



AP1000 Evaluation of Candidate LBB Piping Systems

**Presentation to NRC Staff
Rockville, MD**

October 2, 2003





AP1000 LBB Piping Assessment

- **AP1000 LBB Piping Assessment Methodology (DSER OI 3.6.3.4-2)**
 - Seismic Response Spectra Affects
 - Pipe Line Diameter Affects
 - Material Strength Affects
 - Leak Rate Detection Affects



AP1000 LBB Piping Assessment

- **Seismic Response Spectra Affects**

- Compare AP600 vs. AP1000 Response Spectra
- Identify Maximum Increase Factor Based on Corresponding Peak Acceleration
- Maximum Ratio from Both Horizontal Directions
(North-South: X-direction, East-West: Y-direction)

- **Pipe Line Diameter Affects**

- Compare AP1000 vs. AP600 Pipe Diameter (D_o AP1000 / D_o AP600)
- Estimated Thermal Stress Proportional to Pipe Diameter Increase
- Estimated Seismic Stress Proportional to 1 / Pipe Diameter Increase



AP1000 LBB Piping Assessment

- Material Strength Affects
 - Bounding Analysis Curves (BACs) Based on Code Minimum Values
 - Certified Material Test Reports (CMTR) Review for 169 Heats
 - Revised BACs Modified to Incorporate CMTR Data as Needed

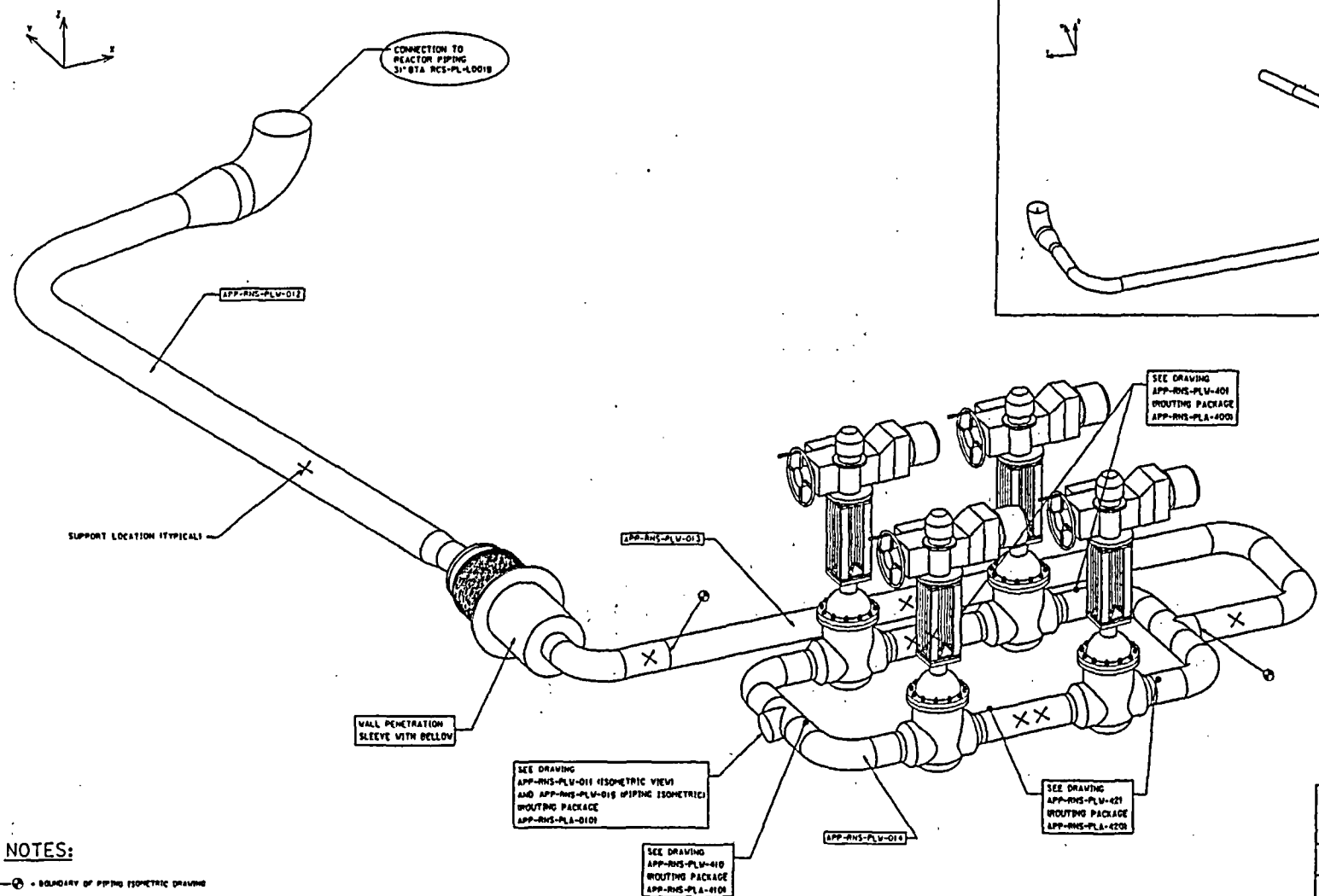
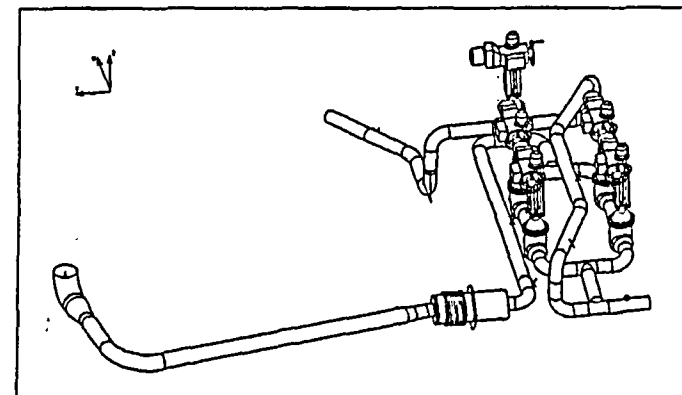
- Leak Detection Rate Affects
 - Bounding Analysis Curves (BACs) Based on 0.50 gpm Leak Detection Capability
 - Certified Material Test Reports (CMTR) Review for 169 Heats
 - Revised BACs Modified to Incorporate 0.25 Leak Detection Capability as Needed



