UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

November 8, 1991

Docket Nos. 50-390
and 50-391

LICENSEE: TENNESSEE VALLEY AUTHORITY

FACILITY: WATTS BAR NUCLEAR PLANT, UNITS 1 AND 2

SUBJECT: OCTOBER 31, 1991 MEETING WITH THE TENNESSEE VALLEY AUTHORITY REGARDING OUTSTANDING ISSUE 19(j) (TAC NOS. M79717 AND 80346)

References: Meeting Notice by P. S. Tam (NRC), dated October 22, 1991

The subject meeting was held on October 31, 1991, at NRC headquarters in Rockville, Maryland as a result of the staff's request. The purpose was to specifically address the concern of thermal evaluation of structural steel members, part of the Outstanding Issue 19(j) described in the Watts Bar SER Supplement 6. Enclosure 1 is the meeting attendance list.

The main topic of the discussion concerned allowable ductility ratio for a steel member when subjected to a severe loading combination that includes stresses induced by accident-related temperatures (such as temperatures as the result of a LOCA).

A discussion was held following the handout of documents which were provided by TVA (Enclosures 2-5 of this summary). Enclosure 3 shows that TVA has identified 204 cases of thermal concerns for structural members, of which, 15 cases have been analyzed to be the worst cases. The staff stated that Watts Bar, being a plant applying for an operating license (OL), is expected to follow closely the guidelines of the Standard Review Plan (SRP), specifically, Section 3.8.4; if necessary, and if the cost is not prohibitive, TVA should make suitable modifications to reduce thermal stresses on structural members. TVA personnel stated that they do not believe that Watts Bar is deviating from the SRP guidelines on this issue and while the cost to make modifications may amount to only $500,000, they do not believe they need to make any modifications since Watts Bar is in compliance. A typical modification, according to TVA, would be an attempt to put in slotted holes to allow for thermal expansion.

The staff also pointed out that the ductility ratio of 3 alone does not provide the staff with the necessary information to make a safety determination; additional attributes such as limits of end rotation, deflection and maximum strain should be established at some acceptable predetermined values.

The staff summarized its concerns as follows:

1. TVA should provide experimental data demonstrating that the proposed ductility ratio of three does not mean a state of imminent structural instability (collapse) due to lateral loading, and represents the maintenance of sufficient margin. The experimental data should include, as a minimum, the following parameters:

   a. beam-column effect,

   b. compatability and comparability of transverse and axial loads tested to those of Watts Bar beams being evaluated,

   c. dynamic response due to safe-shutdown earthquake in a post-inelastic region, and

   d. combination of a. and c. above.

2. Since the ANSYS code is the primary tool to calculate the ductility of a member as well as the extent of the thermal axial load relaxation, there should be a verification of the code based on applicable experiments in an inelastic region. This should include comparison of the ANSYS results with experiments performed in 1. above, as well as numerical studies regarding error estimate and instability associated with the calculations.

The meeting was adjourned with the understanding that TVA will request another meeting with the staff when it is ready to address the concerns identified above.

Original signed by

Peter S. Tam, Senior Project Manager
Project Directorate II-4
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

Enclosures:
1. Attendance List
2. Outline of TVA Presentation
3. Flow Chart on Thermal Task
4. Various Graphs
5. Model of Induced Loads

cc w/enclosures:
See next page

| OFC | :PDII-4/LA | :PDII-4/PM | :PDII-4/D | :ESGB | : |
|---|---|---|---|---|---|
| NAME | :MSanders | :PTam:as | :FHebdon | : GBagchi | : |
| DATE | :11/7/91 | :11/7/91 | :11/8/91 | : 11/7/91 | : |

OFFICIAL RECORD COPY
Document Name: MTG. SUMMARY - OCTOBER 31

The staff summarized its concerns as follows:

1. TVA should provide experimental data demonstrating that the proposed ductility ratio of three does not mean a state of imminent structural instability (collapse) due to lateral loading, and represents the maintenance of sufficient margin. The experimental data should include, as a minimum, the following parameters:

   a. beam-column effect,

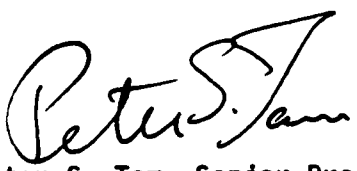
   b. compatability and comparability of transverse and axial loads tested to those of Watts Bar beams being evaluated,

   c. dynamic response due to safe-shutdown earthquake in a post-inelastic region, and

   d. combination of a. and c. above.

