DEMONSTRATION OF THE CONFORMANCE

OF

EXXON NUCLEAR COMPANY FUEL

TO THE

WESTINGHOUSE K(Z) OPERATING ENVELOPE

FOR THE

ROBERT E. GINNA NUCLEAR POWER PLANT

Westinghouse Electric Corporation

Nuclear Technology Division

Nuclear Safety Department

Safeguards Engineering and Development

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I. Introduction

This document reports the results of a sensitivity study that was performed in order to demonstrate conformance of Exxon Nuclear Company nuclear fuel in the Robert E. Ginna nuclear power plant to the Westinghouse K(z) operating envelope. In particular, the results of this analysis show that for skewed to the top power shapes, in addition to the power shape peaked at the mid-core elevation, that the worst peak cladding temperature (PCT) in the unlikely event of a Loss-Of-Coolant-Accident (LOCA) remains below the 2200 deg-F limit as specified by Appendix K of 10CFR50.46.

II. Method of Analysis

The sensitivity study was performed using the LOCTA computer code of the Westinghouse 1981 Large Break LOCA Evaluation Model (WEM) to calculate the PCT for Exxon fuel for three power shapes. The power shapes investigated were peaked at 6.0 ft., 8.0 ft., and at 10.5 ft. The power shapes used in the LOCA analyses are shown in Figures 1-3. The peak power of each power shape is limited by the current K(z) envelope for the Robert E. Ginna (RGE) power plant. The current K(z) envelope for RGE assumes a maximum total peaking factor of 2.32, and a hot channel enthalpy rise factor of 1.66.

The fuel design parameters for the Exxon fuel were obtained from the Exxon Nuclear Company through a three-party proprietary agreement between Westinghouse, Rochester Gas & Electric, and Exxon. The fuel parameters specific to each power shape were generated by Exxon and transmitted to Westinghouse. The fuel parameters, which included fuel pellet temperatures and gap pressures, were then used as input in each of the LOCTA calculations. The results of the LOCTA calculations are summarized in the following table:

<u>Comparison of Exxon Fuel Peak Cladding Temperatures</u>

Power Shape Peak ft.	PCT °F	PCT Elevation ft.	PCT Time sec.
6.0	1781	7.25	106
8.0	1598	7.25	5.1
10.5	1528	10.00	4.9

These results demonstrate that for the Robert E. Ginna Unit, that the chopped cosine power shape (i.e. 6.0 ft. peaked shape) generates the most limiting peak clad temperature. Figures 4-6 show the clad temperature response for the peak node for the 6.0, 8.0, and 10.5 ft. power shapes respectively. An important observation of these results is that for the top-skewed shapes, the peak cladding temperature occurs during the blowdown phase. This is important because most of the Appendix K prescribed analytical models have their greatest influence during the reflood phase. A peak

clad temperature which occurs during reflood is sensitive to core-wide and system-wide hydraulic phenomena, while a blowdown peak is a stronger function of initial fuel stored energy. A comparison of the peak clad temperatures during the blowdown and reflood phases for each of these power shapes provides a more conclusive demonstration that the chopped cosine power shape produces the most limiting LOCA results.

Comparison of Peak Cladding Temperatures During Blowdown

Power Shape Peak	PCT-Blowdown	PCT Elevation	Time
ft.	^{o}F	ft.	sec.
6.0	1635	6.00	5.0
8.0	1598	7.25	5.1
10.5	1528	10.00	4.9

The comparison of peak clad temperatures during blowdown shows that the highest PCT occurs for the chopped cosine power shape. This is reasonable, because 6.0 ft. shape permits the highest total local peaking factor (2.32). The fact that the PCT for the top-skewed shapes occurs below the peak power location is due to the better heat transfer at higher elevations that occurs during the period of negative core flow.