AP1000 LBB Piping Assessment

- **Sample of Piping Assessment**

- Normal RHR Suction Line – 10" Pipe
 - Seismic Response Spectra Increase
- Passive RHR Return Line – 10" Pipe to 14" Pipe
 - Seismic Response Spectra Increase
 - Pipe Size Increase
- Passive Core Cooling Line CMT-B (East) – 8" pipe
 - Seismic Response Spectra Increase
 - Modified BACs (CMTR Data / 0.25 gpm Leak Rate Detection)
- Pressurizer Safety – 6"
 - Seismic Response Spectra Increase



NOTES:

—•— BOUNDARY OF PIPING ISOMETRIC DRAWING

REVISION 1 2 3	LINE NO. SIZE CLASS INSULATION				© 2001 Westinghouse Electric Company LLC TITANIC FILE # APP-RNS-PLA-01000 REV. FILE DATE REV. FILE THIRD ANGLE PROJECTION ETC. REV.	P.E. STAMP DATE TIME	APP-RNS-PLW-010 0

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AP1000
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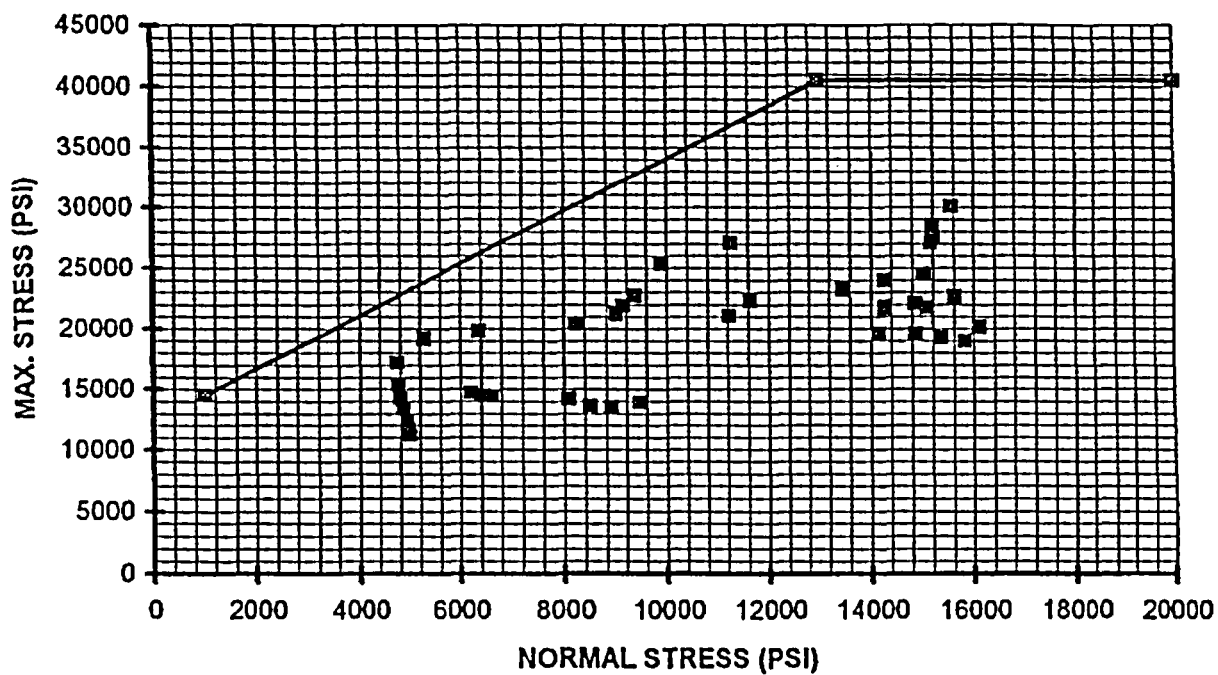
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NORMAL RESIDUAL HEAT REMOVAL SYSTEM
ROOM 11202&11208 REACTOR BLDG. AREA 3&4
ANALYSIS PACKAGE APP-RNS-PLA-010

APP-RNS-PLW-010 0

Progetto Project	AP600	Identificativo Document no. RNS-PLR-010	Rev. Rev. 0	Pagina Page 125 of 151
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**FIG. 4.6.5.4 LBB BOUNDING EVALUATION 10" PIPE Normal RHR
(Pop + DWT + TH.STR. + SSE)**



Normal RHR Suction (East) – 10” pipe		
AP600 Analysis	Maximum Stress	30.0 ksi
	Normal Stress	15.6 ksi
	SSE Stress (5% damping)	14.4 ksi
	SSE Stress (4% damping) ⁽¹⁾	16.4 ksi
	Maximum Stress'	32.0 ksi
AP1000 Estimate	SSE Stress (4% damping) ⁽²⁾	23.3 ksi
	Normal Stress	15.6 ksi
	Maximum Stress	38.9 ksi