2. Since the ANSYS code is the primary tool to calculate the ductility of a member as well as the extent of the thermal axial load relaxation, there should be a verification of the code based on applicable experiments in an inelastic region. This should include comparison of the ANSYS results with experiments performed in 1. above, as well as numerical studies regarding error estimate and instability associated with the calculations.

The meeting was adjourned with the understanding that TVA will request another meeting with the staff when it is ready to address the concerns identified above.



Peter S. Tam, Senior Project Manager
Project Directorate II-4
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

Enclosures:
1. Attendance List
2. Outline of TVA Presentation
3. Flow Chart on Thermal Task
4. Various Graphs
5. Model of Induced Loads

cc w/enclosures:
See next page

ENCLOSURE 1

NRC-TVA MEETING ON

WATTS BAR NUCLEAR PLANT

OCTOBER 31, 1991

| Attendee | Organization |
|---|---|
| R. K. Alexander | TVA - Watts Bar |
| Hans Ashar | NRC/NRR/ESGB |
| Goutam Bagchi | NRC/NRR/ESGB |
| S. J. Chen | EBASCO |
| Walter Grossman | Brookhaven National Laboratory |
| F. J. Hebdon | NRC/NRR/PDII-4 |
| R. O. Hernandez | TVA - Watts Bar |
| John J. Hughes | TVA - Corporate Engineering |
| Roger W. Huston | TVA - Rockville Office |
| David C. Jeng | NRC/NRR/ESGB |
| Sang Bo Kim | NRC/NRR/ESGB |
| S. Alan Lin | EBASCO |
| Wayne A. Massie | TVA - Watts Bar Licensing |
| Peter S. Tam | NRC/NRR/PDII-4 |
| Joe Williams | NRC/NRR/PDII-4 |