Comparison of Peak Cladding Temperatures During Reflood

Power Shape Peak	PCT-Reflood	PCT Elevation	Time
ft.	^{o}F	ft.	sec.
6.0	1781	7.25	106
8.0	1585	8.00	74
10.5	1458	10.00	68

The comparison of reflood peak clad temperatures shows an even wider margin between the chopped cosine shape and the top-skewed power shapes. In addition to showing that the chopped cosine power shape is the "worst" power shape for a LOCA analysis of RGE with Exxon fuel, it also demonstrates a large margin to the 2200 deg-F limit for the top-skewed shapes for this plant.

III. Use of Non-Exxon Fuel Hydraulics

This sensitivity study was performed by re-calculating the clad temperature response for Exxon for the three power shapes using the LOCTA computer code. The hot assembly hydraulics was not re-calculated for the Exxon fuel. The blowdown and reflood hydraulic transients are generated using the SATAN, WREFLOOD and COCO computer codes. Existing blowdown and reflood hydraulics from a previous RGE plant specific analysis with W-OFA fuel were used as hot assembly boundary conditions for the LOCTA calculations. Use of the OFA hydraulics are justifiable for this sensitivity study on the following basis:

(1) The W-OFA rod size is smaller than the Exxon rod size. This will result in a slower reflood of a full core of W-OFA fuel. Thus, for a given power shape, the use of the OFA core reflood rate provides a conservative reflood rate for the Exxon fuel heat-up calculation.

(2) Previous sensitivities with top-skewed power shapes in SATAN have not shown a large effect on the end-of-blowdown fuel temperatures. Thus, the use of SATAN chopped cosine power shape results for top-skewed LOCTA calculations can be considered sufficiently accurate for a rough sensitivity study. Because of the wide margin between the cosine and the top-skewed shape PCTs in this analysis, re-calculation of the SATAN transient is not expected to change the conclusions of this analysis.

IV. Conclusions

The Westinghouse Large Break LOCA Evaluation Model clad heat-up computer code, LOCTA, was used to analyze Exxon fuel for three power shapes. The results confirmed that the power shape peaked at the center of the core produces the highest peak cladding temperature. This result for the Exxon fuel is consistent with power shape studies performed by Westinghouse with the same computer codes for Westinghouse fuel. The results of this study demonstrate that the Exxon fuel in the Robert E. Ginna nuclear power plant conforms to the current operating K(z) envelope for top-skewed power shapes. While the entire transient was not recalculated for this analysis, a complete re-analysis would not be expected to change the conclusions of this sensitivity study.

