December 24, 1992

Note to Jim McKnight:

The attached is part of an earlier submittal made by TU Electric. Please make the same distribution for this as was done for the previous submittal. I have also enclosed a copy of the RIDS sheet that shows the distribution and subject. If you have any problems or questions, please give me a call. Thanks.

Eileen

Eileen Peyton
504-1305

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Log # TXX-92353
File # 10010 (clo)

August 12, 1992

William J. Cahill, Jr.
Group Vice President

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

SUBJECT: COMANCHE PEAK STEAM ELECTRIC STATION (CPSES) - UNIT 2
DOCKET NO. 50-446
REQUEST FOR ADDITIONAL INFORMATION ON ME215,
SAPCAS COMPUTER CODE

Gentlemen:

Per your request for additional information on the subject computer codes, the following enclosures are provided for your review as follows:

(1) Introduction of computer program ME215. This write-up provides a brief description of the three documents included in this transmittal.

(2) The "User and Theory Manual". (proprietary)

(3) The "Validation Manual", computer outputs of validation problems are not included in the verification manual. (proprietary)

(4) Comanche Peak No. 2 GENX Calculation No. 2-NP-GENX-544. This GENX calculation is prepared to resolve the technical issue regarding the automatically generated element size at the pipe near a pad. This GENX calculation satisfactorily resolved the concern.

(5) The response to the NRC's questions arising from the review made at Bechtel's Gaithersburg office.

(6) A complete copy of microfiche of ME215 and ANSYS output (total 49 sheets). (proprietary)

(7) Bechtel Application for Withholding Proprietary Information with Accompanying Affidavit, Proprietary Information Notice and Copyright Notice.

As portions of this submittal contains information proprietary to Bechtel, it is supported by an affidavit signed by Bechtel, the owner of the information. The affidavit sets forth the basis on which the information may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in paragraph (b)(4) of 10CFR2.790.

5pp

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Accordingly, it is respectfully requested that the information which is proprietary to Bechtel be withheld from public disclosure in accordance with 10CFR2.790. Correspondence with respect to the proprietary aspects of the Application for Withholding should reference the supporting Bechtel affidavit and be addressed to Mr. G. L. Lusbaugh, Bechtel Project Engineer, Comanche Peak Steam Electric Station, P.O. Box 1002, Farm Road 56 Mail Zone C07, Glen Rose, Texas 76043.

Sincerely,

William J. Cahill, Jr.

William J. Cahill, Jr.

By: Roger D. Walker

Roger D. Walker
Manager of Regulatory
Affairs for NEO

CEJ/tg
Enclosures

c - Mr. J. L. Milhoan, Region IV w/o encl
Mr. B. E. Holian, NRR, w/encl
Resident Inspectors, CPSES (2) w/o encl

INTRODUCTION OF COMPUTER PROGRAM ME215, VERSION 1.0

1. INTRODUCTION

ME215 is a special purpose finite element computer program for calculating the membrane and membrane-plus-bending stress intensities (S.I.) at pipes, pads, attachments, and welds. The piping components can be a circular run pipe, elbow, or a square tubular steel. The attachment can be a circular pipe, rectangular tube, or rectangular solid lug.

The structural analysis solver of the ME215 program is based on the SOLID SAP and SAP-IV. ME215 element library contains quadrilateral plate element of SAP-IV, 3D solid (brick) element of SOLID-SAP, and 3D beam element of SAP-IV.

The program utilizes a minimum set of free format, engineering based input commands and keywords. It then automatically generates a finite element mesh to model the user defined piping attachment. Some control parameters are available for the user to adjust the modeling of the attachment. By default, the minimum element size at the attachment interface will be about the run pipe thickness, or the pad thickness if applicable.

Local stress calculations for Comanche Peak Unit 2 integral welded attachments are evaluated and qualified using computer program ME214. ME214 is based on the Welding Research Council (WRC) Bulletin No. 107, ASME Code Cases, and Comanche Peak Design Criteria 2EP-5.12 and 2EP-5.13. If a local stress calculation can not be qualified using ME214 due excessive conservatism or if the attachment being evaluated is beyond the program limitations, then ME215, if applicable, may be used for the qualification of local stress calculation. ME215 will provide a realistic solution of local piping stress as compared to the more conservative approach used in computer program ME214.

2. USER AND THEORY MANUAL

The user and theory manual of ME215 provides the following information:

a. Theoretical basis of the computer program and its references.

b. Program capability, limitation and assumption.

c. Preparation of input data

- Defines the coordinate systems

- Identifies the geometric configuration of integral welded attachment on a run pipe

- Describes the attachment/pipe dimensions

- Describes load input

d. Output Interpretation

- Describes the format of output. Two tables listing the maximum 25 stress points are reported for the whole finite element model. One table is sorted according to the membrane plus bending stress intensity and the other according to the membrane stress intensity.

- Printouts of model geometry, nodal displacements and rotations.

- Printouts of the detailed element stresses for each plate or brick elements.

3. VALIDATION MANUAL

The ME215 Validation Manual revision 0 covers 14 validation problems. A checklist explains which of the various features were validated by each of the validation problems. The validation problems are numbered as VER-E1, VER-E2,... VER-B1,... VER-A1, etc. The problems selected are based on their numerical sensitivities, system characteristics, unique features, available solutions, program capacities, built-in criteria, defaulted values, etc. In this report, ME215 results have been compared against the commercially available computer program ANSYS, simplified closed form or conservative methodology, the standard benchmark problem from the ASME and/or other technical publication.

Tables or charts show typical values extracted from the ME215 computer output compared with the results from one of the references listed in the previous section. The results compared are typical of the results for numerical figures ranging from low to high values for these problems.

4. GENX CALCULATION 544 - Reconciliation of Local Evaluation Using ME215 Analysis

In the ME215 analysis, the element mesh size is generated automatically. During a TU audit on ME215, it was concluded that the generated element sizes are adequate at welds, attachments, pads, and piping near attachments. However, a concern was raised relative to the adequacy of the element size at the pipe near a pad.

To assess this concern a GENX calculation was prepared in which the adequacy of ME215 mesh size in this region was addressed further using additional comparisons with ANSYS. The GENX calculation demonstrates the acceptability of usage of ME215 relative to the concern raised.

5. FUTURE PROGRAM RELEASES

Version 2.0 of the program (currently being documented) will further enhance the automatic mech generation feature for pipe elements near a reinforcement pad. Options to vary the size of elements will also be available. The preliminary validation runs of version 2.0 show close correlation with the results of ANSYS. The new version of ME215 is intended for issuance in the near future.

FIGURE 7.1

CALCULATION TITLE PAGE

TEXAS UTILITIES ELECTRIC CO. / CPSES UNIT 2

PAGE 1

TOTAL NO. OF PAGES 32

CALCULATION TITLE (Indicative of the Objective):

RECONCILIATION OF LOCAL STRESS EVALUATION USING ME215 ANALYSIS

CALCULATION CLASSIFICATIONS:

☒ CLASS I or II

☐ NON-SAFETY

CALCULATION IDENTIFICATION

ORGANIZATION: BECHTEL,PSAS

CALCULATION NUMBER — TYPE: PSG2 — NUMBER: 2-NP-GENX-544

WPST NUMBER: __ __ __ __ __ (OR)

WPN 2 9 D

COMPUTER OUTPUT: YES ☒ NO ☐

ATTACHED: YES ☐ NO ☒

SYSTEM/SUB-SYSTEM:

APPROVALS - PRINT NAME, SIGN, AND DATE

PREPARER(S)	CHECKER(S)/ REVIEWER(S)	APPROVAL(S)/ INDEPENDENT REVIEWER(S)	REV. NO.	SUPPLEMENTS/ SUPERSEDES (TYPE/NUM/REV.)	CONFIRMATION REQUIRED YES	CONFIRMATION REQUIRED NO
H.Y. Chow [signature] 2/28/92	J.K. Shen [signature] 3/2/92	CHII YUH CHEIN [signature] 3/2/92	0	N/A		X
R.C.Wilkinson [signature] 1/13/92	H.Y. Chow [signature] 2/28/92					

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FIGURE 7.4
COMPUTER OUTPUT/CROSS REFERENCE

ORGANIZATION: BECHTEL,PSAS

CALC NO.: GENX-544 JOB NO. 20935

REV. 0 PAGE 2

COMPUTER RUN UNIQUE IDENTIFIER					
1JOB DATE	PROG. NAME2	VERSION/LEVEL2	LIBRARY NAME2	COMPUTER 1JOB NUMBER*	ADD/ DELETE
8-29-91	ME215	0	2DU80:[ME101TEST]	TM4812	
8-29-91	ME215	0	- Ditto -	TI0254	
8-29-91	ME215	0	- Ditto -	TD0106	
8-28-91	ME215	0	- Ditto -	SR5507	
9-20-91	ME215	0	- Ditto -	KD5727	
9-19-91	ME215	0	- Ditto -	JW5555	
9-19-91	ME215	0	- Ditto -	JQ2058	
9-19-91	ME215	0	- Ditto -	JU3147	
9-19-91	ME215	0	- Ditto -	JC3800	

*For unique identification number
1) Mandatory
2) Optional, as appropriate

More Computer Run Listing on Next P

CROSS REFERENCE			
CALC. TYPE	CALC. NUMBER	REVISION	ADD/DELETE

FIGURE 7.4
COMPUTER OUTPUT/CROSS REFERENCE

ORGANIZATION: BECHTEL,PSAS

CALC NO.: GENX-544 JOB NO. 20935

REV. 0 PAGE 3

COMPUTER RUN UNIQUE IDENTIFIER

1JOB DATE	PROG. NAME2	VERSION/LEVEL2	LIBRARY NAME2	COMPUTER 1JOB NUMBER*	ADD/ DELETE
9-19-91	ME215	0	2DUB0:[ME101TEST]	JM0408	
9-23-91	ME215	0	- Ditto -	NH3450	
9-19-91	ME215	0	- Ditto -	J02937	
9-19-91	ME215	0	- Ditto -	J03032	
9-19-91	ME215	0	- Ditto -	JQ5852	
9-21-91	ME215	0	- Ditto -	LE3805	
9-21-91	ME215	0	- Ditto -	LH1942	
9-21-91	ME215	0	- Ditto -	LJ0943	
9-23-91	ME215	0	- Ditto -	NH5149	

*For unique identification number
1) Mandatory
2) Optional, as appropriate

More Computer Run Listing on Next Pg.

