

# ACCELERATED DISTRIBUTION DEMONSTRATION SYSTEM

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 MECREDY, R.C. Rochester Gas & Electric Corp. *See RPA*  
 RECIP. NAME: RECIPIENT AFFILIATION  
 JOHNSON, A.R. Project Directorate I-3

SUBJECT: Forwards Rev 0 to EWR 5327, "Design Verification Ginna Station Containment Foundation Mat Analysis" & "Design Analysis Ginna Station Containment Mat Design Water Level Elevation 265 ft, 0 Inches."

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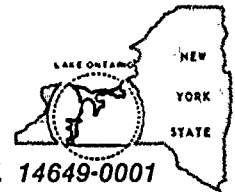
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ROBERT C. MECREDY  
Vice President  
Ginna Nuclear Production

TELEPHONE  
AREA CODE 716 546-2700

April 15, 1991

U.S. Nuclear Regulatory Commission  
Document Control Desk  
Attn: Allen R. Johnson  
Project Directorate I-3  
Washington, D.C. 20555

Subject: Additional Information of Structural Integrity  
R. E. Ginna Nuclear Power Plant  
Docket No. 50-244

Dear Mr. Johnson:

This letter transmits to you the additional information relative to the latest questions raised by Mr. H. Ashar of the NRC staff concerning containment integrity. We trust that this information satisfies all outstanding unresolved issues on this subject.

The following attachments, with a description of their content, are being sent:

Attachment A

This contains the load combinations that were checked as part of the original design (UFSAR Table 3.8-6), a list of the various computer analyses run to simulate numerous boundary conditions (Table 1), the force and stress resultants of those analyses combined per the requirements of the UFSAR, the tension bar forces for the combination, and the radial displacements for the combinations.

Attachment B

These are the interaction diagrams for the containment wall, considering its strength based on various moment resisting components.

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A001  
11

The ultimate capacity of the section for shear is also shown.

The capacity of the tension bars is also presented.

Attachment C

These are the wall interaction diagrams with a plot of the stress resultants of UFSAR load combinations "a" and "c" for computer run RGE09. The results of RGE09 are plotted because the boundary conditions used for that analysis are the same as those used in the original design analysis.

The shears and tension bar forces are also presented for that load case.

Attachment D

This document is the stress analysis that was performed on the foundation mat for groundwater at Elev. 265 feet as opposed to water at Elev. 252 feet per original assumptions.

Attachment E

This is a summary record of the recently measured thickness of the liner near the base. The condition of the liner, in the area of the measurements, was in excellent condition with no visible signs of deterioration to either the liner or the paint.

Very truly yours,

  
Robert C. Mecredy

LAS:mkd/221  
Attachments

xc: Mr. Allen R. Johnson (Mail Stop 14D1)  
Project Directorate I-3  
Washington, D.C. 20555

U.S. Nuclear Regulatory Commission  
Region I  
475 Allendale Road  
King of Prussia, PA 19406

Ginna Senior Resident Inspector



# ATTACHMENT A



## 5.0 LOAD COMBINATION TABLES

The load case results developed in ABB Impell calculation No. 8450-073-002 and presented in table four in the calculation were combined in the following load combination equations taken from Reference 2, Table 3.8-6.

### LOAD COMBINATION CONDITION

$$\text{"a" 21 : } 1.0DL + 1.0VP + 1.0OT_w + 1.5IP + 1.0AT_{q_0}$$

$$\text{"a" 31 : } 1.0DL + 1.0VP + 1.0OT_s + 1.5IP + 1.0AT_{q_0}$$

$$\text{"c" 41 : } 1.0DL + 1.0VP + 1.0OT_w + 1.0IP + 1.0AT_{b_0} + 2.0E$$

$$\text{"c" 43 : } 1.0DL + 1.0VP + 1.0OT_s + 1.0IP + 1.0AT_{b_0} + 2.0E$$

See Table 3.8-6 on pages 23-24.

					R&E Corporation Steel Substation Truss	
REV	BY	DATE	CHECKED	DATE	JOB NO 8450-073-1683	PAGE 22 OF 70
0	GSB	3/27/91	7/27/91		CALC NO 8450-073-1683	
IMPELL CORPORATION						





(Reference 2)

Table 3.8-6

## CONTAINMENT STRUCTURE LOADING COMBINATIONS

Load Combinations	Load No.	DL	VP	OT <sub>W</sub>	OT <sub>S</sub>	IP P=60	AT <sub>60</sub>	AT <sub>90</sub>	E a=0.1g
Normal Operation	1	1.0	1.0	1.0					
	2	1.0	1.17	1.0					
	3	1.0	1.0		1.0				
	4	1.0	1.17		1.0				
	5	1.0	1.0	1.0					2.0
	6	1.0	1.17	1.0					2.0
	7	1.0	1.0		1.0				2.0
	8	1.0	1.17		1.0				2.0
	9	1.0	1.0	1.0					-2.0
	10	1.0	1.17	1.0					-2.0
	11	1.0	1.0		1.0				-2.0
	12	1.0	1.17		1.0				-2.0
Test	13	1.0	1.0	1.0		1.15			
	14	1.0	1.17	1.0		1.15			
	15	1.0	1.0		1.0	1.15			
	16	1.0	1.17		1.0	1.15			
Accident Pressure Condition "d"	17	1.0	1.0	1.0		1.0	1.0		
	18	1.0	1.17	1.0		1.0			
	19	1.0	1.0		1.0	1.0	1.0		
	20	1.0	1.17		1.0	1.0	1.0		
	21	1.0	1.0	1.0		1.0	1.0		0.8
	22	1.0	1.17	1.0		1.0	1.0		0.8
	23	1.0	1.0		1.0	1.0	1.0		0.8
	24	1.0	1.17		1.0	1.0	1.0		0.8
	25	1.0	1.0	1.0		1.0	1.0		-0.8
	26	1.0	1.17	1.0		1.0	1.0		-0.8
	27	1.0	1.0		1.0	1.0	1.0		-0.8
	28	1.0	1.17		1.0	1.0	1.0		-0.8
Condition "a"	29	1.0	1.0	1.0		1.5		1.0	
	30	1.0	1.17	1.0		1.5		1.0	
	31	1.0	1.0		1.0	1.5		1.0	
	32	1.0	1.17		1.0	1.5		1.0	
Condition "b"	33	1.0	1.0	1.0		1.25		1.0	1.0
	34	1.0	1.17	1.0		1.25		1.0	1.0
	35	1.0	1.0		1.0	1.25		1.0	1.0
	36	1.0	1.17		1.0	1.25		1.0	1.0
	37	1.0	1.0	1.0		1.25		1.0	-1.0
	38	1.0	1.17	1.0		1.25		1.0	-1.0
	39	1.0	1.0		1.0	1.25		1.0	-1.0
	40	1.0	1.17		1.0	1.25		1.0	-1.0

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Table 3.8-6  
CONTAINMENT STRUCTURE LOADING COMBINATIONS (Continued)

Load Combinations	Load No.	DL	VP	OT <sub>W</sub>	OT <sub>S</sub>	IP P=60	AT <sub>60</sub>	AT <sub>90</sub>	E a=0.1g
Condition "c"	41	1.0	1.0	1.0		1.0	1.0		2.0
	42	1.0	1.17	1.0		1.0	1.0		2.0
	43	1.0	1.0		1.0	1.0	1.0		2.0
	44	1.0	1.17		1.0	1.0	1.0		2.0
	45	1.0	1.0	1.0		1.0	1.0		-2.0
	46	1.0	1.17	1.0		1.0	1.0		-2.0
	47	1.0	1.0		1.0	1.0	1.0		-2.0
	48	1.0	1.17		1.0	1.0	1.0		-2.0

Key

Loading Number Fundamental Load	Symbol	Meaning
No. 1	DL	Dead Load
No. 2	VP	Vertical Prestress
No. 3	OT <sub>W</sub>	Operating Temperature - Winter
No. 4	OT <sub>S</sub>	Operating Temperature - Summer
No. 5	IP	Internal Pressure (P=60 psig)
No. 6	AT <sub>60</sub>	Accident Pressure + Temperature (P=60 psig; T = 286 °F)
No. 7	AT <sub>90</sub>	Accident Pressure + Temperature (P=90 psig; T = 312°F)
No. 8	E	Design Earthquake (horizontal acceleration 0.10g)

DESIGN VERIFICATION	
CLIENT <u>RG&amp;E</u>	
JOB NO. <u>0950-073-1683</u>	
CALC/PROB NO. <u>0950-073-006</u>	
BY: <u>GSR</u>	DATE: <u>3/27/91</u>
CHKD: <u>[Signature]</u>	DATE: <u>7/25/91</u>

Rev. 0

PAGE 24 of 70



## Case Reference Chart - Shell Model

Run Name	Load Cases (1)	Applicable Loads (1)	Base Boundary Conditions					Material Properties			
			Tie-Rods	Tangential	Vertical	Rotational (ft-lbs/ft)	Radial	Modulus Meridional [psi]	Circumferencial [psi]	Dome [psi]	Poisson Ratio
RGE01	D,PS,P,2E	2E	Inactive	Fixed	Fixed	Free	Fixed	4.10E+06	4.10E+06	Uncracked	0.15
RGE02	D,PS,P,2E	2E	Inactive	Free	Fixed	Free	Fixed	4.10E+06	4.10E+06	Uncracked	0.15
RGE03	D,PS,P,2E	2E	Active	Free	Fixed	Free	Free	4.10E+06	4.10E+06	Uncracked	0.15
RGE04	D,PS,P,2E	D,PS,P	Inactive	Fixed	Fixed	Free	Fixed	4.10E+06	3#18@9"	Uncracked	0
RGE05	D,PS,P,2E	D,PS,P	Inactive	Free	Fixed	Free	Fixed	4.10E+06	3#18@9"	Uncracked	0
RGE06	D,PS,P,2E	D,PS,P	Active	Free	Fixed	Free	Free	4.10E+06	3#18@9"	Uncracked	0
RGE07	D,PS,P,2E	2E	Active	Liner(2)	Fixed	Free	Free	4.10E+06	4.10E+06	Uncracked	0.15
RGE08	D,PS,P,2E	D,PS,P	Active	Fixed	Fixed	Free	Free	4.10E+06	Rebar Varies	Cracked	0
RGE09	D,PS,P,2E	D,PS,P	Active	Fixed	Fixed	3.00E+01	Free	4.10E+06	Rebar Varies	Cracked	0
RGE10	D,PS,P,2E	D,PS,P	Active	Fixed	Fixed	9.00E+01	Free	4.10E+06	Rebar Varies	Cracked	0
RGE11	D,PS,P,2E	D,PS,P	Active	Fixed	Fixed	3.00E+02	Free	4.10E+06	Rebar Varies	Cracked	0
RGE12	D,PS,P,2E	D,PS,P	Active	Fixed	Fixed	Fixed	Free	4.10E+06	Rebar Varies	Cracked	0
RGE14	D,PS,P,2E	D,PS,P	Inactive	Fixed	Fixed	Free	Fixed	4.10E+06	Rebar Varies	Cracked	0
RGE15	D,PS,P,2E	D,PS,P	Inactive	Fixed	Fixed	3.00E+01	Fixed	4.10E+06	Rebar Varies	Cracked	0
RGE16	D,PS,P,2E	D,PS,P	Inactive	Fixed	Fixed	9.00E+01	Fixed	4.10E+06	Rebar Varies	Cracked	0
RGE17	D,PS,P,2E	D,PS,P	Inactive	Fixed	Fixed	3.00E+02	Fixed	4.10E+06	Rebar Varies	Cracked	0
RGE18	D,PS,P,2E	D,PS,P	Inactive	Fixed	Fixed	Fixed	Fixed	4.10E+06	Rebar Varies	Cracked	0
RGE20	D,PS,P,2E	2E	Active	Free	Fixed	Free	(90-180°)Fxd	4.10E+06	4.10E+06	Uncracked	0.15
RGE21	D,PS,P,2E	2E	Inactive	Free	Fixed	Free	(72-180°)Fxd	4.10E+06	4.10E+06	Uncracked	0.15
RGE22	D,PS,P,2E	2E	Inactive	Free	Fixed	Free	(81-180°)Fxd	4.10E+06	Rebar Varies	Cracked	0

(1) D = Dead Weight  
PS = Tendon Prestress  
P = 60 psl Internal Pressure

(2) Liner = The tangential stiffness associated with the steel containment liner

TABLE 1

DESIGN VERIFICATION	
CLIENT <u>PG&amp;E</u>	
JOB NO. <u>0950-073-1683</u>	
CALC/PROB NO. <u>0950-073-006</u>	R10
BY: <u>GJB</u>	DATE <u>3/27/91</u>
CHKD: <u>[Signature]</u>	DATE <u>3/27/91</u>

From Reference 5

# Containment Shell Stress Resultants and Stress Couples

Loading: Load Combination

Comments:

Internal Pressure Case RGE08

Condition "a" LC 29: (1.0\*DL) + (1.0\*VP) + (1.0\*OTw) + (1.5\*IP) + (1.0\*AT90)

Height from Base [ft]	Stress Resultant		Stress Couples		Meridional Shear	Radial Displacement
	Meridional [kips/ft]	Hoop [kips/ft]	Meridional [ft kips/ft]	Hoop [ft kips/ft]	[kips/ft]	[in]
0	-29.0	191.0	0.0	99.5	54.7	0.103
3	-27.4	251.3	158.5	99.5	51.2	0.271
6	-49.3	397.5	282.9	99.5	32.5	0.430
10	-23.7	482.8	373.2	99.5	13.7	0.608
15	-21.1	565.1	401.0	99.5	-1.1	0.769
20	-18.5	652.0	373.2	99.5	-9.0	0.872
30	-13.2	699.7	269.1	99.5	-10.2	0.933
40	-8.0	736.4	191.3	99.5	-5.2	0.918
60	2.5	699.8	175.4	99.5	3.5	0.892

DL = Dead Load ANSYS

VP = Vertical Tendon Prestress ANSYS

OTw = Operating Temperature in Winter

IP = Internal Pressure (60psig) RGE08

AT90 = Accident Pressure (P=90psig) T=312°F

PAGE 26 of 70

DESIGN VERIFICATION	
CLIENT	RGE
JOB NO.	0950-073-1683
CALC/PROB NO.	0950-073-0060
BY: GSB	DATE: 3/27/91
CHKD: T/pt	DATE: 3/27/91



# Containment Shell Stress Resultants and Stress Couples

Loading: Load Combination  
Condition "a" LC 31: (1.0\*DL) + (1.0\*VP) + (1.0\*OTs) + (1.5\*IP) + (1.0\*AT90)

Comments:

Internal Pressure Case RGE08

Height from Base [ft]	Stress Resultant		Stress Couples		Meridional Shear	Radial Displacement
	Meridional [kips/ft]	Hoop [kips/ft]	Meridional [ft kips/ft]	Hoop [ft kips/ft]	[kips/ft]	[in]
0	-29.0	-69.4	0.0	0.0	67.9	0.103
3	-27.4	117.4	184.3	0.0	55.7	0.334
6	-49.3	302.4	312.4	0.0	30.9	0.465
10	-23.7	436.4	385.0	0.0	7.1	0.617
15	-21.1	549.6	372.2	0.0	-10.2	0.752
20	-18.5	663.9	298.7	0.0	-17.9	0.853
30	-13.2	721.6	121.2	0.0	-15.7	0.915
40	-8.0	727.3	6.6	0.0	-7.3	0.908
60	2.5	699.8	-18.3	0.0	3.9	0.891

DL = Dead Load ANSYS  
VP = Vertical Tendon Prestress ANSYS  
OTs = Operating Temperture in Summer

IP = Internal Pressure (60psig) RGE08  
AT90 = Accident Pressure (P=90psig) T=312°F

PAGE 27 of 70

DESIGN VERIFICATION	
CLIENT	RGE
JOB NO.	0950-073-1683
CALC/PROB NO.	0950-073-006
BY: GSB	DATE: 3/27/91
CHKD: TLT	DATE: 3/27/91



# Containment Shell Stress Resultants and Stress Couples

Loading: Load Combination      Comments:      Internal Pressure Case RGE08  
 Condition "c" LC 41: (1.0\*DL) + (1.0\*VP) + (1.0\*OTw) + (1.0\*IP) + (1.0\*AT60) + (2.0 \* E)

Height from Base [ft]	Stress Resultant		Stress Couples		Meridional Shear [kips/ft]	Radial Displacement [in]
	Meridional [kips/ft]	Hoop [kips/ft]	Meridional [ft kips/ft]	Hoop [ft kips/ft]		
0	-1.3	171.9	0.0	99.5	33.6	0.069
3	-3.7	211.5	100.0	99.5	32.7	0.189
6	-24.1	293.8	184.3	99.5	23.2	0.304
10	-11.9	333.8	253.0	99.5	11.6	0.431
15	-15.9	381.8	286.4	99.5	2.1	0.543
20	-25.7	427.4	282.9	99.5	-3.3	0.611
30	-33.3	456.8	234.8	99.5	-11.5	0.642
40	-40.5	490.8	191.6	99.5	-10.4	0.618
60	-57.8	460.0	181.0	99.5	-10.6	0.572

DL = Dead Load ANSYS  
 VP = Vertical Tendon Prestress ANSYS  
 OTw = Operating Temperture in Winter

IP = Internal Pressure (60psig) RGE08  
 AT60 = Accident Pressure (P=60psig) T=286°F  
 E = 0.10 g Earthquake Horizontal + Vertical ANSYS RGE01

PAGE 28 of 70

DESIGN VERIFICATION	
CLIENT	RGE
JOB NO.	0950-073-1683
CALC/PROB NO.	0950-073-006
BY: GSB	DATE: 3/27/91



# Containment Shell Stress Resultants and Stress Couples

Loading: Load Combination      Comments:      Internal Pressure Case RGE08  
 Condition "c" LC 43: (1.0\*DL) + (1.0\*VP) + (1.0\*OTs) + (1.0\*IP) + (1.0\*AT60) + (2.0 \* E)

Height from Base [ft]	Stress Resultant		Stress Couples		Meridional Shear [kips/ft]	Radial Displacement [in]
	Meridional [kips/ft]	Hoop [kips/ft]	Meridional [ft kips/ft]	Hoop [ft kips/ft]		
0	-1.3	-88.5	0.0	0.0	46.8	0.069
3	-3.7	77.6	125.8	0.0	37.2	0.252
6	-24.1	198.7	213.8	0.0	21.6	0.339
10	-11.9	287.4	264.8	0.0	5.0	0.440
15	-15.9	366.3	257.6	0.0	-7.0	0.526
20	-25.7	439.3	208.4	0.0	-12.2	0.592
30	-33.3	478.7	86.9	0.0	-17.0	0.624
40	-40.5	481.7	6.9	0.0	-12.5	0.608
60	-57.8	460.0	-12.7	0.0	-10.2	0.571

DL = Dead Load ANSYS  
 VP = Vertical Tendon Prestress ANSYS  
 OTs = Operating Temperture in Summer

IP = Internal Pressure (60psig) RGE08  
 AT60 = Accident Pressure (P=60psig) T=286°F  
 E = 0.10 g Earthquake Horizontal + Vertical