- (1) 1.14 increase factor: 5% damping → 4% damping
(2) 1.42 increase factor: AP600 → AP1000 Response Spectra

See Figure 28 (DSER OI 3.6.3.4-2 Addendum 1)

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

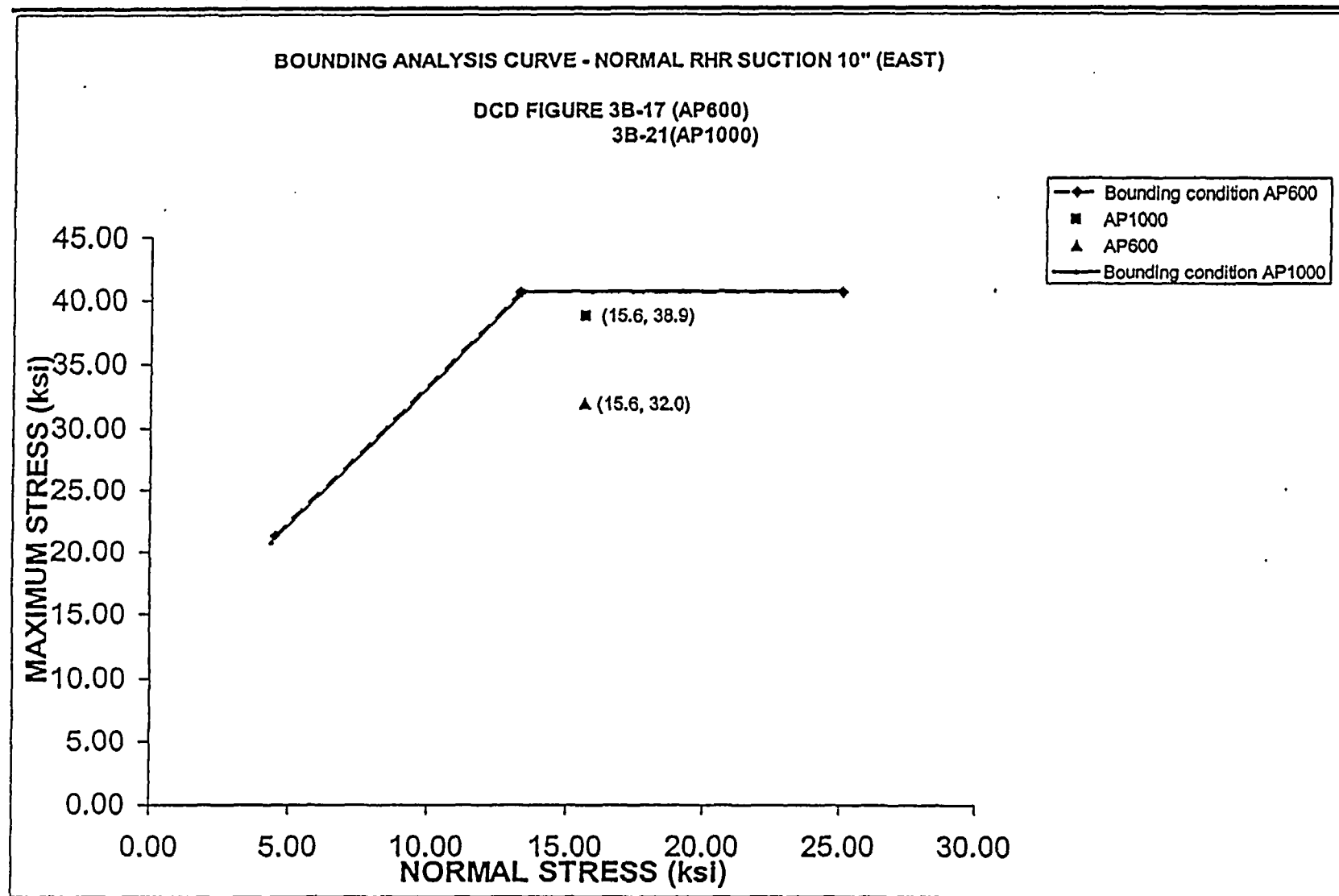
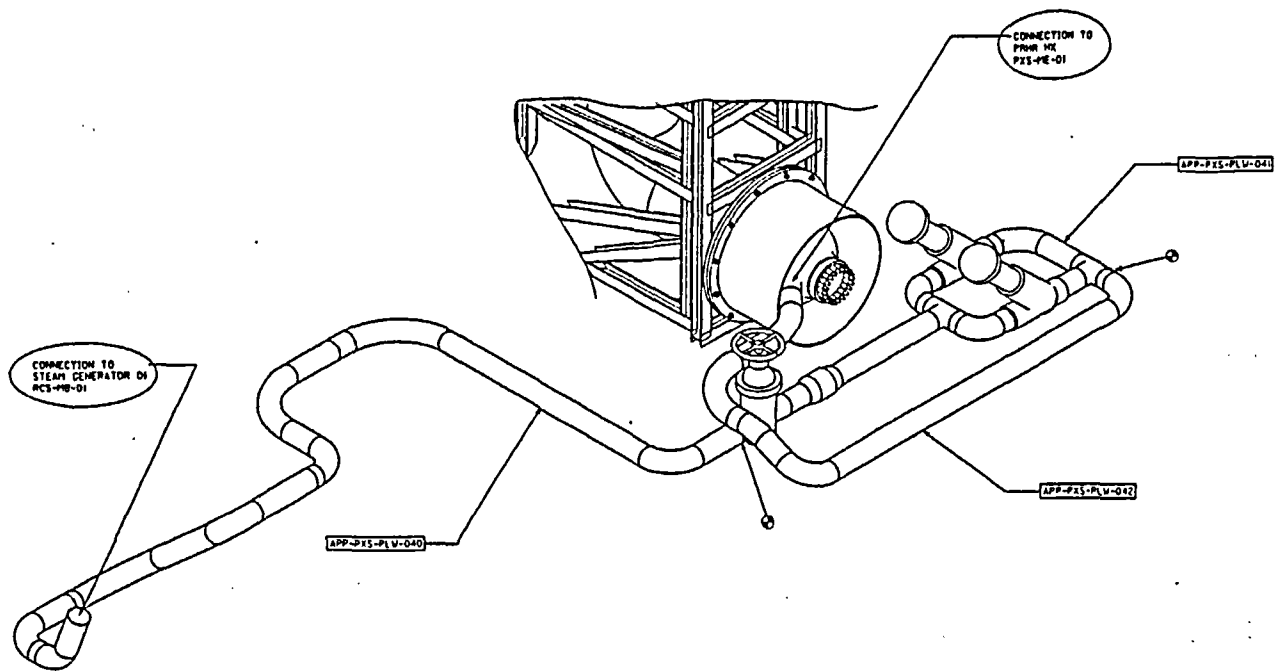


