ATTACHMENT 2

Braidwood Station, Unit 1

Lug Stress Calculation for 1MS06007S

Exelon Nuclear

ATTACHMENT 1
Design Analysis Major Revision Cover Sheet
Page 1 of 1

Design Analysis (Major Revision)		**Last Page No.** 18 & A25	(Page i)
Analysis No.: [1]	2009-07204	**Revision:** [2]	0
Title: [3]	Lug Stress Calculation for 1MS06007S		
EC/ECR No.: [4]	376251	**Revision:** [5]	000

		Component(s): [14]	
Station(s): [7]	Braidwood		
Unit No.: [8]	01	1MS06007S	
Discipline: [9]	M		
Descrip. Code/Keyword: [10]			
Safety/QA Class: [11]	SR		
System Code: [12]	MS		
Structure: [13]			

CONTROLLED DOCUMENT REFERENCES [15]

Document No.:	From/To	Document No.:	From/To

Is this Design Analysis Safeguards Information? [16] **Yes** ☐ **No** ☒ If yes, see SY-AA-101-106

Does this Design Analysis contain Unverified Assumptions? [17] **Yes** ☐ **No** ☒ If yes, ATI/AR#:

This Design Analysis SUPERCEDES: [18] NA **in its entirety.**

Description of Revision (list affected pages for partials): [19] Original Issue – S&L performed a finite element analysis on the shear lugs for snubber support 1MS06007S to determine the normal stresses on the flaw plane of the linear indications discovered during A1R14. An Exelon calculation cover sheet and Owner's Review checklist are being attached to the front of the S&L calculation in order to enter it into the Exelon documentation system for future record retrieval purposes.

	Print Name	Sign Name	Date
Preparer: [20]	Chee W. Mak	(See page 1)	07-13-2009

Method of Review: [21] **Detailed Review** ☐ **Alternate Calculations (attached)** ☐ **Testing** ☐

	Print Name	Sign Name	Date
Reviewer: [22]	Phuong H. Hoang	(See page 1)	07-13-2009

Review Notes: [23] Independent review ☒ Peer review ☐

EXELON REVIEWER NOTE - ADMINISTRATIVE CORRECTION - MT VS. UT, 4 PAGES (3, 6, 7, 14). AFM 9-2-09

(For External Analyses Only)

	Print Name	Sign Name	Date
External Approver: [24]	A. A. Dermenjian	(See page 1)	07-13-2009
Exelon Reviewer: [25]	Alan F. Mikottis	A.F. Mikottis	07-14-2009

Independent 3rd Party Review Reqd? [26] **Yes** ☐ **No** ☒

	Print Name	Sign Name	Date
Exelon Approver: [27]	Raymond J. Belair	Raymond J. Belair RJB 09/09/09	07/17/09

ATTACHMENT 2
Owners Acceptance Review Checklist for External Design Analysis
Page 1 of 1

(Page ii)

DESIGN ANALYSIS NO. 2009-07204 **REV:** 0

		Yes	No	N/A
1.	Do assumptions have sufficient rationale?	☒	☐	☐
2.	Are assumptions compatible with the way the plant is operated and with the licensing basis?	☐	☐	☒
3.	Do the design inputs have sufficient rationale?	☒	☐	☐
4.	Are design inputs correct and reasonable?	☒	☐	☐
5.	Are design inputs compatible with the way the plant is operated and with the licensing basis?	☒	☐	☐
6.	Are Engineering Judgments clearly documented and justified?	☒	☐	☐
7.	Are Engineering Judgments compatible with the way the plant is operated and with the licensing basis?	☒	☐	☐
8.	Do the results and conclusions satisfy the purpose and objective of the Design Analysis?	☒	☐	☐
9.	Are the results and conclusions compatible with the way the plant is operated and with the licensing basis?	☒	☐	☐
10.	Does the Design Analysis include the applicable design basis documentation?	☒	☐	☐
11.	Have any limitations on the use of the results been identified and transmitted to the appropriate organizations?	☐	☐	☒
12.	Are there any unverified assumptions?	☐	☒	☐
13.	Do all unverified assumptions have a tracking and closure mechanism in place?	☐	☐	☒
14.	Have all affected design analyses been documented on the Affected Documents List (ADL) for the associated Configuration Change?	☐	☐	☒
15.	Do the sources of inputs **and** analysis methodology used meet current technical requirements and regulatory commitments? (If the input sources **or** analysis methodology are based on an out-of-date methodology or code, additional reconciliation may be required if the site has since committed to a more recent code)	☒	☐	☐
16.	Have vendor supporting technical documents and references (including GE DRFs) been reviewed when necessary?	☐	☐	☒

EXELON REVIEWER: Alan F. Mikottis / [signature] **DATE:** 07-13-09
Print / Sign

ISSUE SUMMARY
Form SOP-0402-07

DESIGN CONTROL SUMMARY

CLIENT:	**Exelon**	UNIT NO.: 1	Page No.: 1
PROJECT NAME:	**Braidwood Station**		
PROJECT NO.:	**11329-121**	☒ NUCLEAR SAFETY- RELATED	
CALC. NO.:	**2009-07204**	☐ NOT NUCLEAR SAFETY-RELATED	
TITLE:	**Lug Stress Calculation for 1MS06007S**		
EQUIPMENT NO.:			

IDENTIFICATION OF PAGES ADDED/REVISED/SUPERSEDED/VOIDED & REVIEW METHOD

Original Issue

INPUTS/ ASSUMPTIONS
☒ VERIFIED
☐ UNVERIFIED

REVIEW METHOD:	Detailed Review	REV.	0
STATUS:	Approved	DATE FOR REV.:	7/13/2009
PREPARER	Chee W. Mak	DATE:	7/13/2009
REVIEWER	Phuong H. Hoang	DATE:	7/13/2009
APPROVER	A. A. Dermenjian	DATE:	7/13/2009

IDENTIFICATION OF PAGES ADDED/REVISED/SUPERSEDED/VOIDED & REVIEW METHOD

INPUTS/ ASSUMPTIONS
☐ VERIFIED
☐ UNVERIFIED

REVIEW METHOD:		REV.	
STATUS:		DATE FOR REV.:	
PREPARER		DATE:	
REVIEWER		DATE:	
APPROVER		DATE:	

IDENTIFICATION OF PAGES ADDED/REVISED/SUPERSEDED/VOIDED & REVIEW METHOD

INPUTS/ ASSUMPTIONS
☐ VERIFIED
☐ UNVERIFIED

REVIEW METHOD:		REV.	
STATUS:		DATE FOR REV.:	
PREPARER		DATE:	
REVIEWER		DATE:	
APPROVER		DATE:	

NOTE: PRINT AND SIGN IN THE SIGNATURE AREAS

TABLE OF CONTENTS

1.0 Purpose and Scope ..... Page 3

2.0 Design Input and Assumptions ..... Page 4

3.0 References ..... Page 6

4.0 Methodology ..... Page 7

5.0 Calculation ..... Page 13

6.0 Results / Conclusion ..... Page 14

ATTACHMENTS:

A ANSYS Input ..... 25 Pages

1.0 PURPOSE AND SCOPE

The purpose of this calculation is to determine the normal stresses on the flaw plane of the linear indications identified by the WesDyne ~~UT~~ MT data Reports (Reference 3.9) on the lugs of support 1MS06007S due to the following loadings: AFM 9-2-09

- Axial Force of 100 kips
- Bending moments of 1,000 in-kips
- Pressure loading of 1,000 psi
- Thermal transient stress due to fluid temperature change of 100°F/hour.

This calculation is applicable for Braidwood Units 1 and 2 provided that the geometry of the lugs and design parameters listed in Section 2 are the same.

2.0 DESIGN INPUT & ASSUMPTIONS

2.1 Input Data:

2.1.1 Per component lug and stanchion schedule drawing, Reference 3.3.2, the lug size is 2.5" thick x 5" wide x 16" long with weld size of 1.5". A total of 8 lugs (4 on the top of the pipe clamp and 4 underneath the pipe clamp) are attached to the MS pipe. The MS pipe OD is 32.75" with thickness of 1.344". The material of the pipe and lug are carbon steel SA-155 Gr. KC65 CL1 (which is equivalent to SA-515 Gr. 65 per ASTM A155, Reference 3.4.1) and SA-515 Gr. 65 respectively. The maximum operating temperature and pressure are 557°F and 1092 psig.

2.1.2 Per Appendix I of ASME Section III code, reference 3.1, the coefficients of Thermal Expansion (α), Thermal Conductivity (K), Density times Specific Heat (ρCp) and Modulus of Elasticity (E) for carbon steel are tabulated in Table 1.

Table 1: Material Properties

Temp.	K	ρCp	α	E
(°F)	(Btu/hr-ft-°F)	(Btu/ft^3-°F)	(in/in/°F*10^{-6})	(psi*10^6)
70	31.50	55.34	6.07	29.90
100	31.00	56.27	6.13	29.81
200	30.00	57.19	6.38	29.50
300	29.10	59.05	6.60	29.00
400	28.10	60.88	6.82	28.30
500	27.20	62.70	7.02	27.40
600	26.20	64.52	7.23	26.70
700	25.30	67.23	7.44	25.40

2.2 Assumptions:

2.2.1 The thermal transient calculation was based on a very conservative heat transfer film coefficient of 4,000 Btu/(hr*ft^2*°F). Thus, no further verification is required.

3.0 REFERENCES

3.1 ASME Section III, Division 1 – 1977 Edition.

3.2 ANSYS Finite Element Analysis, Version 11, Sargent & Lundy SVVR 03.7.596-1101, "ANSYS/Mechanical/CFX-FLO, Version 11", Rev. 0, dated 2/8/08, PC-ANSYS64-1.

3.3 Braidwood Unit 1 Drawings:
- 3.3.1 M-1MS06007S, Sh.s 1 & 2, Rev. F.
- 3.3.2 M-914, Sh. 36, Rev. D.
- 3.3.3 M-536, Sh. 4, Rev. R.

3.4 ASTM code:
- 3.4.1 A155, 1977 Ed.
- 3.4.2 A515, 1977 Ed.

3.5 CC-AA-309-1011, Revision 3, General Station Piping Analysis.

3.6 Heat Transfer, by J. P. Holman, 1989 Edition.

3.7 ASME Steam Tables, Third Edition.

3.8 MathCad Version 11.2 Professional, Sargent & Lundy LLC Program Number 03.7.548-11.2.

3.9 WesDyne ~~UT~~ MT MM 9-2-09 data Reports:
- 3.9.1 A1R14-MT-001, dated 3-31-09.
- 3.9.2 A1R14-MT-003, dated 4-06-09.

4.0 METHODOLOGY

4.1 Finite Element Models:

Based on the pipe and lug dimensions specified in the component lug and stanchion schedule drawing, Reference 3.3.2, Finite Element models shown in Figures 4.1 and 4.2 were generated using ANSYS program, Reference 3.2, for determining the normal stresses on the flaw plane near the lug fillet weld toe for loadings described in Section 4.2. A cross section of the shear lugs on the same plane of the indications identified in WesDyne ~~UT~~ MT data Reports, Reference 3.9, is selected for stress output. This cross section is at the fillet weld toe (1.5" from the pipe surface) and is parallel to the pipe surface.