PAGE 29 of 70

ANSYS DESIGN VERIFICATION	
CLIENT: <u>DGE</u>	
JOB NO: <u>0150-073-1683</u>	
CALC/PROB NO: <u>0150-073-006</u>	
BY: <u>ESB</u>	DATE: <u>3/27/91</u>
CHKD: <u>Th</u>	DATE: <u>3/27/91</u>



# Containment Shell Stress Resultants and Stress Couples

Loading: Load Combination

Comments:

Internal Pressure Case RGE09

Condition "a" LC 29: (1.0\*DL) + (1.0\*VP) + (1.0\*OTw) + (1.5\*IP) + (1.0\*AT90)

Height from Base [ft]	Stress Resultant		Stress Couples		Meridional Shear [kips/ft]	Radial Displacement [in]
	Meridional [kips/ft]	Hoop [kips/ft]	Meridional [ft kips/ft]	Hoop [ft kips/ft]		
0	-29.0	193.4	-45.0	99.5	57.0	0.111
3	-27.4	252.1	120.7	99.5	53.6	0.273
6	-49.3	395.3	252.5	99.5	34.9	0.428
10	-23.7	478.0	351.9	99.5	15.8	0.603
15	-21.1	559.3	389.3	99.5	0.5	0.762
20	-18.5	646.8	368.3	99.5	-7.9	0.861
30	-13.2	696.5	270.8	99.5	-9.9	0.929
40	-8.0	735.3	193.8	99.5	-5.3	0.917
60	2.5	700.1	175.8	99.5	3.4	0.893

DL = Dead Load ANSYS

VP = Vertical Tendon Prestress ANSYS

OTw = Operating Temperature in Winter

IP = Internal Pressure (60psig) RGE09

AT90 = Accident Pressure (P=90psig) T=312°F

PAGE 30 of 70

DESIGN VERIFICATION	
CLIENT	RGE
JOB NO.	0950-073-1683
CALC/PROB NO.	0950-073-006
BY: GSB	DATE: 3/27/91
CHKD: 1/4	DATE: 3/27/91

# Containment Shell Stress Resultants and Stress Couples

Loading: Load Combination      Comments:  
 Condition "a" LC 31: (1.0\*DL) + (1.0\*VP) + (1.0\*OTs) + (1.5\*IP) + (1.0\*AT90)

Internal Pressure Case RGE09

Height from Base [ft]	Stress Resultant		Stress Couples		Meridional Shear [kips/ft]	Radial Displacement [in]
	Meridional [kips/ft]	Hoop [kips/ft]	Meridional [ft kips/ft]	Hoop [ft kips/ft]		
0	-29.0	-67.0	-45.0	0.0	70.2	0.111
3	-27.4	118.2	146.5	0.0	58.1	0.336
6	-49.3	300.2	282.0	0.0	33.3	0.463
10	-23.7	431.6	363.7	0.0	9.2	0.612
15	-21.1	543.8	360.5	0.0	-8.6	0.745
20	-18.5	658.7	293.8	0.0	-16.8	0.842
30	-13.2	718.4	122.9	0.0	-15.4	0.911
40	-8.0	726.2	9.1	0.0	-7.4	0.907
60	2.5	700.1	-17.9	0.0	3.8	0.892

DL = Dead Load ANSYS  
 VP = Vertical Tendon Prestress ANSYS  
 OTs = Operating Temperature in Summer

IP = Internal Pressure (60psig) RGE09  
 AT90 = Accident Pressure (P=90psig) T=312°F

PAGE 31 of 70

DESIGN VERIFICATION	
CLIENT	ZGE
JOB NO.	0950-073-1083
CALC/PROB NO.	0950-073-006
BY: GSB	DATE 3/27/91
CHKD: <i>[Signature]</i>	DATE 3/27/91

# Containment Shell Stress Resultants and Stress Couples

Loading: Load Combination      Comments:      Internal Pressure Case RGE09  
 Condition "c" LC 41: (1.0\*DL) + (1.0\*VP) + (1.0\*OTw) + (1.0\*IP) + (1.0\*AT60) + (2.0 \* E)

Height from Base [ft]	Stress Resultant		Stress Couples		Meridional Shear [kips/ft]	Radial Displacement [in]
	Meridional [kips/ft]	Hoop [kips/ft]	Meridional [ft kips/ft]	Hoop [ft kips/ft]		
0	-1.3	173.5	-30.0	99.5	35.1	0.074
3	-3.7	212.1	74.8	99.5	34.3	0.191
6	-24.1	292.4	164.0	99.5	24.8	0.303
10	-11.9	330.6	238.8	99.5	13.0	0.427
15	-15.9	377.9	278.6	99.5	3.2	0.538
20	-25.7	424.0	279.7	99.5	-2.6	0.604
30	-33.3	454.7	235.9	99.5	-11.3	0.640
40	-40.5	490.1	193.3	99.5	-10.4	0.618
60	-57.8	460.2	181.3	99.5	-10.7	0.572

DL = Dead Load ANSYS

VP = Vertical Tendon Prestress ANSYS

OTw = Operating Temperture in Winter

IP = Internal Pressure (60psig) RGE09

AT60 = Accident Pressure (P=60psig) T=286°F

E = 0.10 g Earthquake Horizontal + Vertical

PAGE 32 of 70

ANSYS RGE09 DESIGN VERIFICATION	
CLIENT	PG&E
JOB NO.	0950-073-1683
CALC/PROB NO.	0950-073-006
BY: GSB	DATE: 3/27/91
CHKD: TLT	DATE: 3/27/91





# Containment Shell Stress Resultants and Stress Couples

Loading: Load Combination      Comments:      Internal Pressure Case RGE09  
 Condition "c" LC 43: (1.0\*DL) + (1.0\*VP) + (1.0\*OTs) + (1.0\*IP) + (1.0\*AT60) + (2.0 \* E)

Height from Base [ft]	Stress Resultant		Stress Couples		Meridional Shear [kips/ft]	Radial Displacement [in]
	Meridional [kips/ft]	Hoop [kips/ft]	Meridional [ft kips/ft]	Hoop [ft kips/ft]		
0	-1.3	-86.9	-30.0	0.0	48.3	0.074
3	-3.7	78.2	100.6	0.0	38.8	0.254
6	-24.1	197.3	193.5	0.0	23.2	0.338
10	-11.9	284.2	250.6	0.0	6.4	0.436
15	-15.9	362.4	249.8	0.0	-5.9	0.521
20	-25.7	435.9	205.2	0.0	-11.5	0.585
30	-33.3	476.6	88.0	0.0	-16.8	0.622
40	-40.5	481.0	8.6	0.0	-12.5	0.608
60	-57.8	460.2	-12.4	0.0	-10.3	0.571

DL = Dead Load ANSYS  
 VP = Vertical Tendon Prestress ANSYS  
 OTs = Operating Temperature in Summer

IP = Internal Pressure (60psig) RGE09  
 AT60 = Accident Pressure (P=60psig) T=286°F  
 E = 0.10 g Earthquake Horizontal + Vertical ANSYS RGE09

PAGE 33 of 70

DESIGN VERIFICATION	
CLIENT	RGE
JOB NO.	0950-073-1683
CALC/PROB NO.	0950-073-006
BY: GSB	DATE: 3/27/91
CHKD: JH	DATE: 3/27/91

22

11.11.11



# Containment Shell Stress Resultants and Stress Couples

Loading: Load Combination

Comments:

Internal Pressure Case RGE10

Condition "a" LC 29: (1.0\*DL) + (1.0\*VP) + (1.0\*OTw) + (1.5\*IP) + (1.0\*AT90)

Height from Base [ft]	Stress Resultant		Stress Couples		Meridional Shear [kips/ft]	Radial Displacement [in]
	Meridional [kips/ft]	Hoop [kips/ft]	Meridional [ft kips/ft]	Hoop [ft kips/ft]		
0	-29.0	196.6	-135.0	99.5	62.3	0.121
3	-27.4	250.7	46.7	99.5	59.0	0.271
6	-49.3	387.6	194.3	99.5	40.0	0.419
10	-23.7	466.3	312.8	99.5	20.2	0.590
15	-21.1	546.6	369.0	99.5	3.7	0.748
20	-18.5	636.3	361.2	99.5	-5.8	0.849
30	-13.2	690.5	275.4	99.5	-9.4	0.923
40	-8.0	733.6	199.2	99.5	-5.5	0.915
60	2.5	700.7	176.6	99.5	3.2	0.893

DL = Dead Load ANSYS

VP = Vertical Tendon Prestress ANSYS

OTw = Operating Temperature in Winter

IP = Internal Pressure (60psig) RGE09

AT90 = Accident Pressure (P=90psig) T=312°F

PAGE 34 of 70

DESIGN VERIFICATION	
CLIENT	RGE
JOB NO.	0950-073-11083
CALC/PROB NO.	0950-073-006
BY: GSB	DATE: 3/27/91
CHKD: [Signature]	DATE: 3/27/91



# Containment Shell Stress Resultants and Stress Couples

Loading: Load Combination  
Condition "a" LC 31: (1.0\*DL) + (1.0\*VP) + (1.0\*OTs) + (1.5\*IP) + (1.0\*AT90)

Comments:

Internal Pressure Case RGE10

Height from Base [ft]	Stress Resultant		Stress Couples		Meridional Shear [kips/ft]	Radial Displacement [in]
	Meridional [kips/ft]	Hoop [kips/ft]	Meridional [ft kips/ft]	Hoop [ft kips/ft]		
0	-29.0	-63.8	-135.0	0.0	75.5	0.121
3	-27.4	116.8	72.5	0.0	63.5	0.334
6	-49.3	292.5	223.8	0.0	38.4	0.454
10	-23.7	419.9	324.6	0.0	13.6	0.599
15	-21.1	531.1	340.2	0.0	-5.4	0.731
20	-18.5	648.2	286.7	0.0	-14.7	0.830
30	-13.2	712.4	127.5	0.0	-14.9	0.905
40	-8.0	724.5	14.5	0.0	-7.6	0.905
60	2.5	700.7	-17.1	0.0	3.6	0.892

DL = Dead Load ANSYS

VP = Vertical Tendon Prestress ANSYS

OTs = Operating Temperture in Summer

IP = Internal Pressure (60psig) RGE09

AT90 = Accident Pressure (P=90psig) T=312°F

PAGE 35 of 70

DESIGN VERIFICATION	
CLIENT	RGE E
JOB NO.	0150-073-1683
CALC/PROB NO.	0150-073-006
BY: GSB	DATE 3/27/91
CHKD: [Signature]	DATE 3/27/91

## Containment Shell Stress Resultants and Stress Couples

Loading: Load Combination      Comments:      Internal Pressure Case RGE10  
 Condition "c" LC 41: (1.0\*DL) + (1.0\*VP) + (1.0\*OTw) + (1.0\*IP) + (1.0\*AT60) + (2.0 \* E)

Height from Base [ft]	Stress Resultant		Stress Couples		Meridional Shear [kips/ft]	Radial Displacement [in]
	Meridional [kips/ft]	Hoop [kips/ft]	Meridional [ft kips/ft]	Hoop [ft kips/ft]		
0	-1.3	175.6	-90.0	99.5	38.7	0.080
3	-3.7	211.1	25.5	99.5	37.9	0.190
6	-24.1	287.2	125.2	99.5	28.2	0.297
10	-11.9	322.8	212.7	99.5	15.9	0.419
15	-15.9	369.4	265.2	99.5	5.3	0.529
20	-25.7	416.9	274.9	99.5	-1.2	0.596
30	-33.3	450.7	239.0	99.5	-11.0	0.636
40	-40.5	488.9	196.9	99.5	-10.6	0.617
60	-57.8	460.6	181.8	99.5	-10.8	0.572

DL = Dead Load ANSYS

VP = Vertical Tendon Prestress ANSYS

OTw = Operating Temperature in Winter

IP = Internal Pressure (60psig) RGE09

AT60 = Accident Pressure (P=60psig) T=286°F

E = 0.10 g Earthquake Horizontal + Vertical

PAGE 36 of 70

ANSYS VERIFICATION	
CLIENT	RGE
JOB NO.	0950-073-1683
CALC/PROB NO.	0950-073-006
BY: GSB	DATE: 3/27/91
CHKD: JH	DATE: 3/27/91



# Containment Shell Stress Resultants and Stress Couples

Loading: Load Combination      Comments:      Internal Pressure Case RGE10  
 Condition "c" LC 43: (1.0\*DL) + (1.0\*VP) + (1.0\*OTs) + (1.0\*IP) + (1.0\*AT60) + (2.0 \* E)

Height from Base [ft]	Stress Resultant		Stress Couples		Meridional Shear [kips/ft]	Radial Displacement [in]
	Meridional [kips/ft]	Hoop [kips/ft]	Meridional [ft kips/ft]	Hoop [ft kips/ft]		
0	-1.3	-84.8	-90.0	0.0	51.9	0.080
3	-3.7	77.2	51.3	0.0	42.4	0.253
6	-24.1	192.1	154.7	0.0	26.6	0.332
10	-11.9	276.4	224.5	0.0	9.3	0.428
15	-15.9	353.9	236.4	0.0	-3.8	0.512
20	-25.7	428.8	200.4	0.0	-10.1	0.577
30	-33.3	472.6	91.1	0.0	-16.5	0.618
40	-40.5	479.8	12.2	0.0	-12.7	0.607
60	-57.8	460.6	-11.9	0.0	-10.4	0.571

DL = Dead Load ANSYS  
 VP = Vertical Tendon Prestress ANSYS  
 OTs = Operating Temperture in Summer

IP = Internal Pressure (60psig) RGE09  
 AT60 = Accident Pressure (P=60psig) T=286°F  
 E = 0.10 g Earthquake Horizontal + Vertical ANSYS RGE01

PAGE 30 of 70

DESIGN VERIFICATION	
CLIENT	DGE
JOB NO.	0950-073-1683
CALC/PROB NO.	0950-073-006
BY: GSB	DATE 3/27/91
CHECKED	DATE 4/1/91





# Containment Shell Stress Resultants and Stress Couples

Loading: Load Combination  
Condition "a" LC 29: (1.0\*DL) + (1.0\*VP) + (1.0\*OTw) + (1.5\*IP) + (1.0\*AT90)

Comments:

Internal Pressure Case RGE11

Height from Base [ft]	Stress Resultant		Stress Couples		Meridional Shear [kips/ft]	Radial Displacement [in]
	Meridional [kips/ft]	Hoop [kips/ft]	Meridional [ft kips/ft]	Hoop [ft kips/ft]		
0	-29.0	207.4	-450.0	99.5	80.8	0.153
3	-27.4	245.9	-212.3	99.5	77.7	0.266
6	-49.3	360.6	-9.5	99.5	57.8	0.390
10	-23.7	425.2	175.6	99.5	35.5	0.543
15	-21.1	502.0	298.2	99.5	14.9	0.698
20	-18.5	599.6	336.3	99.5	1.5	0.805
30	-13.2	669.5	291.6	99.5	-7.8	0.902
40	-8.0	727.4	217.8	99.5	-6.1	0.911
60	2.5	702.7	179.1	99.5	2.7	0.896

DL = Dead Load ANSYS

VP = Vertical Tendon Prestress ANSYS

OTw = Operating Temperature in Winter

IP = Internal Pressure (60psig) RGE09

AT90 = Accident Pressure (P=90psig) T=312°F

PAGE 38 of 70

DESIGN VERIFICATION	
CLIENT	<u>EG&amp;E</u>
JOB NO.	<u>0950-073-1683</u>
CALC/PROB NO.	<u>0950-073-006</u>
BY: <u>GSB</u>	DATE: <u>8/27/91</u>
CHKD: <u>HET</u>	DATE: <u>3/27/91</u>



# Containment Shell Stress Resultants and Stress Couples

Loading: Load Combination  
Condition "a" LC 31: (1.0\*DL) + (1.0\*VP) + (1.0\*OTs) + (1.5\*IP) + (1.0\*AT90)

Comments:

Internal Pressure Case RGE11

Height from Base [ft]	Stress Resultant		Stress Couples		Meridional Shear [kips/ft]	Radial Displacement [in]
	Meridional [kips/ft]	Hoop [kips/ft]	Meridional [ft kips/ft]	Hoop [ft kips/ft]		
0	-29.0	-53.0	-450.0	0.0	94.0	0.153
3	-27.4	112.0	-186.5	0.0	82.2	0.329
6	-49.3	265.5	20.0	0.0	56.2	0.425
10	-23.7	378.8	187.4	0.0	28.9	0.552
15	-21.1	486.5	269.4	0.0	5.8	0.681
20	-18.5	611.5	261.8	0.0	-7.4	0.786
30	-13.2	691.4	143.7	0.0	-13.3	0.884
40	-8.0	718.3	33.1	0.0	-8.2	0.901
60	2.5	702.7	-14.6	0.0	3.1	0.895

DL = Dead Load ANSYS

VP = Vertical Tendon Prestress ANSYS

OTs = Operating Temperture in Summer

IP = Internal Pressure (60psig) RGE09

AT90 = Accident Pressure (P=90psig) T=312°F

PAGE 39 of 70

DESIGN VERIFICATION	
CLIENT	RGE
JOB NO.	950-073-1683
CALC/PROB NO.	950-073-006
BY: GSB	DATE 8/27/91
CHKD: TPT	DATE 8/27/91



## Containment Shell Stress Resultants and Stress Couples

Loading: Load Combination      Comments:      Internal Pressure Case RGE11  
 Condition "c" LC 41: (1.0\*DL) + (1.0\*VP) + (1.0\*OTw) + (1.0\*IP) + (1.0\*AT60) + (2.0 \* E)

Height from Base [ft]	Stress Resultant		Stress Couples		Meridional Shear [kips/ft]	Radial Displacement [in]
	Meridional [kips/ft]	Hoop [kips/ft]	Meridional [ft kips/ft]	Hoop [ft kips/ft]		
0	-1.3	182.9	-300.0	99.5	51.0	0.102
3	-3.7	207.9	-147.2	99.5	50.4	0.186
6	-24.1	269.2	-10.7	99.5	40.1	0.277
10	-11.9	295.4	121.2	99.5	26.1	0.388
15	-15.9	339.8	217.9	99.5	12.8	0.495
20	-25.7	392.4	258.3	99.5	3.7	0.567
30	-33.3	436.7	249.8	99.5	-9.9	0.622
40	-40.5	484.8	209.3	99.5	-11.0	0.614
60	-57.8	462.0	183.5	99.5	-11.1	0.575

DL = Dead Load ANSYS  
 VP = Vertical Tendon Prestress ANSYS  
 OTw = Operating Temperature in Winter

IP = Internal Pressure (60psig) RGE09  
 AT60 = Accident Pressure (P=60psig) T=286°F  
 E = 0.10 g Earthquake Horizontal + Vertical ANSYS RGE01

PAGE 40 of 70

DESIGN VERIFICATION	
CLIENT	RGE
JOB NO.	0950-073-1683
CALC/PROB NO.	0950-073-006
BY: GSB	DATE: 8/27/91
CHKD: TAT	DATE: 8/27/91



# Containment Shell Stress Resultants and Stress Couples

Loading: Load Combination      Comments:      Internal Pressure Case RGE11  
 Condition "c" LC 43: (1.0\*DL) + (1.0\*VP) + (1.0\*OTs) + (1.0\*IP) + (1.0\*AT60) + (2.0 \* E)

