Westinghouse Electric Corporation
Energy Systems

Box 355
Pittsburgh Pennsylvania 15230-0355

AW-95-881

September 12, 1995

Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

ATTENTION: MR. T. R. QUAY

APPLICATION FOR WITHHOLDING PROPRIETARY INFORMATION FROM PUBLIC DISCLOSURE

SUBJECT: AP600 DESIGN CERTIFICATION PROGRAM - LEAK-BEFORE-BREAK (LBB) INFORMATION

Dear Mr. Quay:

The application for withholding is submitted by Westinghouse Electric Corporation ("Westinghouse") pursuant to the provisions of paragraph (b)(1) of Section 2.790 of the Commission's regulations. It contains commercial strategic information proprietary to Westinghouse and customarily held in confidence.

The proprietary material for which withholding is being requested is identified in the proprietary version of the subject report. In conformance with 10CFR Section 2.790, Affidavit AW-95-881 accompanies this application for withholding setting forth the basis on which the identified proprietary information may be withheld from public disclosure.

Accordingly, it is respectfully requested that the subject information which is proprietary to Westinghouse be withheld from public disclosure in accordance with 10CFR Section 2.790 of the Commission's regulations.

Correspondence with respect to this application for withholding or the accompanying affidavit should reference AW-95-881 and should be addressed to the undersigned.

Very truly yours,

Brian A. McIntyre, Manager
Advanced Plant Safety and Licensing

/nja

cc: Kevin Bohrer NRC 12H5

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AW-95-881

AFFIDAVIT

COMMONWEALTH OF PENNSYLVANIA:

ss

COUNTY OF ALLEGHENY:

Before me, the undersigned authority, personally appeared Brian A. McIntyre, who, being by me duly sworn according to law, deposes and says that he is authorized to execute this Affidavit on behalf of Westinghouse Electric Corporation ("Westinghouse") and that the averments of fact set forth in this Affidavit are true and correct to the best of his knowledge, information, and belief:

Brian A. McIntyre, Manager
Advanced Plant Safety and Licensing

Sworn to and subscribed
before me this 13 day
of September, 1995

Rose Marie Payne
Notary Public

Notarial Seal
Rose Marie Payne, Notary Public
Monroeville Boro, Allegheny County
My Commission Expires Nov. 4, 1996
Member, Pennsylvania Association of Notaries

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(1) I am Manager, Advanced Plant Safety And Licensing, in the Advanced Technology Business Area, of the Westinghouse Electric Corporation and as such, I have been specifically delegated the function of reviewing the proprietary information sought to be withheld from public disclosure in connection with nuclear power plant licensing and rulemaking proceedings, and am authorized to apply for its withholding on behalf of the Westinghouse Energy Systems Business Unit.

(2) I am making this Affidavit in conformance with the provisions of 10CFR Section 2.790 of the Commission's regulations and in conjunction with the Westinghouse application for withholding accompanying this Affidavit.

(3) I have personal knowledge of the criteria and procedures utilized by the Westinghouse Energy Systems Business Unit in designating information as a trade secret, privileged or as confidential commercial or financial information.

(4) Pursuant to the provisions of paragraph (b)(4) of Section 2.790 of the Commission's regulations, the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld.

(i) The information sought to be withheld from public disclosure is owned and has been held in confidence by Westinghouse.

(ii) The information is of a type customarily held in confidence by Westinghouse and not customarily disclosed to the public. Westinghouse has a rational basis for determining the types of information customarily held in confidence by it and, in that connection, utilizes a system to determine when and whether to hold certain types of information in confidence. The application of that system and the substance of that system constitutes Westinghouse policy and provides the rational basis required.

Under that system, information is held in confidence if it falls in one or more of several types, the release of which might result in the loss of an existing or potential competitive advantage, as follows:

(a) The information reveals the distinguishing aspects of a process (or component, structure, tool, method, etc.) where prevention of its use by any of Westinghouse's competitors without license from Westinghouse constitutes a competitive economic advantage over other companies.

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

(c) Its use by a competitor would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing a similar product.

(d) It reveals cost or price information, production capacities, budget levels, or commercial strategies of Westinghouse, its customers or suppliers.

(e) It reveals aspects of past, present, or future Westinghouse or customer funded development plans and programs of potential commercial value to Westinghouse.

(f) It contains patentable ideas, for which patent protection may be desirable.

There are sound policy reasons behind the Westinghouse system which include the following:

(a) The use of such information by Westinghouse gives Westinghouse a competitive advantage over its competitors. It is, therefore, withheld from disclosure to protect the Westinghouse competitive position.

(b) It is information which is marketable in many ways. The extent to which such information is available to competitors diminishes the Westinghouse ability to

sell products and services involving the use of the information.

(c) Use by our competitor would put Westinghouse at a competitive disadvantage by reducing his expenditure of resources at our expense.

(d) Each component of proprietary information pertinent to a particular competitive advantage is potentially as valuable as the total competitive advantage. If competitors acquire components of proprietary information, any one component may be the key to the entire puzzle, thereby depriving Westinghouse of a competitive advantage.

(e) Unrestricted disclosure would jeopardize the position of prominence of Westinghouse in the world market, and thereby give a market advantage to the competition of those countries.

(f) The Westinghouse capacity to invest corporate assets in research and development depends upon the success in obtaining and maintaining a competitive advantage.

(iii) The information is being transmitted to the Commission in confidence and, under the provisions of 10CFR Section 2.790, it is to be received in confidence by the Commission.

(iv) The information sought to be protected is not available in public sources or available information has not been previously employed in the same original manner or method to the best of our knowledge and belief.

(v) Enclosed is Letter NTD-NRC-95-4552, September 12, 1995 being transmitted by Westinghouse Electric Corporation (W) letter and Application for Withholding Proprietary Information from Public Disclosure, Brian A. McIntyre (W), to Mr. T. R. Quay, Office of NRR. The proprietary information as submitted for use by Westinghouse Electric Corporation is in response to questions concerning the AP600 plant and the associated design certification application and is expected to be

The development of the technology described in part by the information is the result of applying the results of many years of experience in an intensive Westinghouse effort and the expenditure of a considerable sum of money.

In order for competitors of Westinghouse to duplicate this information, similar technical programs would have to be performed and a significant manpower effort, having the requisite talent and experience, would have to be expended for developing analytical methods and receiving NRC approval for those methods.

Further the deponent sayeth not.

Attachment 2 to Letter NTD-NRC-95-4552

Selected AP600 Bounding Analysis Curves and input parameters for bounding analysis curves.