AFM 9-2-09

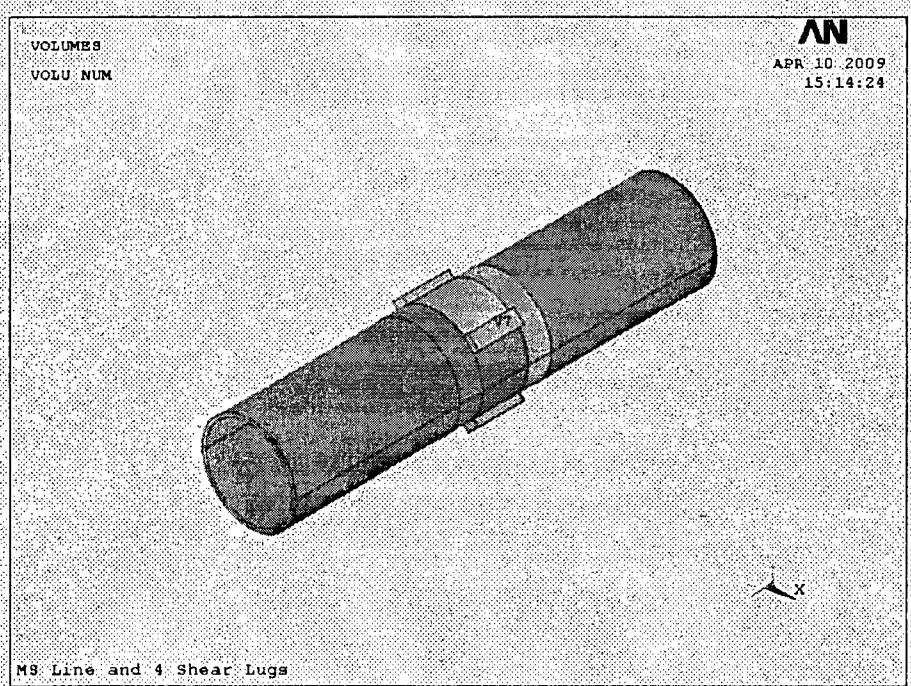

Figure 4.1: Solid Geometry of the FEA Model

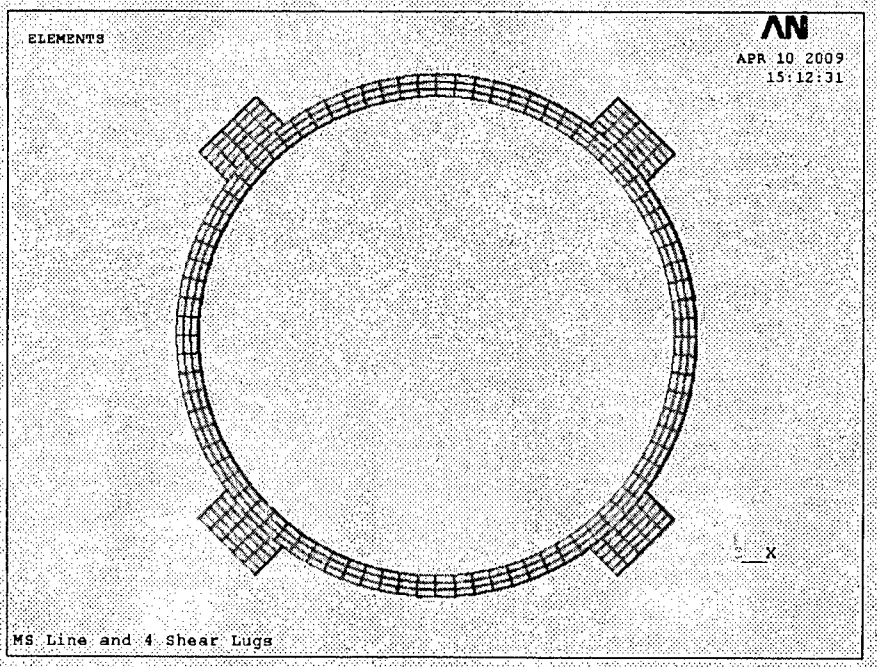

Figure 4.2: MS Pipe Cross Section at Support 1MS06007S

4.2 Description of Load Cases Analyzed:

4.2.1 Axial Force Fa of 100 kips

Unit Load Fa is applied at the top of the vertical pipe model as shown in Figure 4.2.1. This model is constrained at the four welding lugs where the support clamp contact lines (0.5" from the lug top surface).

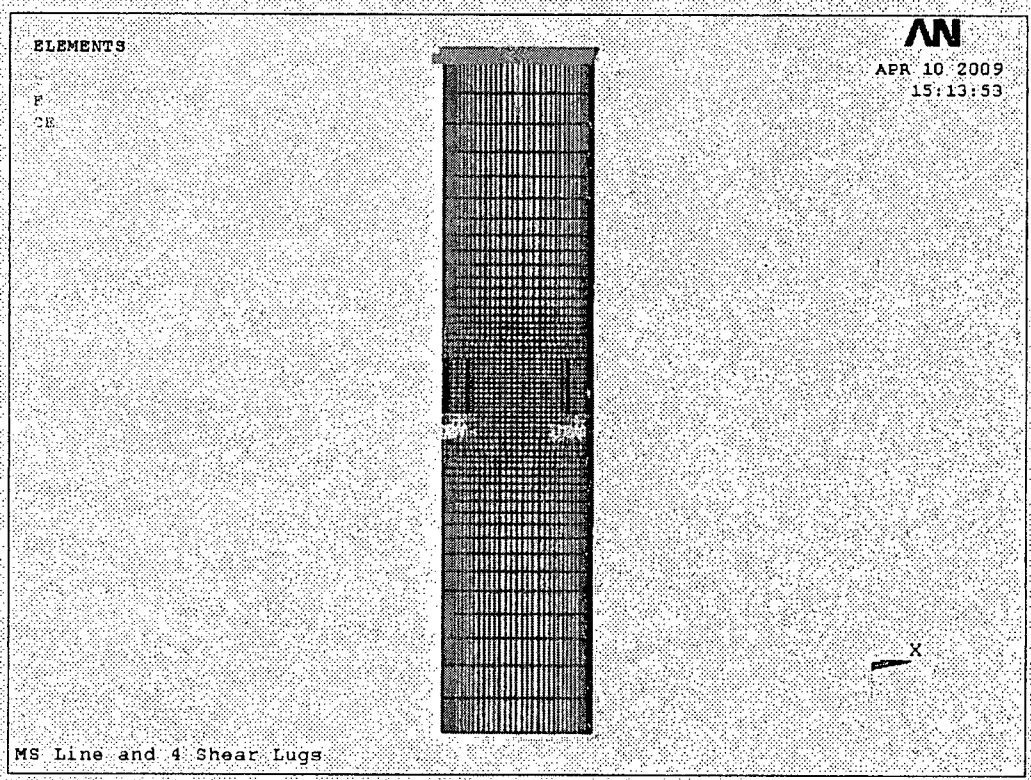

Figure 4.2.1: Axial Load Model

4.2.2 Bending Moments Mb of 1,000 in-kips

Unit Load Mb is applied at the top of the vertical pipe model as shown in Figure 4.2.2. This model is constrained at the bottom of a vertical pipe model instead of at the welding lugs to reflect a bending moment applied to a vertical pipe which is restrained at the center line of the pipe. Note that, if the shear lug is designed to restrain bending moments/pipe rotations, then the lug reaction force due to bending moment should be combined with the lug reaction force due to the pipe axial load in lug stress calculation. In this section, only stress due to pipe bending moment (no lug reaction) is calculated.

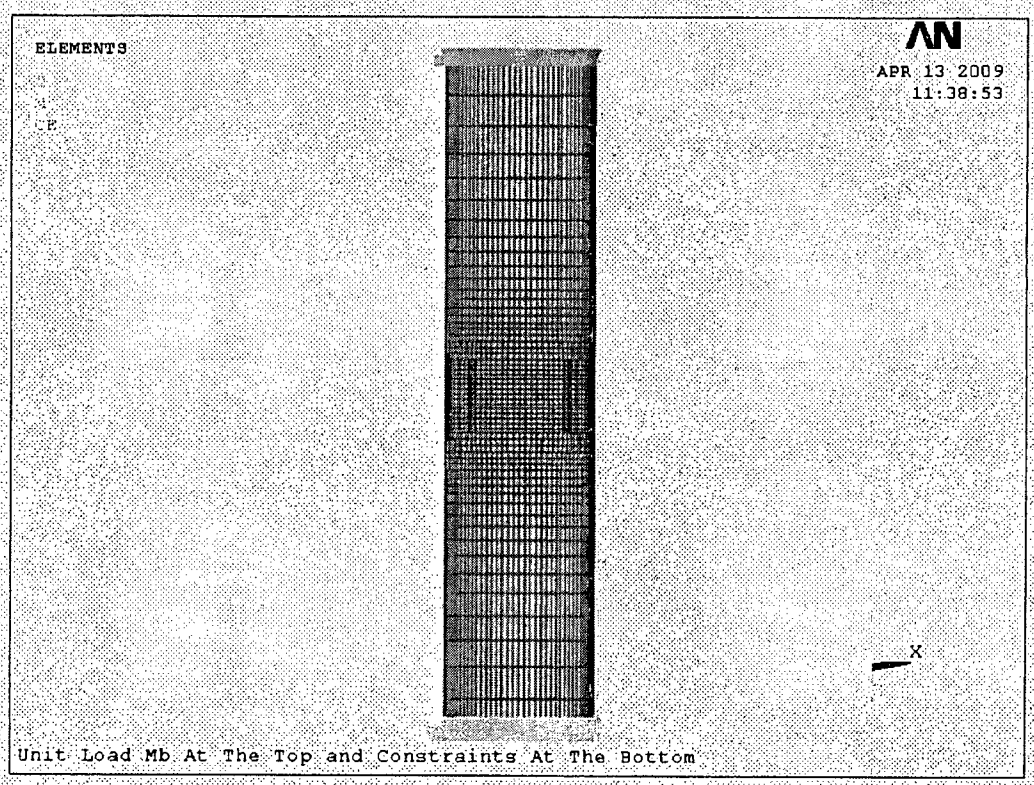

Figure 4.2.2: Bending Moment Model

4.2.3 Pressure Loading P of 1000 psi

Unit pressure loading P is applied on the inner surface of the vertical pipe model as shown in Figure 4.2.3. This model is constrained in vertical direction at the four welding lugs where the support clamp contact lines (0.5" from the lug top surface). Pressure load in piping does not require restraint. However, to avoid rigid body motion, vertical restraints were added. This should not affect the lug stress due to pressure.