CROSS REFERENCE

CALC. TYPE	CALC. NUMBER	REVISION	ADD/DELETE

FIGURE 7.4
COMPUTER OUTPUT/CROSS REFERENCE

ORGANIZATION: BECHTEL,PSAS

CALC NO.: GENX-544 JOB NO. 20935

REV. 0 PAGE 4

COMPUTER RUN UNIQUE IDENTIFIER					
1JOB DATE	PROG. NAME2	VERSION/LEVEL2	LIBRARY NAME2	COMPUTER 1JOB NUMBER*	ADD/ DELETE
10-01-91	ME215	0	2DUB0:[ME101TEST]	1U0752	
10-01-91	ME215	0	- Ditto -	1P1906	
9-19-91	ME215	0	- Ditto -	JF0336	
9-18-91	ME215	0	- Ditto -	IV2129	
10-01-91	ME215	-	- Ditto -	1W2737	
9-20-91	ME215	0	- Ditto -	KB4623	
9-19-91	ME215	0	- Ditto -	JA0450	
9-20-91	ME215	0	- Ditto -	KC5149	

*For unique identification number
1) Mandatory
2) Optional, as appropriate

More Computer Run Listing on Next Pg.

CROSS REFERENCE

CALC. TYPE	CALC. NUMBER	REVISION	ADD/DELETE

FIGURE 7.4
COMPUTER OUTPUT/CROSS REFERENCE

ORGANIZATION: BECHTEL,PSAS

CALC NO.: GENX-544 JOB NO. 20935

REV. 0 PAGE 5

COMPUTER RUN UNIQUE IDENTIFIER

1JOB DATE	PROG. NAME2	VERSION/LEVEL2	LIBRARY NAME2	COMPUTER 1JOB NUMBER*	ADD/ DELETE
8-30-91	ANSYS	4.4A	[RODABAUGH,ME101]	120845	
9-28-91	ANSYS	4.4A	- Ditto -	174535	
10-03-91	ANSYS	4.4A	- Ditto -	130136	

*For unique identification number
1) Mandatory
2) Optional, as appropriate

CROSS REFERENCE

CALC. TYPE	CALC. NUMBER	REVISION	ADD/DELETE

TABLE OF CONTENTS

ORIGINATOR	CHECKER	
H. Y. Chow	J. K. Shen	Page 1 - 25
R. C. Wilkinson	H. Y. Chow	Pages A1 - A7

1.0 PURPOSE

The purpose of this generic calculation is:

(1) To evaluate the adequacy of the pipe element size generated by ME215 automatic mesh generator near a pad area.

(2) To establish a methodology of using ME215 results for local stress evaluation if the pipe element size is determined not to be adequate.

(3) To reconcile previously completed ME215 analysis results, if required, against the methodology established in this generic calculation.

2.0 BACKGROUND

2.1 When Integral Welded Attachments (IWA's) are evaluated using ME215 analysis, the basic evaluation procedure is as described below:

(1) Modeling

The size/dimensions of the attachment, the run pipe and the pad, if exists, are modelled to represent their actual dimensions. For IWA's with an all around pad, an equivalent pipe with the pad thickness and OD dimensions may be used to represent the pad and the run pipe if following requirements are met:

- The pad size meets the minimum edge distance requirement of Section 5.2.1.2 or 5.3.1.2 of 2EP-5.12. That is:

$$L_p > L_a + 2\sqrt{R_p T_p}$$

where L_p, R_p and T_p are the length, outside radius and thickness of the reinforcing pad, respectively, L_a is the attachment longitudinal length

- The attachment is welded to the pad, and it's centerline coincides with the geometric center of the surface of the pad.

- The pad weld is not less than 1.09 times the nominal thickness of the pipe.

(2) Allowable Stresses

Material allowables (S, S_h, S_c, S_y) used may be based upon the material of the item for which a stress evaluation is being made, rather than the lowest of all. Additionally, the allowables and the methodology used for weld evaluations may be based on ASME Code Cases N-318 and N-392.

(3) Local Discontinuity Stress Evaluation

The local stresses at attachment-to-pad and pipe-to-pad junctions are checked. The maximum attachment, pad and pipe stresses are checked against the allowable stresses of each respective item. These local stresses at attachments and pads are directly found from ME215 results. The local pipe stress at the pipe to pad is taken as the higher of the stresses calculated at the pipe/pad interface (i.e., representing the weld) or the pipe stress from ME215 results. For IWA's with an all around pad, when the "equivalent pipe model" method is used, the stresses at pipe-to-pad junction are calculated by using the stresses intensification factor for a fillet weld connection and pipe moments at each respective juncture.

(4) Pad Weld Stress

Pad welds are qualified per Attachment 4-2 of 2EP-5.13. The pipe/pad interface (weld stress) from the ME215 output are not used for weld qualification. The higher of the pipe/pad interface (weld stress) or the pipe stress from ME215 results is considered as pipe local stress and used for IWA local stress evaluation.

2.2 In the ME215 analysis, the element mesh size is generated automatically. The generated element sizes are adequate at welds, attachments and pads. However, the element size at the pipe near a pad is relatively coarse and hence may result in less conservative calculated stresses. This only occurs when the welded attachment has a reinforcing pad and the pad is:

- not a wrap around 360 degree pad, or
- a wrap around 360 degree pad but the "equivalent pipe model" option is not chosen

2.3 With the exception of the relatively coarse pipe element near a pad, analyses using ME215 computer program are conservative in the following manner:

(1) In performing ME215 analysis, two loading conditions are considered for each load case. One loading condition applies three moments simultaneously. The other condition applies three forces simultaneously. The total calculated stresses are the absolute summation of the calculated stresses from these two loading conditions. Thus the potential counteracting effect of the actual combined stresses from forces and moments are avoided. In addition, the maximum calculated stresses from these two separate loading conditions are assumed to occur at the same location (element).

(2) ME215 model does not consider the interacting effect between a pad and the pipe. The applied load is transmitted from the pad to the pipe through the pipe/pad interface (weld) only. There are no gap elements between the pipe and the pad which would provide for the pipe to directly share some of the applied loads. This tends to maximize stresses on the pad weld and the local pipe area surrounding the pad weld. For simplicity, the stresses in the FEA model in the area of the pipe/pad interface are referred to as the "weld stresses" even though they are not used in the weld evaluation.

(3) The higher of the weld stress or the pipe stress from ME215 results is used to represent the local pipe stress in that area. The weld stress is typically bounding when the pad weld size is smaller than the nominal pipe wall thickness. When the pad weld size is greater than the pipe wall thickness, two or more layers are usually specified for the pad weld in the ME215 analysis model. Since the higher of the weld stress or the pipe stress is used, the calculated pipe stresses by ME215, are not expected to be relevant to the local stress evaluation since the weld stresses typically control.

(4) The pipe minimum nominal stress (MNS) is combined with the pipe local stress calculated by ME215. In the ME215 analysis model, both ends of the run pipe are assumed fixed. For anchors, this results in calculated local stresses which include the effect of the moments of the run pipe from both sides of the anchor. Thus, the pipe MNS stresses are over-accounted for in the final stress evaluation.

3.0 EVALUATION METHOD

The method of evaluation of the pipe element size, when pads are used, uses the following approach:

(1) Determine whether the calculated local stresses at the pad-to-pipe weld would be governing for that location in all cases.

(2) The maximum stresses (the higher of the weld stresses or the pipe local stresses), at pipe/pad junction, calculated by ME215 are compared to ANSYS results at pipe elements to establish the level of conservatism in ME215 analyses.

(3) Establish a method of reconciliation of the ME215 analysis results if the results of items 1 and 2 above could not establish an overall level of conservatism.

Two basic F.E. models are used to perform this evaluation. One model represents the case in which the size of the pad weld is smaller than the pipe wall thickness. The second model represents the case in which the size of the pad weld is greater than the pipe wall thickness. In each of the two basic models the other parameters are selected such that the stresses on the pad/pipe juncture are maximized. The pad thickness is taken to be thicker than the pipe wall thickness and the pad length is such that the distance between the surface of the attachment and the edge of the pad is less than decay length $\sqrt{R_p T_p}$. The actual pipe and pad size used in the analyses are:

Pipe outside diameter: 3.5"; Thickness of the pipe: 0.216"
Pad size: 6" (length) x 7" (180 degree) x 0.75" (thickness)

In ANSYS analyses, gap elements are used between the pad and the pipe. The pipe element size near pad weld is 0.25" (compared to $\sqrt{Rt}$ of 0.615") which is small enough so that the calculated local stresses are realistic.