Height from Base [ft]	Stress Resultant		Stress Couples		Meridional Shear [kips/ft]	Radial Displacement [in]
	Meridional [kips/ft]	Hoop [kips/ft]	Meridional [ft kips/ft]	Hoop [ft kips/ft]		
0	-1.3	-77.5	-300.0	0.0	64.2	0.102
3	-3.7	74.0	-121.4	0.0	54.9	0.249
6	-24.1	174.1	18.8	0.0	38.5	0.312
10	-11.9	249.0	133.0	0.0	19.5	0.397
15	-15.9	324.3	189.1	0.0	3.7	0.478
20	-25.7	404.3	183.8	0.0	-5.2	0.548
30	-33.3	458.6	101.9	0.0	-15.4	0.604
40	-40.5	475.7	24.6	0.0	-13.1	0.604
60	-57.8	462.0	-10.2	0.0	-10.7	0.574

DL = Dead Load ANSYS  
 VP = Vertical Tendon Prestress ANSYS  
 OTs = Operating Temperture in Summer

IP = Internal Pressure (60psig) RGE09  
 AT60 = Accident Pressure (P=60psig) T=286°F  
 E = 0.10 g Earthquake Horizontal + Vertical

PAGE 41 of 70

DESIGN VERIFICATION	
CLIENT	PGE
JOB NO.	0950-073-1683
CALC/PROB NO.	0950-073-006
BY: GSB	DATE: 3/27/91
CHKD: JH	DATE: 3/27/91





# Containment Shell Stress Resultants and Stress Couples

Loading: Load Combination      Comments:  
 Condition "a" LC 29: (1.0\*DL) + (1.0\*VP) + (1.0\*OTw) + (1.5\*IP) + (1.0\*AT90)

Internal Pressure Case RGE12

Height from Base [ft]	Stress Resultant		Stress Couples		Meridional Shear [kips/ft]	Radial Displacement [in]
	Meridional [kips/ft]	Hoop [kips/ft]	Meridional [ft kips/ft]	Hoop [ft kips/ft]		
0	-29.0	221.4	-892.6	99.5	107.3	0.194
3	-27.4	236.4	-574.7	99.5	104.5	0.254
6	-49.3	319.5	-293.4	99.5	83.1	0.344
10	-23.7	365.5	-14.0	99.5	57.0	0.475
15	-21.1	438.5	201.6	99.5	30.6	0.626
20	-18.5	547.7	303.6	99.5	11.5	0.744
30	-13.2	640.2	315.4	99.5	-5.7	0.873
40	-8.0	719.1	244.2	99.5	-7.1	0.904
60	2.5	705.7	182.6	99.5	2.0	0.900

DL = Dead Load ANSYS  
 VP = Vertical Tendon Prestress ANSYS  
 OTw = Operating Temperature in Winter

IP = Internal Pressure (60psig) RGE08  
 AT90 = Accident Pressure (P=90psig) T=312°F

PAGE 42 of 70

DESIGN VERIFICATION	
CLIENT	RGE
JOB NO.	0950-073-11083
CALC/PROB NO.	0950-073-006
BY: GSB	DATE: 8/27/91
CHKD: fct	DATE: 8/27/91

# Containment Shell Stress Resultants and Stress Couples

Loading: Load Combination  
Condition "a" LC 31: (1.0\*DL) + (1.0\*VP) + (1.0\*OTs) + (1.5\*IP) + (1.0\*AT90)

Comments:

Internal Pressure Case RGE12

Height from Base [ft]	Stress Resultant		Stress Couples		Meridional Shear [kips/ft]	Radial Displacement [in]
	Meridional [kips/ft]	Hoop [kips/ft]	Meridional [ft kips/ft]	Hoop [ft kips/ft]		
0	-29.0	-39.0	-892.6	0.0	120.5	0.194
3	-27.4	102.5	-548.9	0.0	109.0	0.317
6	-49.3	224.4	-263.9	0.0	81.5	0.379
10	-23.7	319.1	-2.2	0.0	50.4	0.484
15	-21.1	423.0	172.8	0.0	21.5	0.609
20	-18.5	559.6	229.1	0.0	2.6	0.725
30	-13.2	662.1	167.5	0.0	-11.2	0.855
40	-8.0	710.0	59.5	0.0	-9.2	0.894
60	2.5	705.7	-11.1	0.0	2.4	0.899

DL = Dead Load ANSYS

VP = Vertical Tendon Prestress ANSYS

OTs = Operating Temperture in Summer

IP = Internal Pressure (60psig) RGE08

AT90 = Accident Pressure (P=90psig) T=312°F

PAGE 43 of 70

DESIGN VERIFICATION	
CLIENT	RGE
JOB NO.	0950-073-1683
CALC/PROB NO.	0950-073-006
BY: GSB	DATE: 3/27/91
CHKD: T/A	DATE: 3/27/91

# Containment Shell Stress Resultants and Stress Couples

Loading: Load Combination

Comments:

Internal Pressure Case RGE12

Condition "c" LC 41: (1.0\*DL) + (1.0\*VP) + (1.0\*OTw) + (1.0\*IP) + (1.0\*AT60) + (2.0 \* E)

Height from Base [ft]	Stress Resultant		Stress Couples		Meridional Shear [kips/ft]	Radial Displacement [in]
	Meridional [kips/ft]	Hoop [kips/ft]	Meridional [ft kips/ft]	Hoop [ft kips/ft]		
0	-1.3	192.2	-595.1	99.5	68.6	0.129
3	-3.7	201.6	-388.8	99.5	68.2	0.178
6	-24.1	241.8	-199.9	99.5	56.9	0.247
10	-11.9	255.6	-5.2	99.5	40.5	0.342
15	-15.9	297.4	153.6	99.5	23.2	0.447
20	-25.7	357.9	236.5	99.5	10.4	0.526
30	-33.3	417.2	265.6	99.5	-8.5	0.603
40	-40.5	479.3	226.9	99.5	-11.6	0.609
60	-57.8	464.0	185.8	99.5	-11.6	0.577

DL = Dead Load ANSYS

VP = Vertical Tendon Prestress ANSYS

OTw = Operating Temperature in Winter

IP = Internal Pressure (60psig) RGE08

AT60 = Accident Pressure (P=60psig) T=286°F

E = 0.10 g Earthquake Horizontal + Vertical

PAGE 44 of 70

DESIGN VERIFICATION	
CLIENT	PG&E
JOB NO.	0950-073-1683
CALC/PROB NO.	0950-073-006
BY: GSP	DATE: 3/27/91
CHKD: [Signature]	DATE: 3/27/91



# Containment Shell Stress Resultants and Stress Couples

Loading: Load Combination

Comments:

Internal Pressure Case RGE12

Condition "c" LC 43: (1.0\*DL) + (1.0\*VP) + (1.0\*OTs) + (1.0\*IP) + (1.0\*AT60) + (2.0 \* E)

Height from Base [ft]	Stress Resultant		Stress Couples		Meridional Shear [kips/ft]	Radial Displacement [in]
	Meridional [kips/ft]	Hoop [kips/ft]	Meridional [ft kips/ft]	Hoop [ft kips/ft]		
0	-1.3	-68.2	-595.1	0.0	81.8	0.129
3	-3.7	67.7	-363.0	0.0	72.7	0.241
6	-24.1	146.7	-170.4	0.0	55.3	0.282
10	-11.9	209.2	6.6	0.0	33.9	0.351
15	-15.9	281.9	124.8	0.0	14.1	0.430
20	-25.7	369.8	162.0	0.0	1.5	0.507
30	-33.3	439.1	117.7	0.0	-14.0	0.585
40	-40.5	470.2	42.2	0.0	-13.7	0.599
60	-57.8	464.0	-7.9	0.0	-11.2	0.576

DL = Dead Load ANSYS

VP = Vertical Tendon Prestress ANSYS

OTs = Operating Temperture in Summer

IP = Internal Pressure (60psig) RGE08

AT60 = Accident Pressure (P=60psig) T=286°F

E = 0.10 g Earthquake Horizontal + Vertical ANSYS RGE01

PAGE 45 of 70

DESIGN VERIFICATION	
CLIENT	RGE
JOB NO.	0950-073-1683
CALC/PROB NO.	0950-073-006
BY: GSB	DATE: 3/27/91
CHKD: T/A	DATE: 3/27/91



# Containment Shell Stress Resultants and Stress Couples

Loading: Load Combination      Comments:  
 Condition "a" LC 29: (1.0\*DL) + (1.0\*VP) + (1.0\*OTw) + (1.5\*IP) + (1.0\*AT90)

Internal Pressure Case RGE14

Height from Base [ft]	Stress Resultant		Stress Couples		Meridional Shear [kips/ft]	Radial Displacement [in]
	Meridional [kips/ft]	Hoop [kips/ft]	Meridional [ft kips/ft]	Hoop [ft kips/ft]		
0	-29.0	161.0	0.0	99.5	64.5	0.000
3	-27.4	201.7	185.2	99.5	59.3	0.189
6	-49.3	341.7	328.1	99.5	36.9	0.368
10	-23.7	447.0	428.7	99.5	14.7	0.569
15	-21.1	547.3	454.5	99.5	-2.6	0.751
20	-18.5	649.0	416.6	99.5	-11.4	0.863
30	-13.2	704.3	288.1	99.5	-12.4	0.939
40	-8.0	741.9	194.5	99.5	-6.2	0.924
60	2.5	700.4	172.7	99.5	3.6	0.893

DL = Dead Load ANSYS  
 VP = Vertical Tendon Prestress ANSYS  
 OTw = Operating Temperature in Winter

IP = Internal Pressure (60psig) RGE09  
 AT90 = Accident Pressure (P=90psig) T=312°F

PAGE 46 of 70

DESIGN VERIFICATION	
CLIENT	RGE
JOB NO.	0950-073-16B3
CALC/PROB NO.	0950-073-006
BY: GSB	DATE: 5/27/91
CHKD: JPT	DATE: 5/27/91





# Containment Shell Stress Resultants and Stress Couples

Loading: Load Combination

Comments:

Internal Pressure Case RGE14

Condition "a" LC 31: (1.0\*DL) + (1.0\*VP) + (1.0\*OTs) + (1.5\*IP) + (1.0\*AT90)

Height from Base [ft]	Stress Resultant		Stress Couples		Meridional Shear [kips/ft]	Radial Displacement [in]
	Meridional [kips/ft]	Hoop [kips/ft]	Meridional [ft kips/ft]	Hoop [ft kips/ft]		
0	-29.0	-99.4	0.0	0.0	77.7	0.000
3	-27.4	67.8	211.0	0.0	63.8	0.252
6	-49.3	246.6	357.6	0.0	35.3	0.403
10	-23.7	400.6	440.5	0.0	8.1	0.578
15	-21.1	531.8	425.7	0.0	-11.7	0.734
20	-18.5	660.9	342.1	0.0	-20.3	0.844
30	-13.2	726.2	140.2	0.0	-17.9	0.921
40	-8.0	732.8	9.8	0.0	-8.3	0.914
60	2.5	700.4	-21.0	0.0	4.0	0.892

DL = Dead Load ANSYS

VP = Vertical Tendon Prestress ANSYS

OTs = Operating Temperature in Summer

IP = Internal Pressure (60psig) RGE09

AT90 = Accident Pressure (P=90psig) T=312°F

PAGE 47 of 70

DESIGN VERIFICATION	
CLIENT	RGE & F
JOB NO.	0950-073-11083
CALC/PROB NO.	0950-073-006
BY: GSB	DATE: 3/27/91
CHKD: TAT	DATE: 3/27/91

# Containment Shell Stress Resultants and Stress Couples

Loading: Load Combination      Comments:      Internal Pressure Case RGE14  
 Condition "c" LC 41: (1.0\*DL) + (1.0\*VP) + (1.0\*OTw) + (1.0\*IP) + (1.0\*AT60) + (2.0 \* E)

Height from Base [ft]	Stress Resultant		Stress Couples		Meridional Shear [kips/ft]	Radial Displacement [in]
	Meridional [kips/ft]	Hoop [kips/ft]	Meridional [ft kips/ft]	Hoop [ft kips/ft]		
0	-1.3	151.9	0.0	99.5	40.1	0.000
3	-3.7	178.5	117.8	99.5	38.1	0.135
6	-24.1	256.6	214.5	99.5	26.1	0.263
10	-11.9	310.0	290.0	99.5	12.3	0.405
15	-15.9	369.9	322.1	99.5	1.1	0.531
20	-25.7	425.4	311.9	99.5	-4.9	0.606
30	-33.3	459.9	247.5	99.5	-13.0	0.647
40	-40.5	494.4	193.8	99.5	-11.1	0.623
60	-57.8	460.5	179.2	99.5	-10.5	0.573

DL = Dead Load ANSYS  
 VP = Vertical Tendon Prestress ANSYS  
 OTw = Operating Temperature in Winter

IP = Internal Pressure (60psig) RGE09  
 AT60 = Accident Pressure (P=60psig) T=286°F  
 E = 0.10 g Earthquake Horizontal + Vertical

PAGE 48 of 70

DESIGN VERIFICATION	
CLIENT	RGE
JOB NO.	0950-073-1683
CALC/PROB NO.	0950-073-006
BY: GSB	DATE: 3/27/91
CHKD: JBT	DATE: 3/27/91

# Containment Shell Stress Resultants and Stress Couples

Loading: Load Combination      Comments:      Internal Pressure Case RGE14  
 Condition "c" LC 43: (1.0\*DL) + (1.0\*VP) + (1.0\*OTs) + (1.0\*IP) + (1.0\*AT60) + (2.0 \* E)

Height from Base [ft]	Stress Resultant		Stress Couples		Meridional Shear [kips/ft]	Radial Displacement [in]
	Meridional [kips/ft]	Hoop [kips/ft]	Meridional [ft kips/ft]	Hoop [ft kips/ft]		
0	-1.3	-108.5	0.0	0.0	53.3	0.000
3	-3.7	44.6	143.6	0.0	42.6	0.198
6	-24.1	161.5	244.0	0.0	24.5	0.298
10	-11.9	263.6	301.8	0.0	5.7	0.414
15	-15.9	354.4	293.3	0.0	-8.0	0.514
20	-25.7	437.3	237.4	0.0	-13.8	0.587
30	-33.3	481.8	99.6	0.0	-18.5	0.629
40	-40.5	485.3	9.1	0.0	-13.2	0.613
60	-57.8	460.5	-14.5	0.0	-10.1	0.572

DL = Dead Load ANSYS  
 VP = Vertical Tendon Prestress ANSYS  
 OTs = Operating Temperture in Summer

IP = Internal Pressure (60psig) RGE09  
 AT60 = Accident Pressure (P=60psig) T=286°F  
 E = 0.10 g Earthquake Horizontal + Vertical ANSYS RGE01

PAGE 49 of 70

DESIGN VERIFICATION	
CLIENT	RGE
JOB NO.	0950-073-1683
CALC/PROB NO.	0950-073-006
BY: GSB	DATE: 5/27/01
CHKD: JAT	DATE: 5/27/01

# Containment Shell Stress Resultants and Stress Couples

Loading: Load Combination  
Condition "a" LC 29: (1.0\*DL) + (1.0\*VP) + (1.0\*OTw) + (1.5\*IP) + (1.0\*AT90)

Comments:

Internal Pressure Case RGE15

Height from Base [ft]	Stress Resultant		Stress Couples		Meridional Shear [kips/ft]	Radial Displacement [in]
	Meridional [kips/ft]	Hoop [kips/ft]	Meridional [ft kips/ft]	Hoop [ft kips/ft]		
0	-29.0	161.2	-45.0	99.5	67.6	0.000
3	-27.4	198.8	149.4	99.5	62.3	0.184
6	-49.3	335.3	301.1	99.5	39.6	0.361
10	-23.7	439.5	411.6	99.5	16.9	0.560
15	-21.1	540.1	446.8	99.5	-1.0	0.743
20	-18.5	643.6	415.0	99.5	-10.4	0.857
30	-13.2	701.5	291.3	99.5	-12.2	0.937
40	-8.0	741.3	197.3	99.5	-6.4	0.924
60	2.5	700.8	172.9	99.5	3.5	0.894

DL = Dead Load ANSYS

VP = Vertical Tendon Prestress ANSYS

OTw = Operating Temperature in Winter

IP = Internal Pressure (60psig) RGE09

AT90 = Accident Pressure (P=90psig) T=312°F

PAGE 50 of 70

DESIGN VERIFICATION	
CLIENT <u>RGE</u>	
JOB NO. <u>950-073-1683</u>	
CALC/PROB NO. <u>950-073-006</u>	
BY: <u>CSB</u>	DATE: <u>3/27/91</u>
CHKD: <u>1/27</u>	DATE: <u>3/27/91</u>



## Containment Shell Stress Resultants and Stress Couples

Loading: Load Combination      Comments:  
 Condition "a" LC 31: (1.0\*DL) + (1.0\*VP) + (1.0\*OTs) + (1.5\*IP) + (1.0\*AT90)

Internal Pressure Case RGE15

Height from Base [ft]	Stress Resultant		Stress Couples		Meridional Shear	Radial Displacement
	Meridional [kips/ft]	Hoop [kips/ft]	Meridional [ft kips/ft]	Hoop [ft kips/ft]	[kips/ft]	[in]
0	-29.0	-99.2	-45.0	0.0	80.8	0.000
3	-27.4	64.9	175.2	0.0	66.8	0.247
6	-49.3	240.2	330.6	0.0	38.0	0.396
10	-23.7	393.1	423.4	0.0	10.3	0.569
15	-21.1	524.6	418.0	0.0	-10.1	0.726
20	-18.5	655.5	340.5	0.0	-19.3	0.838
30	-13.2	723.4	143.4	0.0	-17.7	0.919
40	-8.0	732.2	12.6	0.0	-8.5	0.914
60	2.5	700.8	-20.8	0.0	3.9	0.893

DL = Dead Load ANSYS  
 VP = Vertical Tendon Prestress ANSYS  
 OTs = Operating Temperature in Summer

IP = Internal Pressure (60psig) RGE09  
 AT90 = Accident Pressure (P=90psig) T=812°F

PAGE 51 of 70

DESIGN VERIFICATION	
CLIENT	DGE
JOB NO.	0950-073-1683
CALC/PROB NO.	0950-073-006
BY: GSB	DATE: 5/27/91
CHKD: JAT	DATE: 5/27/91

# Containment Shell Stress Resultants and Stress Couples

Loading: Load Combination

Comments:

Internal Pressure Case RGE15

Condition "c" LC 41: (1.0\*DL) + (1.0\*VP) + (1.0\*OTw) + (1.0\*IP) + (1.0\*AT60) + (2.0 \* E)

Height from Base [ft]	Stress Resultant		Stress Couples		Meridional Shear [kips/ft]	Radial Displacement [in]
	Meridional [kips/ft]	Hoop [kips/ft]	Meridional [ft kips/ft]	Hoop [ft kips/ft]		
0	-1.3	152.0	-30.0	99.5	42.2	0.000
3	-3.7	176.5	93.9	99.5	40.1	0.132
6	-24.1	252.3	196.4	99.5	27.9	0.258
10	-11.9	305.0	278.6	99.5	13.7	0.399
15	-15.9	365.1	317.0	99.5	2.2	0.525
20	-25.7	421.8	310.8	99.5	-4.3	0.601
30	-33.3	458.1	249.6	99.5	-12.9	0.645
40	-40.5	494.0	195.6	99.5	-11.2	0.623
60	-57.8	460.7	179.3	99.5	-10.6	0.573