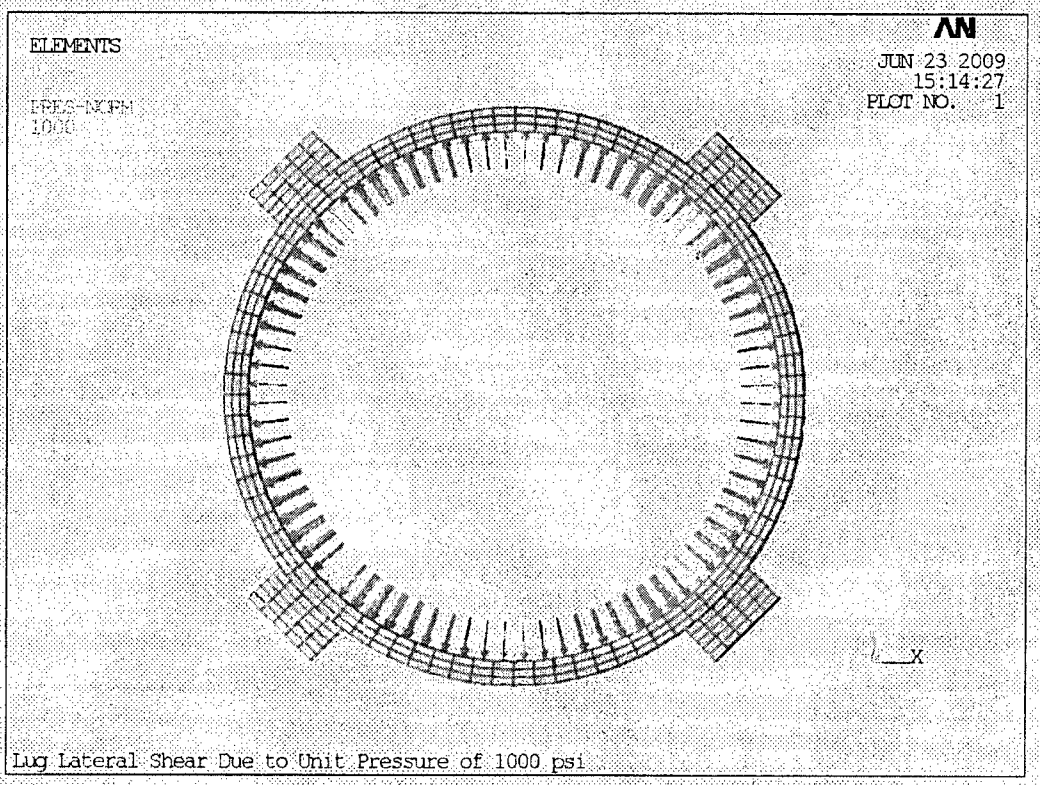

Figure 4.2.3: Pressure Loading Model

4.2.4 Thermal Transient Stress due to Fluid Temperature Change of 100°F/hour

Due to the symmetry of the applied loads on the pipe model only half of the model is used for the thermal analysis. Piping is initially set at 560°F and then cooling off at a rate of 100°F/hr with heat transfer coefficient h of 4,000 Btu/(hr*ft^2*°F) applied on the inner surface of the vertical pipe model as shown in Figure 4.2.4. This model is constrained in the pipe axial direction at one end of pipe and free at the other end. Symmetry boundary condition is applied at the half model.

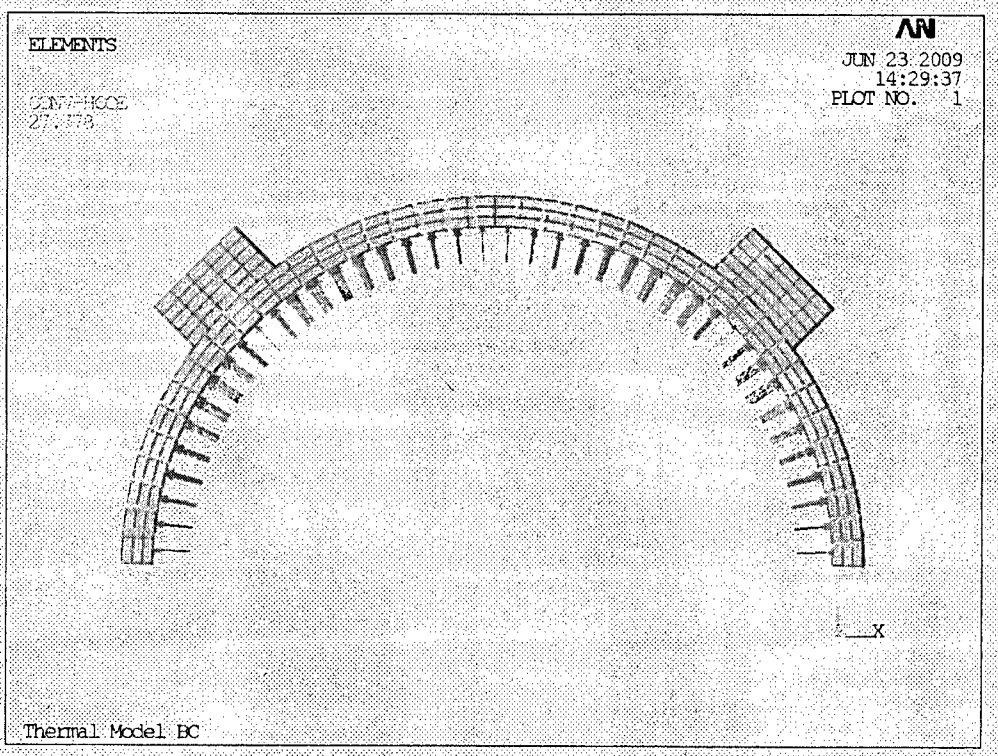

Figure 4.2.4: Thermal Transient Model

4.3 Acceptance Criteria

None.

5.0 CALCULATION

The analyses were performed to determine the normal stresses in the MS support lugs using the methodology stated in Section 4. The analysis input are documented in Attachment A and the the analysis result are discussed in Section 6.

6.0 RESULTS / CONCLUSION

6.1 Results:

A cross section of the shear lugs on the same plane of the laminar flaw identified in WesDyne MT ~~UT~~ data Reports, Reference 3.9, is selected for stress output. This cross section is at the fillet weld toe (1.5" from the pipe surface) and is parallel to the pipe surface. Radial stress or the normal stress to the cross section are extracted from the analysis results and shown in Figures 6.1 to 6.4 respectively for axial loading, bending moment loading, pressure loading and thermal transient loading.