ME215 Models

In variations of different pad weld element mesh size and loadings on the two basic models discussed above, a total of five (5) configurations and twenty-six (26) separate load cases as shown in table 7.4 are used to perform the ME215 analyses. In the five (5) configurations three (3) configurations are for ¼" pad weld size with 1, 2, and 3 No. of layers and two (2) configurations are for 3/16" pad weld with 1 and 2 No. of layers. The higher stresses of pad welds or pipe elements from ME215 results are compared to those of pipe elements from comparable ANSYS results. Among the twenty-six load cases used, eighteen (18) load cases are used for the purpose of direct comparison of the results, three (3) load cases are used for the purpose of validating the proposed reconciliation method and the remaining five (5) load cases are used for both purposes as shown in Tables 7.2 and 7.3 of Section 7.0.

ANSYS Models

Since pad weld mesh size has little effect on the stresses at pipe elements, only one pad weld element mesh size (one layer) is used in the ANSYS models. The type of element used is STIF45-3D Isoparametric element. Thus, the number of configurations analyzed by ANSYS is limited to the two basic models discussed above. Twelve (12) load cases are used in conjunction with the ANSYS models which are sufficient to compare to those described for ME215 analysis above. See table (7.4) for cross referencing of ANSYS to ME215 load cases.

4.0 RESULTS/CONCLUSIONS

4.1 Comparison of ANSYS and ME215 Analysis Results

4.1.a Comparison of Local Membrane Stress Intensity, SI(M)

The results from the twenty-three (23) load cases from ME215 analysis are compared to the results from the corresponding ten (10) load cases of ANSYS analyses in Table 7.1 of Section 7.0. ME215/ANSYS stress ratios as high as 2.141 are indicated by the table. These indicate that ME215 provides more conservative local Membrane Stress Intensities SI(M) than ANSYS for all cases except in the load case where three forces of Fx = Fy = Fz = 1000 lbs are applied. In this case, the results of ME215 are slightly less conservative (stress ratio of ME215/ANSYS is 0.950). The results of this comparison are reasonable because:

(1) Local membrane (across wall) stresses decay much slower than bending stress (page 471 of Ref. 8.4). Thus, the element size has little effect on the membrane stress than on the bending stresses.

(2) The pad and pipe wall interact with each other in the normal direction, thus, consideration of the interaction effect in ANSYS (using gap element) reduces local membrane stress, SI(M).

4.1.b Comparison of Membrane Plus Bending Stress Intensity, SI(M+B)

For the load cases evaluated, the higher of the membrane plus bending stresses at pipe or pad weld element from ME215 analysis are compared with the corresponding load cases at pipe element from ANSYS analyses. The results are shown in Table 7.2 of Section 7.0. In general, the ratios of ME215 (enveloped pipe and pad weld)/ ANSYS (pipe) local stresses in the pad-to-pipe juncture area is either

greater than or slightly below unity, for combined forces, and combined moments, when these combined forces, or moments are constituents of equal values. Table 7.2, however indicates that for individual moment components, the ratio varies, with ME215 pad weld results underestimating the local stresses at the pipe based on ANSYS by up to 26.6% for the My direction of moment. ME215 results for the pad weld stress for the other moment directions are consistent with those from ANSYS. It is therefore concluded, that the ME215 results may underestimate the pipe wall stresses if the My component loading dominates those from the other moment direction, Thus, a reconciliation methodology is developed and included in this GENX to provide guidance on reconciliation and use of ME215.

The following discussion pertains to relevant aspects of this comparison:

(1) The effect of the gap on the interaction between the pad and the pipe has greater beneficial results under the circumferential moment loading than those under the longitudinal moment loading because the interacting normal force between the pad and pipe can share the loads more effectively for the circumferential moment loading case than for the longitudinal moment loading case.

(2) The pad size was purposely selected much thicker than the pipe, the beneficial effects of the gap in the ANSYS runs are minimized. In real applications, the ratio of the pad thickness to the pipe wall thickness will be smaller than those use in this GENX.

(3) The membrane plus bending stress intensities, SI(M+B), from ANSYS results are calculated from the element surface and have not been linearized (across solid wall section) while those from ME215 results have. In ME215, the two stress components which exhibit bending characteristics along the class lines (across wall thickness) are linearized. The linearized stresses at discontinuity location, in general, are lower than the corresponding surface (non-linearized) stresses. Therefore, the maximum stress ratios reported in Table 7.2 of Section 7.0 are more conservative than if those stress ratios were based on surface (non-linearized) stresses from ME215 results. In the analysis model considered in this evaluation, one layer is used for the pipe wall elements. For pipe wall made up of one layer, the difference between the linearized stress and the surface stress is minimal.

(4) Since the local stresses calculated per the project criteria are combined stresses which include the local effect and pipe stress (MNS), the combined stress ratios (ME215+MNS/ANSYS+MNS, ME215+MNS/ANSYS) are calculated and shown in Tables 7.1 and 7.2. Stress ratios of combined stresses (ME215+MNS/ ANSYS+MNS) indicate that the maximum difference between the two methods was reduced to 15.6% (as shown in Table 7.2). In fact, the results of both ANSYS and ME215 analyses have already included the effect of pipe stresses (MNS). Therefore, the adequacy of ME215 approach may be demonstrated based on the stress ratios of ME215+MNS/ANSYS as shown in Tables 7.1 and 7.2. It is noted that in this case all stress ratios from moment loading are greater than 1.0, which indicates that the overall ME215 analysis approach (see section 2) is conservative and adequate.

As shown, the ME215 results are, in general, very conservative except under longitudinal moment loading. The stress ratios under longitudinal moment loading are not as conservative as those under other loadings. This underconservatism, is however outweighed by the fact that the analysis approach overaccounts for the MNS. In order to provide additional conservatism for ME215 approach, it is recommended that the results of ME215 be adjusted in accordance with the approach suggested in Section 5.0, when the longitudinal moment load are dominant over torsional or circumferential moment.

4.2 Conclusion

The local membrane stresses from ME215 analysis results under moment loadings are conservative. The contribution of the local stresses from "3 forces" is small compared to those from moments, therefore, the local stresses evaluation for those code equations using ME215 analysis results are valid with no reconciliation required.

The membrane plus bending stresses SI(M+B), from ME215 analysis results are in general reasonably conservative. However, if the contribution from the longitudinal moment loading is dominating, the calculated membrane plus bending stress using ME215 results at the pad weld to represent the piping local stress may be less conservative. To account for the possibility of this unconservatism, the ME215 membrane plus bending stress results should be reconciled in accordance with the method outlined in Section 5.0 of this GENX.

5.0 METHOD OF RECONCILIATION

5.1 IWA local stress evaluations using ME215 analysis need not be reconciled if one of the following conditions exist:

(1) The IWA does not contain a reinforcing pad.

(2) The ME215 analysis results are not used for evaluation of code equations 10 or 11, or if used, the margin to the allowable of Eq. 10 or 11 for pipe or pad weld element is 40% or more (i.e., allowable stress/combined local stress ≥ 1.4).

(3) The reinforcing pad is a wrap around 360 degree pad and the "equivalent pipe model" as described in Section 2.1 is used in the ME215 analysis.

5.2 If the conditions of Section 5.1 above are not met, the ME215 analysis shall be reconciled in accordance with the following procedure (see figure 1 of attachment A):

(1) Calculate modification factor R,

$$R = \sqrt{(R(M_x) \cdot M_{xi})^2 + (R(M_y) \cdot M_{yi})^2 + (R(M_z) \cdot M_{zi})^2} \Big/ \sqrt{(M_{xi})^2 + (M_{yi})^2 + (M_{zi})^2}$$

where:

$R(M_x)$, $R(M_y)$ and $R(M_z)$ are the maximum stress ratios of ANSYS/ME215 results from table 7.2, considering the No. of layers modeled, and the relationship between the weld size and the pipe wall thickness.

The maximum stress ratios for the ¼" pad weld size model shall be used for those IWA's with pad weld sizes greater than or equal to the pipe wall thickness and the 3/16" pad weld size model results shall be used with IWA's pad weld sizes smaller than the pipe wall thickness.

M_x, M_y and M_z are the circumferential, longitudinal and torsional moment loadings in the directions defined by figure 7.1.

(2) If the calculated modification factor R value is less than or equal to one (1.) the ME215 analysis results are conservative, and no reconciliation or further adjustment is necessary. Otherwise continue step (3).

(3) Calculate the modified ME215 membrane plus bending local stress, S, by:

S = S (force) + R * S (moment), where

S (force) and S (moment) are ME215 calculated enveloped maximum membrane plus local bending stresses at pipe and pad weld element under "3 force" and "3 moment" loadings used in the Equation 10 (or 11) evaluations. This modified local stress S shall then be combined with the pipe minimum nominal stress (MNS) in accordance with project procedure to check against the code allowables.

Examples of calculating the modified local stresses for the "3 moment" loading are given in Table 7.3 of Section 7.0. The calculated modified local stresses are compared to the ANSYS results due to the same "3 moment" loading. For the load cases considered in Table 7.3 of Section 7.0 the modified ME215 stresses are all conservative compared to the corresponding ANSYS results. Table 7.3 demonstrates that the modified local stress using this reconciliation method is conservative.

Although the method of reconciliation derived in this generic calculation is only based on limited finite element analysis data, it is, nevertheless, considered to be sufficient for following reasons:

(1) Inherent conservatism in the ME215 analysis method as discussed in Section 2.3.