DL = Dead Load ANSYS

VP = Vertical Tendon Prestress ANSYS

OTw = Operating Temperture in Winter

IP = Internal Pressure (60psig) RGE09

AT60 = Accident Pressure (P=60psig) T=286°F

E = 0.10 g Earthquake Horizontal + Vertical

PAGE 52 of 70

DESIGN VERIFICATION	
CLIENT	RGE
JOB NO.	0950-073-1683
CALC/PROB NO.	0950-073-006
BY: GSB	DATE: 3/27/91
CHKD: Jdt	DATE: 3/27/91





# Containment Shell Stress Resultants and Stress Couples

Loading: Load Combination

Comments:

Internal Pressure Case RGE15

Condition "c" LC 43: (1.0\*DL) + (1.0\*VP) + (1.0\*OTs) + (1.0\*IP) + (1.0\*AT60) + (2.0 \* E)

Height from Base [ft]	Stress Resultant		Stress Couples		Meridional Shear [kips/ft]	Radial Displacement [in]
	Meridional [kips/ft]	Hoop [kips/ft]	Meridional [ft kips/ft]	Hoop [ft kips/ft]		
0	-1.3	-108.4	-30.0	0.0	55.4	0.000
3	-3.7	42.6	119.7	0.0	44.6	0.195
6	-24.1	157.2	225.9	0.0	26.3	0.293
10	-11.9	258.6	290.4	0.0	7.1	0.408
15	-15.9	349.6	288.2	0.0	-6.9	0.508
20	-25.7	433.7	236.3	0.0	-13.2	0.582
30	-33.3	480.0	101.7	0.0	-18.4	0.627
40	-40.5	484.9	10.9	0.0	-13.3	0.613
60	-57.8	460.7	-14.4	0.0	-10.2	0.572

DL = Dead Load ANSYS

VP = Vertical Tendon Prestress ANSYS

OTs = Operating Temperture in Summer

IP = Internal Pressure (60psig) RGE09

AT60 = Accident Pressure (P=60psig) T=286°F

E = 0.10 g Earthquake Horizontal + Vertical ANSYS RGE01

PAGE 53 of 70

DESIGN VERIFICATION	
CLIENT	RGE
JOB NO.	0950-073-1683
CALC/PROB NO.	0950-073-006
BY: GSB	DATE: 5/27/91
CHKD: /AT	DATE: 3/27/91



# Containment Shell Stress Resultants and Stress Couples

Loading: Load Combination  
Condition "a" LC 29: (1.0\*DL) + (1.0\*VP) + (1.0\*OTw) + (1.5\*IP) + (1.0\*AT90)

Comments:

Internal Pressure Case RGE16

Height from Base [ft]	Stress Resultant		Stress Couples		Meridional Shear [kips/ft]	Radial Displacement [in]
	Meridional [kips/ft]	Hoop [kips/ft]	Meridional [ft kips/ft]	Hoop [ft kips/ft]		
0	-29.0	161.6	-135.0	99.5	73.7	0.000
3	-27.4	192.9	77.8	99.5	68.4	0.175
6	-49.3	322.5	246.9	99.5	45.1	0.347
10	-23.7	424.5	377.4	99.5	21.3	0.543
15	-21.1	525.8	431.4	99.5	2.0	0.727
20	-18.5	632.8	411.9	99.5	-8.6	0.844
30	-13.2	695.9	297.6	99.5	-12.0	0.931
40	-8.0	740.0	202.9	99.5	-6.7	0.923
60	2.5	701.4	173.4	99.5	3.3	0.894

DL = Dead Load ANSYS

VP = Vertical Tendon Prestress ANSYS

OTw = Operating Temperature in Winter

IP = Internal Pressure (60psig) RGE09

AT90 = Accident Pressure (P=90psig) T=312°F

PAGE 54 of 70

DESIGN VERIFICATION	
CLIENT	RGE
JOB NO.	0950-073-11683
CALC/PROB NO.	0950-073-006
BY: GSB	DATE: 5/27/91
CHKD: T/t	DATE: 5/27/91

# Containment Shell Stress Resultants and Stress Couples

Loading: Load Combination      Comments:  
 Condition "a" LC 31: (1.0\*DL) + (1.0\*VP) + (1.0\*OTs) + (1.5\*IP) + (1.0\*AT90)

Internal Pressure Case RGE16

Height from Base [ft]	Stress Resultant		Stress Couples		Meridional Shear [kips/ft]	Radial Displacement [in]
	Meridional [kips/ft]	Hoop [kips/ft]	Meridional [ft kips/ft]	Hoop [ft kips/ft]		
0	-29.0	-98.8	-135.0	0.0	86.9	0.000
3	-27.4	59.0	103.6	0.0	72.9	0.238
6	-49.3	227.4	276.4	0.0	43.5	0.382
10	-23.7	378.1	389.2	0.0	14.7	0.552
15	-21.1	510.3	402.6	0.0	-7.1	0.710
20	-18.5	644.7	337.4	0.0	-17.5	0.825
30	-13.2	717.8	149.7	0.0	-17.5	0.913
40	-8.0	730.9	18.2	0.0	-8.8	0.913
60	2.5	701.4	-20.3	0.0	3.7	0.893

DL = Dead Load ANSYS  
 VP = Vertical Tendon Prestress ANSYS  
 OTs = Operating Temperture in Summer

IP = Internal Pressure (60psig) RGE09  
 AT90 = Accident Pressure (P=90psig) T=312°F

PAGE 55 of 70

DESIGN VERIFICATION	
CLIENT <u>RGE</u>	
JOB NO. <u>0950-073-1683</u>	
CALC/PROB NO. <u>0950-073-006</u>	
BY: <u>GSB</u>	DATE: <u>3/27/91</u>
CHKD: <u>JS</u>	DATE: <u>3/27/91</u>

# Containment Shell Stress Resultants and Stress Couples

Loading: Load Combination      Comments:      Internal Pressure Case RGE16  
 Condition "c" LC 41: (1.0\*DL) + (1.0\*VP) + (1.0\*OTw) + (1.0\*IP) + (1.0\*AT60) + (2.0 \* E)

Height from Base [ft]	Stress Resultant		Stress Couples		Meridional Shear [kips/ft]	Radial Displacement [in]
	Meridional [kips/ft]	Hoop [kips/ft]	Meridional [ft kips/ft]	Hoop [ft kips/ft]		
0	-1.3	152.3	-90.0	99.5	46.3	0.000
3	-3.7	172.6	46.2	99.5	44.2	0.126
6	-24.1	243.8	160.3	99.5	31.6	0.249
10	-11.9	295.0	255.8	99.5	16.7	0.388
15	-15.9	355.6	306.8	99.5	4.2	0.515
20	-25.7	414.6	308.7	99.5	-3.0	0.593
30	-33.3	454.4	253.8	99.5	-12.7	0.642
40	-40.5	493.2	199.4	99.5	-11.4	0.622
60	-57.8	461.1	179.7	99.5	-10.7	0.573

DL = Dead Load ANSYS  
 VP = Vertical Tendon Prestress ANSYS  
 OTw = Operating Temperature in Winter

IP = Internal Pressure (60psig) RGE09  
 AT60 = Accident Pressure (P=60psig) T=286°F  
 E = 0.10 g Earthquake Horizontal + Vertical

PAGE 56 of 70

ANSYS RGE01 VERIFICATION	
CLIENT	RGE
JOB NO.	950-073-1683
CALC/PROB NO.	950-073-006
BY: GSB	DATE: 3/27/91
CHKD: Ht	DATE: 3/27/91

# Containment Shell Stress Resultants and Stress Couples

Loading: Load Combination

Comments:

Internal Pressure Case RGE16

Condition "c" LC 43: (1.0\*DL) + (1.0\*VP) + (1.0\*OTs) + (1.0\*IP) + (1.0\*AT60) + (2.0 \* E)

Height from Base [ft]	Stress Resultant		Stress Couples		Meridional Shear [kips/ft]	Radial Displacement [in]
	Meridional [kips/ft]	Hoop [kips/ft]	Meridional [ft kips/ft]	Hoop [ft kips/ft]		
0	-1.3	-108.1	-90.0	0.0	59.5	0.000
3	-3.7	38.7	72.0	0.0	48.7	0.189
6	-24.1	148.7	189.8	0.0	30.0	0.284
10	-11.9	248.6	267.6	0.0	10.1	0.397
15	-15.9	340.1	278.0	0.0	-4.9	0.498
20	-25.7	426.5	234.2	0.0	-11.9	0.574
30	-33.3	476.3	105.9	0.0	-18.2	0.624
40	-40.5	484.1	14.7	0.0	-13.5	0.612
60	-57.8	461.1	-14.0	0.0	-10.3	0.572

DL = Dead Load ANSYS

VP = Vertical Tendon Prestress ANSYS

OTs = Operating Temperature in Summer

IP = Internal Pressure (60psig) RGE09

AT60 = Accident Pressure (P=60psig) T=286°F

E = 0.10 g Earthquake Horizontal + Vertical ANSYS RGE01

PAGE 57 of 70

DESIGN VERIFICATION	
CLIENT	RGE & E
JOB NO.	950-073-1683
CALC/PROB NO.	950-073-006
BY: GSB	DATE: 5/27/91
CHKD: TBT	DATE: 5/27/91





# Containment Shell Stress Resultants and Stress Couples

Loading: Load Combination  
Condition "a" LC 29: (1.0\*DL) + (1.0\*VP) + (1.0\*OTw) + (1.5\*IP) + (1.0\*AT90)

Comments:

Internal Pressure Case RGE17

Height from Base [ft]	Stress Resultant		Stress Couples		Meridional Shear [kips/ft]	Radial Displacement [in]
	Meridional [kips/ft]	Hoop [kips/ft]	Meridional [ft kips/ft]	Hoop [ft kips/ft]		
0	-29.0	162.9	-450.0	99.5	95.3	0.000
3	-27.4	172.3	-172.7	99.5	89.7	0.144
6	-49.3	277.7	57.5	99.5	64.4	0.297
10	-23.7	372.1	257.9	99.5	36.9	0.484
15	-21.1	475.6	377.6	99.5	12.8	0.671
20	-18.5	595.1	400.7	99.5	-2.1	0.799
30	-13.2	676.4	319.9	99.5	-11.0	0.912
40	-8.0	735.6	222.6	99.5	-7.6	0.920
60	2.5	703.7	175.1	99.5	2.9	0.897

DL = Dead Load ANSYS

VP = Vertical Tendon Prestress ANSYS

OTw = Operating Temperture in Winter

IP = Internal Pressure (60psig) RGE09

AT90 = Accident Pressure (P=90psig) T=312°F

PAGE 58 of 70

DESIGN VERIFICATION	
CLIENT	RGE & E
JOB NO.	0950-073-1683
CALC/PROB NO.	0950-073-006
BY: GSB	DATE 3/27/91
CHKD: TPT	DATE 3/27/91

# Containment Shell Stress Resultants and Stress Couples

Loading: Load Combination  
Condition "a" LC 31: (1.0\*DL) + (1.0\*VP) + (1.0\*OTs) + (1.5\*IP) + (1.0\*AT90)

Comments:

Internal Pressure Case RGE17

Height from Base [ft]	Stress Resultant		Stress Couples		Meridional Shear [kips/ft]	Radial Displacement [in]
	Meridional [kips/ft]	Hoop [kips/ft]	Meridional [ft kips/ft]	Hoop [ft kips/ft]		
0	-29.0	-97.5	-450.0	0.0	108.5	0.000
3	-27.4	38.4	-146.9	0.0	94.2	0.207
6	-49.3	182.6	87.0	0.0	62.8	0.332
10	-23.7	325.7	269.7	0.0	30.3	0.493
15	-21.1	460.1	348.8	0.0	3.7	0.654
20	-18.5	607.0	326.2	0.0	-11.0	0.780
30	-13.2	698.3	172.0	0.0	-16.5	0.894
40	-8.0	726.5	37.9	0.0	-9.7	0.910
60	2.5	703.7	-18.6	0.0	3.3	0.896

DL = Dead Load ANSYS

VP = Vertical Tendon Prestress ANSYS

OTs = Operating Temperture in Summer

IP = Internal Pressure (60psig) RGE09

AT90 = Accident Pressure (P=90psig) T=312°F

PAGE 59 of 70

DESIGN VERIFICATION	
CLIENT	RGE
JOB NO.	0950-073-1683
CALC/PROB NO.	0950-073-006
BY: GSB	DATE: 3/27/91
CHKD: T/A	DATE: 3/27/91



# Containment Shell Stress Resultants and Stress Couples

Loading: Load Combination      Comments:      Internal Pressure Case RGE17  
 Condition "c" LC 41: (1.0\*DL) + (1.0\*VP) + (1.0\*OTw) + (1.0\*IP) + (1.0\*AT60) + (2.0 \* E)

Height from Base [ft]	Stress Resultant		Stress Couples		Meridional Shear	Radial Displacement
	Meridional [kips/ft]	Hoop [kips/ft]	Meridional [ft kips/ft]	Hoop [ft kips/ft]	[kips/ft]	[in]
0	-1.3	153.2	-300.0	99.5	60.6	0.000
3	-3.7	158.8	-120.8	99.5	58.3	0.105
6	-24.1	213.9	34.1	99.5	44.4	0.215
10	-11.9	260.0	176.1	99.5	27.1	0.348
15	-15.9	322.1	270.9	99.5	11.4	0.477
20	-25.7	389.4	301.3	99.5	1.3	0.563
30	-33.3	441.3	268.6	99.5	-12.1	0.629
40	-40.5	490.3	212.5	99.5	-12.0	0.620
60	-57.8	462.6	180.8	99.5	-11.0	0.575

DL = Dead Load ANSYS  
 VP = Vertical Tendon Prestress ANSYS  
 OTw = Operating Temperature in Winter

IP = Internal Pressure (60psig) RGE09  
 AT60 = Accident Pressure (P=60psig) T=286°F  
 E = 0.10 g Earthquake Horizontal + Vertical

PAGE 60 of 70

ANALYSIS VERIFICATION	
CLIENT	RGE
JOB NO.	0950-073-1683
CALC/PROB NO.	0950-073-006
BY: GSB	DATE: 3/27/91
CHKD: TLT	DATE: 3/27/91

8 28

1 2 3 4 5



# Containment Shell Stress Resultants and Stress Couples

Loading: Load Combination      Comments:      Internal Pressure Case RGE17  
 Condition "c" LC 43: (1.0\*DL) + (1.0\*VP) + (1.0\*OTs) + (1.0\*IP) + (1.0\*AT60) + (2.0 \* E)

Height from Base [ft]	Stress Resultant		Stress Couples		Meridional Shear [kips/ft]	Radial Displacement [in]
	Meridional [kips/ft]	Hoop [kips/ft]	Meridional [ft kips/ft]	Hoop [ft kips/ft]		
0	-1.3	-107.2	-300.0	0.0	73.8	0.000
3	-3.7	24.9	-95.0	0.0	62.8	0.168
6	-24.1	118.8	63.6	0.0	42.8	0.250
10	-11.9	213.6	187.9	0.0	20.5	0.357
15	-15.9	306.6	242.1	0.0	2.3	0.460
20	-25.7	401.3	226.8	0.0	-7.6	0.544
30	-33.3	463.2	120.7	0.0	-17.6	0.611
40	-40.5	481.2	27.8	0.0	-14.1	0.610
60	-57.8	462.6	-12.9	0.0	-10.6	0.574

DL = Dead Load ANSYS

VP = Vertical Tendon Prestress ANSYS ANSYS

OTs = Operating Temperature in Summer

IP = Internal Pressure (60psig) RGE09

AT60 = Accident Pressure (P=60psig) T=286°F

E = 0.10 g Earthquake Horizontal + Vertical ANSYS VERIFICATION

PAGE 61 of 70

CLIENT <u>RGE</u>	
JOB NO. <u>0950-073-1083</u>	
CALC/PROB NO. <u>0950-073-006</u>	
BY: <u>GSB</u>	DATE <u>5/27/91</u>
CHKD: <u>ttt</u>	DATE <u>5/27/91</u>

# Containment Shell Stress Resultants and Stress Couples

Loading: Load Combination      Comments:  
 Condition "a" LC 29: (1.0\*DL) + (1.0\*VP) + (1.0\*OTw) + (1.5\*IP) + (1.0\*AT90)

Internal Pressure Case RGE18

Height from Base [ft]	Stress Resultant		Stress Couples		Meridional Shear [kips/ft]	Radial Displacement [in]
	Meridional [kips/ft]	Hoop [kips/ft]	Meridional [ft kips/ft]	Hoop [ft kips/ft]		
0	-29.0	166.2	-1213.8	99.5	147.6	0.000
3	-27.4	122.2	-780.1	99.5	141.3	0.068
6	-49.3	169.0	-401.8	99.5	111.1	0.177
10	-23.7	244.8	-31.9	99.5	74.7	0.340
15	-21.1	354.0	247.2	99.5	38.8	0.535
20	-18.5	503.6	373.7	99.5	13.6	0.690
30	-13.2	629.0	373.8	99.5	-8.8	0.866
40	-8.0	725.0	270.3	99.5	-10.0	0.913
60	2.5	709.3	179.3	99.5	1.7	0.904

DL = Dead Load ANSYS  
 VP = Vertical Tendon Prestress ANSYS  
 OTw = Operating Temperture in Winter

IP = Internal Pressure (60psig) RGE09  
 AT90 = Accident Pressure (P=90psig) T=312°F

PAGE 62 of 70

DESIGN VERIFICATION	
CLIENT	RGE
JOB NO.	0950-073-1683
CALC/PROB NO.	0950-073-006
BY: GSB	DATE: 3/27/91
CHKD: TLT	DATE: 3/27/91





# Containment Shell Stress Resultants and Stress Couples

Loading: Load Combination  
Condition "a" LC 31: (1.0\*DL) + (1.0\*VP) + (1.0\*OTs) + (1.5\*IP) + (1.0\*AT90)

Comments:

Internal Pressure Case RGE18

Height from Base [ft]	Stress Resultant		Stress Couples		Meridional Shear [kips/ft]	Radial Displacement [in]
	Meridional [kips/ft]	Hoop [kips/ft]	Meridional [ft kips/ft]	Hoop [ft kips/ft]		
0	-29.0	-94.2	-1213.8	0.0	160.8	0.000
3	-27.4	-11.7	-754.3	0.0	145.8	0.131
6	-49.3	73.9	-372.3	0.0	109.5	0.212
10	-23.7	198.4	-20.1	0.0	68.1	0.349
15	-21.1	338.5	218.4	0.0	29.7	0.518
20	-18.5	515.5	299.2	0.0	4.7	0.671
30	-13.2	650.9	225.9	0.0	-14.3	0.848
40	-8.0	715.9	85.6	0.0	-12.1	0.903
60	2.5	709.3	-14.4	0.0	2.1	0.903

DL = Dead Load ANSYS

VP = Vertical Tendon Prestress ANSYS

OTs = Operating Temperture in Summer

IP = Internal Pressure (60psig) RGE09

AT90 = Accident Pressure (P=90psig) T=312°F

PAGE 63 of 70

DESIGN VERIFICATION	
CLIENT <u>RGE</u>	
JOB NO. <u>0950-073-1683</u>	
CALC/PROB NO. <u>0950-073-006</u>	
BY: <u>GSB</u>	DATE: <u>5/27/91</u>
CHKD: <u>Tjt</u>	DATE: <u>5/27/91</u>