AFM 9-2-09

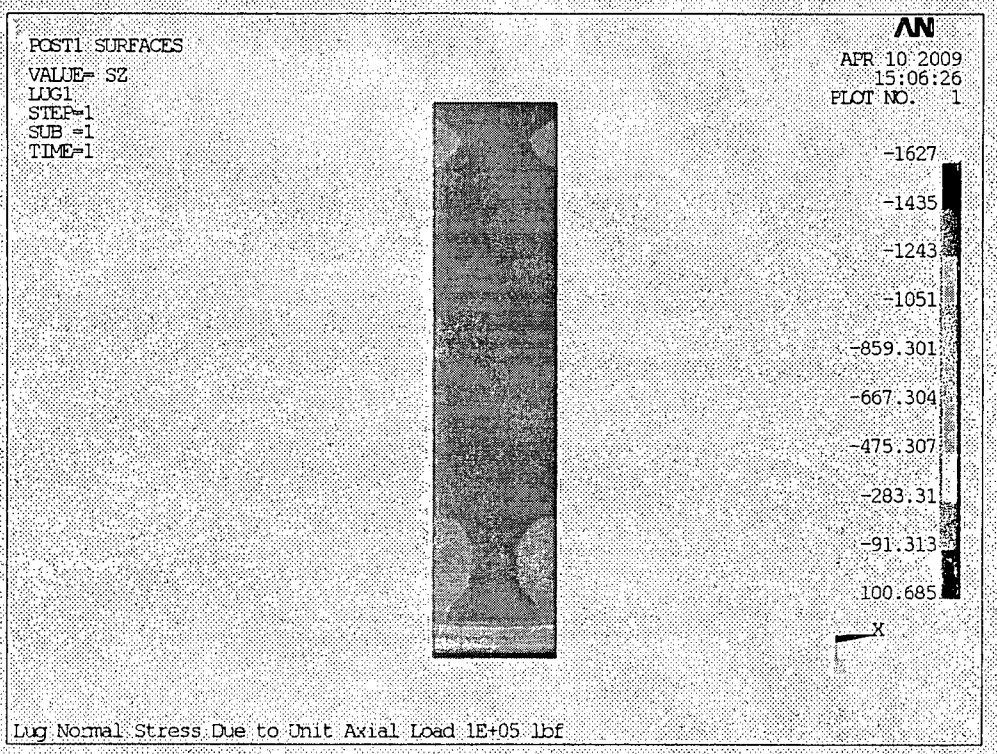

Figure 6.1: Normal Stress on the Flaw Plane Due to Fa of 100 kips

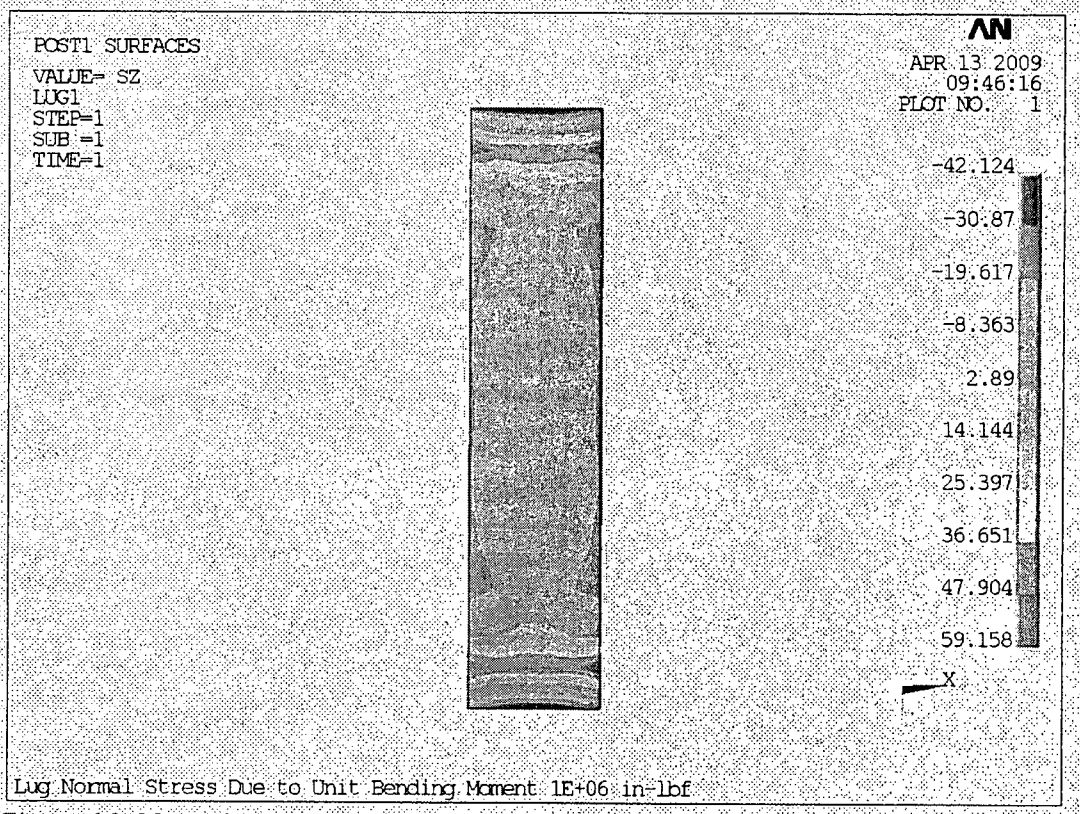

Figure 6.2: Normal Stress on the Flaw Plane Due to Mb = 1,000 in-kips

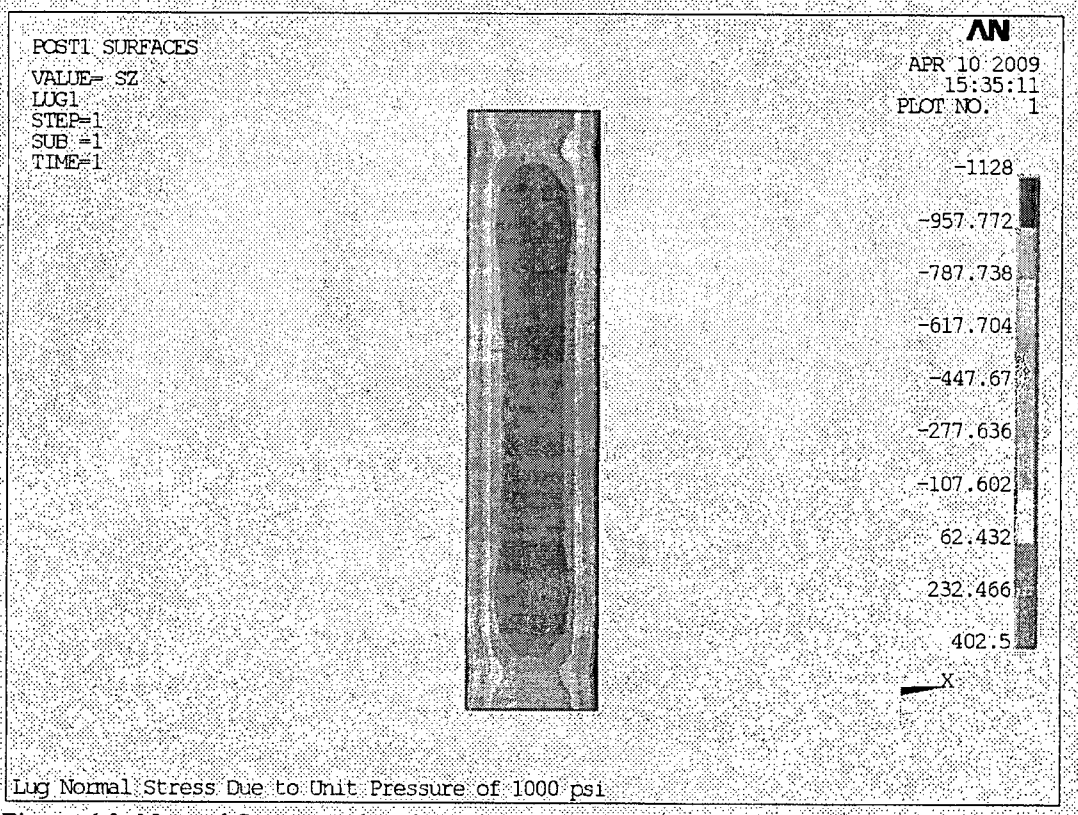

Figure 6.3: Normal Stress on the Flaw Plane Due to Pressure of 1,000 psi

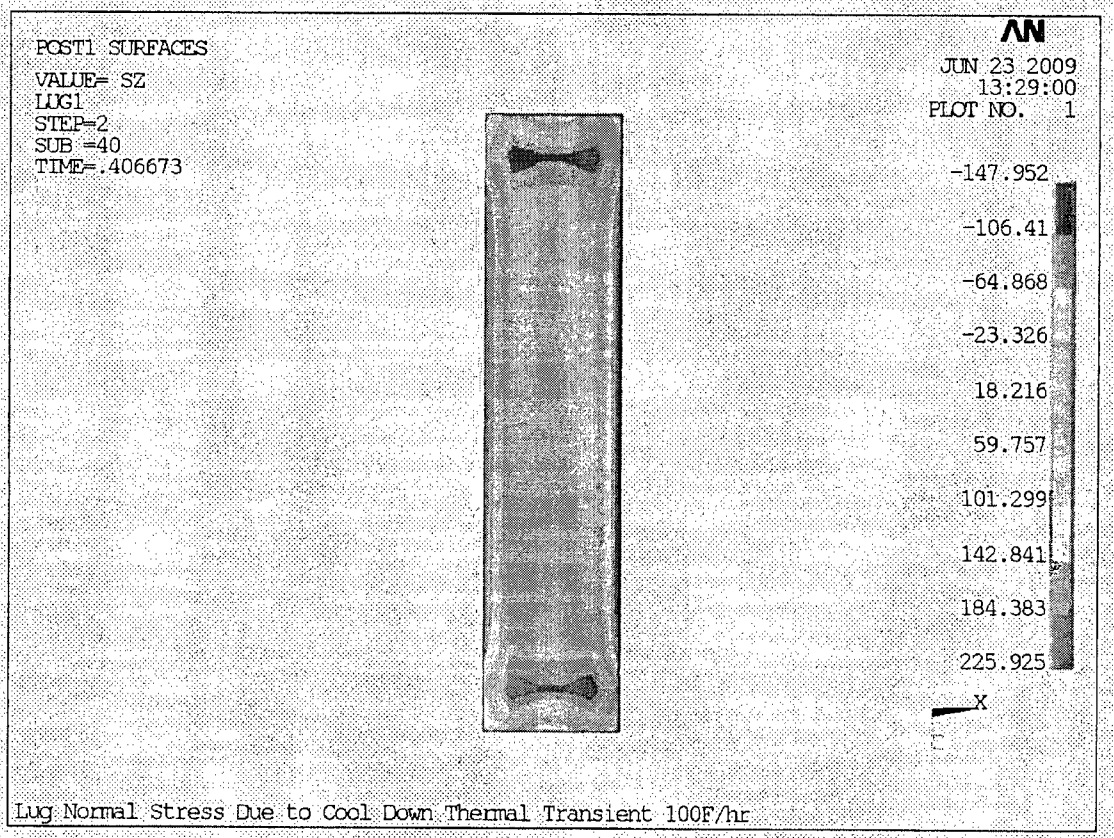

Figure 6.4: Normal Stress on the Flaw Plane Due to Cool Down Thermal Transient 100°F/hr

6.2 Conlusions:

Normal stresses on the flaw plane in the lug at the fillet weld toe are summarized in Table 6.

Note that, if the shear lug is designed to restrain bending moments/pipe rotations, then the lug reaction force due to the bending moment should be combined with the lug reaction force due to the pipe axial load in the lug stress calculation.

Table 6: Stress Summary

Applied Loading	Normal Stress (psi)	Remarks
Axial Force of 100 kips	100.685	Assumes 4 lugs in contact. Double the stress if only assuming 2 lugs in contact, which is normally used for design.
Bending moments of 1,000 in-kips	59.158	Excluding Lug Reaction Force
Pressure loading of 1,000 psi	402.500	
Thermal transient stress	225.925	Due to fluid temperature change of 100°F/hour

Attachment A

ANSYS Input Data Files

File	Date	Time
Lug.txt	4/10/2009	5:03 pm
Lug-1.txt	4/13/2009	4:43 pm
1FAPost1.txt	4/10/2009	5:03 pm
1BendPost1.txt	4/10/2009	5:03 pm
1PPost1.txt	4/10/2009	5:03 pm
1THPost1A.txt	6/23/2009	2:40 pm