(2) The geometric parameters used in the GENX analysis models maximize the stresses at the pad-to-pipe-juncture. This is because pad thickness considered is much higher than for pipe wall thickness and its length is such that the distance between the surface of the edge of the attachment and the edge of the pad is less than decay length, $\sqrt{R_p T_p}$.

(3) The local stress calculated per the project criteria are combined stresses which include the local effect and pipe stress (MNS), the stress ratios of combined stresses [(ME215+MNS/ANSYS+MNS)=0.844] indicate that the maximum difference between the two methods was reduced to 15.6%. In fact, the results of both ANSYS and ME215 analyses have already included the effect of pipe stresses (MNS). Therefore, using factor of 1.4 in the reconciliation procedure is sufficient.

6.0 RESULTS OF RECONCILIATION OF EXISTING ME215 ANALYSIS

As of Dec. 24, 1991, a total of twenty-two (22) anchors have been qualified using ME215 analysis method. Among the twenty-two completed analyses, sixteen do not require reconciliation, as they satisfy the conditions of section 5.1 as follows:

- Seven has no pads.
- Two are not used for code equations 10/11 qualification.
- Seven have margins to code equations 10/11 allowables which exceed 40%.

The remaining six analyses are reconciled per Section 5.0 procedure. Refer to Appendix A for the details of the reconciliation. Results of the reconciliation are summarized as follows:

- The calculated modification factor R values for four (4) of the six analyses are less than one (1.0).

- The calculated modified stress S value for the two analyses with an R value which exceeds 1.0, are less than the stress allowables.

Hence, all completed ME215 analysis as of Dec. 24, 1991 are acceptable without a need for revisions to their analyses packages. Future ME215 analysis past Dec. 24, 1991 should document the results including use of the reconciliation method of Section 5.0.

7.0 TABLES AND FIGURES

The Tables 7.1, 7.2, 7.3 and 7.4 and Figures 7.1, 7.2 and 7.3 are presented on the following sheets:

Table 7.1 Membrane Stress Intensity , SI(M) , Comparison

Loads (lb.) (in-lb.)	MNS (psi) [1]	ME215 Analysis				ANSYS Max. Stress SI(M) (psi)	Max. Stress Ratio R ANSYS/ ME215	Stress Ratio of ME215+MNS/ ANSYS+MNS	Stress Ratio of ME215+MNS/ ANSYS	Stress Ratio of ME215/ ANSYS
		Pad Weld Size	Pad Weld No. of Layer	Max. Stress (psi) pad Weld	Max. Stress (psi) pipe					
3 Forces Fx=Fy=Fz =1000	0	1/4"	3	2017	1993	2102	1.042	0.960	0.960	0.960
			2	1957	1996		1.053	0.950	0.950	0.950
	0	3/16"	2	2436	2000	2102	0.863	1.159	1.159	1.159
Mx per 1000	273	1/4"	3	527	432	366	0.695	1.252	2.187	1.439
			2	530	432		0.691	1.257	2.195	1.447
			1	610	426		0.600	1.382	2.413	1.667
	273	3/16"	2	688	446	376	0.347	1.481	2.557	1.828
			1	801	440		0.469	1.655	2.857	2.132
My per 1000	273	1/4"	3	250	229	188	0.752	1.134	2.783	1.330
			2	253	229		0.743	1.141	2.799	1.346
			1	281	230		0.669	1.202	2.948	1.495
	273	3/16"	2	311	231	270	0.868	1.075	2.164	1.152
			1	347	231		0.778	1.142	2.297	1.285
Mz per 1000	273	1/4"	3	268	285	195	0.684	1.192	2.863	1.462
			2	274	285		0.684	1.192	2.863	1.462
			1	315	284		0.619	1.256	3.017	1.615
	273	3/16"	2	343	291	295	0.860	1.084	2.089	1.163
			1	392	289		0.753	1.171	2.255	1.328
3 Moments Mx=1000 My=1000 Mz=1000	473	1/4"	3	803	684	552	0.687	1.245	2.312	1.455
			2	802	684		0.688	1.244	2.310	1.453
			1	912	679		0.605	1.351	2.510	1.652
	473	3/16"	2	1043	702	560	0.537	1.467	2.708	1.862
			1	1200	696		0.467	1.619	2.988	2.141

Note [1] : MNS is the minimum nominal stress which is equal to half of the applied moment(s) devided by the pipe section modulus.

Table 7.2 Membrane Plus Bending Stress Intensity, SI(M+B), Comparison

Loads (lb.) (in-lb.)	MNS (psi) [1]	ME215 Analysis: Pad Weld Size	ME215 Analysis: Pad Weld No. of Layer	ME215 Analysis: Max. Stress (psi) pad Weld	ME215 Analysis: Max. Stress (psi) pipe [2]	ANSYS Max. Stress SI(M+B) (psi)	Max. Stress Ratio R ANSYS/ ME215	Stress Ratio of ME215+MNS/ ANSYS+MNS	Stress Ratio of ME215+MNS/ ANSYS	Stress Ratio of ME215/ ANSYS
3 Forces Fx=Fy=Fz =1000	0	1/4"	3	3217	2166	2904	0.90	1.108	1.108	1.107
			2	2653	2165		1.095	0.914	0.914	0.913
	0	3/16"	2	3249	2201	2952	0.909	1.101	1.101	1.101
Mx per 1000	273	1/4"	3	931	525	583	0.626	1.406	2.066	1.597
			2	826	525		0.706	1.284	1.886	1.417
			1	610	518		0.956	1.032	1.515	1.046
	273	3/16"	2	1043	546	665	0.638	1.403	1.979	1.568
			1	801	538		0.830	1.145	1.615	1.205
My per 1000	273	1/4"	3	345	282	387	1.122	0.936	1.598	0.891
			2	298	282		1.299	0.865	1.476	0.770
			1	281	284		1.363	0.844	1.440	0.734
	273	3/16"	2	352	284	452	1.284	0.862	1.383	0.779
			1	347	285		1.303	0.855	1.372	0.768
Mz per 1000	273	1/4"	3	398	341	398	1.000	1.000	1.687	1.000
			2	334	341		1.167	0.915	1.543	0.857
			1	315	340		1.171	0.914	1.541	0.854
	273	3/16"	2	414	347	475	1.147	0.918	1.447	0.872
			1	392	346		1.212	0.889	1.401	0.825
3 Moments Mx=1000 My=1000 Mz=1000	473	1/4"	3	1396	864	886	0.635	1.375	2.110	1.578
			2	1233	864		0.719	1.255	1.926	1.392
			1	912	854		0.971	1.019	1.564	1.029
	473	3/16"	2	1562	895	869	0.556	1.516	2.342	1.797
			1	1200	886		0.724	1.247	1.926	1.381

Note [1] MNS is the minimum nomical stress which is equal to half of the applied moment(s) devided by the pipe section modulus.

[2] The memberane plus bending stress intensities, SI(M+B), from ME215 analysis are linearized.

Table 7.3 Modified Membrane Plus Bending Stress Intensity , SI(M+B)

Loads (lb.) (in-lb.)	Weld Size	Weld No. of Layer	ME215 Stress Due to Moment	Stress Ratio, R, of ANSYS/ME215 For Each Moment Component			Modi-fied Factor (1)	Modified ME215 Stress (PSI)	ANSYS Stress (PSI)
				R(Mx)	R(My)	R(Mz)			
3 Moment Mx=1000 My=1000 Mz=1000	1/4"	3	1396	0.652	1.122	1.000	0.946	1320	886
		2	1233	0.735	1.299	1.167	1.094	1349	
		1	912	0.995	1.363	1.171	1.186	1082	
	3/16"	2	1562	0.725	1.284	1.147	1.079	1685	869
		1	1200	0.944	1.303	1.212	1.163	1396	
3 Moment Mx=2188 My=5000 Mz=36715	1/4"	3	15931	0.652	1.122	1.000	1.001	15952	15337
		2	13475	0.735	1.299	1.167	1.168	15743	
	3/16"	2	16707	0.725	1.284	1.147	1.148	19187	16514

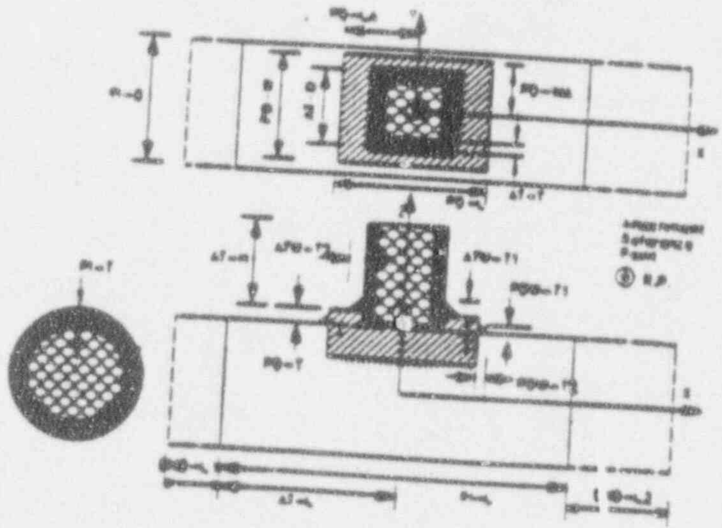
Note (1) Modified Factor = [(R(Mx)*Mx) ^ 2 + (R(My)*My) ^ 2 + (R(Mz)*Mz) ^ 2) ^ 0.5]/(Mx ^ 2 + My ^ 2 + [illegible]z ^ 2) ^ 0.5

Table 7.4 Load Cases Definition in ME215 and ANSYS Analyses

Loads (lb.) (in-lb.)	Pad Weld Size	ME215 Analysis No. of Layers [1]	ME215 Analysis Load Case No.	ANSYS Analysis No. of Layers [1]	ANSYS Analysis Load Case No.
3 Forces Fx=1000 Fy=1000 Fz=1000	1/4"	3	1	1	1
		2	2	1	
	3/16"	2	3	1	2
Mx=1000	1/4"	3	4	1	3
		2	5	1	
		1	6	1	
	3/16"	2	7	1	4
		1	8	1	
My=1000	1/4"	3	9	1	5
		2	10	1	
		1	11	1	
	3/16"	2	12	1	6
		1	13	1	
Mz=1000	1/4"	3	14	1	7
		2	15	1	
		1	16	1	
	3/16"	2	17	1	8
		1	18	1	
3 Moment Mx=1000 My=1000 Mz=1000	1/4"	3	19	1	9
		2	20	1	
		1	21	1	
	3/16"	2	22	1	10
		1	23	1	
3 Moment Mx=2188 My=5000 Mz=36715	1/4"	3	24	1	11
		2	25	1	
	3/16"	2	26	1	12

Note [1] No. of layers are modeled for the pad weld elements.