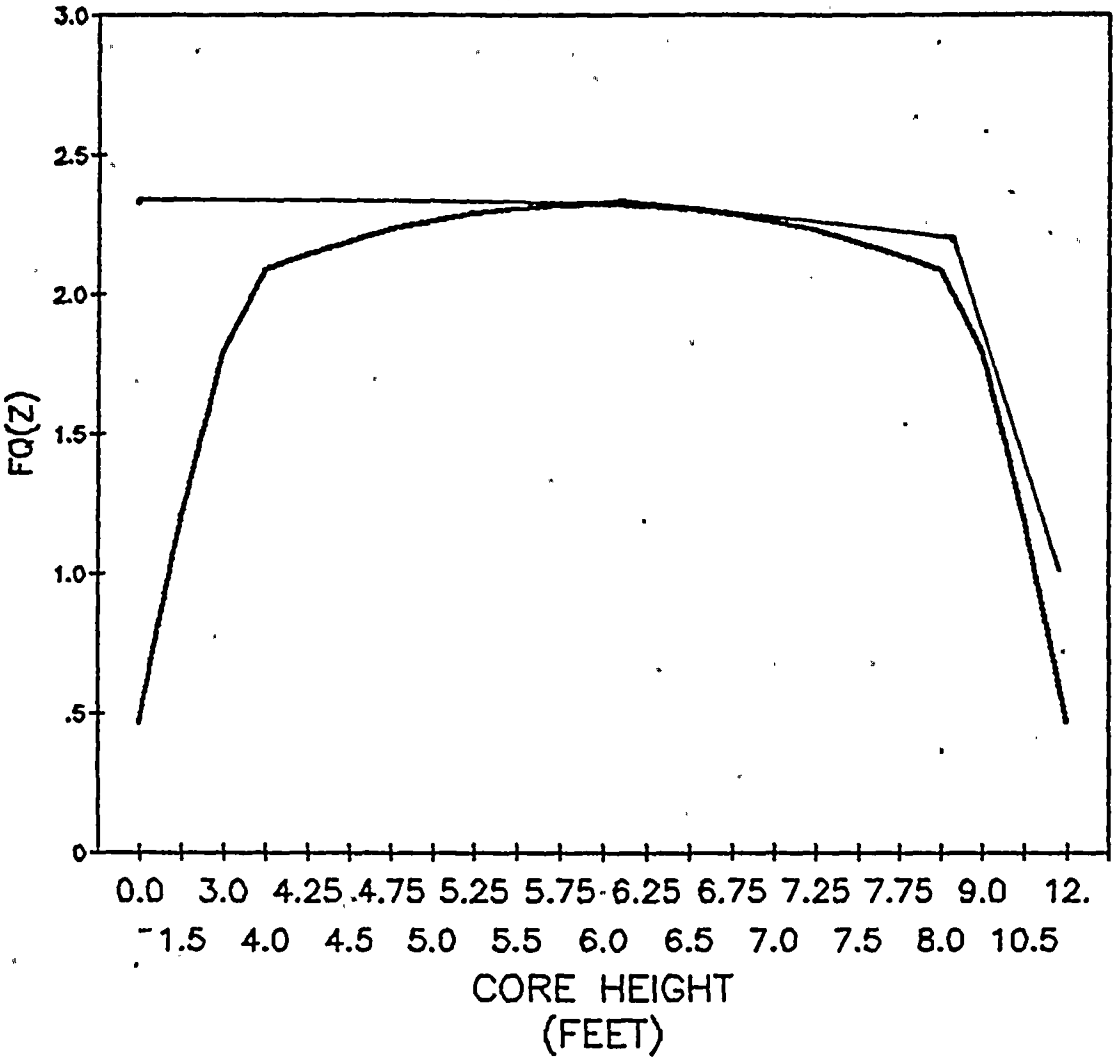

Figure 1. Axial Power Shape Peaked at 6.0 ft.
(Chopped Cosine Power Shape)