Filename: LugS.txt

```
/NOPR   ! Suppress printing of UNDO process
/PMACRO ! Echo following commands to log
FINISH  ! Make sure we are at BEGIN level
/CLEAR,NOSTART  ! Clear model since no SAVE found
/PLOPTS,INFO,3
/PLOPTS,LEG1,1
/PLOPTS,LEG2,1
/PLOPTS,LEG3,1
/PLOPTS,FRAME,1
/PLOPTS,TITLE,1
/PLOPTS,MINM,1
/PLOPTS,FILE,0
/PLOPTS,LOGO,1
/PLOPTS,WINS,1
/PLOPTS,WP,0
/PLOPTS,DATE,2
/TRIAD,RBOT
/REPLOT
/NOPR
/PMETH,OFF,0
KEYW,PR_SET,1
KEYW,PR_STRUC,1
KEYW,PR_THERM,0
KEYW,PR_FLUID,0
KEYW,PR_MULTI,0
/GO


/prep7

ET,1,SOLID185
!*

TREF,70,
temp=550
TUNIF,temp,

!*************************************************
! DEFINE MATERIALS   ************************************************ DEFINE MATERIALS
!*************************************************

! MATERIAL 1: PIPE & REDUCER
MPTEMP,,,,,,,,
MPTEMP,1,0
MPDATA,EX,1,,26.93e6
MPDATA,PRXY,1,,0.3
MPDATA,DENS,1,,0.283/386.4

!*************************************************
! SPECIFY PARAMETERS   ********************************************** SPECIFY PARAMETERS
!*************************************************

OD=32+3/4
PipeTk=1.344
Llug=16
Wlug=5
HLug=2.5
```

```
!*********************************************
! CREATE GEOMETRY   ************************************************* CREATE GEOMETRY
!*********************************************

k,1000,0,0,0
k,1001,0,0,OD/2

CYL4,0,0,OD/2,0,OD/2-PipeTk,180
WPSTYLE,,,,,,,,1
wpro,45.000000,,

SAVE

/PNUM,KP,0
/PNUM,LINE,0
/PNUM,AREA,0
/PNUM,VOLU,1
/PNUM,NODE,0
/PNUM,TABN,0
/PNUM,SVAL,0
/NUMBER,0
!*
/PNUM,ELEM,0
/REPLOT
!*


BLC5,0,0,1.5*OD,Wlug
BLC5,0,0,Wlug,1.5*OD

FLST,2,2,5,ORDE,2
FITEM,2,2
FITEM,2,-3
ASBL,P51X,        1

FLST,2,2,5,ORDE,2
FITEM,2,5
FITEM,2,-6
ADELE,P51X, , ,1

KWPAVE,       14
wpoff,Hlug,0,0

wpro,,,90.000000
ASBW,        4
ADELE,        2, , ,1

KWPAVE,       16
wpoff,0,Hlug,0
wpro,,90.000000,

ASBW,        7
ADELE,        2, , ,1

VOFFST,4,Llug, ,
APLOT
!*
VOFFST,3,Llug, ,
!*
VOFFST,1,Llug, ,
```

```
VOFFST,14,2*OD, ,
VOFFST,1,-2*OD, ,

VADD,ALL

WPCSYS,-1
VSBW,       6
wpoff,0,0,Llug
VSBW,       2
wpoff,0,0,Llug/2
VSBW,       3
wpoff,0,0,-Llug*2
VSBW,       1

FLST,8,3,4
FITEM,8,68
FITEM,8,33
FITEM,8,76
ADRAG,      59, , , , , ,P51X
VSBA,       4,      27
ADELE,      27, , ,1

KWPLAN,-1,    1000,      14,    1001
VSBW,       8

KWPLAN,-1,    1000,      13,    1001
VSBW,       4

KWPLAN,-1,    1000,      15,    1001
VSBW,       9

KWPLAN,-1,    1000,      16,    1001
VSBW,       11

SAVE

!*********************************************
! GENERATE MESH   ************************************************* GENERATE MESH
!*********************************************

! DEFINE NUMBER OF LINE DIVISION

! Pipe thickness
FLST,5,12,4,ORDE,12
FITEM,5,2
FITEM,5,4
FITEM,5,30
FITEM,5,32
FITEM,5,38
FITEM,5,40
FITEM,5,46
FITEM,5,48
FITEM,5,61
FITEM,5,64
FITEM,5,69
FITEM,5,72
CM,_Y,LINE
LSEL, , , ,P51X
CM,_Y1,LINE
CMSEL,,_Y
```

```
!*
LESIZE,_Y1, , ,3, , , , ,1
!*

! From Ext-Lug to outer radial
FLST,5,4,4,ORDE,2
FITEM,5,55
FITEM,5,-58
CM,_Y,LINE
LSEL, , , ,P51X
CM,_Y1,LINE
CMSEL,,_Y
!*
LESIZE,_Y1, , ,8, , , , ,1

! Between lugs
FLST,5,2,4,ORDE,2
FITEM,5,53
FITEM,5,-54
CM,_Y,LINE
LSEL, , , ,P51X
CM,_Y1,LINE
CMSEL,,_Y
!*
LESIZE,_Y1, , ,16, , , , ,1
!*

! From lug to outer axial
FLST,5,12,4,ORDE,8
FITEM,5,50
FITEM,5,-51
FITEM,5,65
FITEM,5,-68
FITEM,5,73
FITEM,5,-76
FITEM,5,80
FITEM,5,-81
CM,_Y,LINE
LSEL, , , ,P51X
CM,_Y1,LINE
CMSEL,,_Y
!*
LESIZE,_Y1, , ,6, , , , ,1
!*



! Lug Width
FLST,5,8,4,ORDE,7
FITEM,5,6
FITEM,5,-8
FITEM,5,14
FITEM,5,-15
FITEM,5,20
FITEM,5,22
FITEM,5,24
CM,_Y,LINE
LSEL, , , ,P51X
CM,_Y1,LINE
CMSEL,,_Y
!*
```

```
LESIZE,_Y1, , ,5, , , , ,1
!*

! Lug Length
FLST,5,8,4,ORDE,4
FITEM,5,16
FITEM,5,-19
FITEM,5,25
FITEM,5,-28
CM,_Y,LINE
LSEL, , , ,P51X
CM,_Y1,LINE
CMSEL,,_Y
!*
LESIZE,_Y1, , ,15, , , , ,1
!*

! Lug Height
FLST,5,8,4,ORDE,5
FITEM,5,5
FITEM,5,9
FITEM,5,-13
FITEM,5,21
FITEM,5,23
CM,_Y,LINE
LSEL, , , ,P51X
CM,_Y1,LINE
CMSEL,,_Y
!*
LESIZE,_Y1, , ,5, , , , ,1
!*

! Pipe ends
FLST,5,8,4,ORDE,8
FITEM,5,1
FITEM,5,29
FITEM,5,41
FITEM,5,-42
FITEM,5,44
FITEM,5,60
FITEM,5,62
FITEM,5,70
CM,_Y,LINE
LSEL, , , ,P51X
CM,_Y1,LINE
CMSEL,,_Y
!*
LESIZE,_Y1, , ,15,0.2, , , ,1
!*
!*
MSHAPE,0,3D
MSHKEY,1
!*
CM,_Y,VOLU
VSEL, , , ,        9
CM,_Y1,VOLU
CHKMSH,'VOLU'
CMSEL,S,_Y
!*
VMESH,_Y1
!*
```

```
CMDELE,_Y
CMDELE,_Y1
CMDELE,_Y2
!*
FLST,5,6,6,ORDE,6
FITEM,5,1
FITEM,5,4
FITEM,5,7
FITEM,5,-8
FITEM,5,10
FITEM,5,12
CM,_Y,VOLU
VSEL, , , ,P51X
CM,_Y1,VOLU
CHKMSH,'VOLU'
CMSEL,S,_Y
!*
VMESH,_Y1
!*
CMDELE,_Y
CMDELE,_Y1
CMDELE,_Y2
!*

FLST,5,2,6,ORDE,2
FITEM,5,5
FITEM,5,-6
CM,_Y,VOLU
VSEL, , , ,P51X
CM,_Y1,VOLU
CHKMSH,'VOLU'
CMSEL,S,_Y
!*
VSWEEP,_Y1
!*
CMDELE,_Y
CMDELE,_Y1
CMDELE,_Y2
!*
FLST,5,2,6,ORDE,2
FITEM,5,2
FITEM,5,-3
CM,_Y,VOLU
VSEL, , , ,P51X
CM,_Y1,VOLU
CHKMSH,'VOLU'
CMSEL,S,_Y
!*
VMESH,_Y1
!*
CMDELE,_Y
CMDELE,_Y1
CMDELE,_Y2

C*** Top Constraint for Applied Load
N, ,0,0,kz(30),,,,
N, ,0,0,kz(30)+1,,,,
!*
!*
ET,2,BEAM4
!*
```

```
R,1,1,1,1,1,1, ,
RMORE, , , , , , ,
Type, 2
Mat,1
Real, 1
E,10937,10938

LoadNode=10937
allsel,all
VSYMM,Y,all, , , ,0,0
NUMMRG,ALL, , , ,LOW
!*
NSEL,S,LOC,Z,kz(29)
CERIG,10937,ALL,ALL, , , ,
allsel,all

C*** Constrains at the lug contact points
FLST,2,24,1,ORDE,16
FITEM,2,1175
FITEM,2,1336
FITEM,2,1405
FITEM,2,-1408
FITEM,2,2295
FITEM,2,2456
FITEM,2,2525
FITEM,2,-2528
FITEM,2,11041
FITEM,2,11202
FITEM,2,11271
FITEM,2,-11274
FITEM,2,19651
FITEM,2,19812
FITEM,2,19881
FITEM,2,-19884
!*
/GO
D,P51X, , , , , ,UX,UY,UZ, , ,
allsel,all
!*
/GO
D,P51X, ,0, , , ,UZ, , , , ,
SAVE
FINISH
```