Figure 7.1 Straight Pipe to Rectangular Attachment, ME215 Model



Pipe:	Outside Diameter	PI-D=3.5"
	Wall	PI-T=0.216"
Attachment:	Length	AT-D=4.0"
	Width	AT-D2=4.0"
	Wall	AT-T=0.5"
Pad:	Length	PD-L=6.0"
	Width	PD-W=7.0"
	Thickness	AT-T=0.75"
Pad Weld Sizes:	1/4" and 3/16"	

Figure 7.2 Side View, ANSYS Model

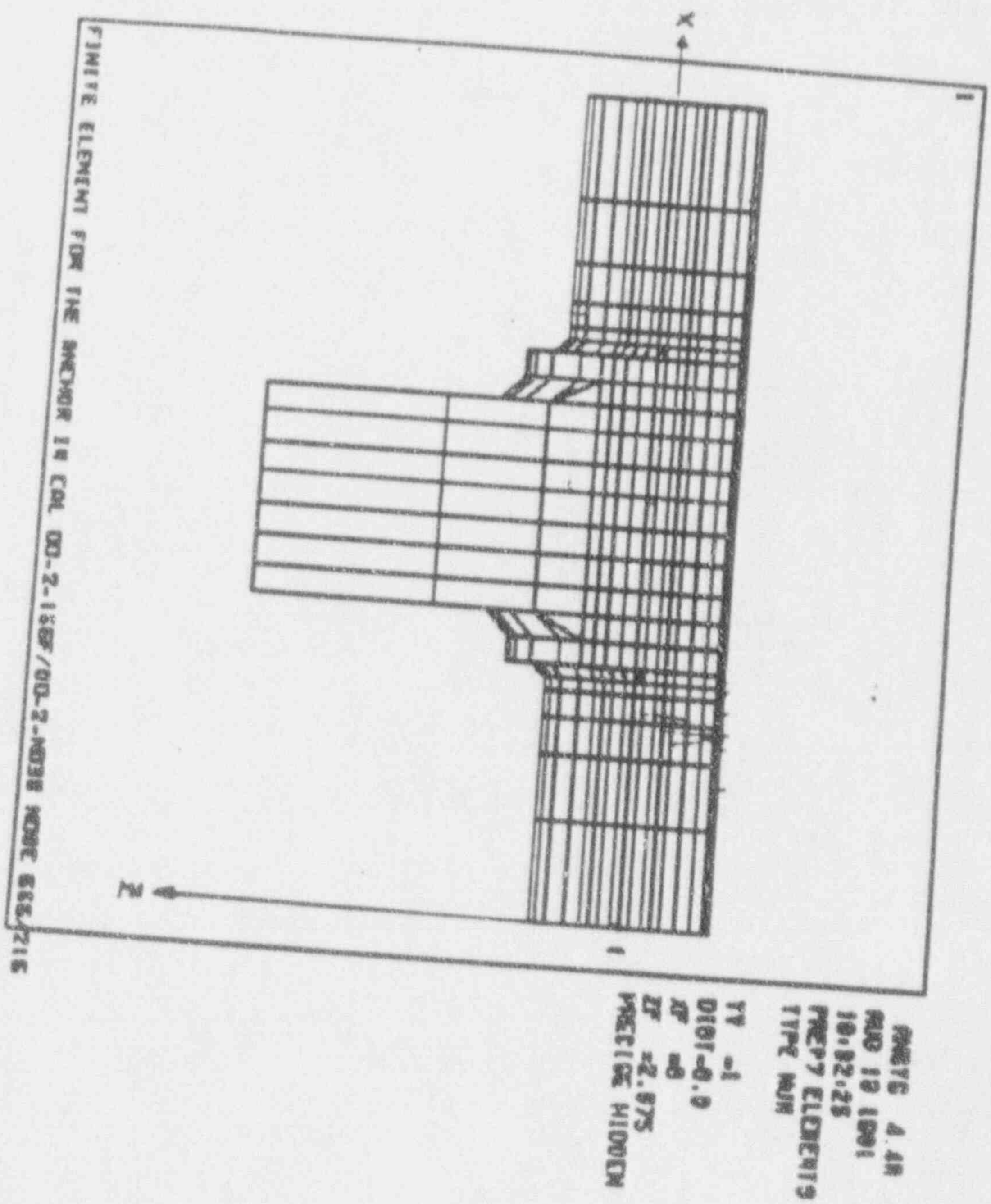
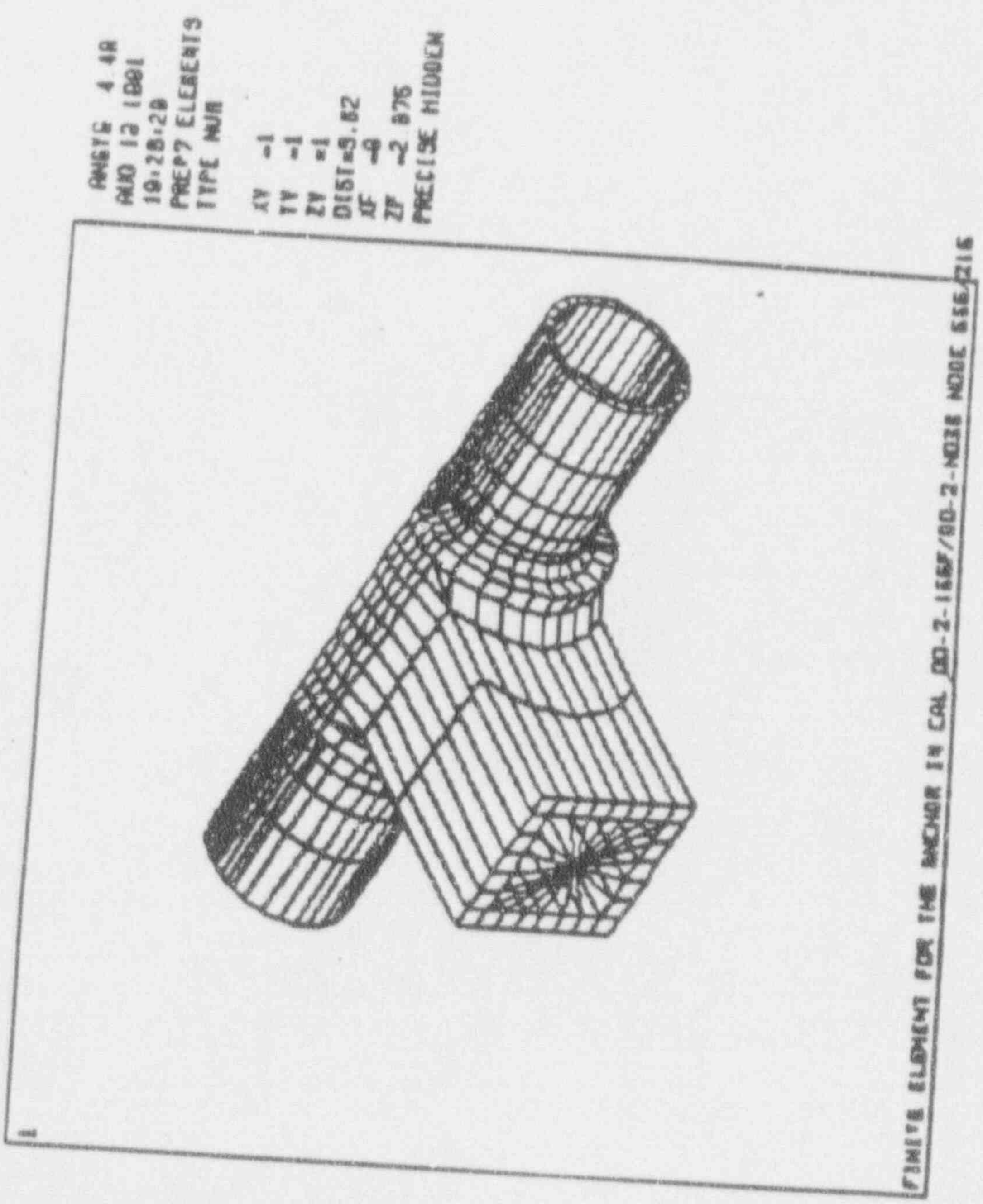


Figure 7.3 Isometric Plot, ANSYS Model



8.0 REFERENCES

8.1 Design Criteria For Pipe Stress and Pipe Supports, 2EP-5.12, 2EP-5.13, Revision 0, TU Electric Comanche Peak Steam Electric Station Unit 2.