Nonproprietary

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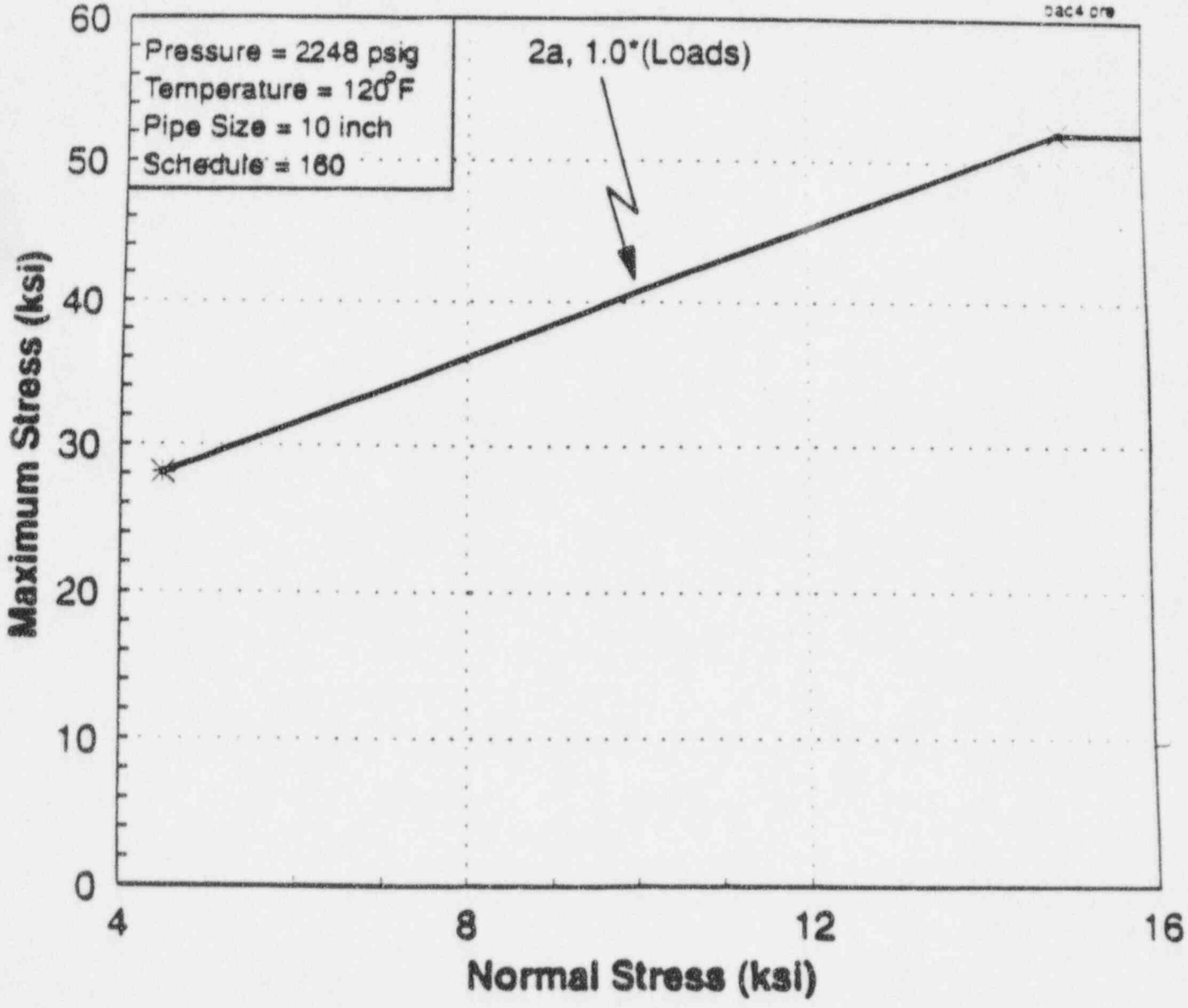


Bounding Analysis Curve #4 for 10" PRHR Retu

AP600 LBB BOUNDING ANALYSIS CURVE (BAC)

BAC #	:	4
DESCRIPTION	:	PRHR Return
PIPE SIZE	:	10 inch
SCHEDULE	:	160
MATERIAL	:	316LN
PRESSURE(psig)	:	2248
TEMPERATURE	:	120° F
PIPE O.D(in)	:	10.75
MEAN RAD.(in)	:	4.8725
MIN. THICK.(in)	:	1.005
AREA(in^2)	:	30.77
SEC.MOD.(in^3)	:	68.67
PRESS.FORCE	:	134867.9 lbs or 134.868 kips
PRESS.STRESS	:	4383.0 psi or 4.383 ksi
YIELD STRESS	:	29100 psi
ULTIMATE STRESS	:	75000 psi
E VALUE	:	28.03 E6 psi

BAC # : 4

LOW NORMAL CASE :

Fx : 134867.9 lbs or 134.868 kips

Mb : 0.1 ksi X 68.67 = 6.867 in-kips or 6867 in-lbs
(0.1 ksi Bending Stress Assumed)

Fx = 0 For PICEP Run

Mb = 1.092 x 6867 = 7499 in-lb For PICEP Run

NORMAL STRESS : 4.383 + 0.1 = 4.48 ksi

MAX. STRESS : 4.383 + (1630.52/68.67) = 28.13 ksi

[ ]a

HIGH NORMAL CASE:

Fx : 134867.9 lbs or 134.868 kips

Mb : 727936.5 in-lbs or 727.937 in-kips

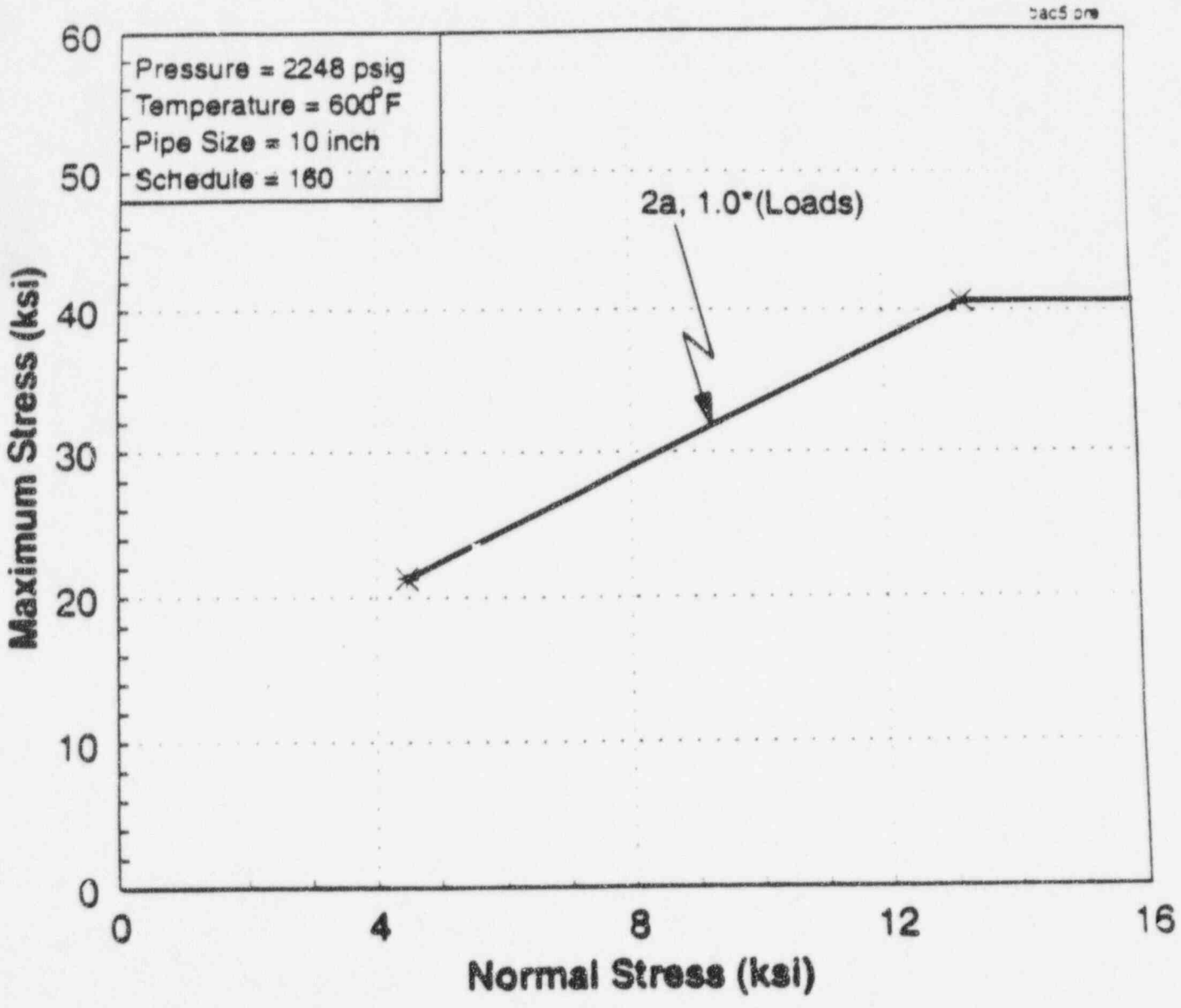
Fx = 0 For PICEP Run

Mb = 1.092 x 727936.5 = 794907 in-lb For PICEP Run

NORMAL STRESS : 4.383 + (727.937/68.67) = 14.98 ksi

MAX. STRESS : 4.383 + (3274.80/68.67) = 52.07 ksi

[ ]a



Bounding Analysis Curve #5 for 10" Normal RHF

AP600 LBB BOUNDING ANALYSIS CURVE (BAC)