# Containment Shell Stress Resultants and Stress Couples

Loading: Load Combination      Comments:      Internal Pressure Case RGE18  
 Condition "c" LC 41: (1.0\*DL) + (1.0\*VP) + (1.0\*OTw) + (1.0\*IP) + (1.0\*AT60) + (2.0 \* E)

Height from Base [ft]	Stress Resultant		Stress Couples		Meridional Shear [kips/ft]	Radial Displacement [in]
	Meridional [kips/ft]	Hoop [kips/ft]	Meridional [ft kips/ft]	Hoop [ft kips/ft]		
0	-1.3	155.4	-809.2	99.5	95.5	0.000
3	-3.7	125.5	-525.8	99.5	92.8	0.054
6	-24.1	141.5	-272.2	99.5	75.6	0.135
10	-11.9	175.2	-17.1	99.5	52.3	0.252
15	-15.9	241.0	183.9	99.5	28.7	0.387
20	-25.7	328.5	283.2	99.5	11.8	0.490
30	-33.3	409.7	304.6	99.5	-10.5	0.598
40	-40.5	483.2	244.3	99.5	-13.6	0.615
60	-57.8	466.4	183.6	99.5	-11.8	0.580

DL = Dead Load ANSYS  
 VP = Vertical Tendon Prestress ANSYS  
 OTw = Operating Temperture in Winter

IP = Internal Pressure (60psig) RGE09  
 AT60 = Accident Pressure (P=60psig) T=286°F  
 E = 0.10 g Earthquake Horizontal + Vertical

PAGE 64 of 70

DESIGN VERIFICATION	
CLIENT	RGE
JOB NO.	0950-073-1683
CALC/PROB NO.	0950-073-006
BY: GSB	DATE: 5/27/91
CHKD: HAF	DATE: 5/27/91



# Containment Shell Stress Resultants and Stress Couples

Loading: Load Combination      Comments:      Internal Pressure Case RGE18  
 Condition "c" LC 43: (1.0\*DL) + (1.0\*VP) + (1.0\*OTs) + (1.0\*IP) + (1.0\*AT60) + (2.0 \* E)

Height from Base [ft]	Stress Resultant		Stress Couples		Meridional Shear [kips/ft]	Radial Displacement [in]
	Meridional [kips/ft]	Hoop [kips/ft]	Meridional [ft kips/ft]	Hoop [ft kips/ft]		
0	-1.3	-105.0	-809.2	0.0	108.7	0.000
3	-3.7	-8.4	-500.0	0.0	97.3	0.117
6	-24.1	46.4	-242.7	0.0	74.0	0.170
10	-11.9	128.8	-5.3	0.0	45.7	0.261
15	-15.9	225.5	155.1	0.0	19.6	0.370
20	-25.7	340.4	208.7	0.0	2.9	0.471
30	-33.3	431.6	156.7	0.0	-16.0	0.580
40	-40.5	474.1	59.6	0.0	-15.7	0.605
60	-57.8	466.4	-10.1	0.0	-11.4	0.579

DL = Dead Load ANSYS  
 VP = Vertical Tendon Prestress ANSYS  
 OTs = Operating Temperature in Summer

IP = Internal Pressure (60psig) RGE09  
 AT60 = Accident Pressure (P=60psig) T=286°F  
 E = 0.10 g Earthquake Horizontal + Vertical

PAGE 65 of 70

DESIGN VERIFICATION	
CLIENT	RGE
JOB NO.	0950-073-1683
CALC/PROB NO.	0950-073-006
BY: GSB	DATE: 5/27/91
CHKD: Tpt	DATE: 6/7/91

### Tension Bar Force for Load Combination "a"

Pressure Run	Factored Tension Bar Force (kips)					Total Force (kips)
	DL L.C. Factor=1.0	VP L.C. Factor=1.0	OTs L.C. Factor=1.0	IP L.C. Factor=1.5	AT90 L.C. Factor=1.0	
RGE08	0.0	0.0	7.0	64.0	1.3	72.3
RGE09	0.0	0.0	7.0	66.5	1.3	74.8
RGE10	0.0	0.0	7.0	72.1	1.3	80.4
RGE11	0.0	0.0	7.0	91.8	1.3	100.1
RGE12	0.0	0.0	7.0	120.0	1.3	128.3
RGE14	0.0	0.0	7.0	74.4	1.3	82.7
RGE15	0.0	0.0	7.0	77.7	1.3	86.0
RGE16	0.0	0.0	7.0	84.3	1.3	92.6
RGE17	0.0	0.0	7.0	107.3	1.3	115.6
RGE18	0.0	0.0	7.0	163.0	1.3	171.3

DL = Dead Load  
 VP = Vertical Tendon Prestress  
 OTs = Operating Temperature in Summer

IP = Internal Pressure (60psig)  
 AT90 = Accident Pressure (P=90psig) T=312°F

DESIGN VERIFICATION	
CLIENT <u>PL&amp;E</u>	
JOB NO. <u>950-073-1683</u>	
CALC/PROB NO. <u>950-073-006</u>	
BY: <u>GSB</u>	DATE: <u>3/27/91</u>
CHKD: <u>Hert</u>	DATE: <u>3/27/91</u>

### Tension Bar Force for Load Combination "c"

Pressure Run	Factored Tension Bar Force [lbs]						Total Force [kips]
	DL L.C. Factor=1.0	VP L.C. Factor=1.0	OTs L.C. Factor=1.0	IP L.C. Factor=1.0	AT60 L.C. Factor=1.0	E L.C. Factor=2.0	
RGE08	0.0	0.0	7.0	42.7	1.3	69.3	120.3
RGE09	0.0	0.0	7.0	44.3	1.3	69.3	122.0
RGE10	0.0	0.0	7.0	48.1	1.3	69.3	125.7
RGE11	0.0	0.0	7.0	61.2	1.3	69.3	138.8
RGE12	0.0	0.0	7.0	80.0	1.3	69.3	157.7
RGE14	0.0	0.0	7.0	49.6	1.3	69.3	127.3
RGE15	0.0	0.0	7.0	51.8	1.3	69.3	129.5
RGE16	0.0	0.0	7.0	56.2	1.3	69.3	133.8
RGE17	0.0	0.0	7.0	71.5	1.3	69.3	149.2
RGE18	0.0	0.0	7.0	108.7	1.3	69.3	186.3

DL = Dead Load  
 VP = Vertical Tendon Prestress  
 OTs = Operating Temperature In Summer

IP = Internal Pressure (60psig)  
 AT60 = Accident Pressure (P=60psig) T=286°F  
 E = 0.10 g Earthquake Horizontal + Vertical ANSYS RGE03

DESIGN VERIFICATION	
CLIENT <u>RGE</u>	
JOB NO <u>950-073-1683</u>	
CALC/PROB NO <u>950-073-006</u>	
BY: <u>GJB</u>	DATE: <u>5/27/91</u>
CHKD: <u>1/pt</u>	DATE: <u>6/7/91</u>

### Radial Displacement for Load Combination "a"

Pressure Run	Factored Radial Displacement [in]					Total Disp. [in]
	DL L.C. Factor=1.0	VP L.C. Factor=1.0	OTs L.C. Factor=1.0	IP L.C. Factor=1.5	AT90 L.C. Factor=1.0	
RGE08	0.000	0.000	0.000	0.103	0.000	0.103
RGE09	0.000	0.000	0.000	0.111	0.000	0.111
RGE10	0.000	0.000	0.000	0.121	0.000	0.121
RGE11	0.000	0.000	0.000	0.153	0.000	0.153
RGE12	0.000	0.000	0.000	0.194	0.000	0.194
RGE14	0.000	0.000	0.000	0.000	0.000	0.000
RGE15	0.000	0.000	0.000	0.000	0.000	0.000
RGE16	0.000	0.000	0.000	0.000	0.000	0.000
RGE17	0.000	0.000	0.000	0.000	0.000	0.000
RGE18	0.000	0.000	0.000	0.000	0.000	0.000

DL = Dead Load

VP = Vertical Tendon Prestress

OTs = Operating Temperature in Summer

IP = Internal Pressure (60psig)

AT90 = Accident Pressure (P=90psig) T=312°F

DESIGN VERIFICATION	
CLIENT	<u>PG&amp;E</u>
JOB NO.	<u>0950-073-1683</u>
CALC/PROB NO.	<u>0950-073-006</u>
BY: <u>GSB</u>	DATE: <sup>Rev 0</sup> <u>5/27/91</u>
CHKD: <u>[Signature]</u>	DATE: <u>5/27/91</u>



0.0000



### Radial Displacement for Load Combination "c"

Pressure Run	Factored Radial Displacement [in]						Total Disp. [in]
	DL L.C. Factor=1.0	VP L.C. Factor=1.0	OTs L.C. Factor=1.0	IP L.C. Factor=1.0	AT60 L.C. Factor=1.0	E L.C. Factor=2.0	
RGE08	0.000	0.000	0.000	0.069	0.000	0.112	0.181
RGE09	0.000	0.000	0.000	0.074	0.000	0.112	0.186
RGE10	0.000	0.000	0.000	0.080	0.000	0.112	0.192
RGE11	0.000	0.000	0.000	0.102	0.000	0.112	0.214
RGE12	0.000	0.000	0.000	0.129	0.000	0.112	0.241
RGE14	0.000	0.000	0.000	0.000	0.000	0.112	0.112
RGE15	0.000	0.000	0.000	0.000	0.000	0.112	0.112
RGE16	0.000	0.000	0.000	0.000	0.000	0.112	0.112
RGE17	0.000	0.000	0.000	0.000	0.000	0.112	0.112
RGE18	0.000	0.000	0.000	0.000	0.000	0.112	0.112

DL = Dead Load

VP = Vertical Tendon Prestress

OTs = Operating Temperature In Summer

IP = Internal Pressure (60psig)

AT60 = Accident Pressure (P=60psig) T=286°F

E = 0.10 g Earthquake Horizontal + Vertical ANSYS RGE03

DESIGN VERIFICATION	
CLIENT	<u>2G8E</u>
JOB NO	<u>0950-073-1083</u>
CALC/PROB NO	<u>0950-073-006</u>
BY: <u>GJB</u>	DATE: <u>12/27/91</u>
CHKD: <u>tpf</u>	DATE: <u>3/27/91</u>

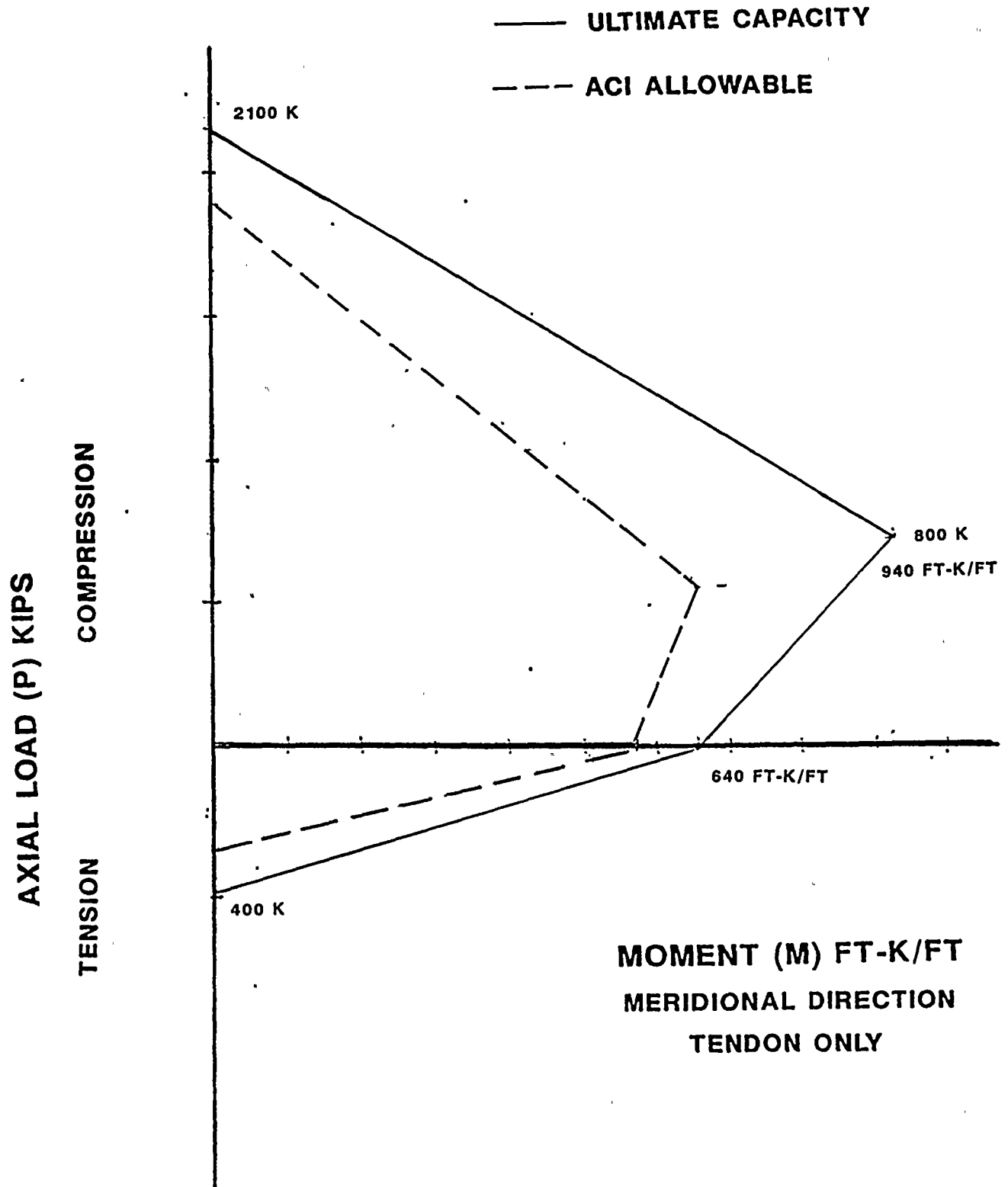
## 6.0 REFERENCES

1. ACI 349-80, Code Requirements for Nuclear Safety Related Concrete Structures, American Concrete Institute.
2. Guima Station Updated Final Safety Analysis Report, pages 3.8-1 to 3.8-227 and figures 3.8-1 to 3.8-62.
3. GAI Analysis, "Guima Station Unit No. 1 Containment Vessel Final Analysis", Work Order 4155, 1969.
4. GAI Drawing, "Reactor Containment Vessel Wall Reinforcement Sectional Plans and Details" D-421-001, Rev. 6.
5. ABB Impell Calculation No. 095-073-002 Rev 0.

					RC & E Containment Shell	
					Interaction Diagram	
REV	BY	DATE	CHECKED	DATE	IMPELL CENTIMARK	JOB NO 095-073-1683 CALC NO 095-073-006
0	GAB	3/27/91	T/H	3/27/91		PAGE 70 OF 70

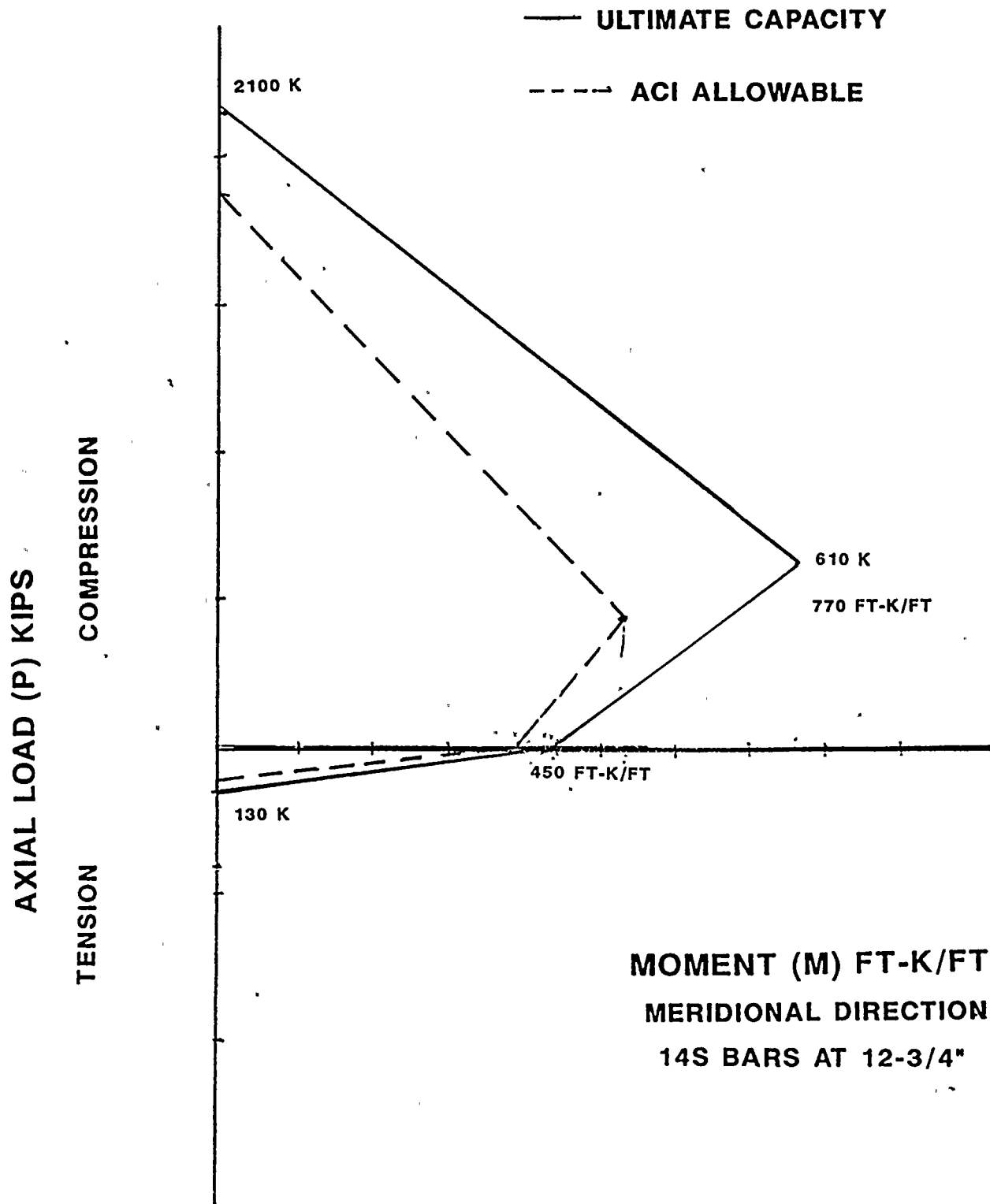
**ATTACHMENT B**

ENG. DEPT.	STATION: <b>GINNA</b>	DATE: <b>4/5/91</b>	PAGE OF
JOB: <b>EWR 5327 CONTAINMENT INTEGRITY</b>		MADE BY: <i>L. Sucherli</i>	CK:





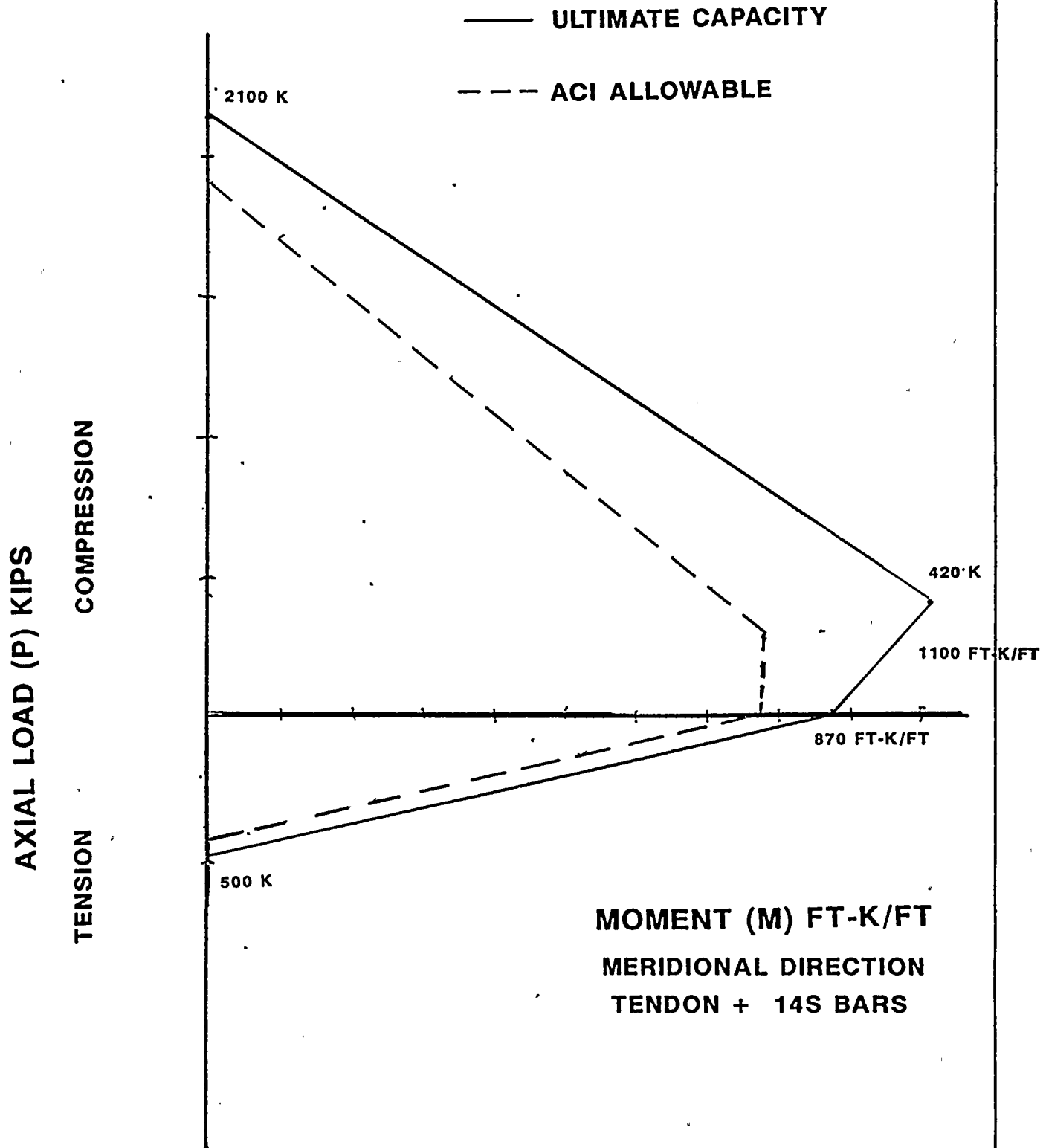
ENG. DEPT.	STATION: <b>GINNA</b>	DATE: <b>4/5/91</b>	PAGE OF
JOB: <b>EWR 5327 CONTAINMENT INTEGRITY</b>		MADE BY: <i>L. Luchesi</i>	CK:







ENG. DEPT.	STATION: <b>GINNA</b>	DATE: <b>4/5/91</b>	PAGE OF
JOB: <b>EWR 5327 CONTAINMENT INTEGRITY</b>		MADE BY: <i>L. Lucherio</i>	CK:



## SHEAR STRENGTH

$$V_u \leq \phi V_n$$

$$\phi = .85$$

$V_u$  = Factored shear force @ section considered

$V_n$  = Nominal shear strength and

$$V_n = V_c + V_s$$

$V_c$  = Nominal shear strength provided by concrete

$V_s$  = Nominal shear strength provided by shear reinforcement

$$V_c = \left( 0.6 \sqrt{f'_c} + 700 \frac{V_u d}{M_u} \right) b_w d \quad (\text{Ref. Eq. 11-10})$$

$$\left( \frac{V_u}{M_u} \right)_{\min} = .12 \quad \text{from Impell analysis}$$

$$d = 21/12 = 1.75' \quad \text{in } \frac{V_u d}{M_u}$$

$$\left( \frac{V_u d}{M_u} \right)_{\min} = .21 \quad \left( \frac{V_u d}{M_u} \right)_{\max} = 1.0$$

$$d \geq .8h = .8(42) = 33.6''$$

$$V_c = \left[ 0.6 (5000)^{1/2} + 700 (.21) \right] (12) (33.6) = 763 \text{ K}_{ft}$$

$$V_c = 76.3 \text{ K/ft} = \text{Shear strength provided by concrete}$$

$$V_s = \frac{A_v f_y d}{s} \quad \text{Ref.} \quad \Sigma 11-17$$

For #7 bars @ 11"

$$A_v = .60 \left( \frac{12}{11} \right) = .65 \text{ in}^2$$

$$V_s = \frac{.65 (40) (33.6)}{12} = 72.8 \text{ K/ft}$$

$$V_s = 72.8 \text{ K/ft}$$

$$V_n = 76.3 + 72.8$$

$$V_n = 149.1$$

$$\phi V_n = .85 (149.1) = 126.7 \text{ K/ft}$$

## TENSION BARS

1 3/8"  $\phi$  Bars (ASTM A322-64a & ASTM A29-64)

$$f_y = 130 \text{ Ksi}$$

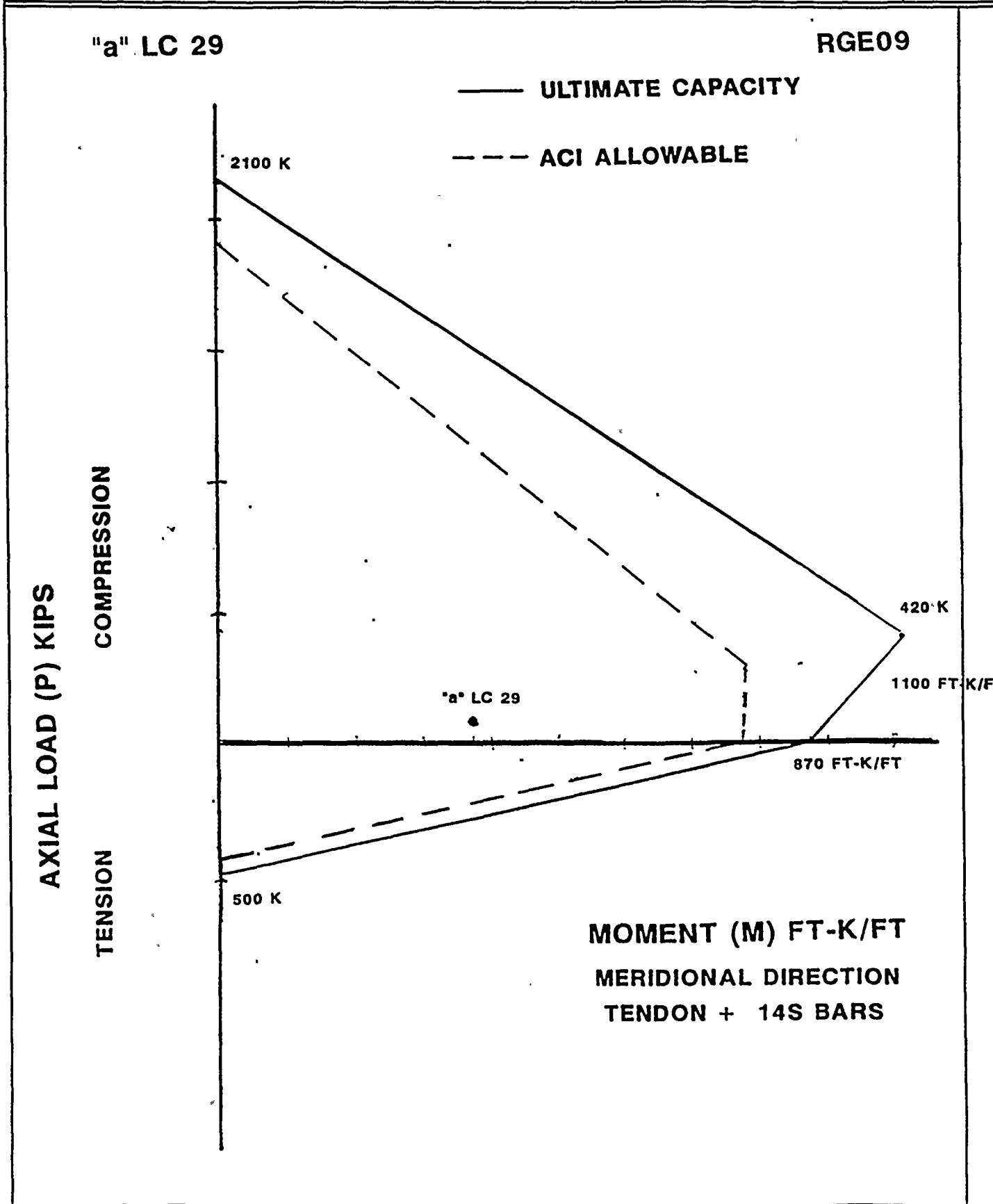
Max tension @ yield

$$F_t = f_y A = \frac{130 (1.375)^2 \pi}{4}$$

$$F_t = 192.9 \text{ Kips / Bar}$$

# **ATTACHMENT C**

ENG. DEPT.	STATION: <b>GINNA</b>	DATE: <i>4/5/91</i>	PAGE OF
JOB: <b>EWR 5327 CONTAINMENT INTEGRITY</b>		MADE BY: <i>L. Luchesi</i>	CK:





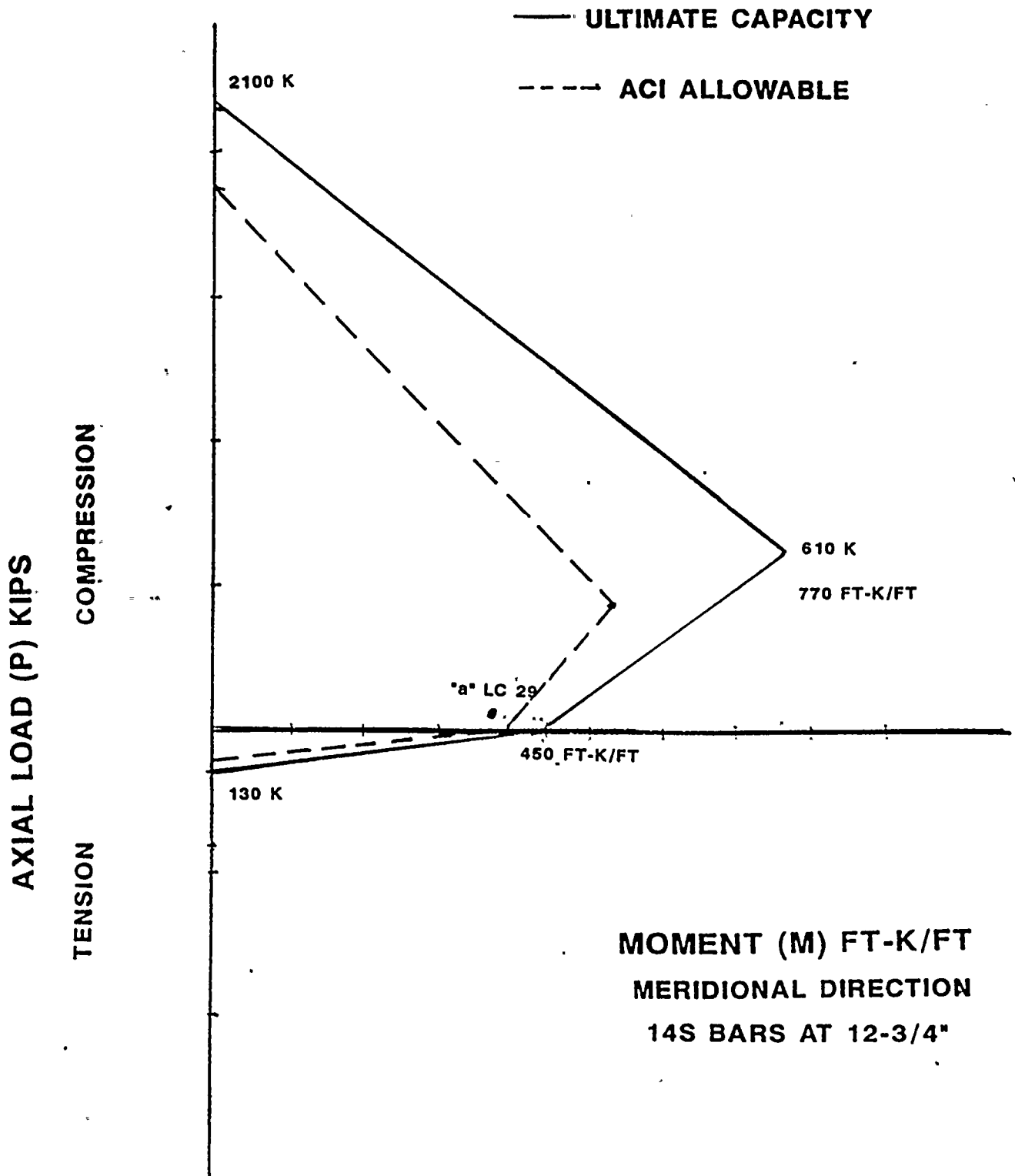
ENG. DEPT.

STATION: **GINNA**DATE: **4/5/91**

PAGE OF

JOB: **EWR 5327 CONTAINMENT INTEGRITY**MADE BY: *L. Luckeski*

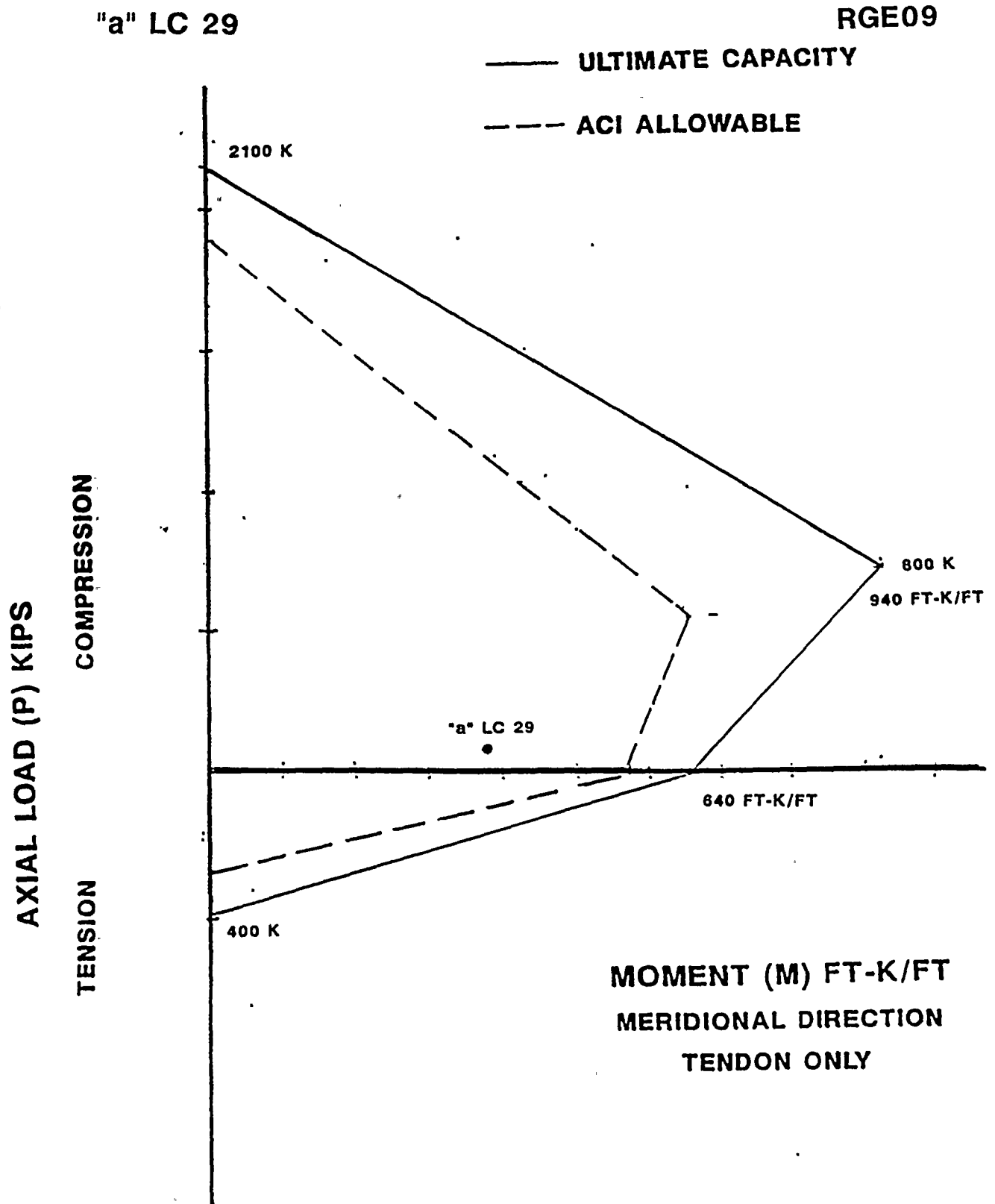
CK:

**"a" LC 29****RGE09**



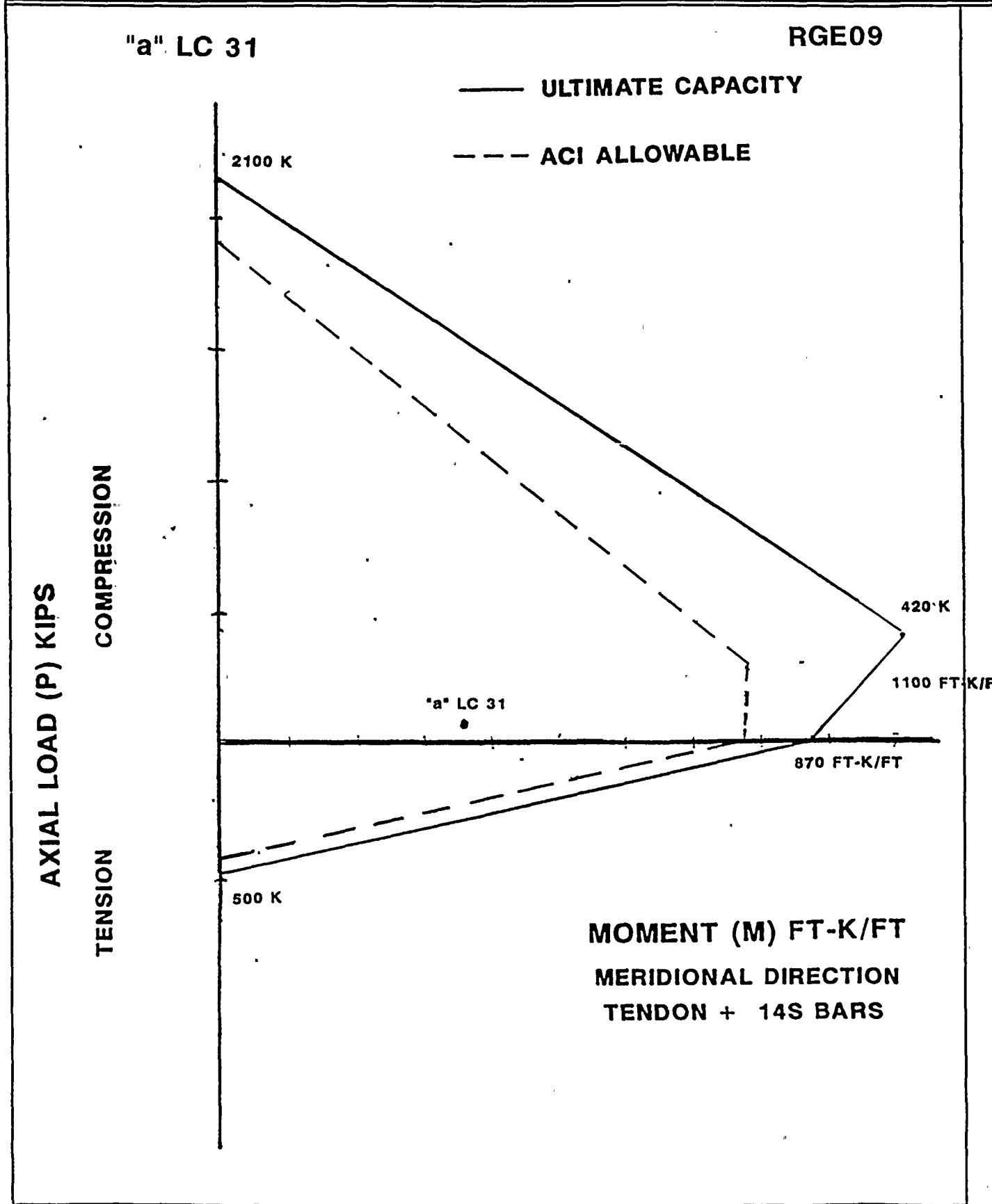


ENG. DEPT.	STATION: <b>GINNA</b>	DATE: <i>4/5/91</i>	PAGE OF
JOB: <b>EWR 5327 CONTAINMENT INTEGRITY</b>		MADE BY: <i>L. Sucherli</i>	CK:





ENG. DEPT.	STATION: <b>GINNA</b>	DATE: <i>4/5/91</i>	PAGE OF
JOB: <b>EWR 5327 CONTAINMENT INTEGRITY</b>		MADE BY: <i>L. Lucherli</i>	CK:

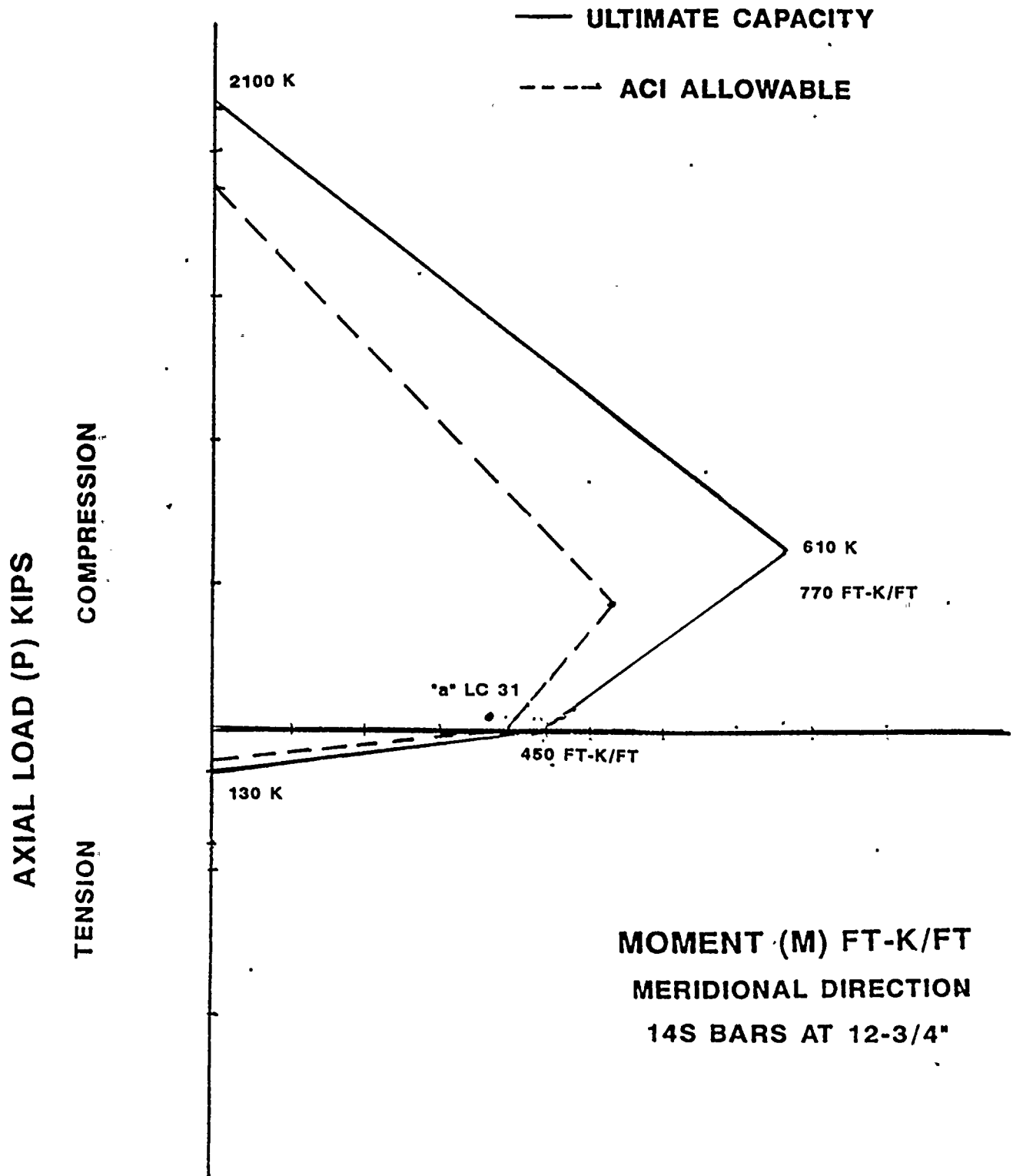




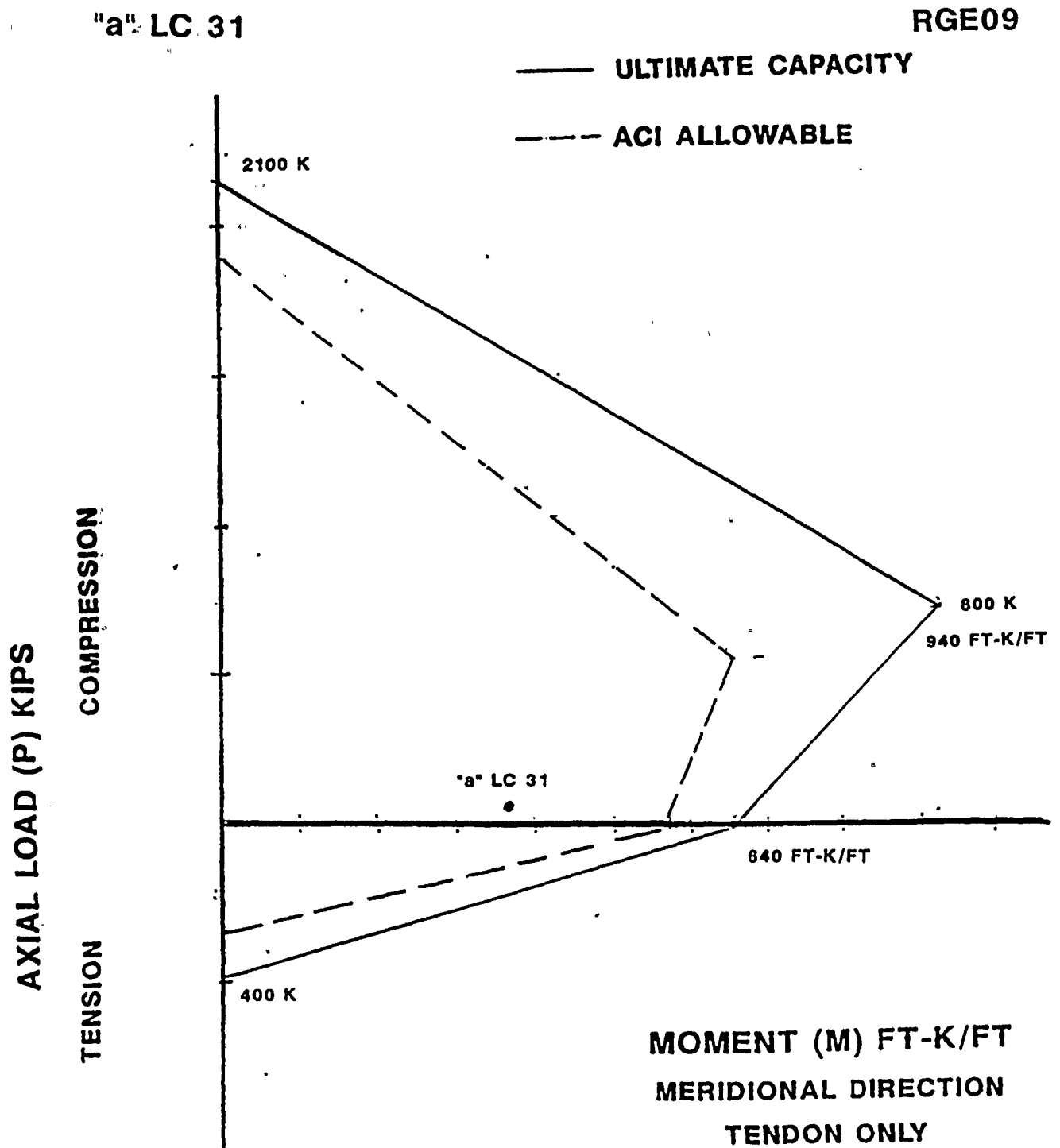
ENG. DEPT.	STATION: <b>GINNA</b>	DATE: <b>4/5/91</b>	PAGE OF
JOB: <b>EWR 5327 CONTAINMENT INTEGRITY</b>		MADE BY: <i>L. Luchesi</i>	CK:

"a" LC 31

RGE09



ENG. DEPT.	STATION: <b>GINNA</b>	DATE: <i>4/5/91</i>	PAGE OF
JOB: <b>EWR 5327 CONTAINMENT INTEGRITY</b>		MADE BY: <i>L. Sucherli</i>	CK:







ENG. DEPT.	STATION: <b>GINNA</b>	DATE: <i>4/5/91</i>	PAGE OF
JOB: <b>EWR 5327 CONTAINMENT INTEGRITY</b>		MADE BY: <i>L. Luchinski</i>	CK:

"c" LC 41

RGE09

AXIAL LOAD (P) KIPS

COMPRESSION

TENSION

— ULTIMATE CAPACITY

- - - ACI ALLOWABLE

2100 K

"c" LC 41

420 K

1100 FT-K/FT

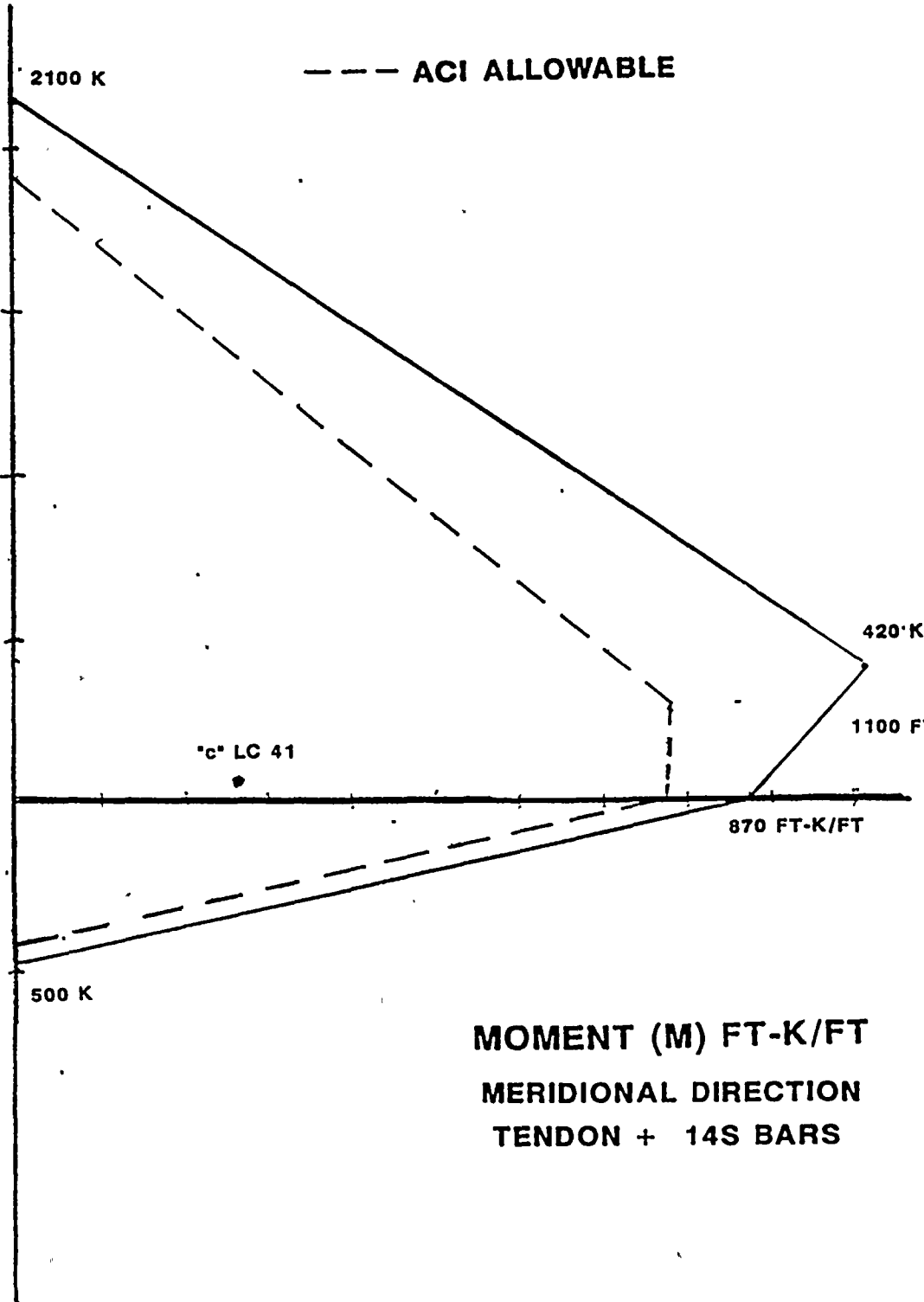
870 FT-K/FT

500 K

MOMENT (M) FT-K/FT

MERIDIONAL DIRECTION

TENDON + 14S BARS



11



ENG. DEPT.

STATION: GINNA

DATE: 4/5/91

PAGE OF

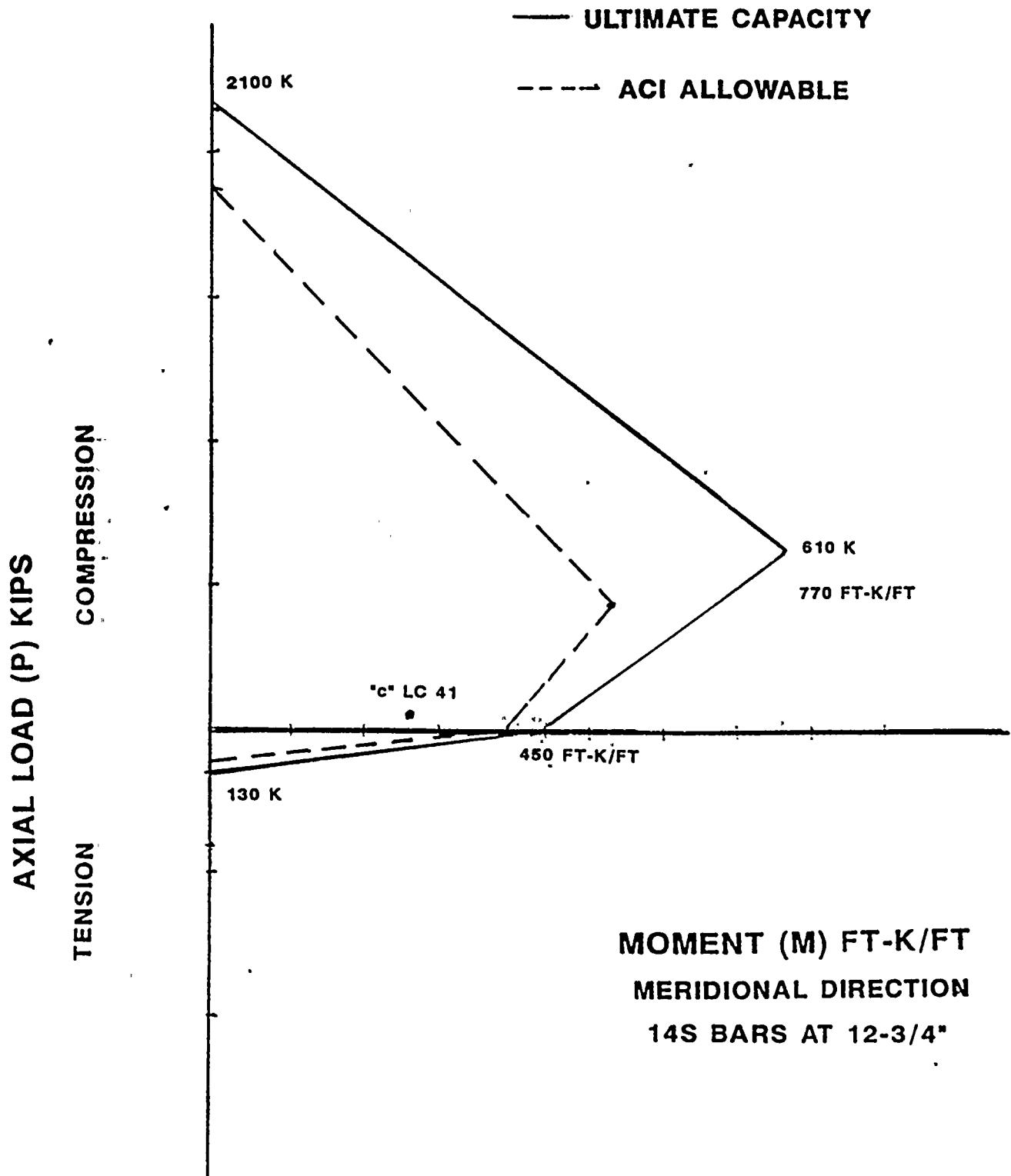
JOB: EWR 5327 CONTAINMENT INTEGRITY

MADE BY: L. Luchinski

CK:

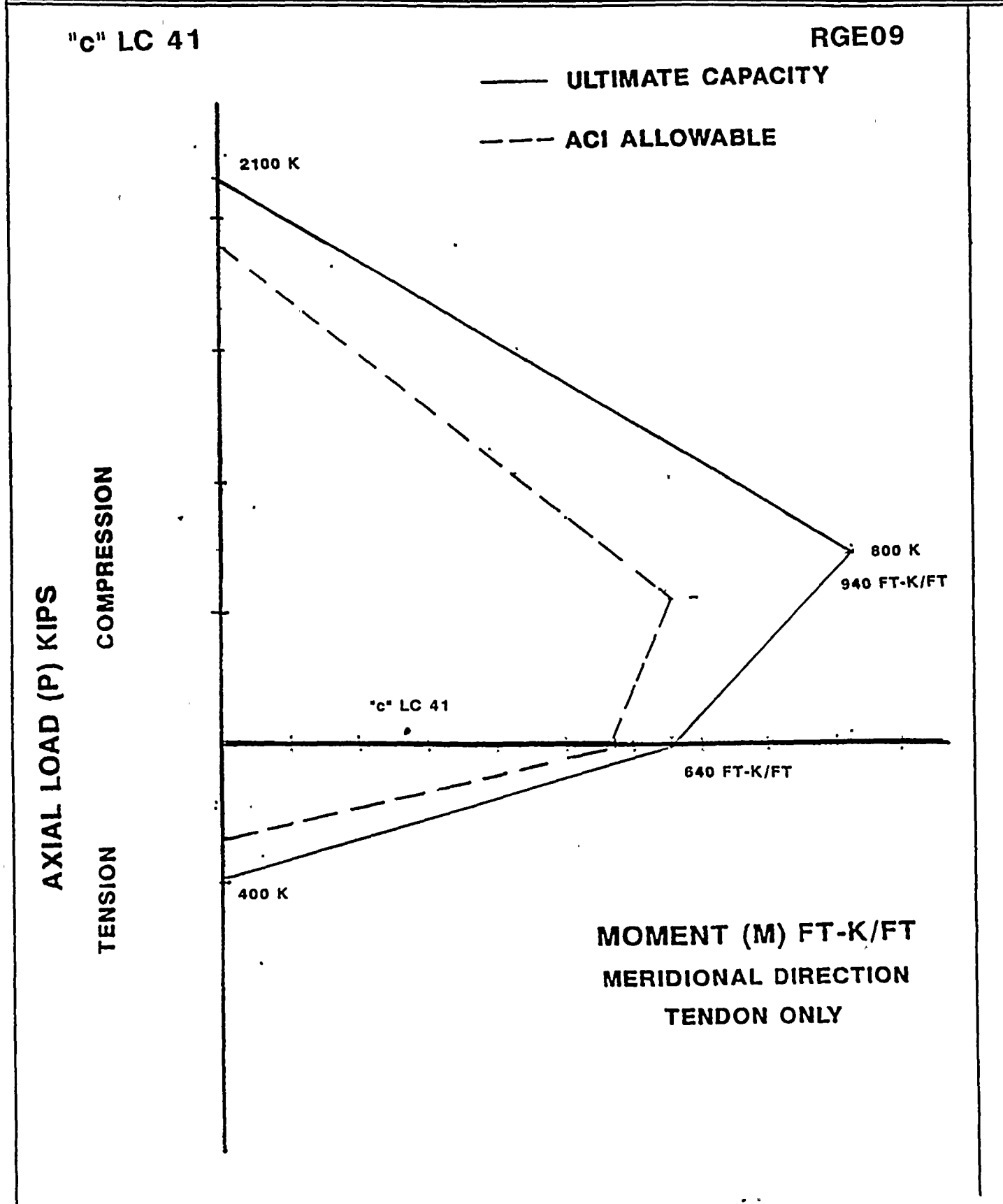
"c" LC 41

RGE09





ENG. DEPT.	STATION: <b>GINNA</b>	DATE: <i>4/5/91</i>	PAGE OF
JOB: <b>EWR 5327 CONTAINMENT INTEGRITY</b>		MADE BY: <i>L. Sucheski</i>	CK:

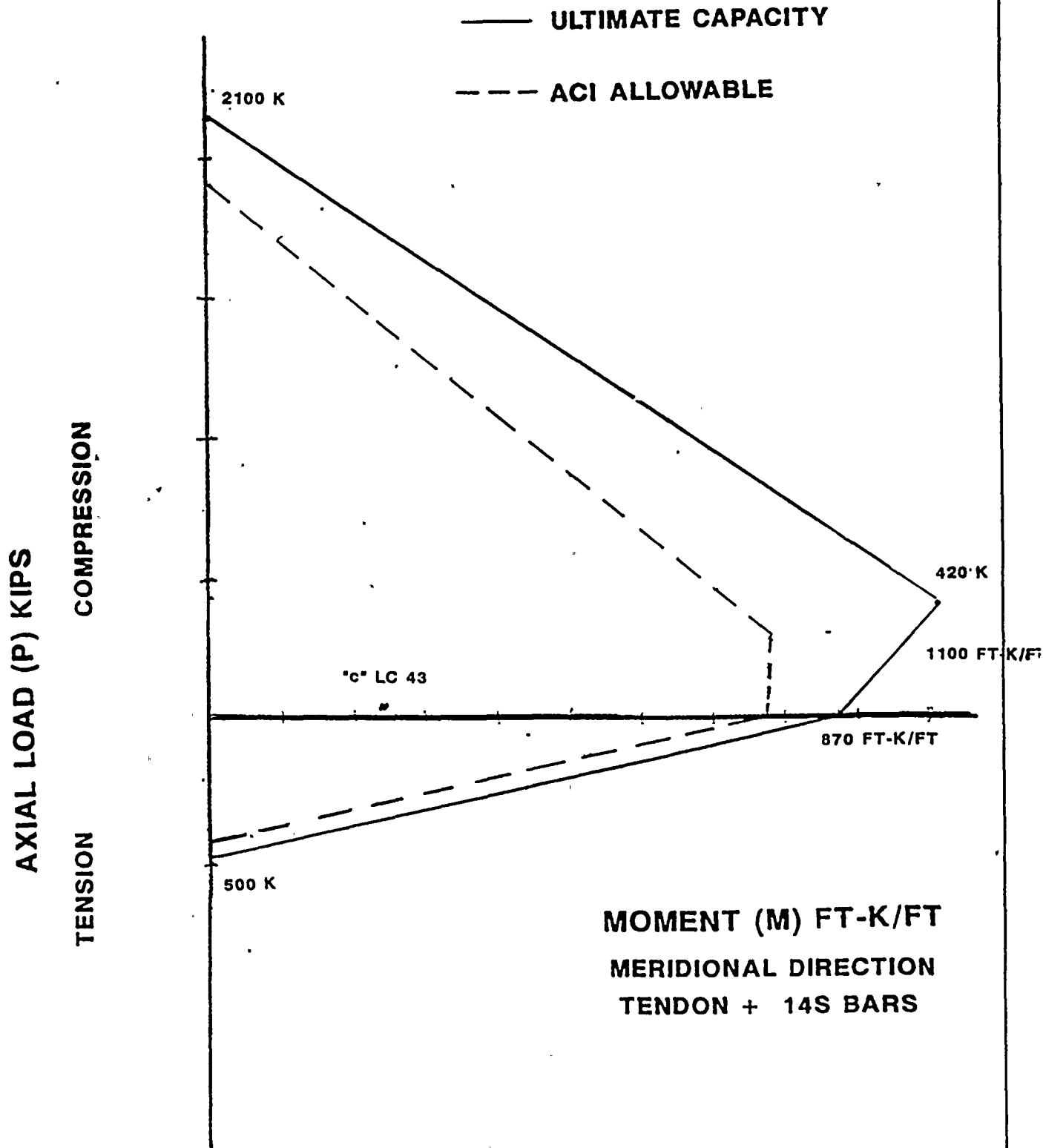




ENG. DEPT.	STATION: <b>GINNA</b>	DATE: <i>4/5/91</i>	PAGE OF
JOB: <b>EWR 5327 CONTAINMENT INTEGRITY</b>		MADE BY: <i>L. Luchesi</i>	CK:

"c" LC 43

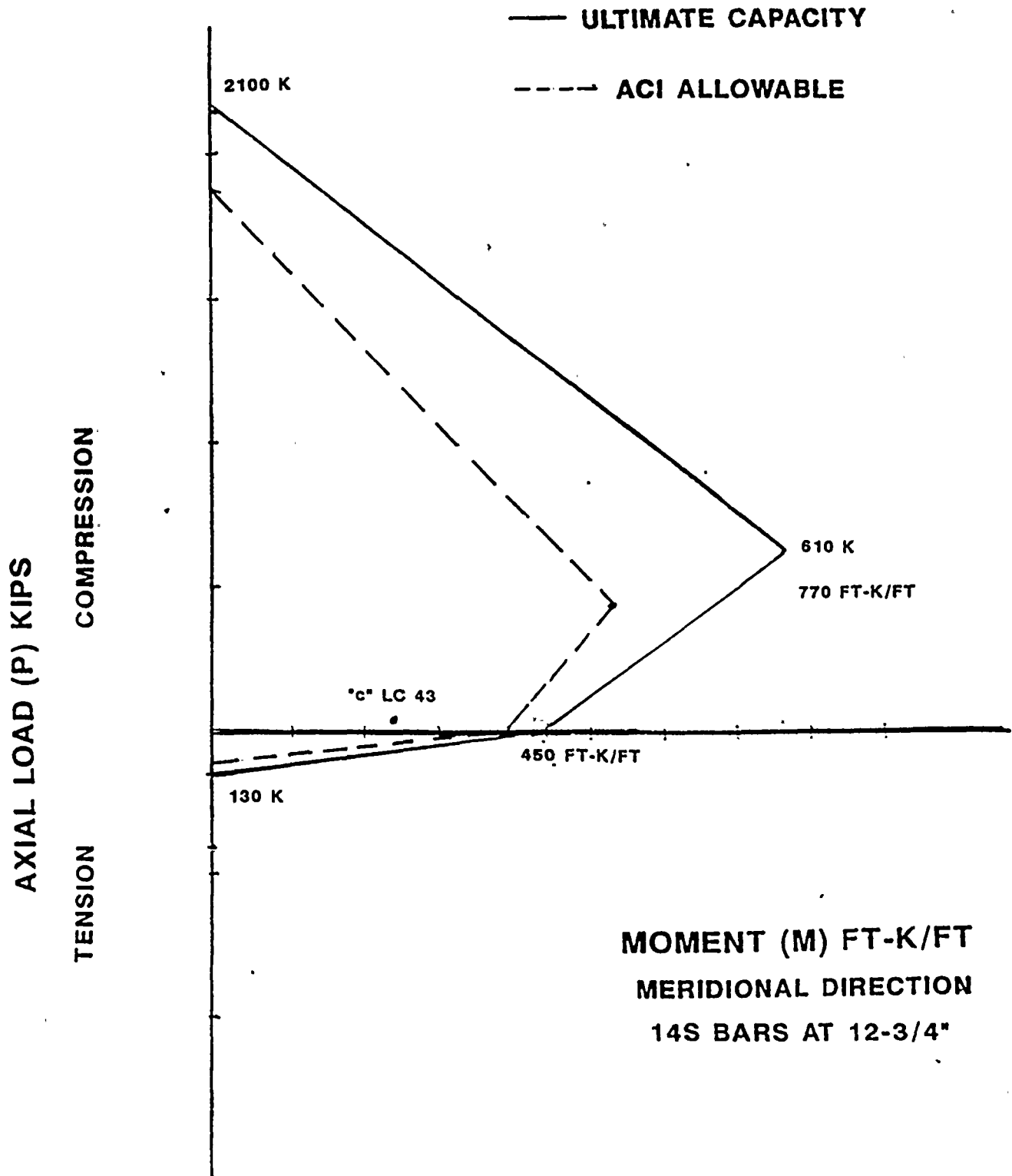
RGE09



ENG. DEPT.	STATION: <b>GINNA</b>	DATE: <b>4/5/91</b>	PAGE OF
JOB: <b>EWR 5327 CONTAINMENT INTEGRITY</b>		MADE BY: <i>L. Luckeski</i>	CK:

"c" LC 43

RGE09





ENG. DEPT.	STATION: <b>GINNA</b>	DATE: <i>4/5/91</i>	PAGE OF
JOB: <b>EWR 5327 CONTAINMENT INTEGRITY</b>		MADE BY: <i>L. Sucherli</i>	CK:

"c" LC 43

RGE09

— ULTIMATE CAPACITY

- - - ACI ALLOWABLE

AXIAL LOAD (P) KIPS

COMPRESSION

TENSION

2100 K

800 K

940 FT-K/FT

"c" LC 43

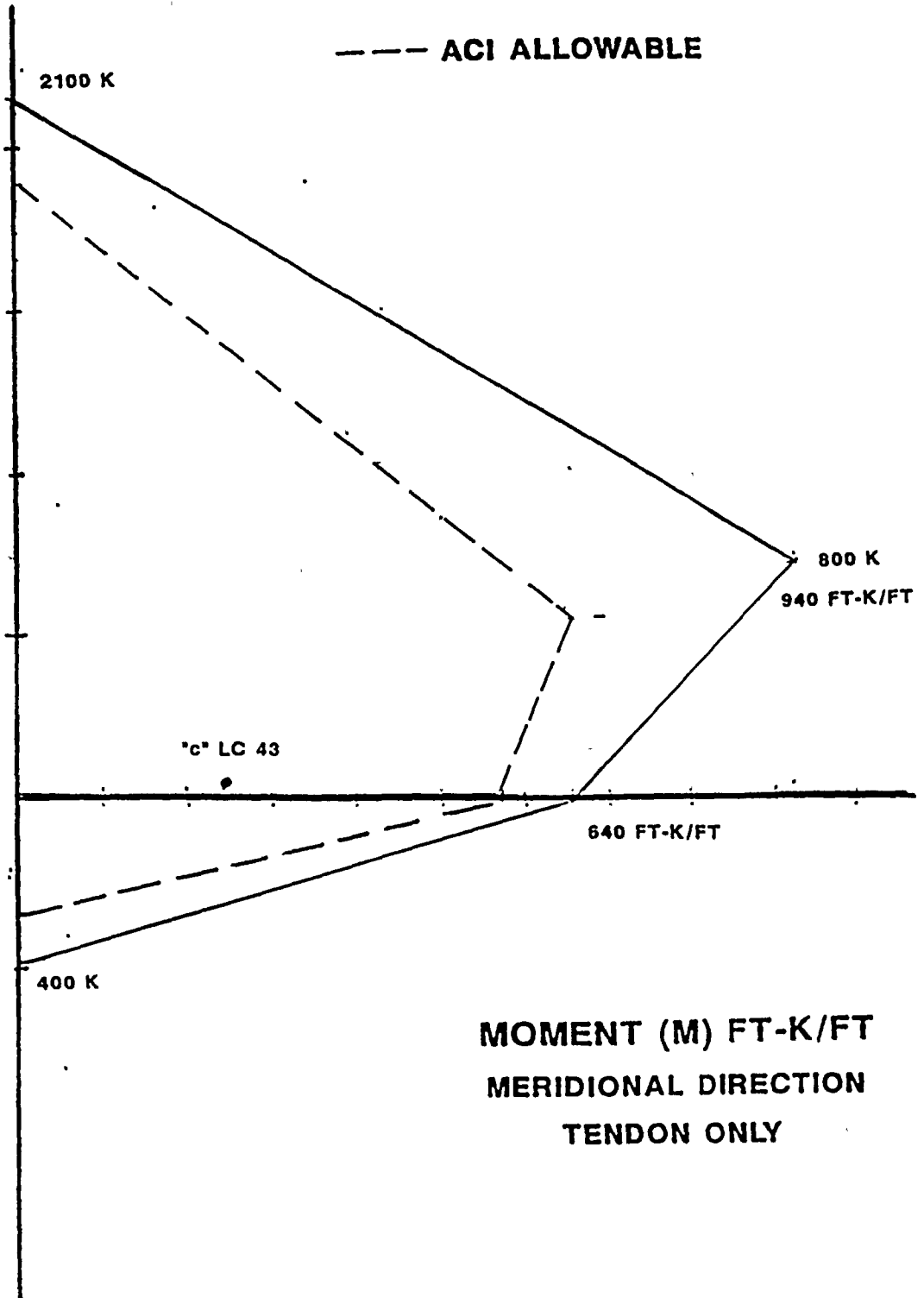
640 FT-K/FT

400 K

MOMENT (M) FT-K/FT

MERIDIONAL DIRECTION

TENDON ONLY



# SHEAR LOADING

INTERNAL PRESSURE CASE	CONDITION	LOAD COMB.	MERIDIONAL SHEAR (K/FT)	
			HEIGHT FROM BASE	
			3'	6'
RGE09	a	LC29	53.6	34.9
		LC31	58.1	33.3
	c	LC41	34.3	24.8
		LC43	38.8	23.2
RGE10	a	LC29	59.0	40
		LC31	63.5	38.4
	c	LC41	37.9	28.2
		LC43	42.4	26.6
RGE11	a	LC29	77.7	57.8
		LC31	82.2	56.2
	c	LC41	50.4	40.1
		LC43	54.9	38.5

MAX ALLOWABLE SHEAR = 126.7 K/FT

## LOAD COMBINATIONS:

a LC 29 1.0 DL + 1.0 VP + 1.0 OTW + 1.5 IP + 1.0 AT 90  
 LC 31 1.0 DL + 1.0 VP + 1.0 OTS + 1.5 IP + 1.0 AT 90

c LC 41 1.0 DL + 1.0 VP + 1.0 OTW + 1.0 IP + 1.0 AT 60 + 2.0 E  
 LC 43 1.0 DL + 1.0 VP + 1.0 OTS + 1.0 IP + 1.0 AT 60 + 2.0 E

10



Where:

DL = DEAD LOAD ANSYS

VP = VERTICAL TENDON PRESTRESS ANSYS

OTW = OPERATING TEMPERATURE IN WINTER

OTS = OPERATING TEMPERATURE IN SUMMER

IP = INTERNAL PRESSURE (60 PSIG)

AT90 = ACCIDENT PRESSURE (P=90 PSIG) T=312°F

AT60 = ACCIDENT PRESSURE (P=60 PSIG) T=286°F

E = 0.10g EARTHQUAKE HORIZONTAL + VERTICAL

# TENSION BAR FORCE

LOAD COMBINATION a (LC29)

PRESSURE RUN

RGEO9

74.8 K

RGEO10

80.4 K

RGEO11

100.1 K

LOAD COMBINATION c (LC41)

PRESSURE RUN

RGEO9

122 K

RGEO10

125.7 K

RGEO11

138.8 K

Min Factor of safety on yield = 1.39