Enclosure 2

# TENNESSEE VALLEY AUTHORITY

# WATTS BAR NUCLEAR PLANT

# THERMAL EVALUATION OF STRUCTURAL STEEL FEATURES

## OCTOBER 31, 1991
## 9:00 A.M.

## NRC OFFICES - WASHINGTON

*THERMAL EVALUATION OF*
*STRUCTURAL STEEL FEATURES*

# AGENDA

## OVERVIEW

- SCOPE
- PROBLEM
- RESOLUTION
- IMPLEMENTATION METHODOLOGY

## TECHNICAL DISCUSSION

*THERMAL EVALUATION OF STRUCTURAL STEEL FEATURES*

# SCOPE

- EXTREME THERMAL LOADS
- IDENTIFICATION OF STRUCTURAL STEEL FEATURES

*THERMAL EVALUATION OF*
*STRUCTURAL STEEL FEATURES*

# PROBLEM: INCONSISTENT DESIGN PRACTICES

- LACK OF DESIGN GUIDANCE
- EXPANSION CAPABILITY
- SELF-RELIEVING AND DUCTILE BEHAVIOR

# RESOLUTION: EXPLICIT DESIGN GUIDANCE

- SELF-RELIEVING BEHAVIOR
- DUCTILE BEHAVIOR
- LOAD COMBINATIONS

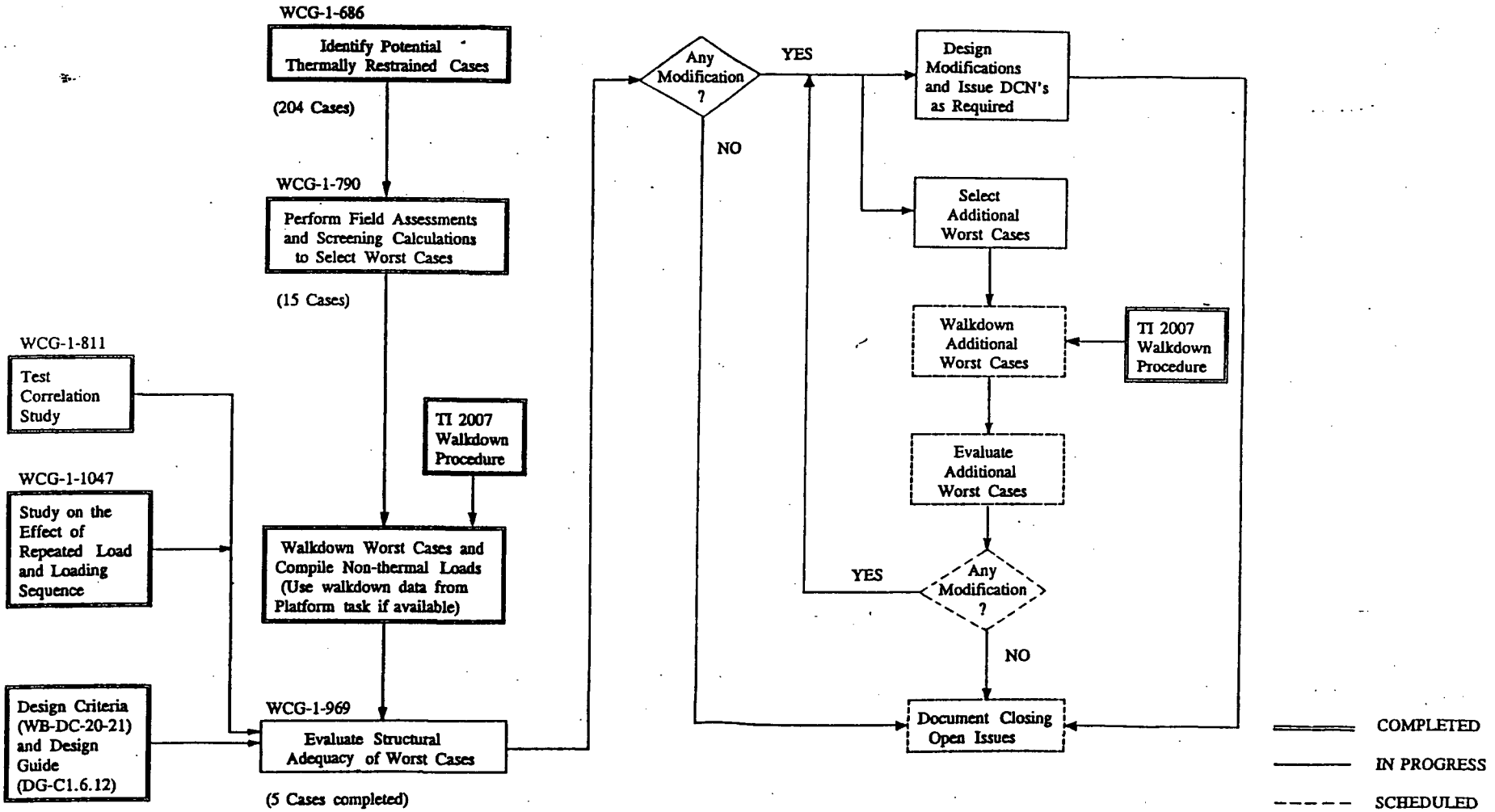
*THERMAL EVALUATION OF*
*STRUCTURAL STEEL FEATURES*

# IMPLEMENTATION METHODOLOGY

- IDENTIFICATION OF RESTRAINT CONDITIONS
- GROUPING OF STRUCTURES
- ANALYSIS AND EVALUATION
- ACCEPTANCE CRITERIA
- MODIFICATIONS