BAC #	:	5
DESCRIPTION	:	Normal RHR
PIPE SIZE	:	10 inch
SCHEDULE	:	160
MATERIAL	:	316LN
PRESSURE(psig)	:	2248
TEMPERATURE	:	600° F
PIPE O.D(in)	:	10.75
MEAN RAD.(in)	:	4.873
MIN. THICK.(in)	:	1.005
AREA(in^2)	:	30.77
SEC.MOD.(in^3)	:	68.67
PRESS.FORCE	:	134867.9 lbs or 134.868 kips
PRESS.STRESS	:	4383.4 psi or 4.383 ksi
YIELD STRESS	:	18300 psi
ULTIMATE STRESS	:	63100 psi
E VALUE	:	25.3 E6 psi

BAC # : 5

LOW NORMAL CASE :

Fx : 134867.9 lbs or 134.868 kips

Mb : 0.1 ksi X 68.67 = 6.867 in-kips or 6867 in-lbs

Fx = 0 For PICEP Run

Mb = 1.092 x 6867 = 7499 in-lb For PICEP Run

NORMAL STRESS : 4.383 + 0.1 = 4.48 ksi

MAX. STRESS : 4.383 + (1163/68.67) = 21.32 ksi

[ ]a

HIGH NORMAL CASE:

Fx : 134867.9 lbs or 134.868 kips

Mb : 609475 in-lbs or 609.475 in-kips (Assumed)

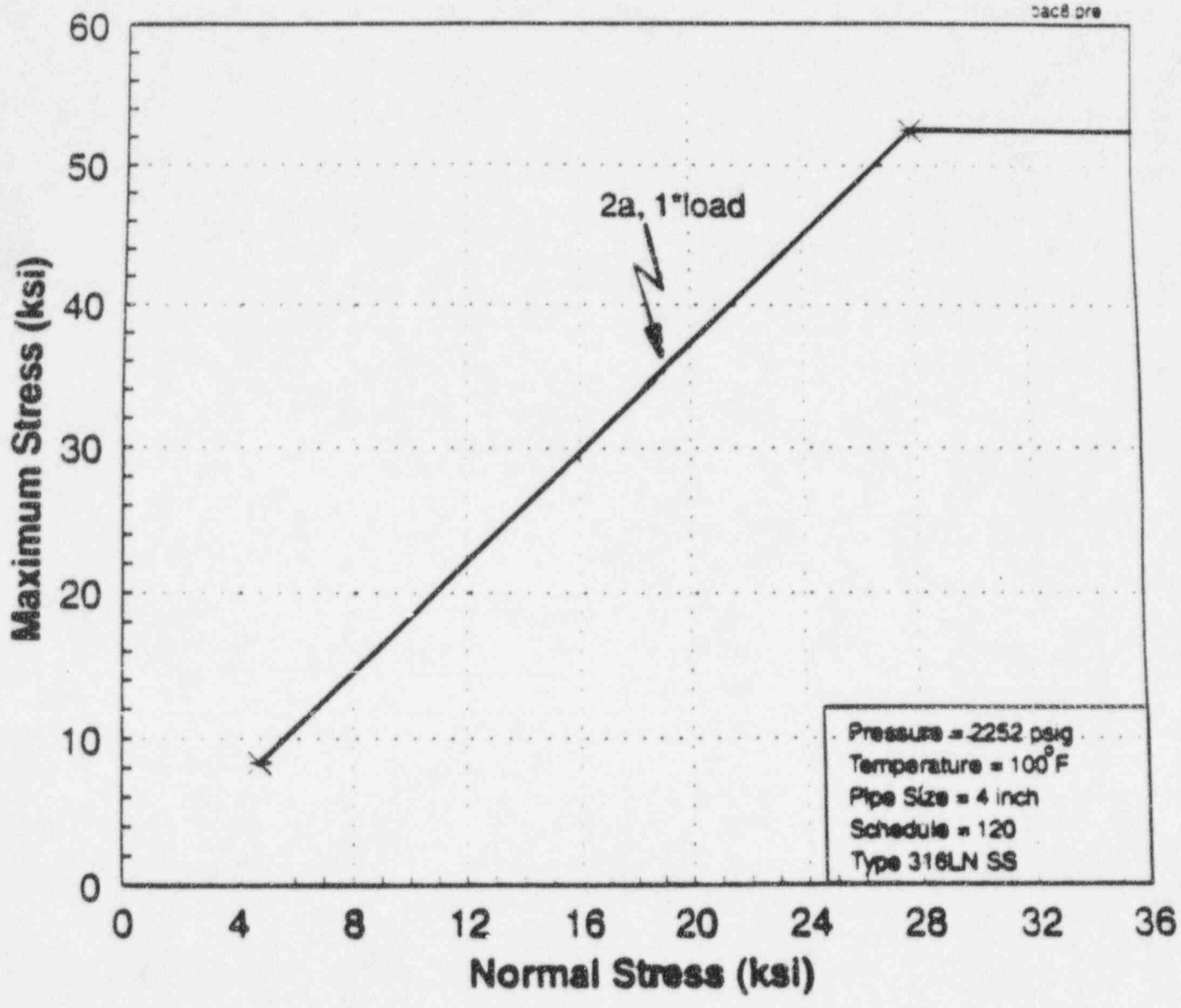
Fx = 0 For PICEP Run

Mb = 1.092 x 609475 = 665547 in-lb For PICEP Run

NORMAL STRESS : 4.383 + (609.475/68.67) = 13.26 ksi

MAX. STRESS : 4.383 + (2488.16/68.67) = 40.62 ksi

[ ]a



Bounding Analysis Curve #8 for 4" ADS Stage

AP600 LBB BOUNDING ANALYSIS CURVE (BAC) 5 - GPM

BAC #	:	8
DESCRIPTION	:	ADS Stage 1
PIPE SIZE	:	4 inch
SCHEDULE	:	120
MATERIAL	:	316LN
PRESSURE(psig)	:	2252
TEMPERATURE	:	100° F
PIPE O.D(in)	:	4.50
MEAN RAD.(in)	:	2.048
MIN. THICK.(in)	:	0.404
AREA(in^2)	:	5.20
SEC.MOD.(in^3)	:	4.89
PRESS.FORCE	:	24109 lbs or 24.109 kips
PRESS.STRESS	:	4638 psi or 4.638 ksi
YIELD STRESS	:	30000 psi
ULTIMATE STRESS	:	75000 psi
E VALUE	:	28.14 E6 psi

BAC # : 8 - 5 GPM

LOW NORMAL CASE :

Fx : 24109 lbs or 24.109 kips

Mb : 0.1 ksi X 4.89 = 0.489 in-kips or 489 in-lbs
(0.1 ksi Bending Stress Assumed)

Fx = 0 For PICEP Run

Mb = 1.0883 x 489 = 533 in-lb For PICEP Run

NORMAL STRESS : 4.638 + 0.1 = 4.74 ksi

MAX. STRESS : 4.638 + (18.239/4.89) = 8.37 ksi

[ ] a

HIGH NORMAL CASE:

Fx : 24109 lbs or 24.109 kips

Mb : 114216 in-lbs or 114.216 in-kips

Fx = 0 For PICEP Run

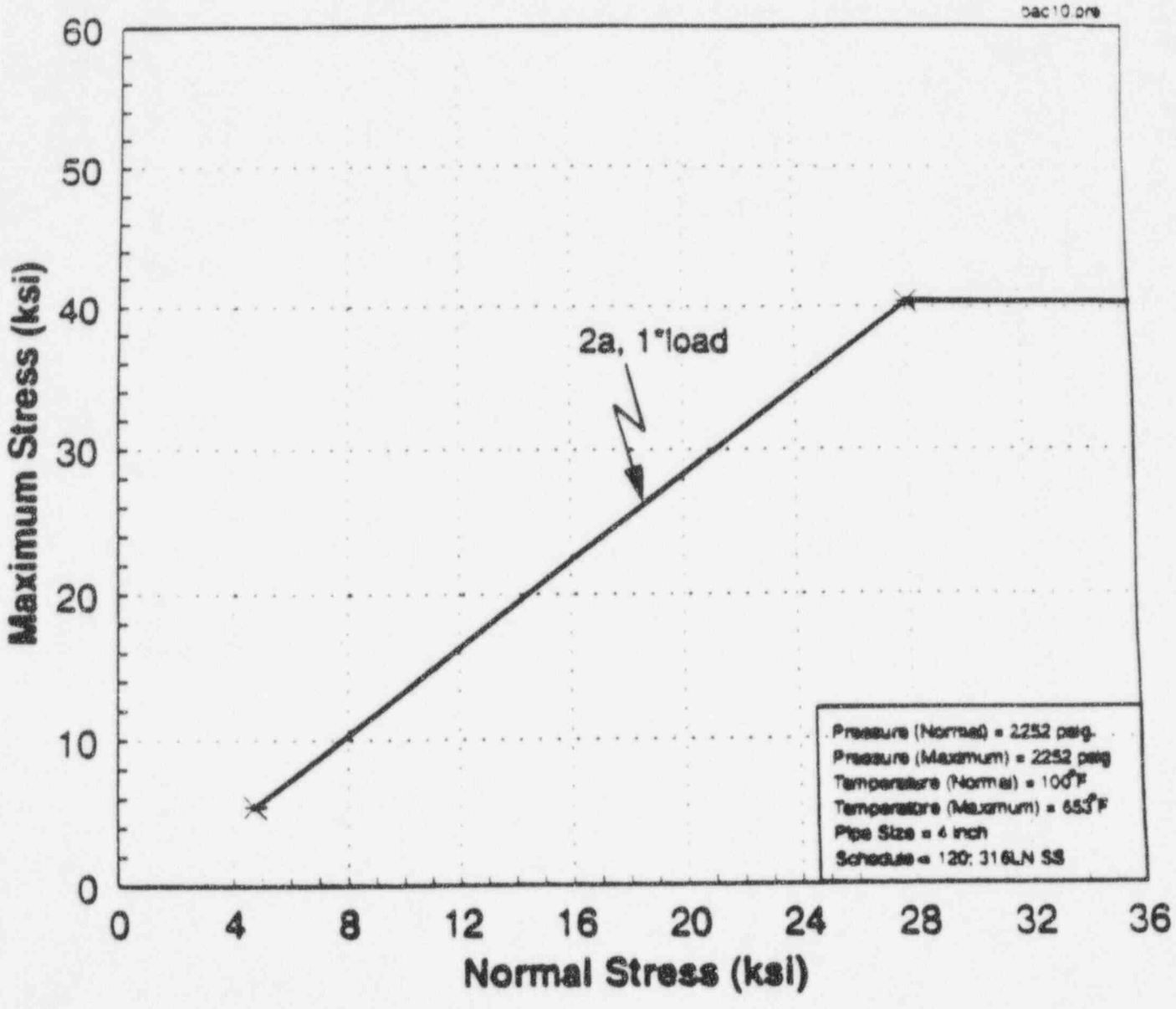
Mb = 1.0883 x 114216 = 124302 in-lb For PICEP Run

NORMAL STRESS : 4.638 + (114.216/4.89) = 28.00 ksi

MAX. STRESS : 4.638 + (234.564/4.89) = 52.61 ksi
> Flow Stress = 52.5

∴ Max.Stress = 52.50 ksi

[ ] a



Bounding Analysis Curve #10 for 4" ADS Stage

AP600 LBB BOUNDING ANALYSIS CURVE (BAC)

BAC #	:	10
DESCRIPTION	:	ADS Stage 1
PIPE SIZE	:	4 inch
SCHEDULE	:	120
MATERIAL	:	316LN
PRESSURE(psig)	:	2252 (Normal & Maximum)
TEMPERATURE	:	100° F (Normal); 653° F (Maximum)
PIPE O.D(in)	:	4.5
MEAN RAD.(in)	:	2.048
MIN. THICK.(in)	:	0.404
AREA(in^2)	:	5.20
SEC.MOD.(in^3)	:	4.89
PRESS.FORCE	:	24109 lbs
PRESS.STRESS	:	4638 psi
YIELD STRESS	:	30000 psi (Normal); 17770 (Maximum)
ULTIMATE STRESS	:	75000 psi (Normal); 62780 (Maximum)
E VALUE	:	28.14 E6 psi (Normal); 25.04 E6 psi (Maximum)

BAC # : 10

LOW NORMAL CASE :

Fx : 24109 lbs

Mb : 0.1 ksi X 4.89 = 0.489 in-kips or 489 in-lbs

Fx = 0 For PICEP Run

Mb = 1.0883 x 489 = 533 in-lb For PICEP Run

NORMAL STRESS : 4.638 + 0.1 = 4.738 ksi

MAX. STRESS : 4.638 + (3.948 /4.89) = 5.445 ksi

[ ]a

HIGH NORMAL CASE:

Fx : 24109 lbs

Mb : 114216 in-lbs

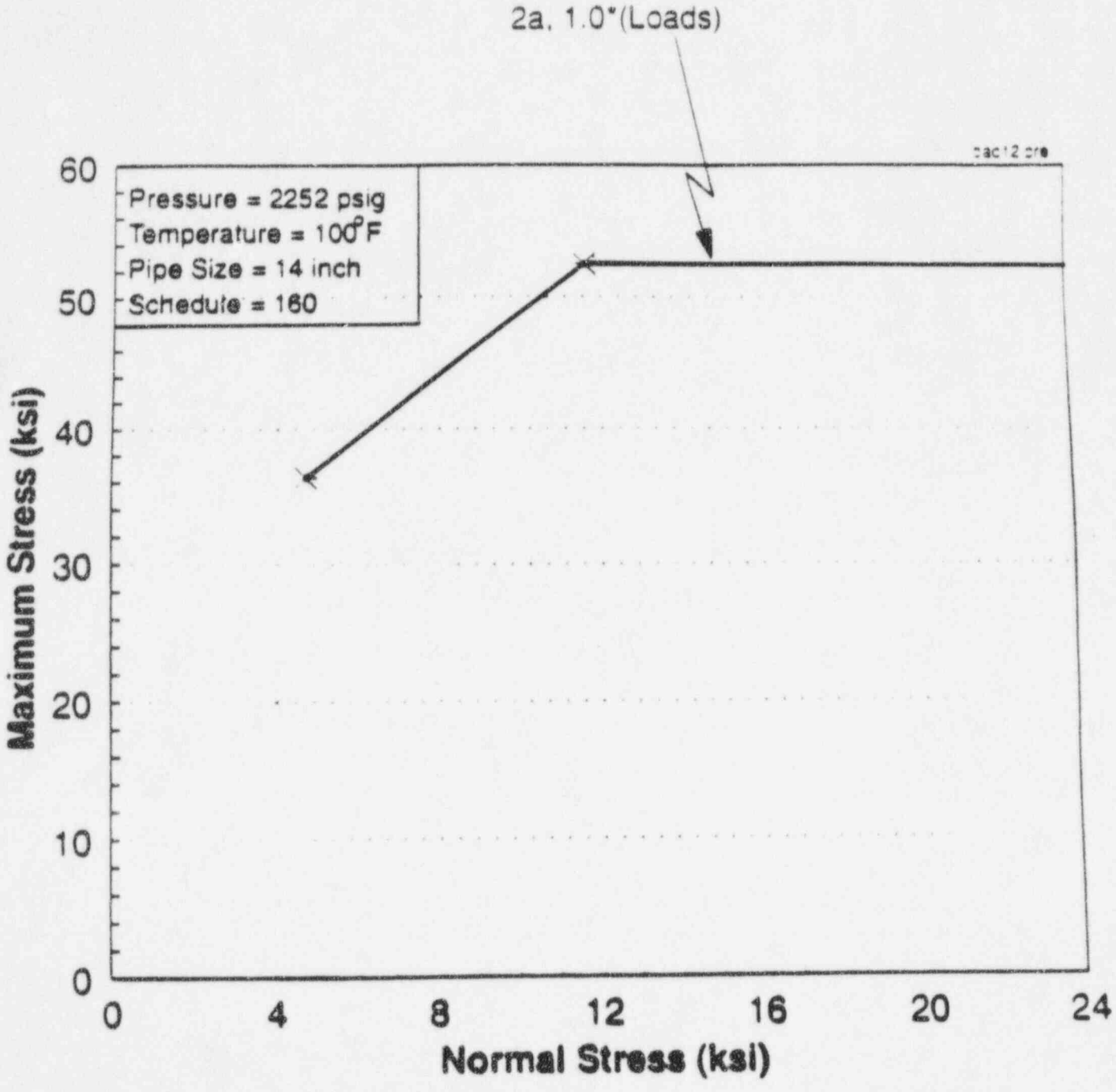
Fx = 0 For PICEP Run

Mb = 1.0883 x 114216 = 124302 in-lb For PICEP Run

NORMAL STRESS : 4.638 + (114.216/4.89) = 28.00 ksi

MAX. STRESS : 4.638 + (174.644/4.89) = 40.35 ksi
use 40.27 ksi

[ ]a



Bounding Analysis Curve #12 for 14" ADS Stage

AP600 LBB BOUNDING ANALYSIS CURVE (BAC)

BAC #	: 12
DESCRIPTION	: ADS Stage 2, 3 / Safety
PIPE SIZE	: 14"
SCHEDULE	: 160
MATERIAL	: 316LN
PRESSURE(psig)	: 2252
TEMPERATURE	: 100° F
PIPE O.D(in)	: 14
MEAN RAD.(in)	: 6.375
MIN. THICK.(in)	: 1.251
AREA(in^2)	: 50.11
SEC.MOD.(in^3)	: 146.83
PRESS.FORCE	: 233831 lbs
PRESS.STRESS	: 4667 psi or 4.67 ksi
YIELD STRESS	: 30000 psi
ULTIMATE STRESS	: 75000 psi
E VALUE	: 28.14 E6 psi

BAC # : 12

LOW NORMAL CASE :

Fx : 233831 lbs or 233.831 kips

Mb : 0.1 X 146.828 = 14.6828 in-kips or 14682.8 in-lb
(0.1 ksi Bending Stress Assumed)

Fx = 0 For PICEP Run

Mb = 1.088 x 14682.8 = 15975 in-lb For PICEP Run

NORMAL STRESS : 4.67 + 0.1 = 4.77 ksi

MAX. STRESS : 4.67 + 4655.18 / 146.83 = 36.37 ksi

[ ] a

HIGH NORMAL CASE:

Fx : 233831 lbs or 233.831 kips

Mb : 1040277 in-lb (Assumed)

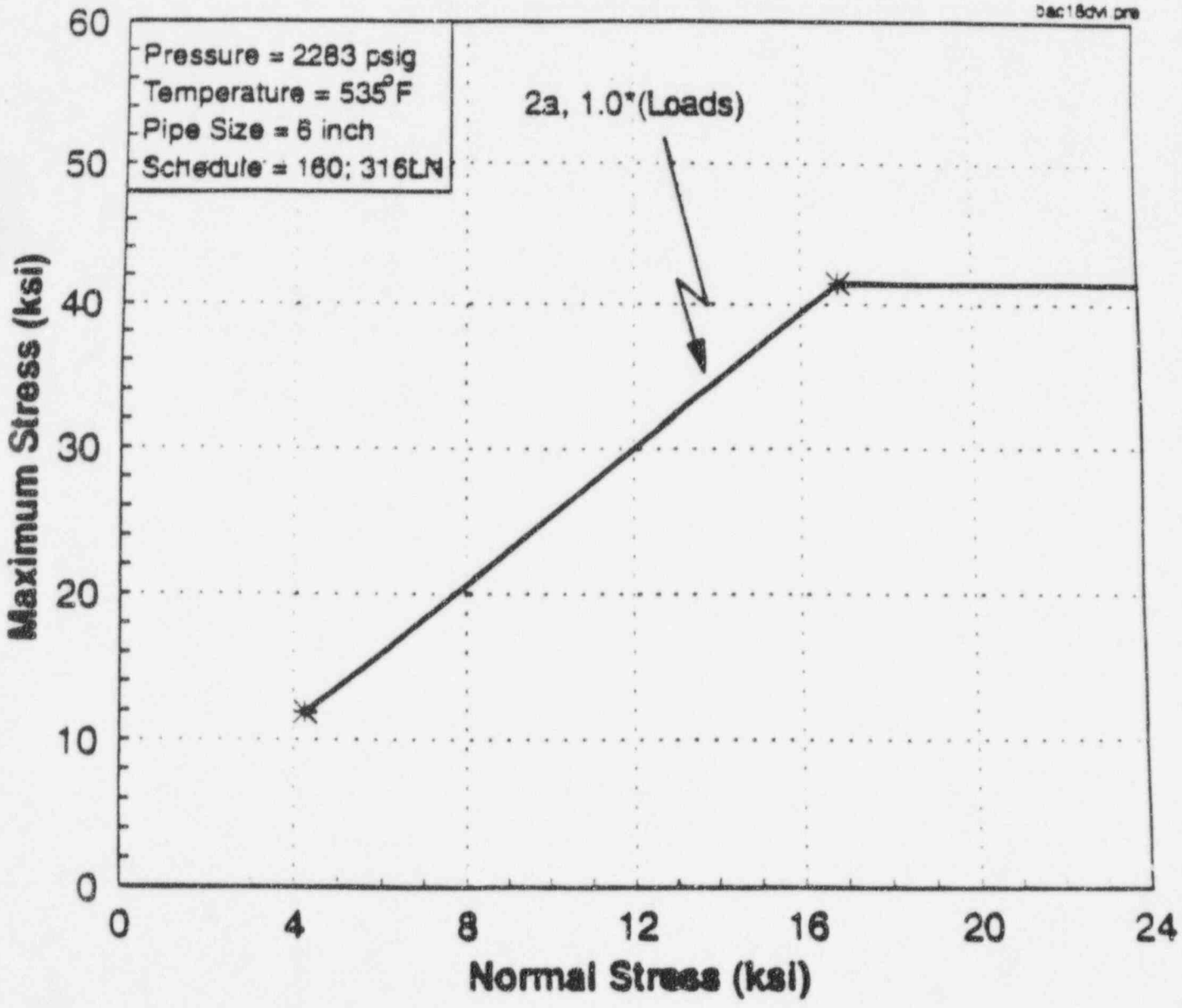
Fx = 0 For PICEP Run

Mb = 1.088 x 1040277 = 1131822 in-lb For PICEP Run

NORMAL STRESS : 4.67 + 1040.277 / 146.83 = 11.75 ksi

MAX. STRESS : 4.667 + 7025.995 / 146.83 = 52.52 ksi
use maximum stress = 52.50 ksi

[ ] a



Bounding Analysis Curve #18 for 6" DVI A&B

AP600 LBB BOUNDING ANALYSIS CURVE (BAC)

BAC #	:	18
DESCRIPTION	:	Direct Vessel Injection - A & B
PIPE SIZE	:	6 inch
SCHEDULE	:	160
MATERIAL	:	316LN
PRESSURE(psig)	:	2283
TEMPERATURE	:	535° F
PIPE O.D(in)	:	6.625
MEAN RAD.(in)	:	2.988
MIN. THICK.(in)	:	0.650
AREA(in^2)	:	12.19
SEC.MOD.(in^3)	:	16.62
PRESS.FORCE	:	50863 lbs or 50.863 kips
PRESS.STRESS	:	4172 psi or 4.172 ksi
YIELD STRESS	:	19020 psi
ULTIMATE STRESS	:	64080 psi
E VALUE	:	25.63 E6 psi

LOW NORMAL CASE :