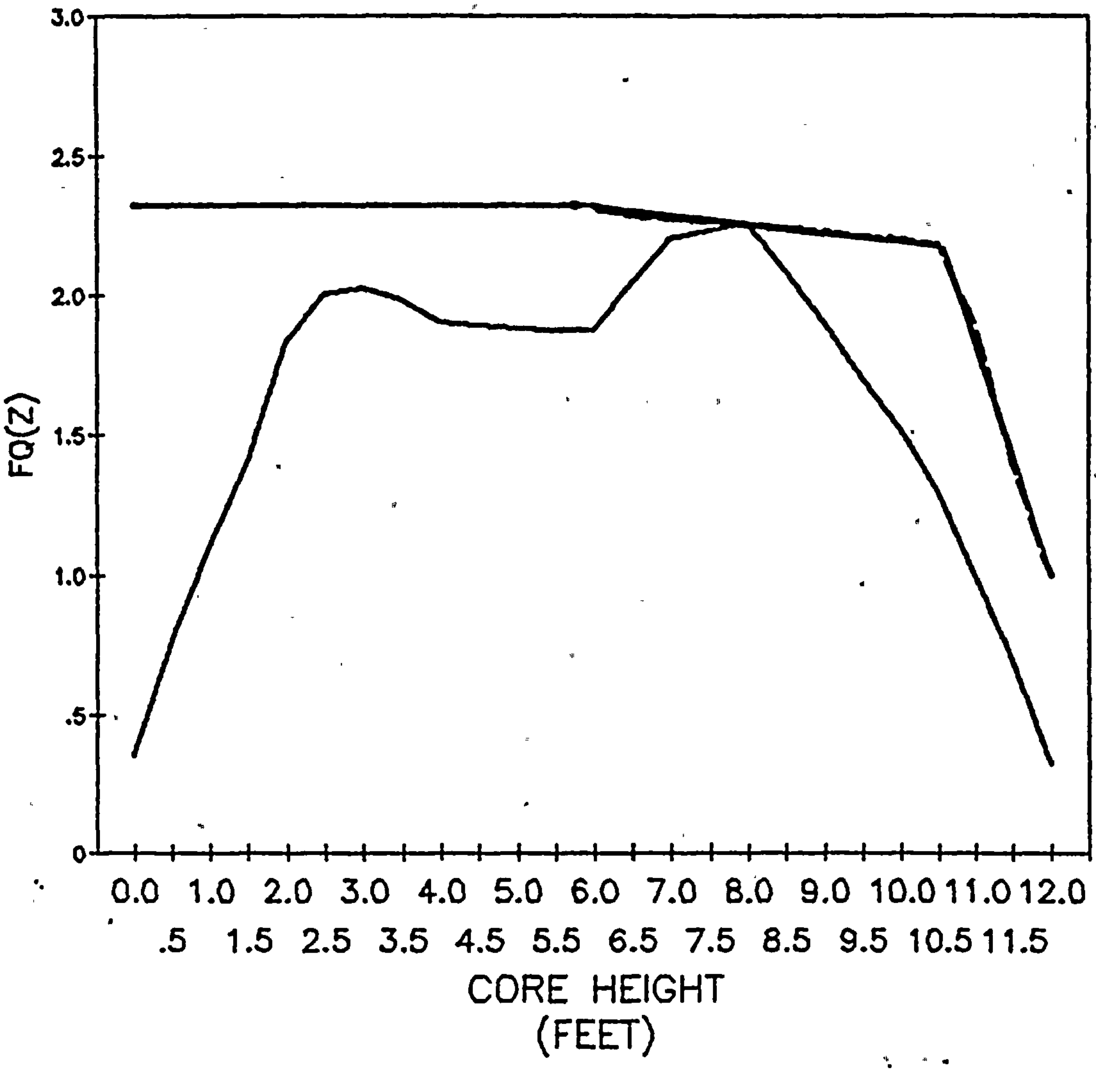

Figure 2. Axial Power Shape Peaked at 8.0 ft.