Figure 28 - Bounding Analysis Curve - Normal RHR Suction - 10"



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PASSIVE CORE COOLING SYSTEM ROOM 11207 REACTOR BLDG AREA 3 ANALYSIS PACKAGE APP-PXS-PLA-040	
DATE 11/14/11	BY D. APP-PXS-PLW-043 0

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1		
2		
3		

LINE NO	SIZE	CLASS	INSULATION

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REV FILE	EXT #
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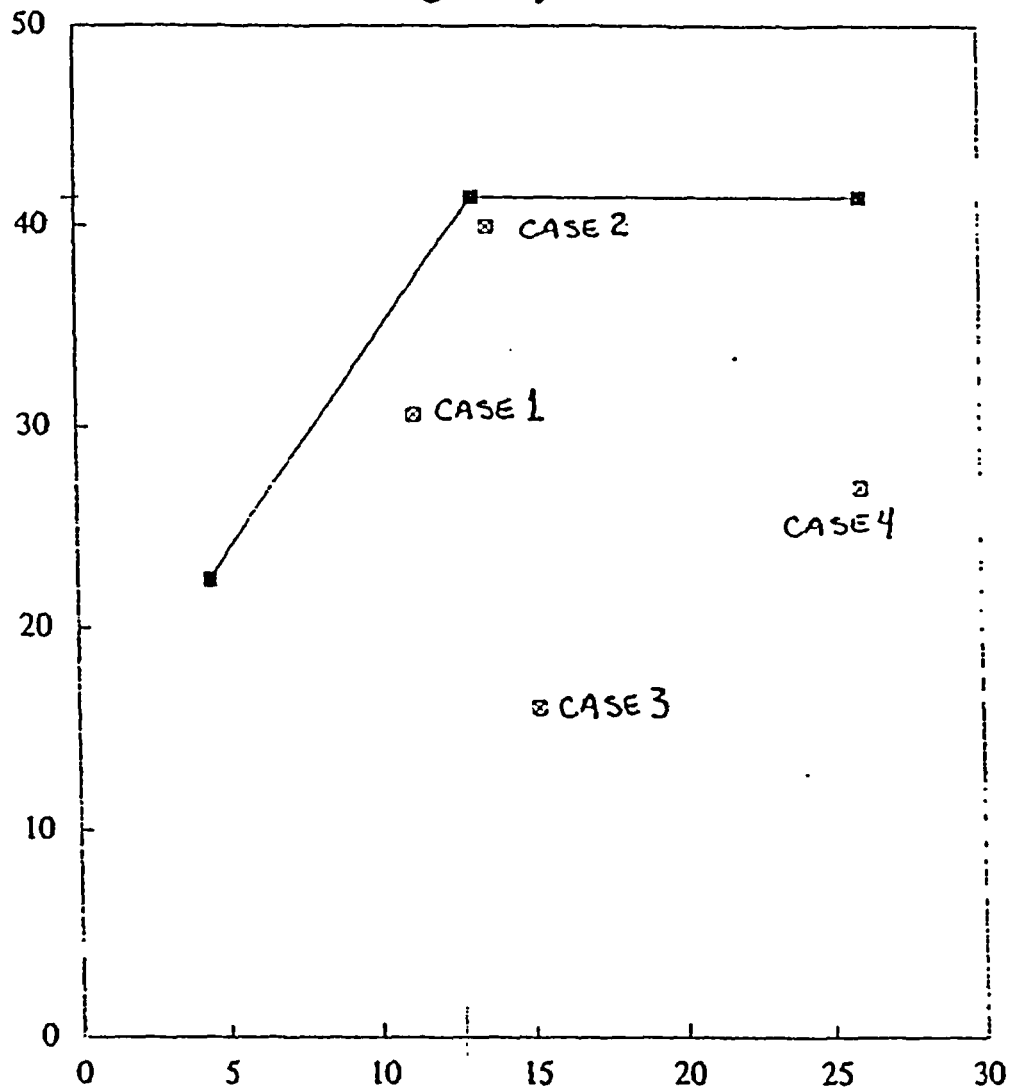
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PXS-040 LBB