# THERMAL TASK OVERVIEW

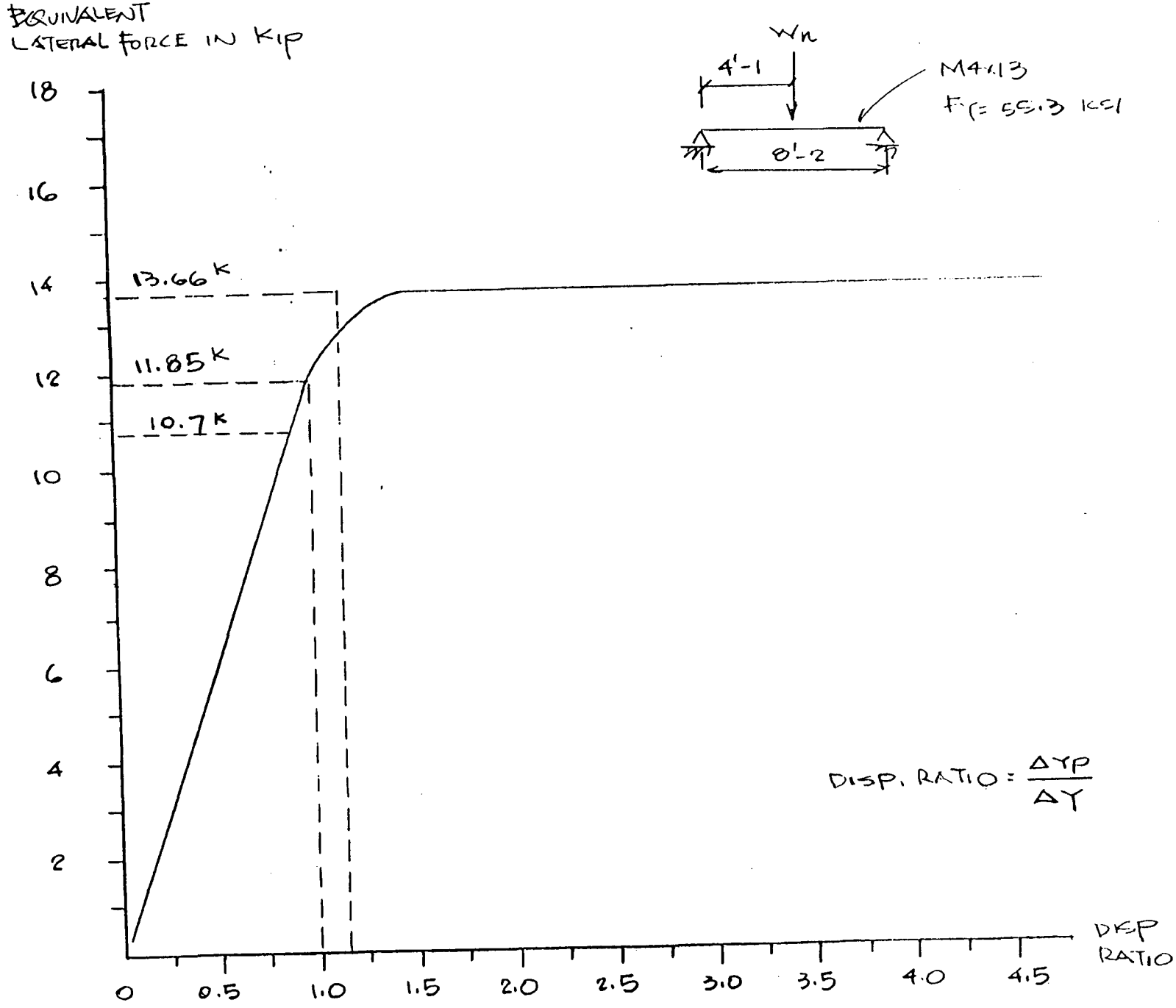
September 1991




Enclosure 3

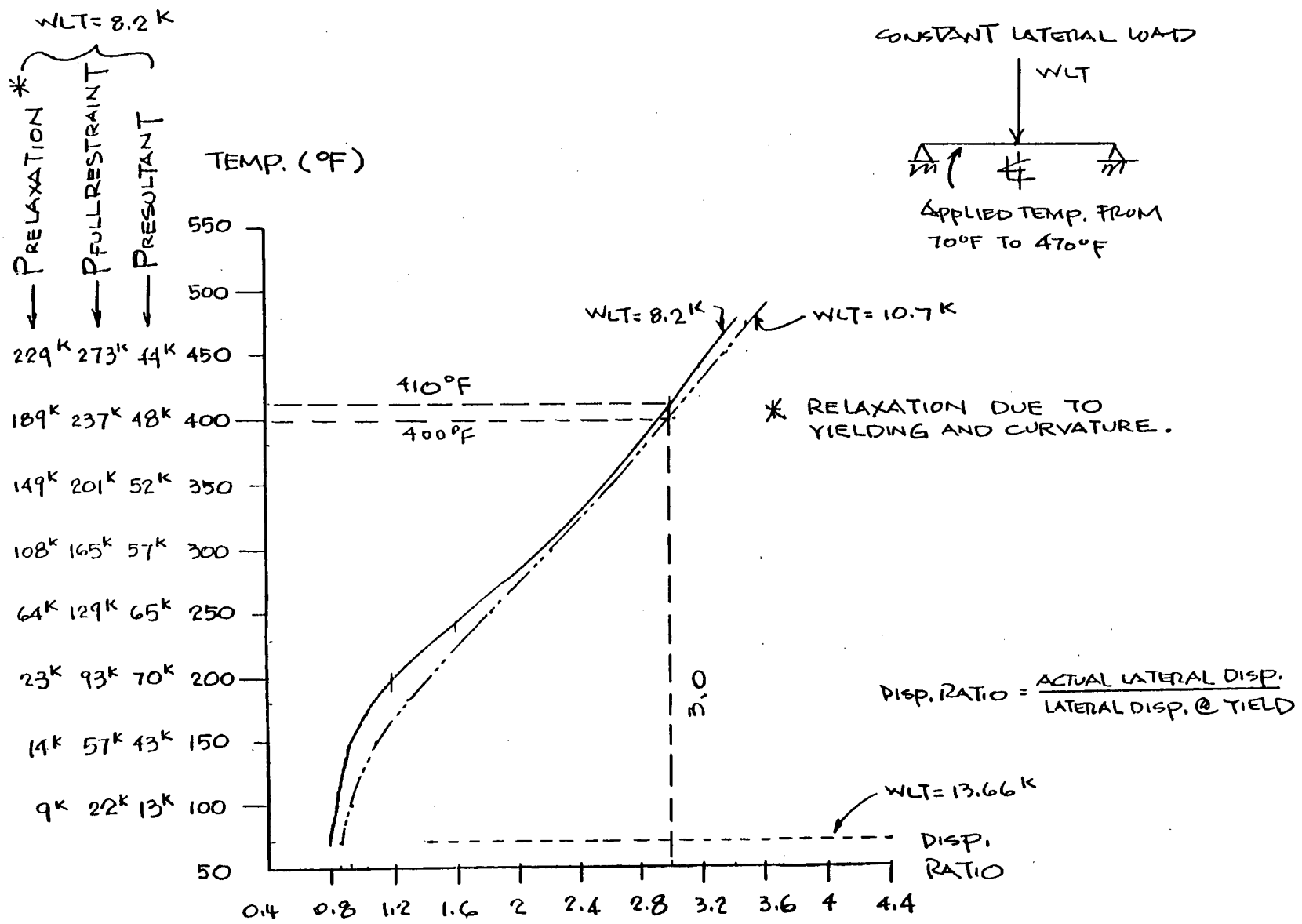
## WORST CASE EVALUATION RESULTS

| Worst Case | Ductility Ratio/Calculation | Remarks |
|---|---|---|
| 1 - 11 | $\mu < 1$ (WCG-1-969) | Linear |
| 1 - 22 | $\mu = 2.9$ (Preliminary) | Potential Modification |
| 1 - 23 | $\mu = 1.9$ (Preliminary) | Potential Modification |
| 1 - 26 | $\mu < 1$ (WCG-1-970) | Linear |
| 1 - 28 | $\mu = 4.4$ (Preliminary) | Modification Projected |
| 2 & 3 - 2 (D) | $\mu = 2.1$ (WCG-1-970) | |
| 1 - 37<br>2 & 3 - 5(H) | $\mu > 3$ (Preliminary)<br>$1 < \mu < 3$ (Preliminary) | Modification Projected |
| 1 - 38<br>2 & 3 - 6(J) | $\mu = 5.1$ (WCG-1-970)<br>$\mu = 2.1$ (WCG-1-970) | Modification/Additional Case<br>Potential Modification |
| 2 & 3 - 7(I) | $\mu = 2$ (WCG-1-970) | |
| 2 & 3 - 8(G) | $\mu < 1$ (WCG-1-969) | Linear |
| 1 - 27 | $\mu = 3.3$ (WCG-1-969) | Modification/Additional Case |
| 2 & 3 - 9(C) | $\mu < 1$ (WCG-1-969) | Linear |
| 5 - 7 | $\mu < 1$ (WCG-1-969) | Linear |