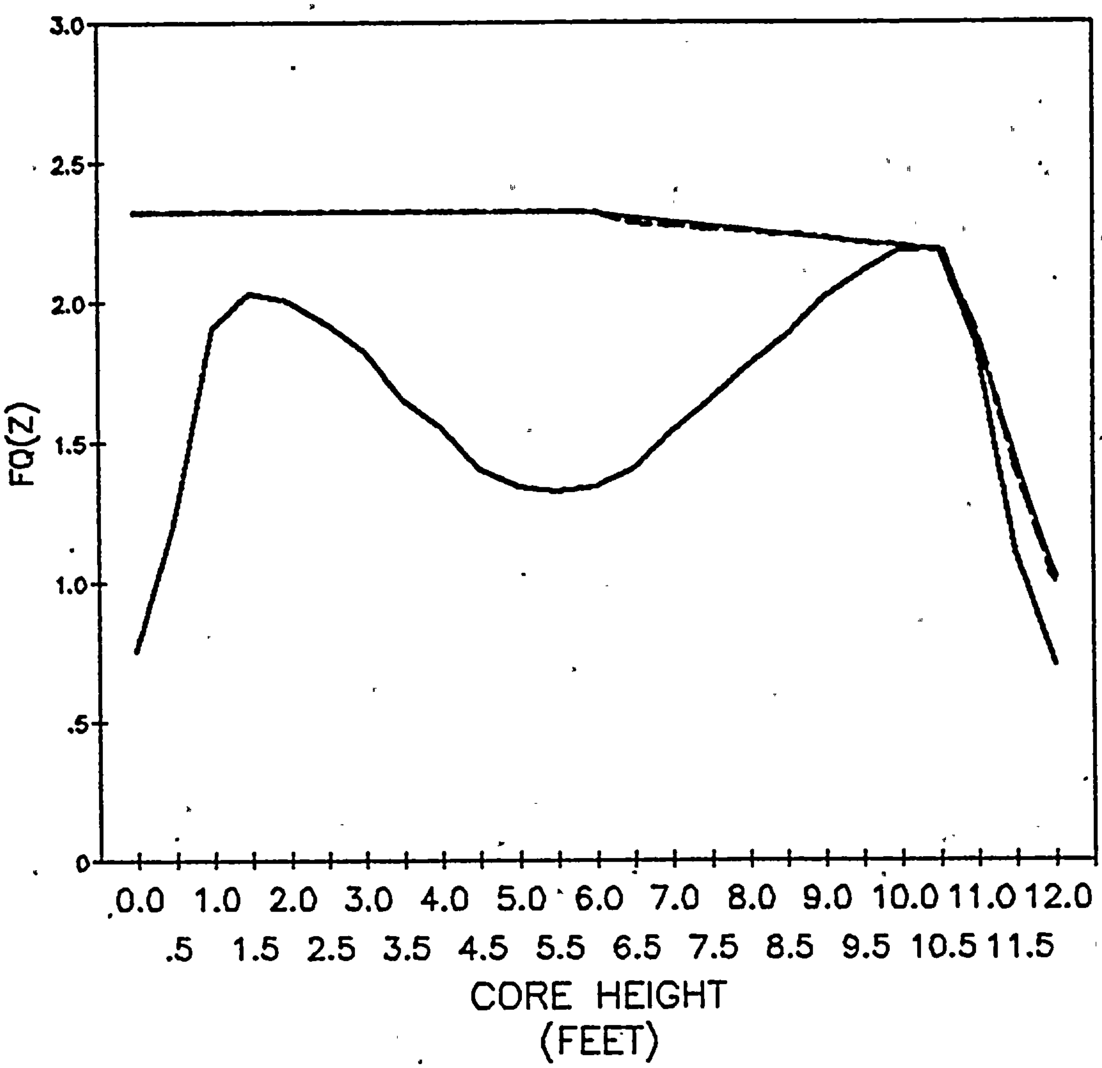

Figure 3. Axial Power Shape Peaked at 10.5 ft.