8.2 ANSYS Finite Element Computer Program, Version 4.2, 4.3 and 4.4.

8.3 Bechtel Computer Program ME215, Revision 0 - Stress Analysis for Pipe Component and Pipe Support Using Finite Element Method.

8.4 "Theory of Plate and Shell", by S. Timoshenko & S. Woinowsky-Krieger, Second Edition.

8.5 ASME Boiler and Pressure Vessel Code, Section III, Division 1 Nuclear Power Plant Components, Subsection NB, 1974 edition.

ATTACHMENT A (Total No. of Pages: 7)

Reconciliation of Existing ME215 Analyses

Figure (1) illustrates the reconciliation method described in GENX-544. Table (1) lists all of the pipe supports for which an ME215 analysis has been performed to qualify an integral attachment to the associated piping, identified to date. The first query of figure (1), "IWA had pad?" corresponds to the column titled "Pad?" in table (1); the second query of figure (1), "360° Pad and Equivalent Pipe Model ?" corresponds to the next column to right in Table (1) (titled "360 deg. Pad + Eq. Pipe Mod."). The query "Eqn. 10/11 margin" conditional of figure (1) has been subdivided into two columns in table 1.

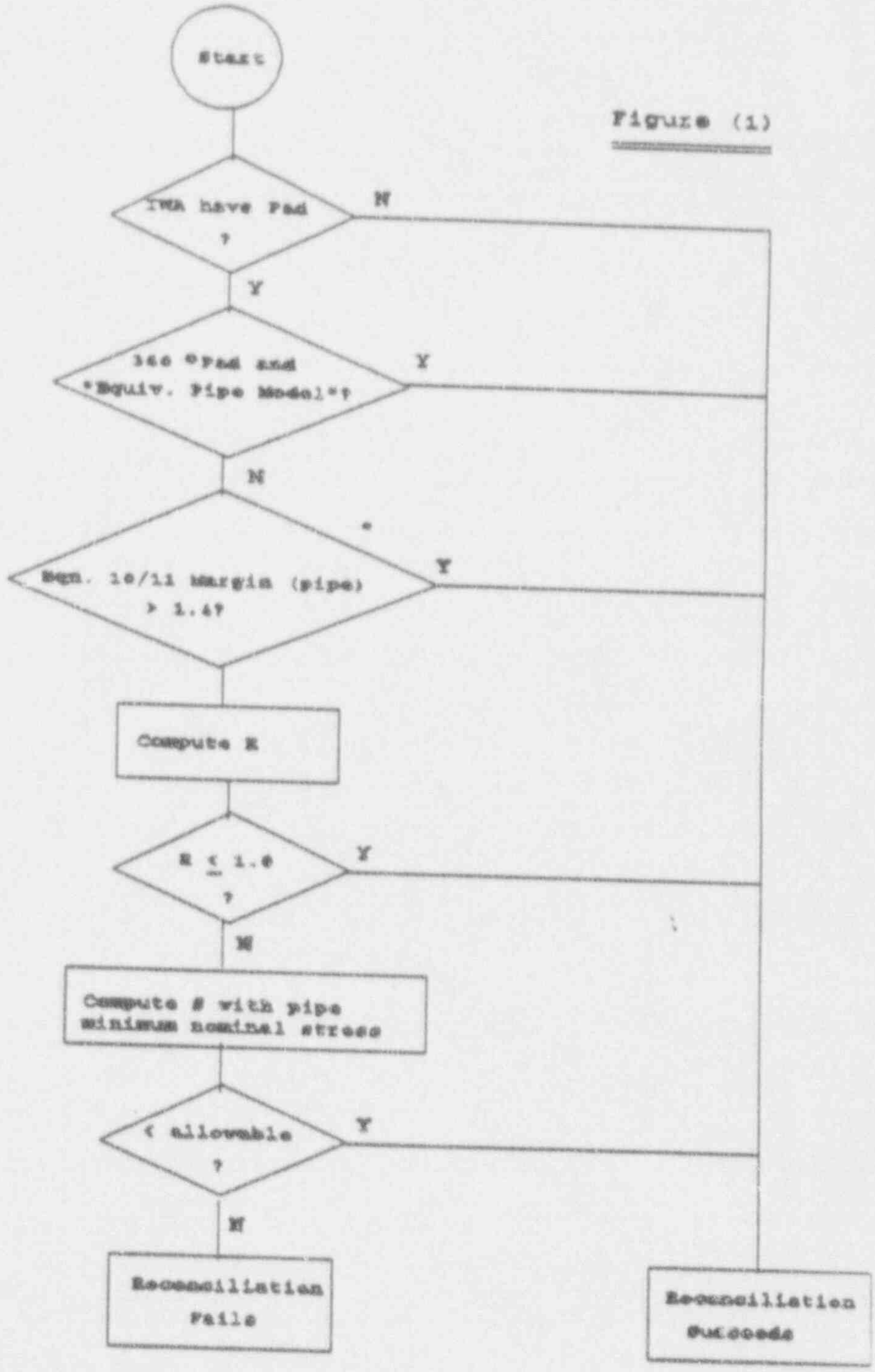
The reconciliation procedure described in GENX-544 provides that if no pad exists at the attachment, the ME215 analysis is reconciled for finite element mesh size without further evaluation (see figure [1]). Therefore, those problems with "N" (i.e., "no") in the column titled "Pad?" in table (1) pass the reconciliation without evaluation of any other attributes as listed in the columns to the right. Similary with the other attributes, if the column with the below titles have the classification listed below the reconciliation passes without need to evaluate other attributes:

Column Title (Table [1])	ME215 Reconciled if
"Pad?"	N
"360 deg. Pad + Eq. Pipe Mod"	Y
"Eqn. 10 or 11 Qual by ME215"	N
"Eqn. 10 or 11 Margin > 40%?"	Y
"R ≤ 1.0?"	Y
"Stress (Pipe) + S < Allow ?"	Y

The results of the reconciliations are shown in the right-most column of table (1); a "P" indicates the ME215 analysis was reconciled for element size concerns, an "F" indicates the opposite.

Logic For Reconciliation of ME215 Analyses

Figure (1)



* Applies to pipe and pad weld only.

TABLE 1

Reconciliation of Comanche Peak ME215 Analyses for Oversize Finite Elements
Representing Pipe and Attachment Welds

Reference: GENX–544,
By: R.C. Wilkinson, 11/15/91

Support No.	Stress Calc #1	Stress Calc #2	Pad?	360 deg. Pad + Eq. Pipe Mod ?	Eqn 10 or 11 Qual by ME215?	Eqn 10 or 11 Margin >40%?	R <= 1.0?	Stress (Pipe) + S < Allow?	Recon. Pass/ fail?
CT–2–026–401–C82A	CT–2–036	CT–2–036	N	--	--	--	--	--	P
AF–2–096–423–S33A	AF–2–010C	AF–2–012B	Y	N	N	--	--	--	P
AF–2–096–424–S33A	AF–2–010A	AF–2–012A	Y	N	Y	Y	--	--	P
H–CC–2–RB–126–01–3	2–5237A		Y	N	Y	Y	--	--	P
CC–2–216–406–C85A	2–0565		Y	N	N	--	--	--	P
FW–2–017–446–C72R	2–007		N(ignor)	--	--	--	--	--	P
CS–2–018–703–S63A	CS–1–NO66	CS–2–NO30	Y	--	--	N	N (R=1.3)	Y	P
DO–2–021–402–D83A	DO–2–167A		Y	N	Y	N	Y (R=0.86)	--	P
DO–2–022–402–D85A	DO–2–167B		Y	N	Y	N	Y (R=0.86)	--	P
DO–2–053–402–D83A	DO–2–167D		Y	N	Y	N	Y (R=0.86)		P
DO–2–086–402–D89A	DO–2–167E		Y	N	Y	N	Y (R=0.88)	--	P
AF–2–100–407–S37A	AF–2–012E	AF–2–010A	N	--	--	--	--	--	P
CT–2–026–401–C82A	CT–2–036	CT–2–036A	N	--	--	--	--	--	P
RH–2–010–401–S22R	RH–2–070		N	--	--	--	--	--	P
SI–2–071–404–S32K	RH–2–069		Y	N	Y	Y	--	--	P
SI–2–071–406–S32K	RH–2–069		Y	N	Y	Y	--	--	P
DO–2–047–700–D08A	DO–2–L169F	DO–2–H069	Y	N	Y	N	N (R=1.3)	Y	P
CT–2–136–408–C72R	CT–2–067X		N	--	--	--	--	--	P
MS–2–191–411–C88R	MS–2–0755		--	--	--	Y	--	--	P
CT–2–069–401–C82A	CT–2–069	CT–2–069A	N	--	--	--	--	--	P
CT–2–042–401–C82A	CT–2–067W		Y	N	--	Y	--	--	P
CT–2–077–404–C82A	CT–2–096A		Y	N	--	Y	--	--	P

CALCULATION SHEET

PROJECT COMANCHE PEAK STEAM ELECTRIC STATION-UNIT 2 JOB NO. 20935

CALC. NO 2-NP-GENX-544

Subject: Reconciliation on Local Stress Evaluation Using ME215 Analysis REV. 0 PAGE A-5