Fx : 50863 lbs or 50.863 kips

Mb : 0.1 ksi X 16.62 = 1.662 in-kips or 1662 in-lbs
(0.1 ksi Bending Stress Assumed)

Fx = 0 For PICEP Run

Mb = 1.096 x 1662 = 1822 in-lb For PICEP Run

NORMAL STRESS : 4.172 + 0.1 = 4.27 ksi

MAX. STRESS : 4.172 + (128.48/16.62) = 11.90 ksi

[ ]a

HIGH NORMAL CASE:

Fx : 50863 lbs or 50.863 kips

Mb : 211277 in-lbs or 211.277 in-kips (Assumed)

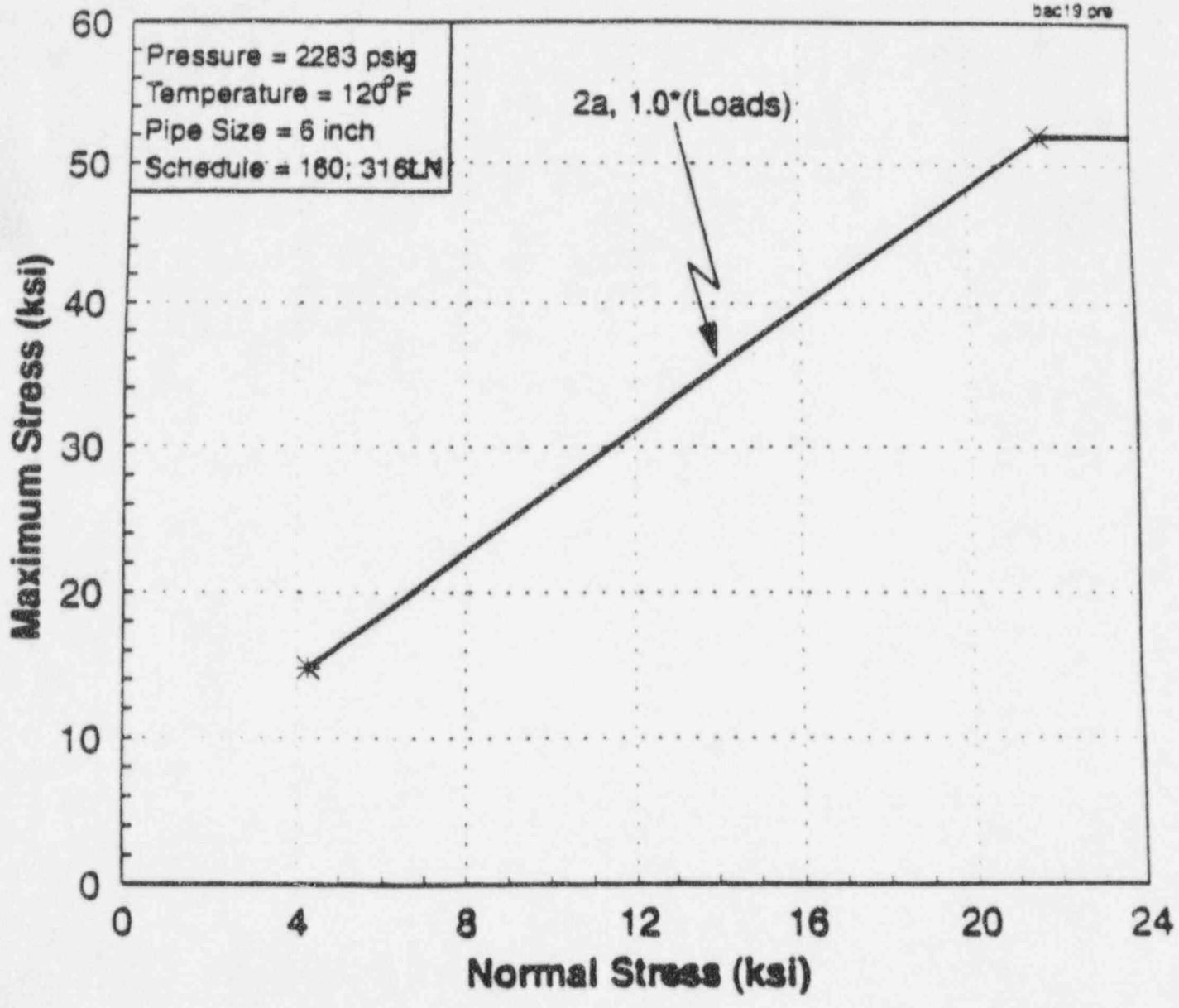
Fx = 0 For PICEP Run

Mb = 1.096 x 211277 = 231560 in-lb For PICEP Run

NORMAL STRESS : 4.172 + (211.277/16.62) = 16.88 ksi

MAX. STRESS : 4.172 + (619.89/16.62) = 41.47 ksi

[ ]a



Bounding Analysis Curve #19 for 6" DVI A & B

AP600 LBB BOUNDING ANALYSIS CURVE (BAC)

BAC #	:	19
DESCRIPTION	:	DVI A & B
PIPE SIZE	:	6 inch
SCHEDULE	:	160
MATERIAL	:	316LN
PRESSURE(psig)	:	2283
TEMPERATURE	:	120° F
PIPE O.D(in)	:	6.625
MEAN RAD.(in)	:	2.988
MIN. THICK.(in)	:	0.65
AREA(in^2)	:	12.1928
SEC.MOD.(in^3)	:	16.6229
PRESS.FORCE	:	50863 lbs or 50.863 kips
PRESS.STRESS	:	4172 psi or 4.172 ksi
YIELD STRESS	:	29100 psi or 29.100 ksi
ULTIMATE STRESS	:	75000 psi or 75.000 ksi
E VALUE	:	28.03 E6 psi

BAC # : 19

LOW NORMAL CASE :

Fx : 50863 lbs or 50.863 kips

Mb : 1662.3 in-lbs

Fx = 0 For PICEP Run

Mb = 1.096 x 1662.3 = 1822 in-lb For PICEP Run

NORMAL STRESS : 4.172 + (1.6623/16.623) = 4.272 ksi

MAX. STRESS : 4.172 + (177.231/16.623) = 14.834 ksi

[ ] a

HIGH NORMAL CASE:

Fx : 50863 lbs or 50.863 kips

Mb : 292829 in-lbs

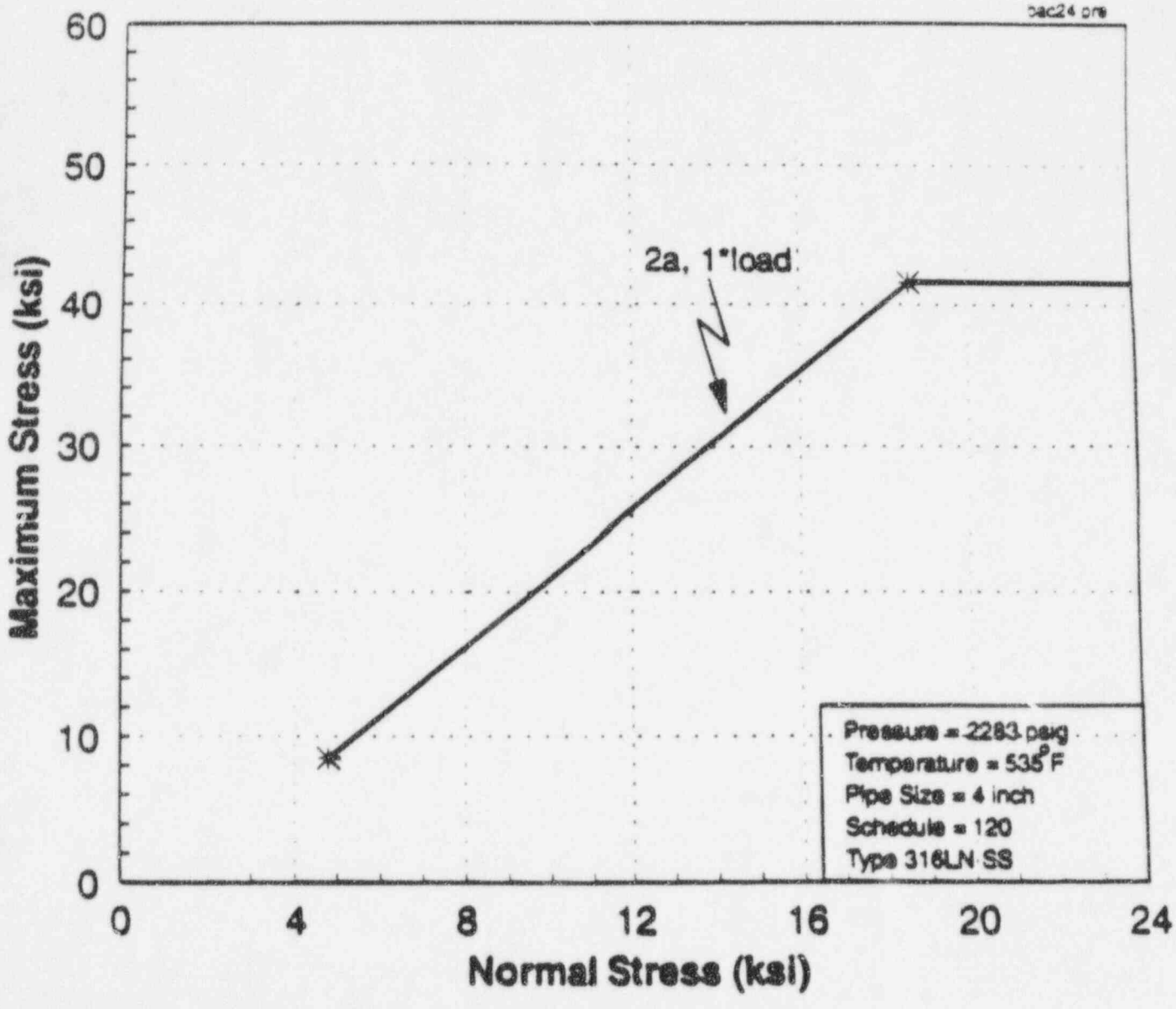
Fx = 0 For PICEP Run

Mb = 1.096 x 292829 = 320941 in-lb For PICEP Run

NORMAL STRESS : 4.172 + (292.829/16.623) = 21.788 ksi

MAX. STRESS : 4.172 + (796.265/16.623) = 52.07 ksi

[ ] a



Bounding Analysis Curve #24 for 4" Spray

AP600 LBB BOUNDING ANALYSIS CURVE (BAC)

BAC #	:	24
DESCRIPTION	:	Spray Line
PIPE SIZE	:	4 inch
SCHEDULE	:	120
MATERIAL	:	316LN
PRESSURE(psig)	:	2283
TEMPERATURE	:	535° F
PIPE O.D(in)	:	4.50
MEAN RAD.(in)	:	2.048
MIN. THICK.(in)	:	0.404
AREA(in^2)	:	5.20
SEC.MOD.(in^3)	:	4.89
PRESS.FORCE	:	24441 lbs or 24.441 kips
PRESS.STRESS	:	4701 psi or 4.701 ksi
YIELD STRESS	:	19020 psi
ULTIMATE STRESS	:	64080 psi
E VALUE	:	25.63 E6 psi

BAC # : 24

LOW NORMAL CASE :

Fx : 24441 lbs or 24.441 kips

Mb : 0.1 X 4.89 = 0.489 in-kips or 489 in-lbs
(0.1 ksi Bending Stress Asssumed)

Fx = 0 For PICEP Run

Mb = 1.0883 x 489 = 533 in-lb For PICEP Run

NORMAL STRESS : 4.701 + 0.1 = 4.80 ksi

MAX. STRESS : 4.701 + (18.672/4.89) = 8.52 ksi

[ ]a

HIGH NORMAL CASE:

Fx : 24441 lbs or 24.441 kips

Mb : 68026.1 in-lbs or 68.026 in-kips (Assumed)

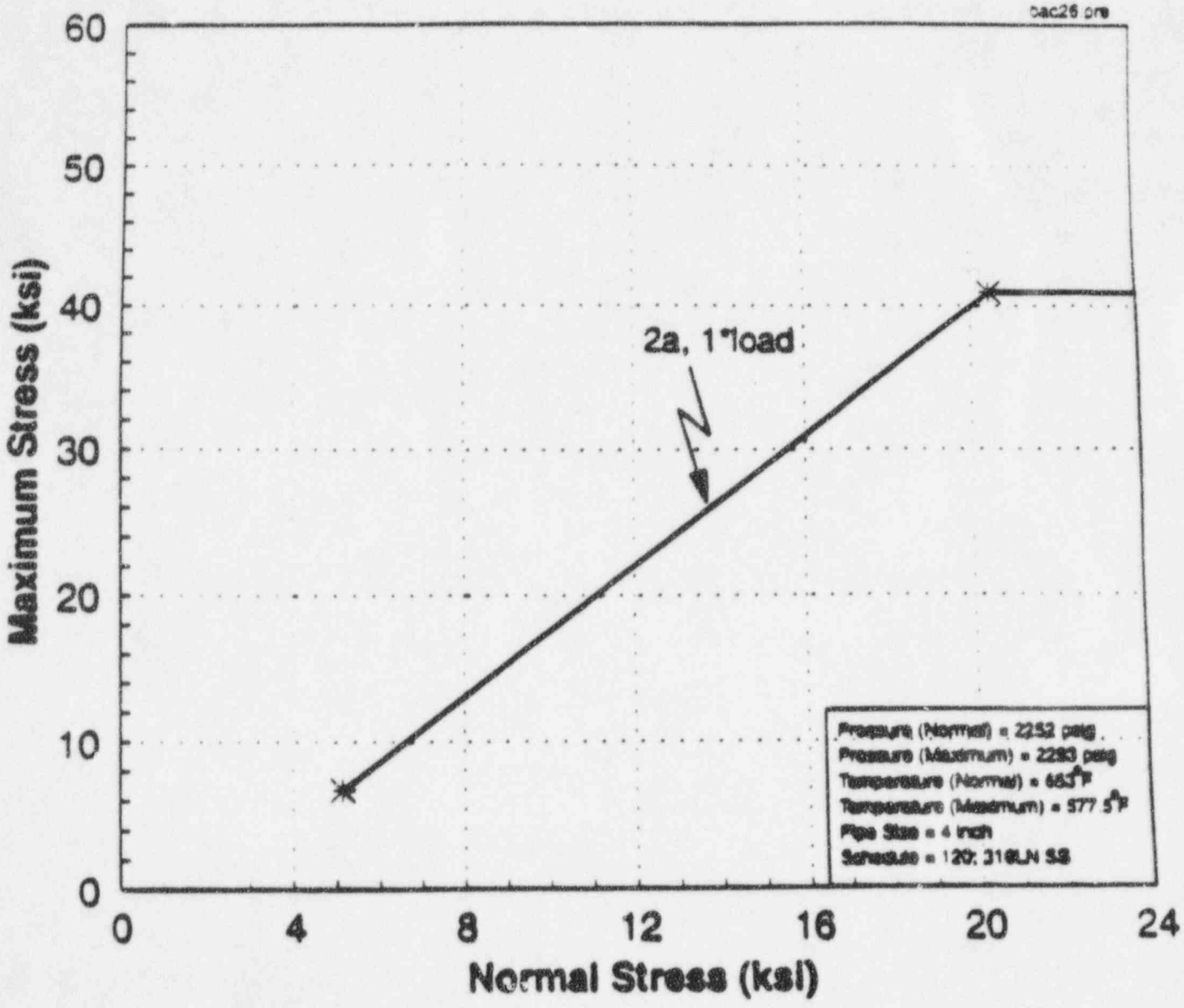
Fx = 0 For PICEP Run

Mb = 1.0883 x 68026.1 = 74033 in-lb For PICEP Run

NORMAL STRESS : 4.701 + (68.026/4.89) = 18.61 ksi

MAX. STRESS : 4.701 + (180.20/4.89) = 41.55 ksi

[ ]a



Bounding Analysis Curve #26 for 4" Spray

AP600 LBB BOUNDING ANALYSIS CURVE (BAC)