Bounding Analysis Curve 11



Passive RHR Return (West)		
AP600 – 10" pipe		
AP1000 – 14" pipe		
AP600 Analysis	Maximum Stress	39.9 ksi
	Normal Stress	14.0 ksi
	SSE Stress (4% damping)	25.9 ksi
	Pressure Stress	4.7 ksi
	Deadweight + Thermal Stress	9.3 ksi
AP1000 Estimate	Pressure Stress	4.7 ksi
	Deadweight + Thermal Stress ⁽¹⁾	12.1 ksi
	Normal Stress	16.8 ksi
	SSE Stress ⁽²⁾	34.6 ksi
	Maximum Stress	51.4 ksi

(1) 1.30 increase factor: 10" pipe → 14" pipe

(2) 0.77 reduction factor: 10" pipe → 14" pipe

1.74 increase factor: AP600 → AP1000 Response Spectra

See Figure 29 (DSER OI 3.6.3.4-2 Addendum 1)

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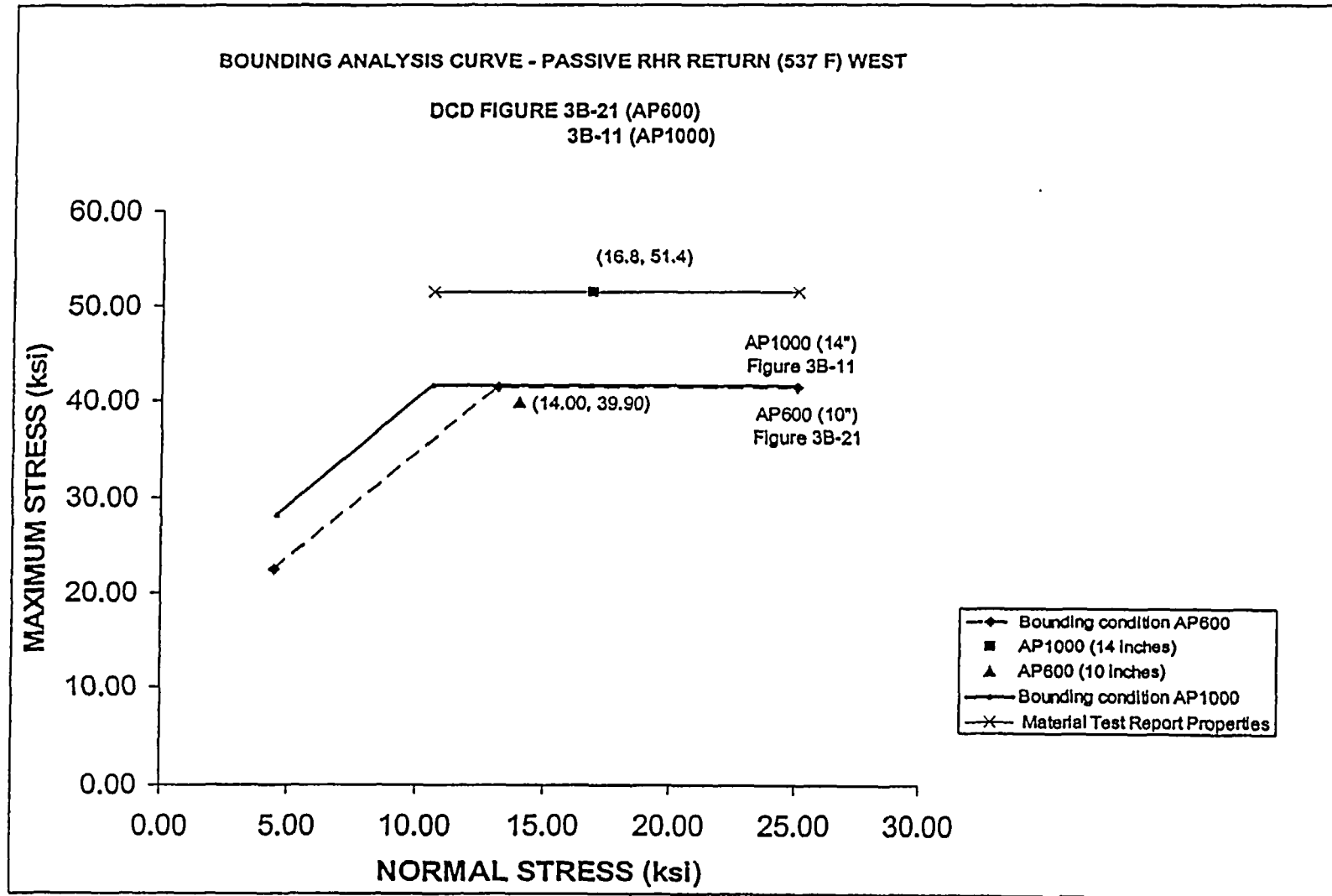


Figure 29 - Bouding Analysis Curve – Passive RHR Return – 14"