Reply 9/23/91 calcs CS-1-N098 and CS-2-N030

weld size: ¼" > pipe wall use ¼" weld data of Table 7.2 per Sect. 5 of GENX-544
weld layers: 2

Moment Loading (in-lb)	Max. Stress Ratios From Table 7.2
$M_x = 3728$	$R(M_x) = .735$
$M_y = 24619$	$R(M_y) = 1.299$
$M_z = 24619$	$R(M_z) = 1.167$

$R = 1.23$

S (force) = 1039 psi (pipe at ends, elem 763)

S (moment) = 11645 psi (pipe near att., elem 609)

$S = 1039 + 1.23\,(11645) = 15362$ psi

$\sigma_{pipe} = 16531$

$\sigma_{total} = \sigma_{pipe} + S = 16531 + 15362 = 31893$ psi

Allow = 36590 psi OK

CALCULATION SHEET

PROJECT COMANCHE PEAK STEAM ELECTRIC STATION-UNIT 2 JOB NO. 20935

CALC. NO 2-NP-GENX-544

Subject: Reconciliation on Local Stress Evaluation Using ME215 Analysis REV. 0 PAGE A-6

Reply 9/24/91 calcs DO-167A,B,D,E; supports DO-2-021-402-D53A,-022,-053,-056

Moment Loading (in-lb)	Max. Stress Ratios From Table 7.2
M_x = 144252	R (M_x) = 0.830
M_y = 17100	R (M_y) = 1.303
M_z = 3588	R (M_z) = 1.212

weld size: ¼" < pipe wall, use 3/16" weld data per Section 5.0 of GENX-544

weld layers: 1

R = 0.85 < 1.0 OK

Reply 10/10/91 calcs DO-2-L165F, D0-2-N038 CCR 4031

weld size: ¼" > pipe wall use ¼" weld data of Table 7.2 for Sect. 5.0 of GENX-544
weld layers: 2

Moment Loading	Max. Stress Ratios From Table 7.2
$M_x = 2190$	$R(M_x) = 0.706$
$M_y = 36700$	$R(M_y) = 1.299$
$M_z = 4960$	$R(M_z) = 1.167$

$R = 1.295$
S (force) = 2287 psi (pipe at ends, elem 515)
S (moment) = 11457 psi (pad weld, elem 1000)
$S = 2287 + 1.295\,(11457) = 17124$ psi
$\sigma_{pipe} = 13441$
$\sigma_{total} = \sigma_{pipe} + S = 13441 + 17124 = 30565$ psi

Allow = 37500 psi OK

The Responses to NRC's Questions

1) The input data such as geometric model, mesh and loadings are the same for both ANSYS and ME215.

2) Many of the ME215 verification problems were selected from configurations previously analyzed by the ME214 computer program. The table of comparison shown on page 44 of the verification manual is intended only as a demonstration of the differences between the results of ME215, which is finite element based, and the more conservative results of ME214. ME214 uses simplified non finite element methodologies based on ASME code cases, WRC Bulletin No. 107 and other conservative empirical methods as contained in CPSES criteria 2EP-5.12 and 5.13. The ME214 methodologies are recognized and intended to be conservative. ME215 is a finite element analysis computer program and, therefore, provides more realistic results than those from the simplified method of ME214.

3) ME215 is a linear finite element analysis. There is no iteration within mathematic solver. ME215 element library contains quadrilateral element of SAP-IV, 3D solid (brick) element of SOLID-SAP and 3D beam element of SAP-IV. Since SAP is a well established program and used widely by the industry, convergence of the code relative the elements used has been established.

   The ME215 automatically generated element sizes at the critical regions are selected based on the experiences of previous finite element analyses and the industry practice. The selected element size in these regions is approximately equal to the size of the element thickness. The element size at the critical area of the pipe is equal to the pipe wall thickness. Based on Timonsenko's "Theory on Plates and Shells", the local effect will decay within $\sqrt{Rt}$ of the distance (this is supported by ASME Section III), if the size of finite element is less than ½ $\sqrt{Rt}$, it will pick up more than 90% of local effect. The element size equal to the pipe wall thickness is less than ½ $\sqrt{Rt}$ (as shown in the attached table). Therefore, the size of element used in ME215 is adequate and is sufficient to account for local effect.

4) The limitation of ME215 is the configuration of the four standard types of piping attachment. The ME215 can not be executed if the configuration of the welded attachment is not one of these four standard types. Limitations such as problem size, degrees of freedom are dependent on the hardware being used to execute the analysis. Within the four standard configurations, there are no limitations.

5) All applications permitted by ME215 have been benchmarked. The validation problems were microfiched and are attached for review.

e:\rpt5\nrc_ques

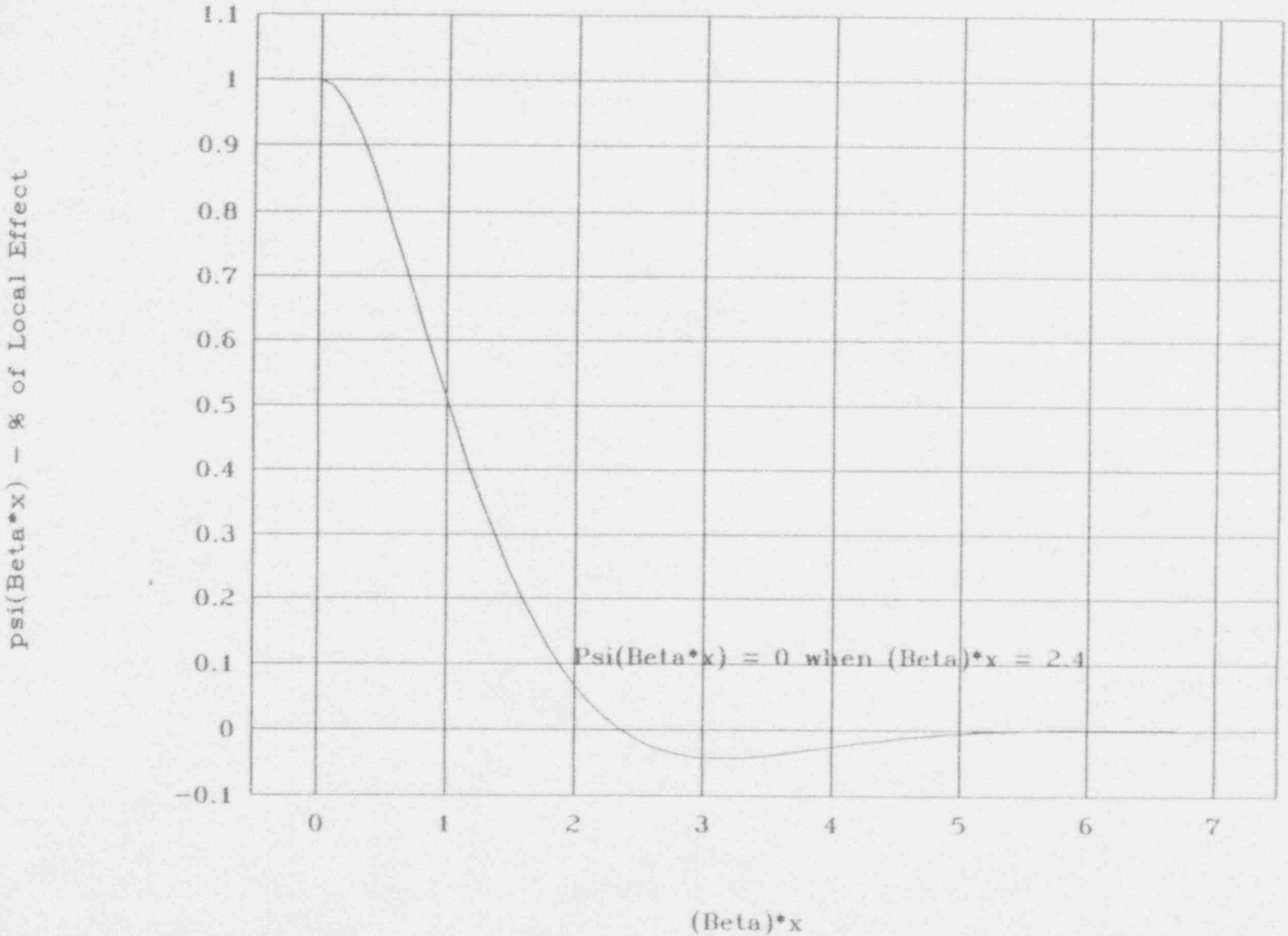
Stress Decay Calculation Based on Timoshenko's Textbook "Theory of Plates And Shells"