Filename: Lug-1.txt

```
/NOPR   ! Suppress printing of UNDO process
/PMACRO ! Echo following commands to log
FINISH  ! Make sure we are at BEGIN level
/CLEAR,NOSTART  ! Clear model since no SAVE found
/PLOPTS,INFO,3
/PLOPTS,LEG1,1
/PLOPTS,LEG2,1
/PLOPTS,LEG3,1
/PLOPTS,FRAME,1
/PLOPTS,TITLE,1
/PLOPTS,MINM,1
/PLOPTS,FILE,0
/PLOPTS,LOGO,1
/PLOPTS,WINS,1
```

```
/PLOPTS,WP,0
/PLOPTS,DATE,2
/TRIAD,RBOT
/REPLOT
/NOPR
/PMETH,OFF,0
KEYW,PR_SET,1
KEYW,PR_STRUC,1
KEYW,PR_THERM,0
KEYW,PR_FLUID,0
KEYW,PR_MULTI,0
/GO


/prep7

ET,1,SOLID5                    ! SOLID5 UX,UY,UZ,TEMP DOF SET
!*

TREF,70,
temp=550
TUNIF,temp,
*SET,DenSTL,0.283
*SET,FFcc,(144*12*DenSTL)

!***********************************************
! DEFINE MATERIALS   ************************************************ DEFINE MATERIALS
!***********************************************

!* Carbon Steel
!*
MPTEMP,1,0
MPDATA,PRXY,1,,.3
MPDATA,DENS,1,,DenSTL
MPTEMP,,,,,,,,
MPTEMP,1,70
MPTEMP,2,100
MPTEMP,3,200
MPTEMP,4,300
MPTEMP,5,400
MPTEMP,6,500
MPTEMP,7,600
MPTEMP,8,700
MPDATA,KXX,1,,31.5/12            !BTU/hr-in-F
MPDATA,KXX,1,,31.0/12
MPDATA,KXX,1,,30.0/12
MPDATA,KXX,1,,29.1/12
MPDATA,KXX,1,,28.1/12
MPDATA,KXX,1,,27.2/12
MPDATA,KXX,1,,26.2/12
MPDATA,KXX,1,,25.3/12
!*
MPDATA,C,1,,55.34/(FFcc)     !BTU/in^3-F
MPDATA,C,1,,56.27/(FFcc)
MPDATA,C,1,,57.19/(FFcc)
MPDATA,C,1,,59.05/(FFcc)
MPDATA,C,1,,60.88/(FFcc)
MPDATA,C,1,,62.70/(FFcc)
MPDATA,C,1,,64.52/(FFcc)
MPDATA,C,1,,67.23/(FFcc)
!*
```

```
MPDATA,EX,1,,29.90E+6                ! For > .3%C
MPDATA,EX,1,,29.81E+6
MPDATA,EX,1,,29.50E+6
MPDATA,EX,1,,29.00E+6
MPDATA,EX,1,,28.30E+6
MPDATA,EX,1,,27.40E+6
MPDATA,EX,1,,26.70E+6
MPDATA,EX,1,,25.40E+6
!*
MPDATA,ALPX,1,,6.07E-6
MPDATA,ALPX,1,,6.13E-6
MPDATA,ALPX,1,,6.38E-6
MPDATA,ALPX,1,,6.60E-6
MPDATA,ALPX,1,,6.82E-6
MPDATA,ALPX,1,,7.02E-6
MPDATA,ALPX,1,,7.23E-6
MPDATA,ALPX,1,,7.44E-6

!*************************************************
! SPECIFY PARAMETERS   ********************************************** SPECIFY PARAMETERS
!*************************************************

OD=32+3/4
PipeTk=1.344
Llug=16
Wlug=5
HLug=2.5
ID=OD/2-PipeTk
!*************************************************
! CREATE GEOMETRY   ************************************************** CREATE GEOMETRY
!*************************************************

k,1000,0,0,0
k,1001,0,0,OD/2

CYL4,0,0,OD/2,0,OD/2-PipeTk,180
WPSTYLE,,,,,,,,1
wpro,45.000000,,

SAVE

/PNUM,KP,0
/PNUM,LINE,0
/PNUM,AREA,0
/PNUM,VOLU,1
/PNUM,NODE,0
/PNUM,TABN,0
/PNUM,SVAL,0
/NUMBER,0
!*
/PNUM,ELEM,0
/REPLOT
!*


BLC5,0,0,1.5*OD,Wlug
BLC5,0,0,Wlug,1.5*OD

FLST,2,2,5,ORDE,2
FITEM,2,2
FITEM,2,-3
```

```
ASBL,P51X,        1

FLST,2,2,5,ORDE,2
FITEM,2,5
FITEM,2,-6
ADELE,P51X, , ,1

KWPAVE,       14
wpoff,Hlug,0,0

wpro,,,90.000000
ASBW,        4
ADELE,        2, , ,1

KWPAVE,       16
wpoff,0,Hlug,0
wpro,,90.000000,

ASBW,        7
ADELE,        2, , ,1

VOFFST,4,Llug, ,
APLOT
!*
VOFFST,3,Llug, ,
!*
VOFFST,1,Llug, ,

VOFFST,14,2*OD, ,
VOFFST,1,-2*OD, ,

VADD,ALL

WPCSYS,-1
VSBW,        6
wpoff,0,0,Llug
VSBW,        2
wpoff,0,0,Llug/2
VSBW,        3
wpoff,0,0,-Llug*2
VSBW,        1

FLST,8,3,4
FITEM,8,68
FITEM,8,33
FITEM,8,76
ADRAG,       59, , , , , ,P51X
VSBA,        4,       27
ADELE,       27, , ,1

KWPLAN,-1,     1000,       14,     1001
VSBW,        8

KWPLAN,-1,     1000,       13,     1001
VSBW,        4

KWPLAN,-1,     1000,       15,     1001
VSBW,        9

KWPLAN,-1,     1000,       16,     1001
VSBW,        11
```

```
SAVE

!*************************************************
! GENERATE MESH   ************************************************** GENERATE MESH
!*************************************************

! DEFINE NUMBER OF LINE DIVISION

! Pipe thickness
FLST,5,12,4,ORDE,12
FITEM,5,2
FITEM,5,4
FITEM,5,30
FITEM,5,32
FITEM,5,38
FITEM,5,40
FITEM,5,46
FITEM,5,48
FITEM,5,61
FITEM,5,64
FITEM,5,69
FITEM,5,72
CM,_Y,LINE
LSEL, , , ,P51X
CM,_Y1,LINE
CMSEL,,_Y
!*
LESIZE,_Y1, , ,3, , , , ,1
!*

! From Ext-Lug to outer radial
FLST,5,4,4,ORDE,2
FITEM,5,55
FITEM,5,-58
CM,_Y,LINE
LSEL, , , ,P51X
CM,_Y1,LINE
CMSEL,,_Y
!*
LESIZE,_Y1, , ,8, , , , ,1

! Between lugs
FLST,5,2,4,ORDE,2
FITEM,5,53
FITEM,5,-54
CM,_Y,LINE
LSEL, , , ,P51X
CM,_Y1,LINE
CMSEL,,_Y
!*
LESIZE,_Y1, , ,16, , , , ,1
!*

! From lug to outer axial
FLST,5,12,4,ORDE,8
FITEM,5,50
FITEM,5,-51
FITEM,5,65
FITEM,5,-68
FITEM,5,73
```

```
FITEM,5,-76
FITEM,5,80
FITEM,5,-81
CM,_Y,LINE
LSEL, , , ,P51X
CM,_Y1,LINE
CMSEL,,_Y
!*
LESIZE,_Y1, , ,6, , , , ,1
!*


! Lug Width
FLST,5,8,4,ORDE,7
FITEM,5,6
FITEM,5,-8
FITEM,5,14
FITEM,5,-15
FITEM,5,20
FITEM,5,22
FITEM,5,24
CM,_Y,LINE
LSEL, , , ,P51X
CM,_Y1,LINE
CMSEL,,_Y
!*
LESIZE,_Y1, , ,5, , , , ,1
!*

! Lug Length
FLST,5,8,4,ORDE,4
FITEM,5,16
FITEM,5,-19
FITEM,5,25
FITEM,5,-28
CM,_Y,LINE
LSEL, , , ,P51X
CM,_Y1,LINE
CMSEL,,_Y
!*
LESIZE,_Y1, , ,15, , , , ,1
!*

! Lug Height
FLST,5,8,4,ORDE,5
FITEM,5,5
FITEM,5,9
FITEM,5,-13
FITEM,5,21
FITEM,5,23
CM,_Y,LINE
LSEL, , , ,P51X
CM,_Y1,LINE
CMSEL,,_Y
!*
LESIZE,_Y1, , ,5, , , , ,1
!*

! Pipe ends
FLST,5,8,4,ORDE,8
```

```
FITEM,5,1
FITEM,5,29
FITEM,5,41
FITEM,5,-42
FITEM,5,44
FITEM,5,60
FITEM,5,62
FITEM,5,70
CM,_Y,LINE
LSEL, , , ,P51X
CM,_Y1,LINE
CMSEL,,_Y
!*
LESIZE,_Y1, , ,15,0.2, , , ,1
!*
!*
MSHAPE,0,3D
MSHKEY,1
!*
CM,_Y,VOLU
VSEL, , , ,        9
CM,_Y1,VOLU
CHKMSH,'VOLU'
CMSEL,S,_Y
!*
VMESH,_Y1
!*
CMDELE,_Y
CMDELE,_Y1
CMDELE,_Y2
!*
FLST,5,6,6,ORDE,6
FITEM,5,1
FITEM,5,4
FITEM,5,7
FITEM,5,-8
FITEM,5,10
FITEM,5,12
CM,_Y,VOLU
VSEL, , , ,P51X
CM,_Y1,VOLU
CHKMSH,'VOLU'
CMSEL,S,_Y
!*
VMESH,_Y1
!*
CMDELE,_Y
CMDELE,_Y1
CMDELE,_Y2
!*

FLST,5,2,6,ORDE,2
FITEM,5,5
FITEM,5,-6
CM,_Y,VOLU
VSEL, , , ,P51X
CM,_Y1,VOLU
CHKMSH,'VOLU'
CMSEL,S,_Y
!*
VSWEEP,_Y1
```

```
!*
CMDELE,_Y
CMDELE,_Y1
CMDELE,_Y2
!*
FLST,5,2,6,ORDE,2
FITEM,5,2
FITEM,5,-3
CM,_Y,VOLU
VSEL, , , ,P51X
CM,_Y1,VOLU
CHKMSH,'VOLU'
CMSEL,S,_Y
!*
VMESH,_Y1
!*
CMDELE,_Y
CMDELE,_Y1
CMDELE,_Y2

FLST,5,9,5,ORDE,9
FITEM,5,15
FITEM,5,23
FITEM,5,35
FITEM,5,40
FITEM,5,50
FITEM,5,53
FITEM,5,-54
FITEM,5,58
FITEM,5,61
ASEL,S, , ,P51X
CM,HFACE,AREA
```

Filename: 1FAPost1.txt

```
/INPUT,'lugS','txt'
/SOL
!*
ANTYPE,0
C*** Unit load of 1E6 in-lbf

F,10937,FZ,100000
SOLVE
FINISH
/POST1
SET,1
NWPLAN,-1,   19811,   19652,   19806
SUCR,Lug1,CPLANE,40,
CSWPLA,11,1,1,1,
!*
RSYS,11

SUMAP,sz,S,Z
SUMAP,Syz,S,YZ
SUMAP,Sxz,S,XZ

/RGB,INDEX,100,100,100, 0
/RGB,INDEX, 80, 80, 80,13
```

```
/RGB,INDEX, 60, 60, 60,14
/RGB,INDEX, 0, 0, 0,15
/REPLOT
!*
/SHOW,PNG
PNGR,COMP,1,-1
PNGR,ORIENT,HORIZ
PNGR,COLOR,2
PNGR,TMOD,1
/GFILE,800,
/VIEW,1,,1
/UDOC,1,CNTR,RIGH

SET,FIRST
/TITLE,Lug Normal Stress Due to Unit Axial Load 1E+05 lbf
SUPL,LUG1,SZ,0
/TITLE,Lug Vertical Shear Due to Unit Axial Load 1E+05 lbf
SUPL,LUG1,SYZ,0
/TITLE,Lug Lateral Shear Due to Unit Axial Load 1E+05 lbf
SUPL,LUG1,SXZ,0
/SHOW,CLOSE
/DEVICE,VECTOR,0
/RGB,INDEX, 0, 0, 0, 0
/RGB,INDEX, 60, 60, 60,13
/RGB,INDEX, 80, 80, 80,14
/RGB,INDEX,100,100,100,15
/REPLOT

!*
```

Filename: 1BendPost1.txt

```
/INPUT,'lugS','txt'
/SOL
!*
ANTYPE,0
C*** Unit load of 1E6 in-lbf

F,10937,MY,707000
F,10937,MX,707000
SOLVE
FINISH
/POST1
SET,1
NWPLAN,-1,   19811,   19652,   19806
SUCR,Lug1,CPLANE,40,
CSWPLA,11,1,1,1,
!*
RSYS,11

SUMAP,sz,S,Z
SUMAP,Syz,S,YZ
SUMAP,Sxz,S,XZ

/RGB,INDEX,100,100,100, 0
/RGB,INDEX, 80, 80, 80,13
/RGB,INDEX, 60, 60, 60,14
/RGB,INDEX, 0, 0, 0,15
/REPLOT
```

```
!*
/SHOW,PNG
PNGR,COMP,1,-1
PNGR,ORIENT,HORIZ
PNGR,COLOR,2
PNGR,TMOD,1
/GFILE,800,
/VIEW,1,,1
/UDOC,1,CNTR,RIGH

SET,FIRST
/TITLE,Lug Normal Stress Due to Unit Bending Moment 1E+06 in-lbf
SUPL,LUG1,SZ,0
/TITLE,Lug Vertical Shear Due to Unit Bending Moment 1E+06 in-lbf
SUPL,LUG1,SYZ,0
/TITLE,Lug Lateral Shear Due to Unit Bending Moment 1E+06 in-lbf
SUPL,LUG1,SXZ,0
/SHOW,CLOSE
/DEVICE,VECTOR,0
/RGB,INDEX, 0, 0, 0, 0
/RGB,INDEX, 60, 60, 60,13
/RGB,INDEX, 80, 80, 80,14
/RGB,INDEX,100,100,100,15
/REPLOT

!*
```

Filename: 1PPost1.txt

```
/INPUT,'lugS','txt'
/SOL
!*
ANTYPE,0
C*** Unit load of 1000 psi
FLST,2,18,5,ORDE,17
FITEM,2,15
FITEM,2,23
FITEM,2,35
FITEM,2,40
FITEM,2,50
FITEM,2,53
FITEM,2,-54
FITEM,2,58
FITEM,2,61
FITEM,2,67
FITEM,2,75
FITEM,2,78
FITEM,2,87
FITEM,2,92
FITEM,2,108
FITEM,2,112
FITEM,2,-114
/GO
!*
SFA,P51X,1,PRES,1000
DDELE,ALL,UX
DDELE,ALL,UY

SOLVE
```

```
FINISH
/POST1
SET,1
NWPLAN,-1,   19811,   19652,   19806
SUCR,Lug1,CPLANE,40,
CSWPLA,11,1,1,1,
!*
RSYS,11

SUMAP,sz,S,Z
SUMAP,Syz,S,YZ
SUMAP,Sxz,S,XZ

/RGB,INDEX,100,100,100, 0
/RGB,INDEX, 80, 80, 80,13
/RGB,INDEX, 60, 60, 60,14
/RGB,INDEX, 0, 0, 0,15
/REPLOT
!*
/SHOW,PNG
PNGR,COMP,1,-1
PNGR,ORIENT,HORIZ
PNGR,COLOR,2
PNGR,TMOD,1
/GFILE,800,
/VIEW,1,,1
/UDOC,1,CNTR,RIGH

SET,FIRST
/TITLE,Lug Normal Stress Due to Unit Pressure of 1000 psi
SUPL,LUG1,SZ,0
/TITLE,Lug Vertical Shear Due to Unit Pressure of 1000 psi
SUPL,LUG1,SYZ,0
/TITLE,Lug Lateral Shear Due to Unit Pressure of 1000 psi
SUPL,LUG1,SXZ,0
/SHOW,CLOSE
/DEVICE,VECTOR,0
/RGB,INDEX, 0, 0, 0, 0
/RGB,INDEX, 60, 60, 60,13
/RGB,INDEX, 80, 80, 80,14
/RGB,INDEX,100,100,100,15
/REPLOT

!*
```