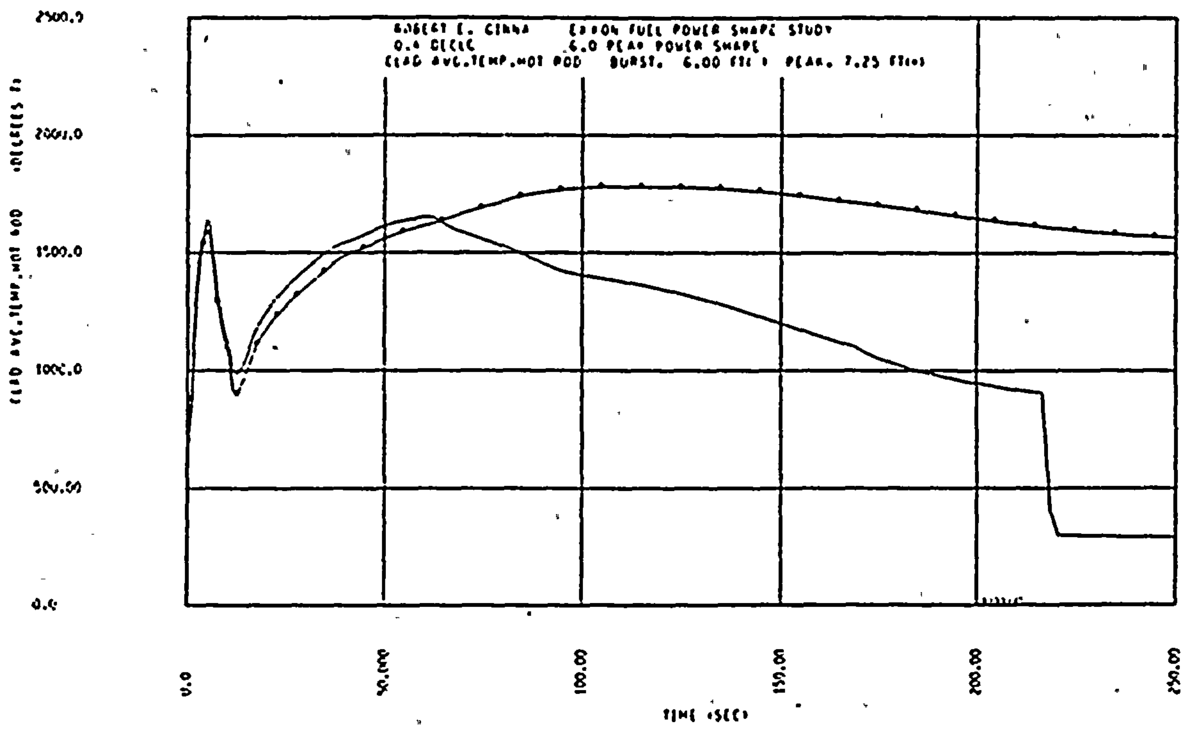

Figure 4. Clad Temperature Response for PCT Location for the 6.0 ft. Power Shape.