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BOUNDING ANALYSIS CURVE 16

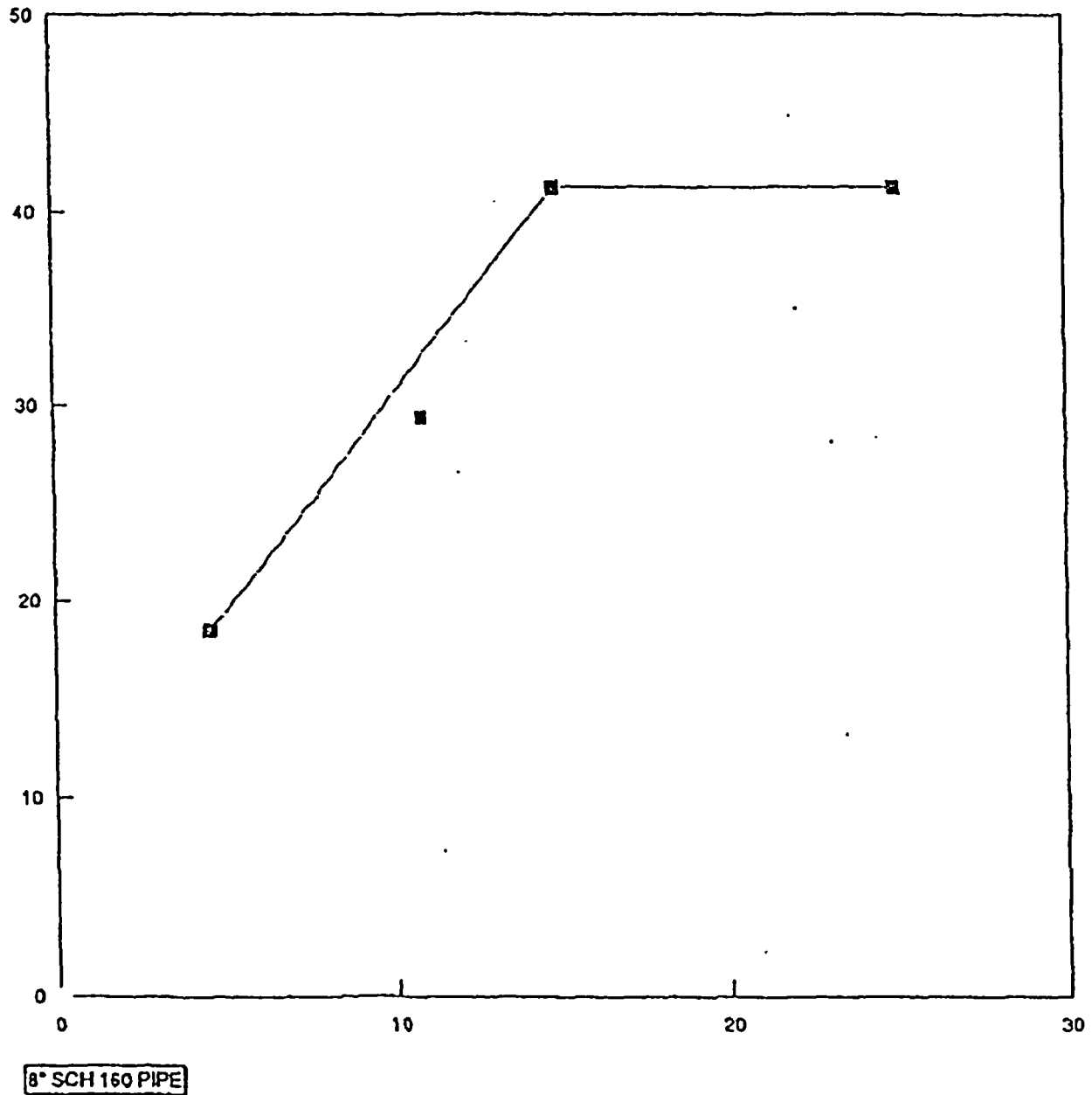


Figure 7.7.1 : Bounding Analysis Curve # 16

Passive Core Cooling CMT-B (East) – 8” pipe		
AP600 Analysis	Maximum Stress	29.4 ksi
	Normal Stress	10.8 ksi
	SSE Stress (5% damping)	18.6 ksi
	SSE Stress (4% damping) ⁽¹⁾	21.3 ksi
	Maximum Stress'	32.1 ksi
AP1000 Estimate	SSE Stress (4% damping) ⁽²⁾	30.3 ksi
	Normal Stress	10.8 ksi
	Maximum Stress	41.1 ksi

(1) 1.14 increase factor: 5% damping → 4% damping

(2) 1.42 increase factor: AP600 → AP1000 Response Spectra

See Figure 36 (DSER OI 3.6.3.4-2 Addendum 1)