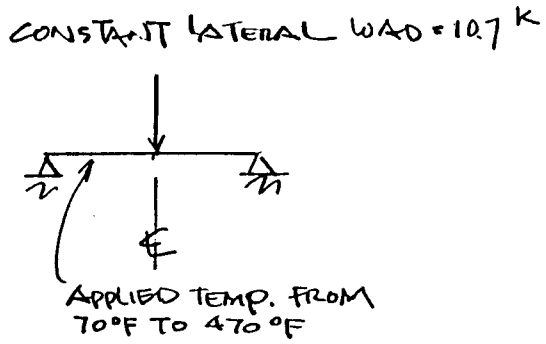


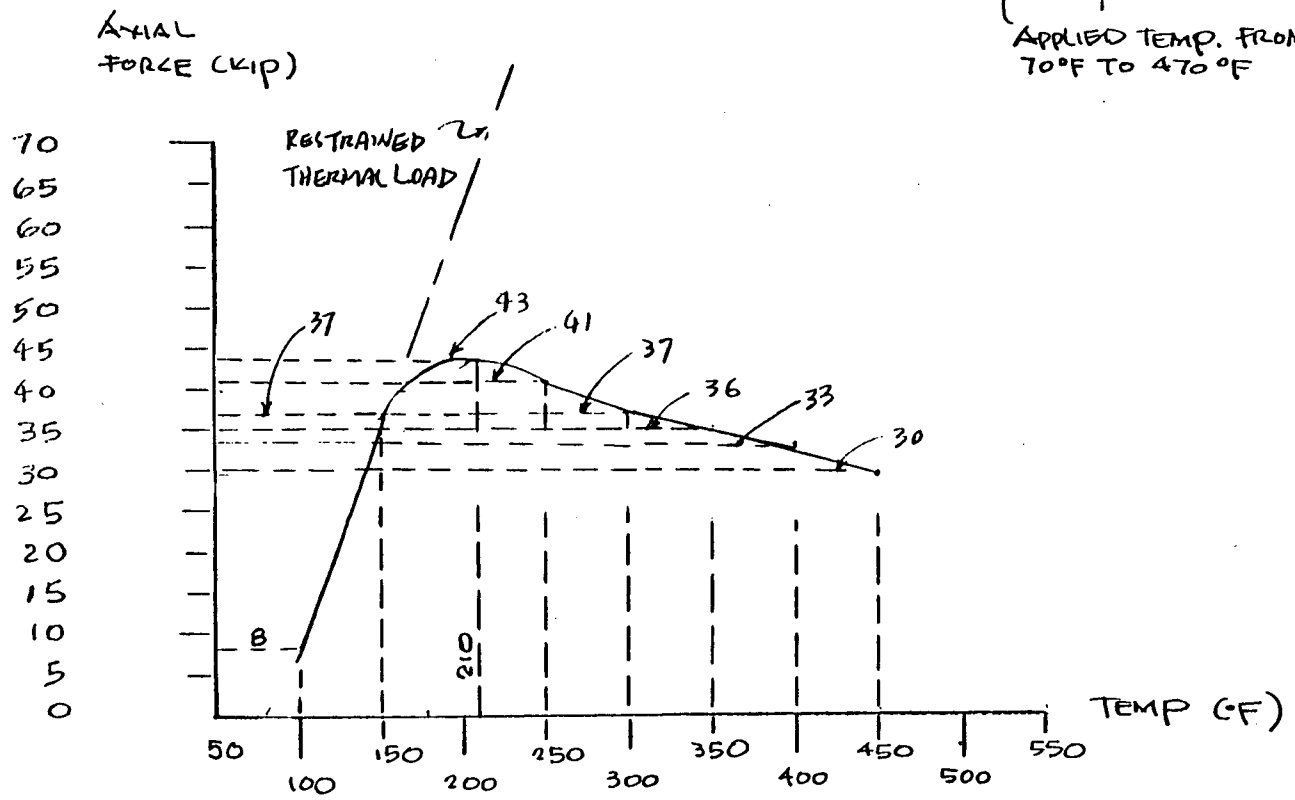

EBASCO SERVICES INCORPORATED

Enclosure 4

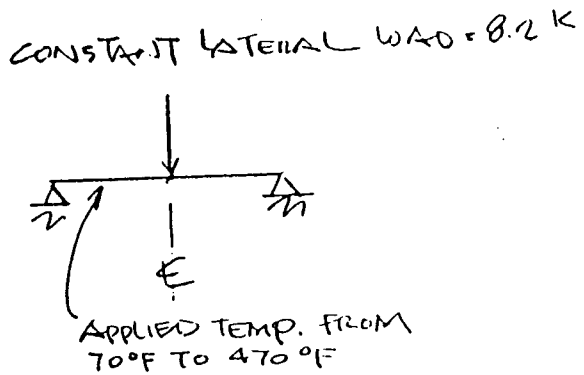


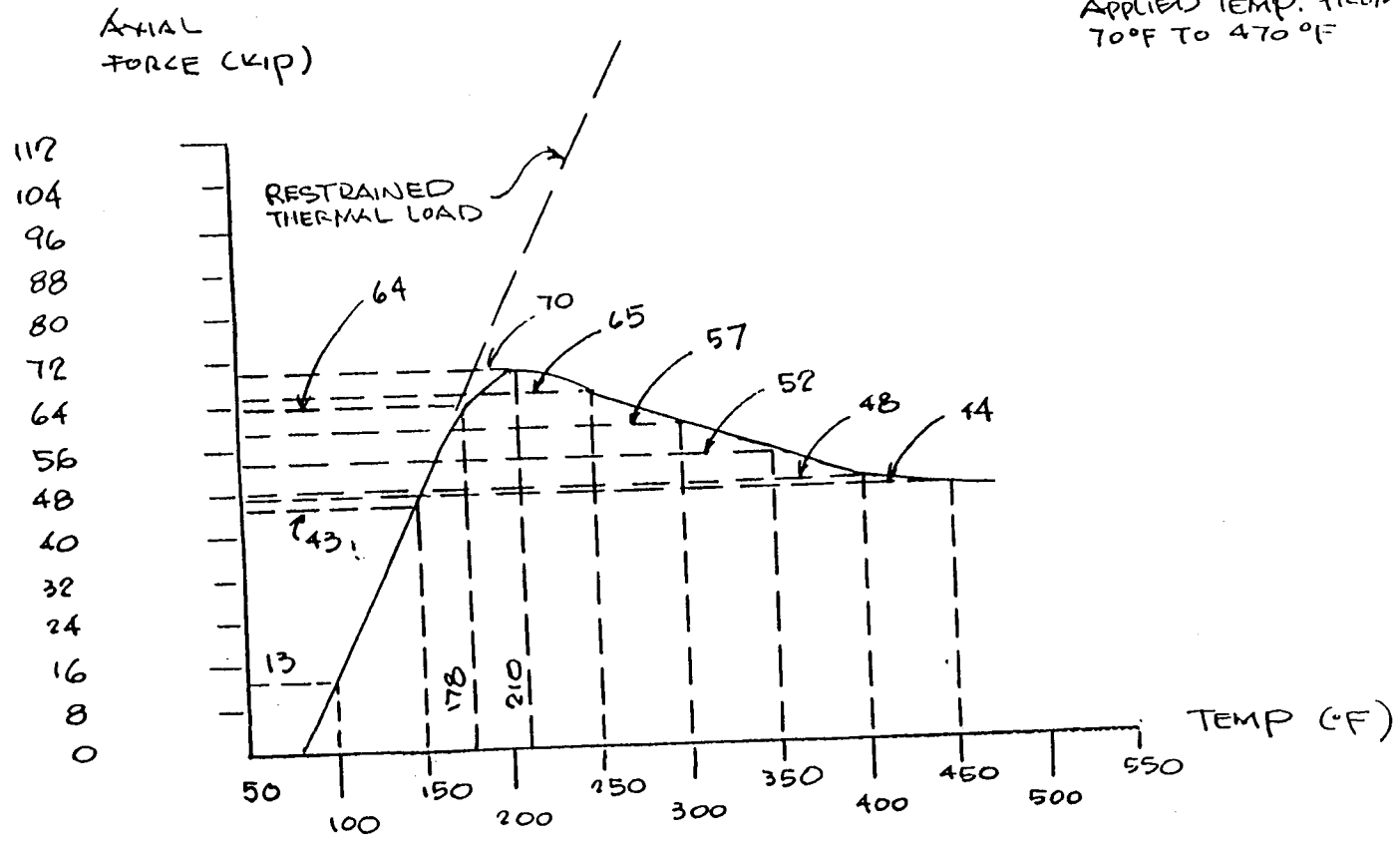

EBASCO SERVICES INCORPORATED



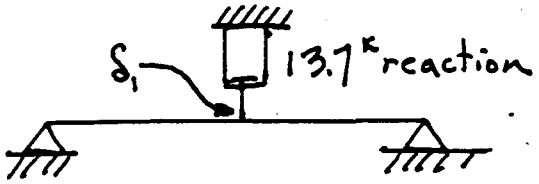

EBASCO SERVICES INCORPORATED


CONSTANT LATERAL LOAD = 8.2 K
APPLIED TEMP. FROM
70°F TO 470°F

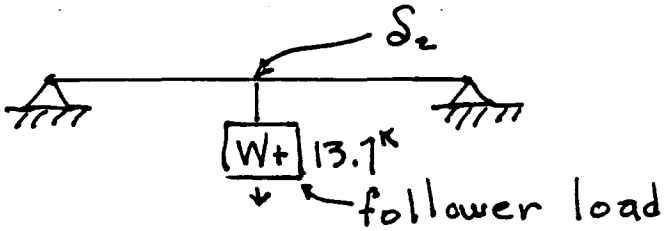

AXIAL
FORCE (KIP)
RESTRAINED