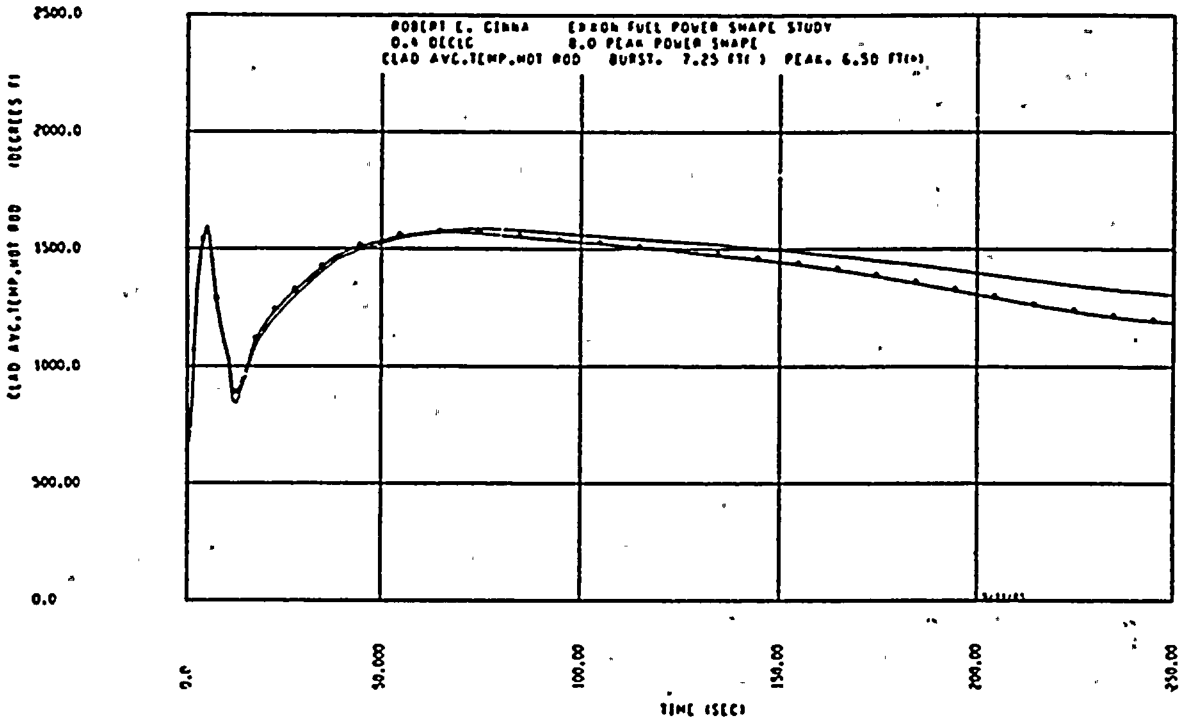

Figure 5. Clad Temperature Response for PCT Location for 8.0 ft. Power Shape

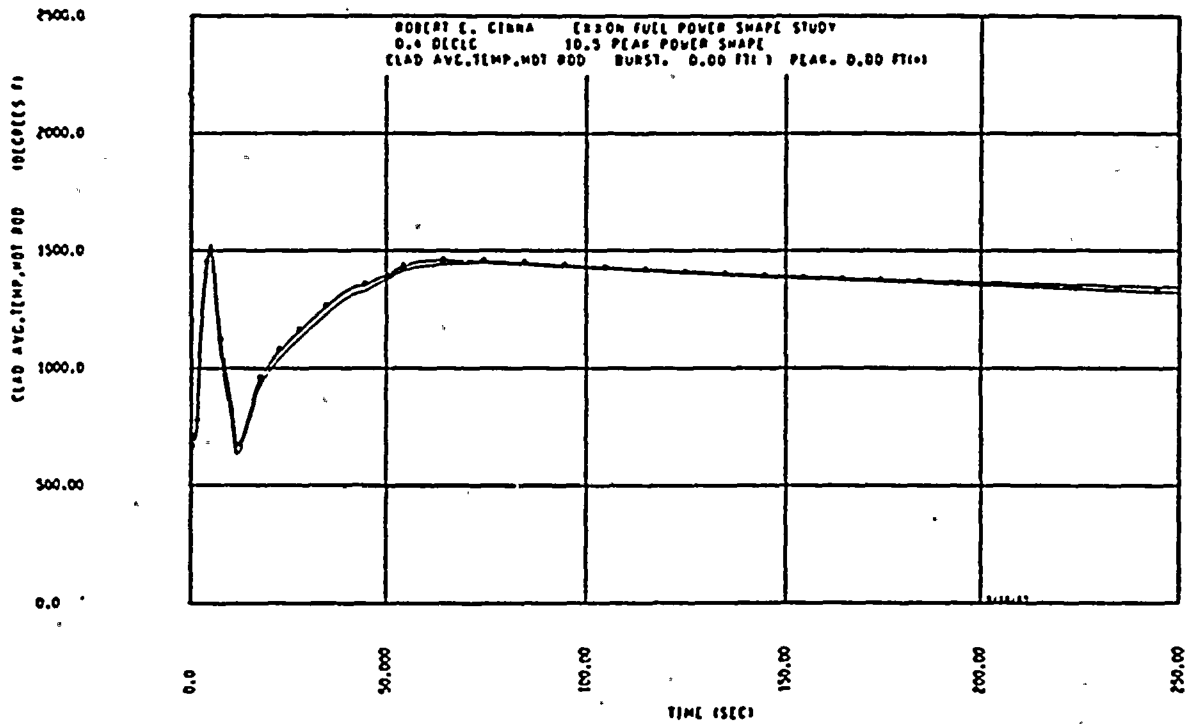

Figure 6. Clad Temperature Response for PCT Location for the 10.5 ft. Power Shape