD MELT TEMPERATURE = 2525 °F
1.0 SPOT
0.9
CLAD TEMPERATURE - °F
TIME AFTER BREAK - SECONDS
3000
2500
2000
1500
1000
500
0
10
20
30
40
50
60
70
80
90
100
110

FIGURE 9

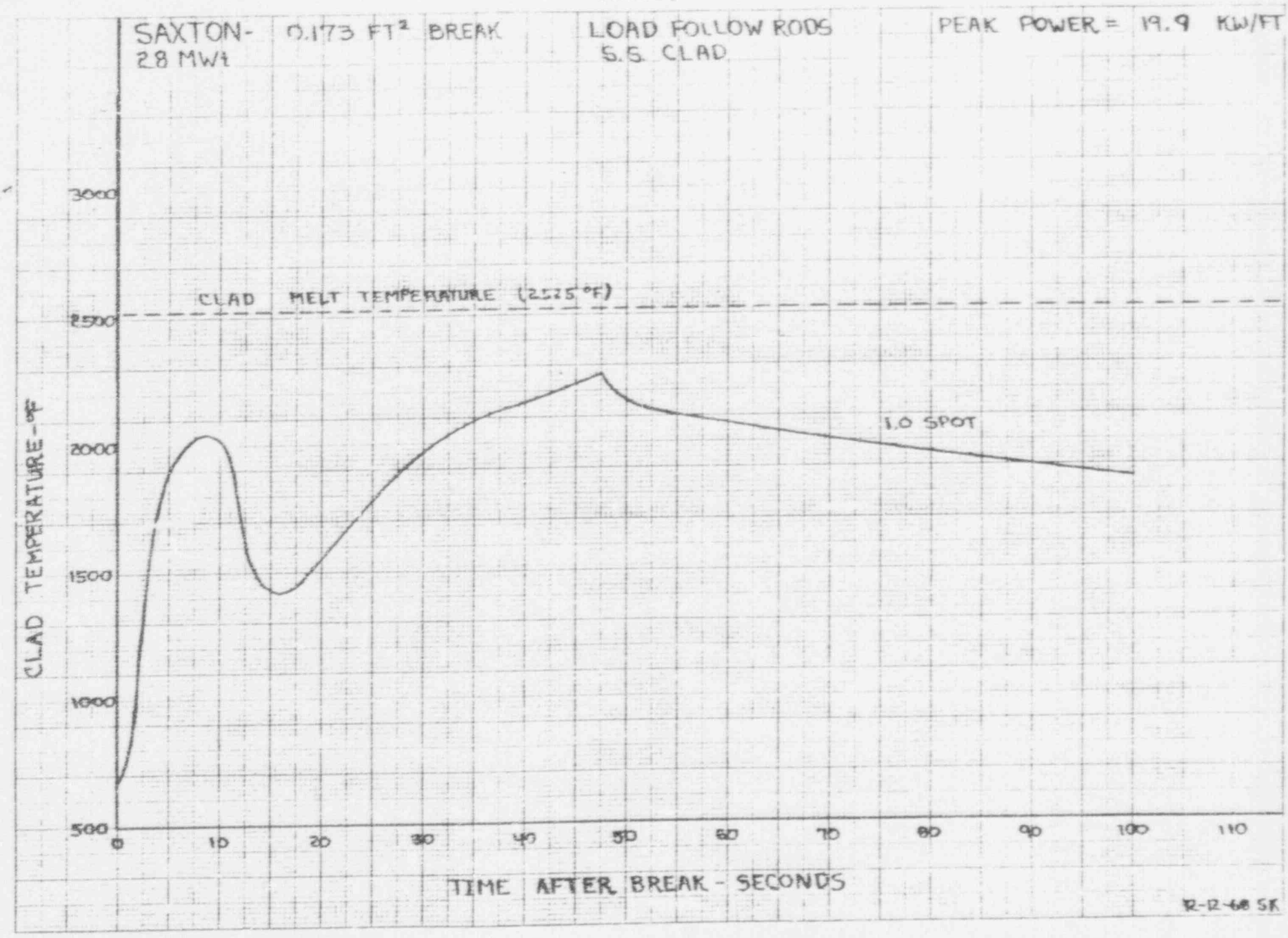
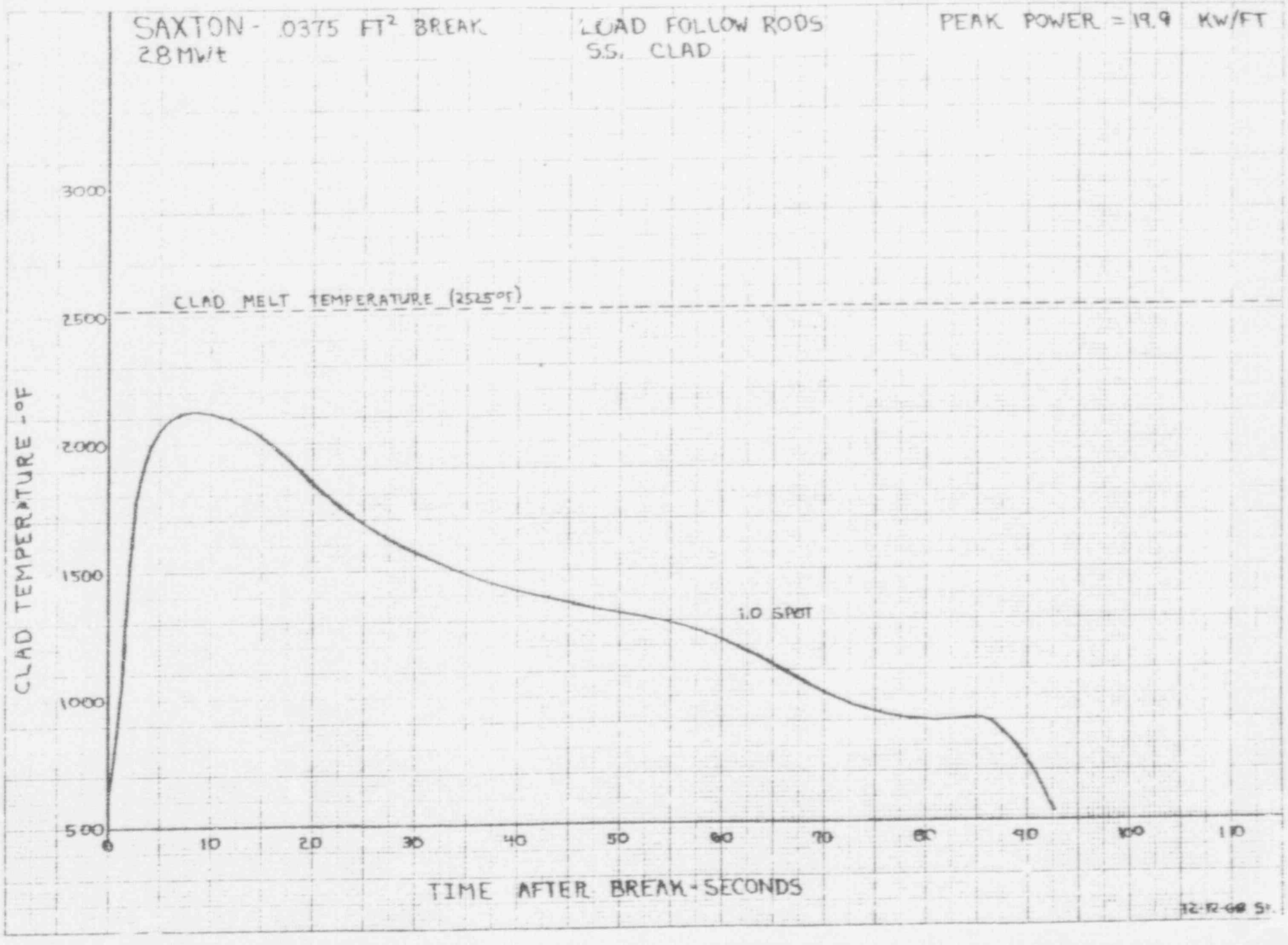

SAXTON-
28 MWt
0.173 FT² BREAK
LOAD FOLLOW RODS
5.5 CLAD
PEAK POWER = 19.9 KW/FT
CLAD MELT TEMPERATURE (2525 °F)
1.0 SPOT
CLAD TEMPERATURE - °F
3000
2500
2000
1500
1000
500
0
10
20
30
40
50
60
70
80
90
100
110
TIME AFTER BREAK - SECONDS
12-12-68 SK

FIGURE 10


SAXTON - .0375 FT² BREAK
2.8 MW/t
LOAD FOLLOW RODS
S.S. CLAD
PEAK POWER = 19.9 KW/FT
CLAD MELT TEMPERATURE (2525°F)
1.0 SPOT
CLAD TEMPERATURE - °F
TIME AFTER BREAK - SECONDS
3000
2500
2000
1500
1000
500
0
10
20
30
40
50
60
70
80
90
100
110