Filename: 1THPost1A.txt

```
!/INPUT,'Lug-1','txt','.\MS-Lug\',, 0!
/PSF,CONV,HCOE,2,0,1
/PBF,DEFA, ,1
/PIC,DEFA, ,1
/PBC,ALL,,1
!*
FLST,2,5,5,ORDE,5
FITEM,2,14
FITEM,2,16
FITEM,2,22
FITEM,2,34
FITEM,2,39
```

```
DA,P51X,SYMM
FLST,2,5,5,ORDE,5
FITEM,2,18
FITEM,2,20
FITEM,2,32
FITEM,2,36
FITEM,2,41
DA,P51X,SYMM
DA,      19,SYMM
FLST,2,1,5,ORDE,1
FITEM,2,19
DA,P51X,UZ,

ALLSEL,ALL
!KEYW,PR_STRUC,0
!KEYW,PR_THERM,1
FINISH

/SOL
!*
ANTYPE,4
!*
TRNOPT,FULL
LUMPM,0
!*
AUTO,on
OUTPR,ALL,ALL,
OUTres,ALL,ALL,

KBC,0
TIMINT,0,STRUCT
TIMINT,1,THERM

!*
TUNIF,560.0,
IC,ALL,Temp,560.0
htc=4000/144                        !h= 4000 BTU/hr-ft^2-F

Time, 0.00001
NSUBST,1,1,1
CMSEL,S,HFACE
SFA,ALL, ,CONV,htc,560
ALLSEL,ALL
SOLVE

Time, 1.0                       !LS=2
Nsub,60,100,60
CMSEL,S,HFACE
SFA,ALL, ,CONV,htc,460
ALLSEL,ALL
SOLVE

Time, 3.0                       !LS=3
Nsub,20,100,20
CMSEL,S,HFACE
SFA,ALL, ,CONV,htc,260
ALLSEL,ALL
!SOLVE

Time, 5.0                       !LS=4
Nsub,10,100,10
```

```
CMSEL,S,HFACE
SFA,ALL, ,CONV,htc,60
ALLSEL,ALL
!SOLVE

FINISH
/POST1
NWPLAN,-1,    2455,    2296,    2450
SUCR,Lug1,CPLANE,40,
CSWPLA,11,1,1,1,
!*
RSYS,11
SET,2,40,1
SUMAP,sz,S,Z
SUMAP,Syz,S,YZ
SUMAP,Sxz,S,XZ

/RGB,INDEX,100,100,100, 0
/RGB,INDEX, 80, 80, 80,13
/RGB,INDEX, 60, 60, 60,14
/RGB,INDEX, 0, 0, 0,15
/REPLOT
!*
/SHOW,PNG
PNGR,COMP,1,-1
PNGR,ORIENT,HORIZ
PNGR,COLOR,2
PNGR,TMOD,1
/GFILE,800,
/VIEW,1,,1
/UDOC,1,CNTR,RIGH

/TITLE,Lug Normal Stress Due to Cool Down Thermal Transient 100F/hr
SUPL,LUG1,SZ,0
/TITLE,Lug Vertical Shear Due to Cool Down Thermal Transient 100F/hr
SUPL,LUG1,SYZ,0
/TITLE,Lug Lateral Shear Due to Cool Down Thermal Transient 100F/hr
SUPL,LUG1,SXZ,0
/SHOW,CLOSE
/DEVICE,VECTOR,0
/RGB,INDEX, 0, 0, 0, 0
/RGB,INDEX, 60, 60, 60,13
/RGB,INDEX, 80, 80, 80,14
/RGB,INDEX,100,100,100,15
/REPLOT

!*
```

ANSYS Program File Listing (PC ANSYS64-1)

```
Volume in drive C has no label.
Volume Serial Number is 84E4-E259

Directory of C:\Program Files\ANSYS Inc\v110\ANSYS\bin\winx64

11/08/2007  11:16 AM    <DIR>          .
11/08/2007  11:16 AM    <DIR>          ..
08/31/2007  12:04 AM            19,968 acon.exe
06/22/2007  03:04 PM           158,208 animate.exe
08/31/2007  12:21 AM             1,571 anstclsh110.bat
08/31/2007  12:21 AM             1,580 answish110.bat
09/05/2007  10:26 AM        71,350,272 ANSYS.exe
08/31/2007  03:37 AM            31,744 ANSYS110.exe
03/31/2006  03:03 AM             7,048 ansys110.ver
11/08/2007  10:42 AM    <DIR>          ANSYSLM
08/31/2007  12:21 AM               739 ansysserv110.bat
08/31/2007  12:20 AM            19,813 ansysts110
08/31/2007  12:21 AM               323 ansysts110.bat
02/21/2007  03:53 PM            61,440 ans_admin.exe
01/20/2002  12:57 PM           671,744 asmutils.dll
08/31/2007  03:36 AM            64,512 binlib.dll
08/31/2007  12:52 AM        16,461,312 cadoe.dll
11/08/2007  10:42 AM    <DIR>          DANSYSMPICH
11/08/2007  10:42 AM    <DIR>          DANSYSMSMPI
09/19/2002  04:28 PM         2,142,277 DataViz370.dll
03/30/2006  12:56 PM           462,848 DFORMD.dll
08/31/2005  04:13 PM           126,976 dispinfo.exe
08/30/2007  05:25 PM           466,944 DisplayW.exe
10/05/2000  04:54 PM           438,342 DSGStreamN.dll
11/08/2007  11:14 AM               204 file.err
04/12/2006  10:02 AM            36,864 gus.exe
09/24/2002  02:48 PM           196,679 HardCopy370.dll
11/23/2004  04:03 PM           283,136 ifdlg100.dll
09/24/2002  02:49 PM         4,833,365 Inv311.dll
09/19/2002  04:28 PM            98,304 Invr311.dll
09/24/2002  02:49 PM           442,454 Invw311.dll
08/17/2004  01:36 PM           150,528 jpeg62.dll
01/26/2006  11:06 AM            45,056 launcher110.exe
10/23/2000  09:00 PM           217,600 libcpepcf90md.dll
09/20/2006  05:49 PM           243,200 libguide40.dll
11/04/2006  07:47 AM           328,192 libguide40_stats.dll
11/04/2006  07:48 AM           757,760 libifcoremd.dll
11/04/2006  07:48 AM           757,760 libifcoremdd.dll
11/04/2006  07:48 AM           746,496 libifcorert.dll
11/04/2006  07:48 AM           746,496 libifcorertd.dll
11/04/2006  07:49 AM           147,968 libifportmd.dll
09/20/2006  08:22 PM             6,144 libimalloc.dll
11/04/2006  07:50 AM         2,192,896 libmmd.dll
11/04/2006  07:51 AM         2,213,888 libmmdd.dll
11/04/2006  07:47 AM           108,544 libomp_db.dll
10/20/2004  03:12 PM           396,288 libtiff.dll
06/12/2007  12:45 PM        71,832,576 ls971_MPP_DP.exeSave
03/07/2002  12:47 PM                65 machines
03/18/2003  10:20 PM         1,060,864 mfc71.dll
10/03/2006  04:26 PM         4,129,792 mkl_def.dll
09/20/2006  08:10 PM           940,544 mkl_ias.dll
09/20/2006  08:10 PM         2,648,064 mkl_lapack32.dll
09/20/2006  08:10 PM         2,703,872 mkl_lapack64.dll
10/03/2006  04:27 PM         4,938,752 mkl_mc.dll
10/03/2006  04:26 PM         5,784,576 mkl_p4n.dll
10/03/2006  04:06 PM         2,392,576 mkl_vml_def.dll
10/03/2006  04:20 PM         3,043,840 mkl_vml_mc.dll
10/03/2006  04:12 PM         3,021,312 mkl_vml_p4n.dll
08/31/2007  01:05 AM           388,096 mnflib.dll
05/07/1999  12:00 AM           645,616 MSCOMCT2.OCX
03/25/2005  08:00 AM           941,568 msvcp60.dll
```

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03/30/2006  12:56 PM          348,160 msvcr71.dll
08/31/2007  12:20 AM            1,587 nlhist110.bat
09/01/2004  03:22 PM          120,832 png.dll
09/24/2002  02:49 PM        3,751,936 qt-mt305.dll
09/22/2003  11:28 AM        3,129,344 splash.exe
11/04/2006  07:53 AM          286,720 svml_dispmd.dll
12/22/2006  05:02 AM       17,944,576 sxpost.exe
12/09/2004  03:50 PM          627,200 tcl83.dll
10/03/2006  01:55 PM          859,648 tcl84.dll
07/18/2005  09:30 AM           17,408 tcldde12.dll
12/09/2004  03:50 PM           13,824 tcldde83.dll
12/09/2004  03:50 PM           27,136 tclpip83.dll
07/18/2005  09:30 AM            6,656 tclpip84.dll
07/18/2005  09:30 AM           18,944 tclreg11.dll
12/09/2004  03:50 PM           15,360 tclreg83.dll
10/03/2006  01:55 PM           11,776 tclsh.exe
10/03/2006  01:55 PM           11,776 tclsh84.exe
04/17/2003  02:58 PM          915,968 tiff.dll
12/09/2004  04:04 PM          924,160 tk83.dll
03/14/2005  03:24 PM        1,374,208 tk84.dll
03/14/2005  03:24 PM           16,896 wish.exe
03/14/2005  03:24 PM           16,896 wish84.exe
04/20/1998  12:08 PM          125,440 wntshell.exe
09/01/2004  03:21 PM           55,808 zlib.dll
               80 File(s)  242,531,855 bytes