THERMAL LOAD
117
104
96
88
80
72
64
56
48
40
32
24
16
8
0
64
70
65
57
52
48
44
43
13
178
210
TEMP (°F)
50
100
150
200
250
300
350
400
450
500
550

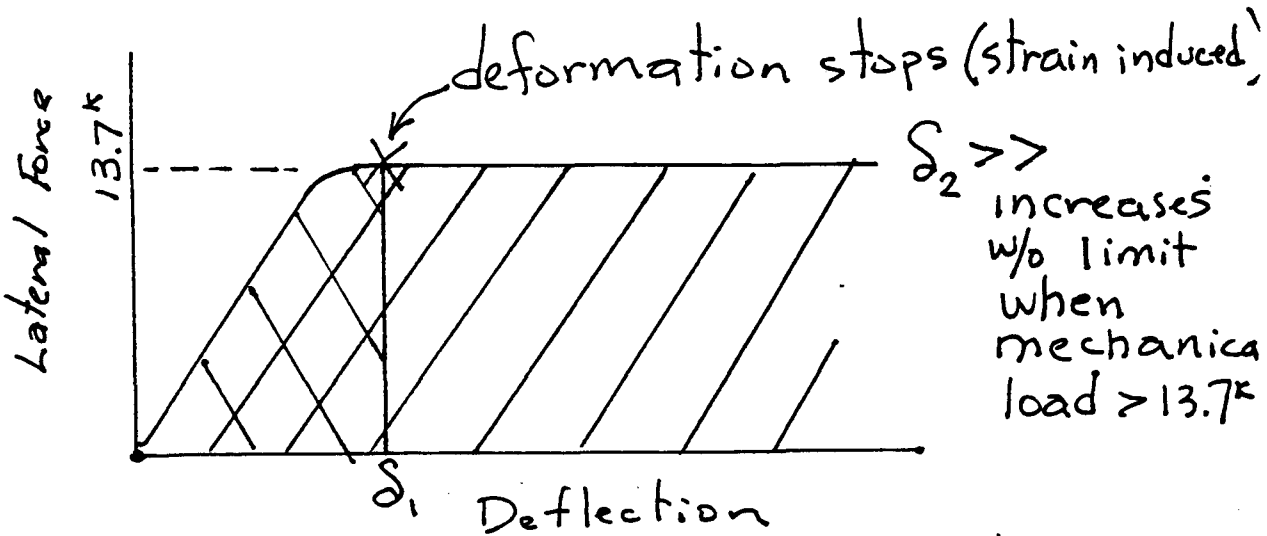
Enclosure 5

Strain Induced Load




Mechanically Induced Load




Available strain induced energy (limited)

Available mechanically induced energy is unlimited ($\delta_2$ is not controlled)

Distribution (with enclosures)

Docket File
NRC PDR
Local PDR

Distribution (without Enclosures 2 - 5)

| | |
|---|---|
| F. Miraglia | 12-G-18 |
| J. Partlow | 12-G-18 |
| S. Varga | 14-E-4 |
| G. Lainas | 14-H-3 |
| F. Hebdon | |
| M. Sanders | |
| P. Tam | |
| B. Wilson | RII |
| J. Weschelberger | 17-G-21 |
| G. Walton | RII |
| H. Livermore | RII |
| OGC | 15-B-18 |
| E. Jordan | MNBB-3701 |
| David C. Jeng | 7-H-15 |
| S. B. Kim | 7-H-15 |
| G. Bagchi | 7-H-15 |
| J. Williams | 14-B-21 |
| ACRS (10) | |
| WBN Reading File | |