Pipe Size	SCH	OD (in)	THI(t) (in)	$\frac{\sqrt{Rt}}{2}$ (in)	(THI)/ $\frac{\sqrt{Rt}}{2}$	Elem Size x (in)		Beta		(Beta)*x		% of Local Effect	
						THI	$\frac{\sqrt{Rt}}{2}$	THI	$\frac{\sqrt{Rt}}{2}$	THI	$\frac{\sqrt{Rt}}{2}$	THI	$\frac{\sqrt{Rt}}{2}$
2 inch	40	2.375	0.154	0.2068	0.7448	0.1540	0.2068	3.1083	3.1083	0.4787	0.6427	95.1%	91.7%
	80	2.375	0.218	0.2424	0.8992	0.2180	0.2424	2.6510	2.6510	0.5779	0.6427	93.1%	91.7%
	160	2.375	0.343	0.2952	1.1621	0.3430	0.2952	2.1774	2.1774	0.7469	0.6427	89.2%	91.7%
4 inch	40	4.500	0.237	0.3554	0.6669	0.2370	0.3554	1.8085	1.8085	0.4286	0.6427	96.0%	91.7%
	80	4.500	0.337	0.4188	0.8047	0.3370	0.4188	1.5347	1.5347	0.5172	0.6427	94.4%	91.7%
	120	4.500	0.437	0.4711	0.9276	0.4370	0.4711	1.3642	1.3642	0.5962	0.6427	92.7%	91.7%
	160	4.500	0.531	0.5133	1.0346	0.5310	0.5133	1.2522	1.2522	0.6649	0.6427	91.2%	91.7%
6 inch	40	6.625	0.280	0.4712	0.5942	0.2800	0.4712	1.3638	1.3638	0.3819	0.6427	96.8%	91.7%
	80	6.625	0.432	0.5783	0.7470	0.4320	0.5783	1.1114	1.1114	0.4801	0.6427	95.1%	91.7%
	120	6.625	0.562	0.6526	0.8611	0.5620	0.6526	0.9848	0.9848	0.5535	0.6427	93.7%	91.7%
	160	6.625	0.718	0.7281	0.9861	0.7180	0.7281	0.8827	0.8827	0.6338	0.6427	91.9%	91.7%
8 inch	40	8.625	0.322	0.5781	0.5570	0.3220	0.5781	1.1118	1.1118	0.3580	0.6427	97.2%	91.7%
	80	8.625	0.500	0.7126	0.7016	0.5000	0.7126	0.9019	0.9019	0.4510	0.6427	95.6%	91.7%
	120	8.625	0.718	0.8424	0.8523	0.7180	0.8424	0.7629	0.7629	0.5478	0.6427	93.8%	91.7%
	160	8.625	0.906	0.9350	0.9690	0.9060	0.9350	0.6874	0.6874	0.6228	0.6427	92.2%	91.7%
10 inch	40	10.750	0.365	0.6883	0.5303	0.3650	0.6883	0.9337	0.9337	0.3408	0.6427	97.4%	91.7%
	80	10.750	0.593	0.8677	0.6834	0.5930	0.8677	0.7407	0.7407	0.4392	0.6427	95.8%	91.7%
	100	10.750	0.718	0.9489	0.7567	0.7180	0.9489	0.6773	0.6773	0.4863	0.6427	95.0%	91.7%
	120	10.750	0.843	1.0217	0.8251	0.8430	1.0217	0.6290	0.6290	0.5303	0.6427	94.1%	91.7%
12 inch	40	12.750	0.406	0.7915	0.5130	0.4060	0.7915	0.8120	0.8120	0.3297	0.6427	97.6%	91.7%
	80	12.750	0.687	1.0178	0.6750	0.6870	1.0178	0.6315	0.6315	0.4338	0.6427	95.9%	91.7%
	100	12.750	0.843	1.1201	0.7526	0.8430	1.1201	0.5738	0.5738	0.4837	0.6427	95.0%	91.7%
	120	12.750	1.000	1.2119	0.8251	1.0000	1.2119	0.5303	0.5303	0.5303	0.6427	94.1%	91.7%
14 inch	40	14.000	0.437	0.8607	0.5077	0.4370	0.8607	0.7467	0.7467	0.3263	0.6427	97.6%	91.7%
	80	14.000	0.750	1.1145	0.6729	0.7500	1.1145	0.5767	0.5767	0.4325	0.6427	96.0%	91.7%
	100	14.000	0.937	1.2369	0.7575	0.9370	1.2369	0.5196	0.5196	0.4869	0.6427	95.0%	91.7%
	120	14.000	1.093	1.3279	0.8231	1.0930	1.3279	0.4840	0.4840	0.5290	0.6427	94.2%	91.7%

Textbook: "Theory of Plates And Shells" , Second Edition, by Timoshenko and Woinowsky-Krieger
Chapter 15 from pp.468-470.

GENERAL STRESS DECAY CURVE

FROM TIMOSHENKO'S TEXTBOOK, CHAPTER 15



AFFIDAVIT

STATE OF TEXAS

CITY OF HOUSTON COUNTY OF HARRIS

David L. Brannen, being first duly sworn, says:

1. I am a Vice President of Bechtel Power Corporation. Bechtel Power Corporation is the owner of information contained in the ME-215 Validation and User and Theory Manuals entitled "Stress Analysis for Pipe Component and Pipe Support Using Finite Element Method" dated April 1991. Bechtel Power Corporation seeks to have these documents withheld from public disclosure.

2. I am making this Affidavit pursuant to the provisions of the Nuclear Regulatory Commission's rules and regulations, including 10 CRF 2.790.

3. I have personal knowledge of the criteria and procedures utilized by Bechtel Power Corporation in determining and designating information as a trade secret, or privileged or confidential commercial or financial information.

   Under that system, information is customarily designated confidential and held in confidence if the release of that information might result in the loss of an existing or potential competitive advantage. Information which falls into one or more of the following categories is designated confidential:

   a. Information which reveals the distinguishing aspects of a process (or component, structure, tool, method, etc.) where prevention of its use by a competitor without license from Bechtel Power Corporation constitutes a competitive economic advantage over other companies.

   b. Information in the form of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), the application of which data secures a competitive economic advantage, e.g. by optimization or improved marketability.

   c. Information which, if available to a competitor would reduce his expenditure or resources or improve his competitive position in the design, manufacture, shipment installation, assurance of quality, or licensing a similar product.

   d. Information concerning cost or price, production capacities, budget levels, or commercial strategies of Bechtel Power Corporation, its customers, or suppliers.

e. Information which reveals aspects of past, present, or future Bechtel Power Corporation or customer funded development plans and programs of potential commercial value to Bechtel Power Corporation.

f. Information which contains patentable ideas or for which patent protection may be desirable.

g. Information relating to an invention.

4. The User and Theory and Validation manuals entitled "Stress Analysis for Pipe Component and Pipe Support using Finite Element Method" are marked "PROPRIETARY" and are transmitted to the Nuclear Regulatory Commission in confidence.

5. The documents contain confidential commercial information relating to computer software developed by Bechtel Power Corporation through the expenditure of substantial amounts of effort and money.

6. The manuals have been held in confidence by Bechtel Power Corporation and have been disclosed only after each proposed recipient of the information has executed an appropriate agreement, if such agreement has been deemed necessary.

7. The information contained in these manuals is not available in public sources and can not be properly acquired without a license from Bechtel Power Corporation, and the information can not be otherwise duplicated by others without a substantial investment of effort and money by them.

8. Because of the substantial investment of both effort and money by Bechtel Power Corporation in conceiving and developing the computer software described in these manuals, it is Bechtel Power Corporation's expectation that this software will substantially enhance its competitive position in the nuclear industry, and therefore Bechtel Power Corporation has a rational basis for holding this information in confidence.

David L. Brannen
David L. Brannen

Subscribed and sworn to before me this 24th day of July, 1992.

Norma Michaelson

Notary Public
My Commission expires

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TUELECTRIC

October 7, 1992

William J. Cahill, Jr.
Group Vice President

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

SUBJECT: COMANCHE PEAK STEAM ELECTRIC STATION (CPSES) - UNIT 2
DOCKET NO. 50-446
REQUEST FOR ADDITIONAL INFORMATION ON ME215
SAPCAS COMPUTER CODE

Gentlemen:

Per your request for permission to ccpy copyright information on the subject computer code, the enclosure is provided for your information.

This enclosure provides BECHTEL's permission to copy the ME-215 User and Theory Manual and the associated validation manual, provided in the referenced letter. Please note that this permission for copying is for internal use only. Please refer to the enclosure for the specifics on copying.

If there are any questions concerning this letter, please call Mr. Carl Corbin at (214) 812-8859.

Sincerely,

William J. Cahill, Jr.

By: [signature]
J. S. Marshall
Generic Licensing Manager

CBC/tg
Enclosure

c - Mr. J. L. Milhoan, Region IV w/o encl
Mr. B. E. Holian, NRR w/enclo
Resident Inspectors, CPSES (2) w/o encl

400 N. Olive Street L.B. 81 Dallas, Texas 75201

Bechtel

Comanche Peak
Steam Electric Station
P.O. Box 1002
Farm Road 56 MZ C07
Glen Rose, Texas 76043

CPSES-9231045
WBS-CG88A
BEC-CCR-0188TR
Subject File 7.21,8.14
September 22, 1992

No Response Required

Mr. R.D. Walker
Manager of Regulatory Affairs
TU Electric
Skyway Tower - L.B. 81
400 N. Olive Street
Dallas, TX 75201

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COMANCHE PEAK STEAM ELECTRIC STATION
CONTRACT NO. C-0001856-7CA
BECHTEL JOB 20935
LRC REVIEW OF ME-215 DOCUMENTATION

Reference: 1. CPSES-9222546 dated July 16, 1992
2. CPSES-9227365 dated August 25, 1992

Dear Mr. Walker:

Reference 1 transmitted the documentation related to Bechtel Computer Code ME-215 for submittal to the NRC. Reference 2 authorized the NRC to copy the copyright version of the documentation for their internal use as required during the review process. The purpose of this letter is to further clarify the authorization provided through reference 2.

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September 22, 1992

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Sincerely,

P. G. Castrichini

P.G. Castrichini C35
Project Engineer

RY
RY/mac

cc: R.W. Braddy C32
T.A. Hope C07
D.M. Rencher C32
M.Z. Khlafallah SFRO