 Directory of C:\Program Files\ANSYS Inc\v110\ANSYS\bin\winx64\ANSYSLM

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01/20/2002  12:57 PM          671,744 asmutils.dll
08/31/2007  03:36 AM           64,512 binlib.dll
08/31/2007  12:52 AM       16,461,312 cadoe.dll
09/19/2002  04:28 PM        2,142,277 DataViz370.dll
03/30/2006  12:56 PM          462,848 DFORMD.dll
10/05/2000  04:54 PM          438,342 DSGStreamN.dll
09/24/2002  02:48 PM          196,679 HardCopy370.dll
11/23/2004  04:03 PM          283,136 ifdlg100.dll
09/24/2002  02:49 PM        4,833,365 Inv311.dll
09/19/2002  04:28 PM           98,304 Invr311.dll
09/24/2002  02:49 PM          442,454 Invw311.dll
08/17/2004  01:36 PM          150,528 jpeg62.dll
10/23/2000  09:00 PM          217,600 libcpepcf90md.dll
09/20/2006  05:49 PM          243,200 libguide40.dll
11/04/2006  07:47 AM          328,192 libguide40_stats.dll
11/04/2006  07:48 AM          757,760 libifcoremd.dll
11/04/2006  07:48 AM          757,760 libifcoremdd.dll
11/04/2006  07:48 AM          746,496 libifcorert.dll
11/04/2006  07:48 AM          746,496 libifcorertd.dll
11/04/2006  07:49 AM          147,968 libifportmd.dll
09/20/2006  08:22 PM            6,144 libimalloc.dll
11/04/2006  07:50 AM        2,192,896 libmmd.dll
11/04/2006  07:51 AM        2,213,888 libmmdd.dll
11/04/2006  07:47 AM          108,544 libomp_db.dll
10/20/2004  03:12 PM          396,288 libtiff.dll
03/18/2003  10:20 PM        1,060,864 mfc71.dll
10/03/2006  04:26 PM        4,129,792 mkl_def.dll
08/21/2005  06:58 PM        6,816,256 mkl_i2p.dll
09/20/2006  08:10 PM          940,544 mkl_ias.dll
09/20/2006  08:10 PM        2,648,064 mkl_lapack32.dll
09/20/2006  08:10 PM        2,703,872 mkl_lapack64.dll
10/03/2006  04:27 PM        4,938,752 mkl_mc.dll
10/03/2006  04:26 PM        5,784,576 mkl_p4n.dll
10/03/2006  04:06 PM        2,392,576 mkl_vml_def.dll
08/11/2005  02:31 PM        1,562,112 mkl_vml_i2p.dll
10/03/2006  04:20 PM        3,043,840 mkl_vml_mc.dll
10/03/2006  04:12 PM        3,021,312 mkl_vml_p4n.dll
08/31/2007  01:05 AM          388,096 mnflib.dll
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03/25/2005  08:00 AM          941,568 msvcp60.dll
03/30/2006  12:56 PM          348,160 msvcr71.dll
09/01/2004  03:22 PM          120,832 png.dll
09/24/2002  02:49 PM        3,751,936 qt-mt305.dll
11/04/2006  07:53 AM          286,720 svml_dispmd.dll
12/09/2004  03:50 PM          627,200 tcl83.dll
10/03/2006  01:55 PM          859,648 tcl84.dll
07/18/2005  09:30 AM           17,408 tcldde12.dll
12/09/2004  03:50 PM           13,824 tcldde83.dll
12/09/2004  03:50 PM           27,136 tclpip83.dll
07/18/2005  09:30 AM            6,656 tclpip84.dll
07/18/2005  09:30 AM           18,944 tclreg11.dll
12/09/2004  03:50 PM           15,360 tclreg83.dll
10/03/2006  01:55 PM           11,776 tclsh.exe
10/03/2006  01:55 PM           11,776 tclsh84.exe
04/17/2003  02:58 PM          915,968 tiff.dll
12/09/2004  04:04 PM          924,160 tk83.dll
03/14/2005  03:24 PM        1,374,208 tk84.dll
09/01/2004  03:21 PM           55,808 zlib.dll
               58 File(s)  155,134,333 bytes

 Directory of C:\Program Files\ANSYS Inc\v110\ANSYS\bin\winx64\DANSYSMPICH

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11/08/2007  10:42 AM    <DIR>          ..
09/05/2007  01:46 PM       77,097,984 ANSYS.exe
01/20/2002  12:57 PM          671,744 asmutils.dll
08/31/2007  03:36 AM           64,512 binlib.dll
08/31/2007  12:52 AM       16,461,312 cadoe.dll
09/19/2002  04:28 PM        2,142,277 DataViz370.dll
03/30/2006  12:56 PM          462,848 DFORMD.dll
10/05/2000  04:54 PM          438,342 DSGStreamN.dll
09/24/2002  02:48 PM          196,679 HardCopy370.dll
11/23/2004  04:03 PM          283,136 ifdlg100.dll
09/24/2002  02:49 PM        4,833,365 Inv311.dll
09/19/2002  04:28 PM           98,304 Invr311.dll
09/24/2002  02:49 PM          442,454 Invw311.dll
08/17/2004  01:36 PM          150,528 jpeg62.dll
10/23/2000  09:00 PM          217,600 libcpepcf90md.dll
09/20/2006  05:49 PM          243,200 libguide40.dll
11/04/2006  07:47 AM          328,192 libguide40_stats.dll
11/04/2006  07:48 AM          757,760 libifcoremd.dll
11/04/2006  07:48 AM          757,760 libifcoremdd.dll
11/04/2006  07:48 AM          746,496 libifcorert.dll
11/04/2006  07:48 AM          746,496 libifcorertd.dll
11/04/2006  07:49 AM          147,968 libifportmd.dll
09/20/2006  08:22 PM            6,144 libimalloc.dll
11/04/2006  07:50 AM        2,192,896 libmmd.dll
11/04/2006  07:51 AM        2,213,888 libmmdd.dll
11/04/2006  07:47 AM          108,544 libomp_db.dll
10/20/2004  03:12 PM          396,288 libtiff.dll
03/18/2003  10:20 PM        1,060,864 mfc71.dll
10/03/2006  04:26 PM        4,129,792 mkl_def.dll
09/20/2006  08:10 PM          940,544 mkl_ias.dll
09/20/2006  08:10 PM        2,648,064 mkl_lapack32.dll
09/20/2006  08:10 PM        2,703,872 mkl_lapack64.dll
10/03/2006  04:27 PM        4,938,752 mkl_mc.dll
10/03/2006  04:26 PM        5,784,576 mkl_p4n.dll
10/03/2006  04:06 PM        2,392,576 mkl_vml_def.dll
10/03/2006  04:20 PM        3,043,840 mkl_vml_mc.dll
10/03/2006  04:12 PM        3,021,312 mkl_vml_p4n.dll
08/31/2007  01:05 AM          388,096 mnflib.dll
08/31/2007  03:44 AM            5,632 mpitestmpich.exe
03/25/2005  08:00 AM          941,568 msvcp60.dll
03/30/2006  12:56 PM          348,160 msvcr71.dll
09/01/2004  03:22 PM          120,832 png.dll
09/24/2002  02:49 PM        3,751,936 qt-mt305.dll
11/04/2006  07:53 AM          286,720 svml_dispmd.dll
12/09/2004  03:50 PM          627,200 tcl83.dll
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10/03/2006  01:55 PM          859,648 tcl84.dll
07/18/2005  09:30 AM           17,408 tcldde12.dll
12/09/2004  03:50 PM           13,824 tcldde83.dll
12/09/2004  03:50 PM           27,136 tclpip83.dll
07/18/2005  09:30 AM            6,656 tclpip84.dll
07/18/2005  09:30 AM           18,944 tclreg11.dll
12/09/2004  03:50 PM           15,360 tclreg83.dll
10/03/2006  01:55 PM           11,776 tclsh.exe
10/03/2006  01:55 PM           11,776 tclsh84.exe
04/17/2003  02:58 PM          915,968 tiff.dll
12/09/2004  04:04 PM          924,160 tk83.dll
03/14/2005  03:24 PM        1,374,208 tk84.dll
09/01/2004  03:21 PM           55,808 zlib.dll
               57 File(s)  153,593,725 bytes

 Directory of C:\Program Files\ANSYS Inc\v110\ANSYS\bin\winx64\DANSYSMSMPI

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11/08/2007  10:42 AM    <DIR>          ..
09/05/2007  01:44 PM       77,097,984 ANSYS.exe
01/20/2002  12:57 PM          671,744 asmutils.dll
08/31/2007  03:36 AM           64,512 binlib.dll
08/31/2007  12:52 AM       16,461,312 cadoe.dll
09/19/2002  04:28 PM        2,142,277 DataViz370.dll
03/30/2006  12:56 PM          462,848 DFORMD.dll
10/05/2000  04:54 PM          438,342 DSGStreamN.dll
09/24/2002  02:48 PM          196,679 HardCopy370.dll
11/23/2004  04:03 PM          283,136 ifdlg100.dll
09/24/2002  02:49 PM        4,833,365 Inv311.dll
09/19/2002  04:28 PM           98,304 Invr311.dll
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08/17/2004  01:36 PM          150,528 jpeg62.dll
10/23/2000  09:00 PM          217,600 libcpepcf90md.dll
09/20/2006  05:49 PM          243,200 libguide40.dll
11/04/2006  07:47 AM          328,192 libguide40_stats.dll
11/04/2006  07:48 AM          757,760 libifcoremd.dll
11/04/2006  07:48 AM          757,760 libifcoremdd.dll
11/04/2006  07:48 AM          746,496 libifcorert.dll
11/04/2006  07:48 AM          746,496 libifcorertd.dll
11/04/2006  07:49 AM          147,968 libifportmd.dll
09/20/2006  08:22 PM            6,144 libimalloc.dll
11/04/2006  07:50 AM        2,192,896 libmmd.dll
11/04/2006  07:51 AM        2,213,888 libmmdd.dll
11/04/2006  07:47 AM          108,544 libomp_db.dll
10/20/2004  03:12 PM          396,288 libtiff.dll
03/18/2003  10:20 PM        1,060,864 mfc71.dll
10/03/2006  04:26 PM        4,129,792 mkl_def.dll
09/20/2006  08:10 PM          940,544 mkl_ias.dll
09/20/2006  08:10 PM        2,648,064 mkl_lapack32.dll
09/20/2006  08:10 PM        2,703,872 mkl_lapack64.dll
10/03/2006  04:27 PM        4,938,752 mkl_mc.dll
10/03/2006  04:26 PM        5,784,576 mkl_p4n.dll
10/03/2006  04:06 PM        2,392,576 mkl_vml_def.dll
10/03/2006  04:20 PM        3,043,840 mkl_vml_mc.dll
10/03/2006  04:12 PM        3,021,312 mkl_vml_p4n.dll
08/31/2007  01:05 AM          388,096 mnflib.dll
08/31/2007  03:43 AM            5,632 mpitestmsmpi.exe
03/25/2005  08:00 AM          941,568 msvcp60.dll
03/30/2006  12:56 PM          348,160 msvcr71.dll
09/01/2004  03:22 PM          120,832 png.dll
09/24/2002  02:49 PM        3,751,936 qt-mt305.dll
11/04/2006  07:53 AM          286,720 svml_dispmd.dll
12/09/2004  03:50 PM          627,200 tcl83.dll
10/03/2006  01:55 PM          859,648 tcl84.dll

07/18/2005  09:30 AM           17,408 tcldde12.dll
12/09/2004  03:50 PM           13,824 tcldde83.dll
12/09/2004  03:50 PM           27,136 tclpip83.dll
07/18/2005  09:30 AM            6,656 tclpip84.dll
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07/18/2005  09:30 AM            18,944 tclreg11.dll
12/09/2004  03:50 PM            15,360 tclreg83.dll
10/03/2006  01:55 PM            11,776 tclsh.exe
10/03/2006  01:55 PM            11,776 tclsh84.exe
04/17/2003  02:58 PM           915,968 tiff.dll
12/09/2004  04:04 PM           924,160 tk83.dll
03/14/2005  03:24 PM         1,374,208 tk84.dll
09/01/2004  03:21 PM            55,808 zlib.dll
              57 File(s)    153,593,725 bytes

     Total Files Listed:
             252 File(s)    704,853,638 bytes
              11 Dir(s)  97,437,290,496 bytes free
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