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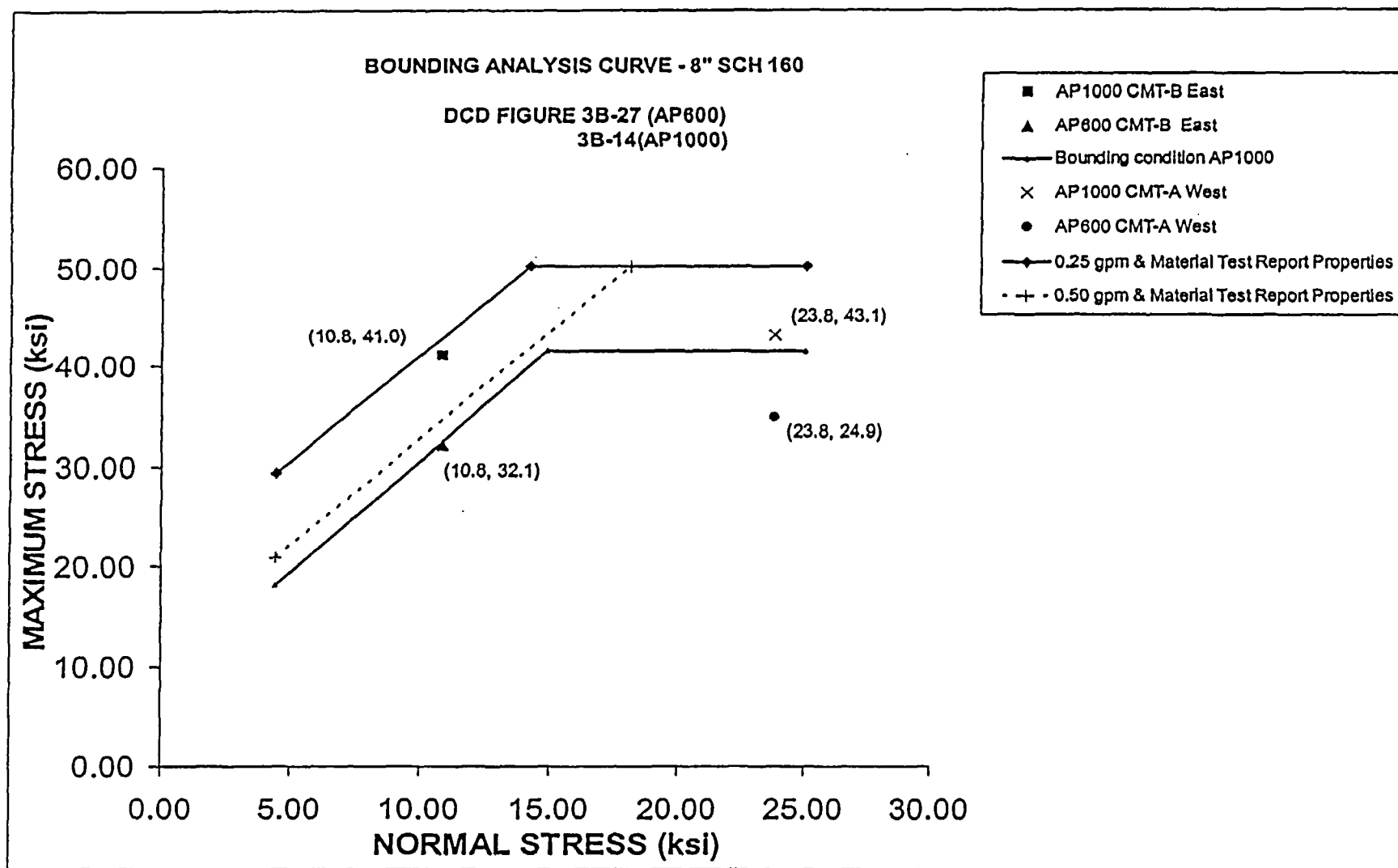




Figure 36 - Bounding Analysis Curve – CMT - 8"

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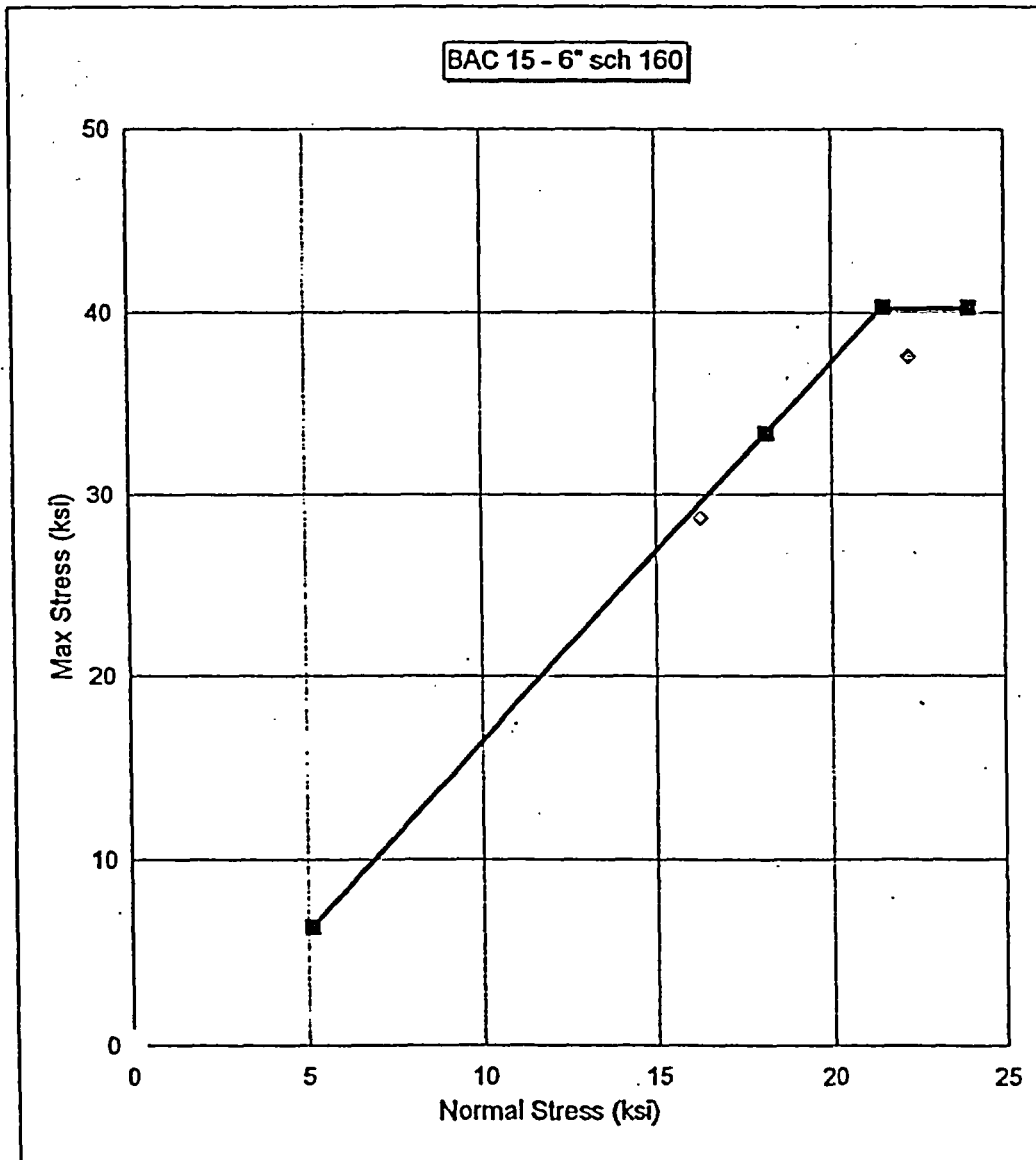


Figure 7.7.3 :Bounding Analysis Curve (BAC) 15 - 6" Schedule 160

Pressurizer Safety – 6” pipe		
AP600 Analysis	Maximum Stress	36.7 ksi
	Normal Stress	22.3 ksi
	SSE Stress (4% damping)	14.4 ksi
AP1000 Estimate	SSE Stress (4% damping) ⁽¹⁾	39.6 ksi
	Normal Stress	22.3 ksi
	Maximum Stress	61.9 ksi

(1) 2.75 increase factor: AP600 → AP1000 Response Spectra

See Figure 21 (DSER OI 3.6.3.4-2 Addendum 1)

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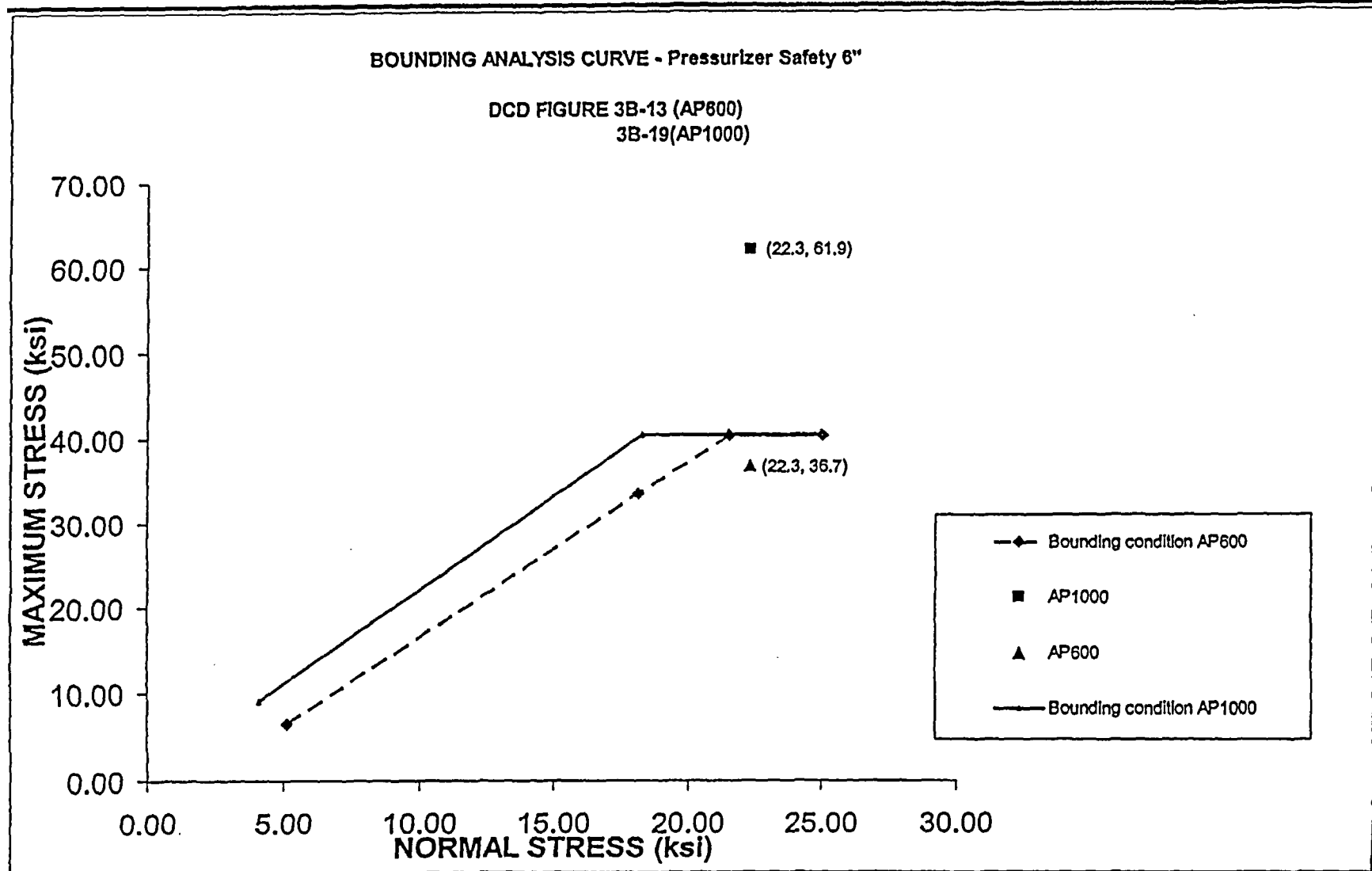


Figure 21 - Bounding Analysis Curve - Pressurizer Safety - 6"