BAC #	:	26
DESCRIPTION	:	Spray Line
PIPE SIZE	:	4 inch
SCHEDULE	:	120
MATERIAL	:	316LN
PRESSURE(psig)	:	2252 (Normal); 2283 (Maximum)
TEMPERATURE	:	653° F (Normal); 577.5° F (Maximum)
PIPE O.D(in)	:	4.50
MEAN RAD.(in)	:	2.048
MIN. THICK.(in)	:	0.404
AREA(in^2)	:	5.20
SEC.MOD.(in^3)	:	4.89
PRESS.FORCE	:	24109 lbs (Normal); 24441 lbs (Maximum)
PRESS.STRESS	:	4638 psi (Normal); 4700 psi (Maximum)
YIELD STRESS	:	17700 psi (Normal); 18550 psi (Maximum)
ULTIMATE STRESS	:	62780 psi (Normal); 63440 psi (Maximum)
E VALUE	:	25.04 E6 psi (Normal); 25.41 E6 psi (Maximum)

BAC # : 26

LOW NORMAL CASE :

Fx : 24109 lbs (Leakage); 24441 lbs (Limit Moment)

Mb : 0.5 ksi or 500 psi X 4.89 = 2445 in-lbs or 2.445 in-kips

Fx = 0 For PICEP Run

Mb = 1.0883 x 2445 = 2661 in-lb For PICEP Run

NORMAL STRESS : 4.638 + 0.5 = 5.138 ksi

MAX. STRESS : 4.700 + (9.946/4.89) = 6.73 ksi

[ ]a

HIGH NORMAL CASE:

Fx : 24109 lbs (Leakage); 24441 lbs (Limit Moment)

Mb : 77318 in-lbs or 77.318 in-kips (Assumed)

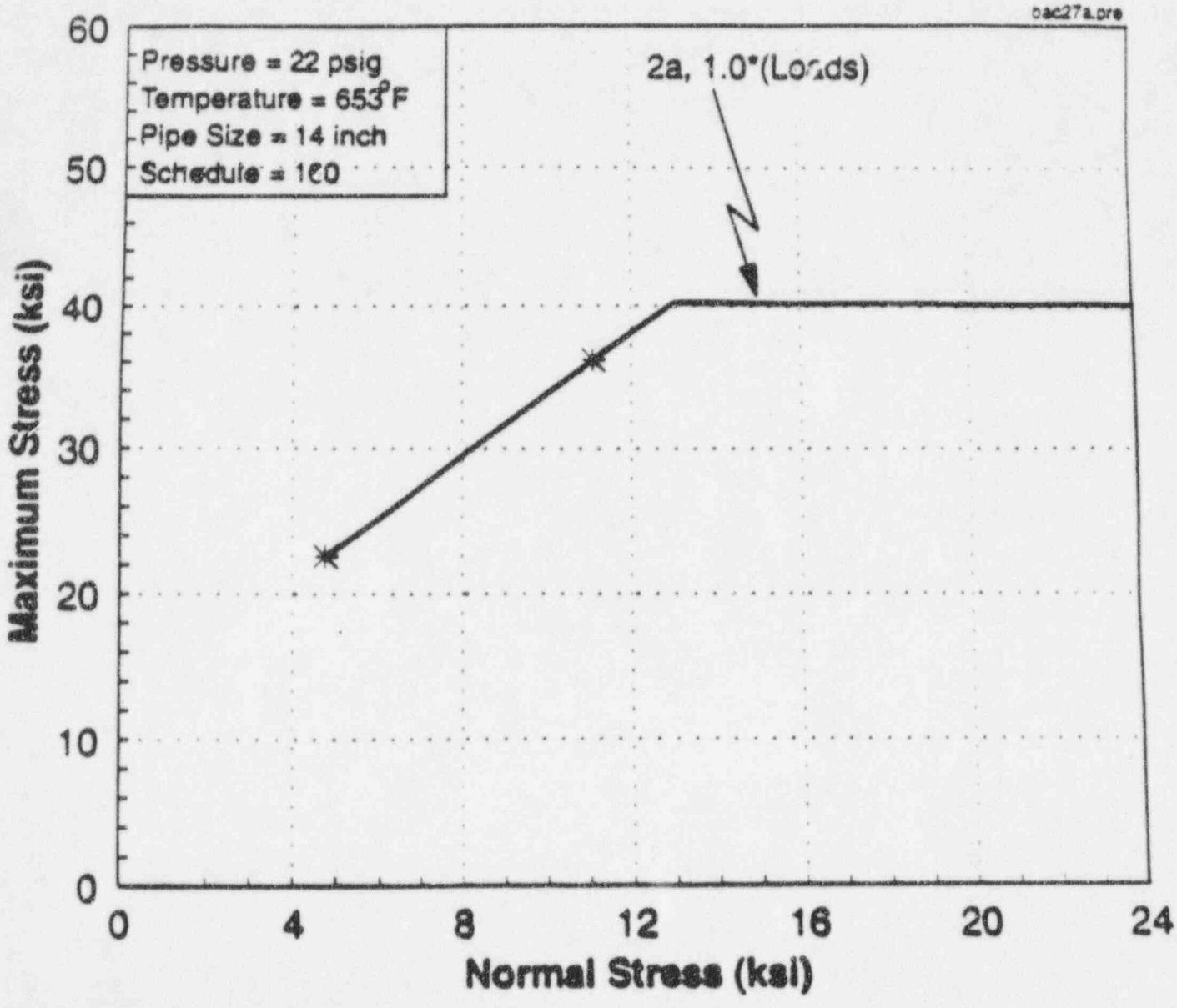
Fx = 0 For PICEP Run

Mb = 1.0883 x 77318 = 84146 in-lb For PICEP Run

NORMAL STRESS : 4.638 + (77.318/4.89) = 20.449 ksi

MAX. STRESS : 4.700 + (177.198/4.89) = 40.94 ksi

[ ]a



Bounding Analysis Curve #27 for 14" ADS Stage 2, 3

AP600 LBB BOUNDING ANALYSIS CURVE (BAC)

BAC #	: 27
DESCRIPTION	: ADS Stage 2, 3 / Safety
PIPE SIZE	: 14"
SCHEDULE	: 160
MATERIAL	: 316LN
PRESSURE(psig)	: 2252
TEMPERATURE	: 653° F
PIPE O.D(in)	: 14.0
MEAN RAD.(in)	: 6.375
MIN. THICK.(in)	: 1.251
AREA(in^2)	: 50.11
SEC.MOD.(in^3)	: 146.828
PRESS.FORCE	: 233831 lbs or 233.831 kips
PRESS.STRESS	: 4667 psi or 4.667 ksi
YIELD STRESS	: 17770 psi
ULTIMATE STRESS	: 62780 psi
E VALUE	: 25.04 E6 psi

BAC # : 27

LOW NORMAL CASE :

Fx : 233831 lbs or 233.831 kips

Mb : 0.1 X 146.828 = 14.6828 in-kip or 14683 in-lb
(0.1 ksi Bending Stress Assumed)

Fx = 0 For PICEP Run

Mb = 1.088 x 14683 = 15975 in-lb For PICEP Run

NORMAL STRESS . : 4.667 + 0.1 = 4.77 ksi

MAX. STRESS : 4.667 + (2632.3 / 146.828) = 22.59 ksi

[ ]a

HIGH NORMAL CASE:

Fx : 233831 lbs or 233.831 kips

Mb : 946307 in-lb (Assumed)

Fx = 0 For PICEP Run

Mb = 1.088 x 946307 = 1029582 in-lb For PICEP Run

NORMAL STRESS : 4.667 + (946.307 / 146.828) = 11.11 ksi

MAX. STRESS : 4.667 + (4631.46 / 146.828) = 36.21 ksi

[ ]a

Attachment 4 to Letter NTD-NRC-95-4552

Selected pages from AP600 Bounding Analysis Curves Calculation

Nonproprietary

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WESTINGHOUSE CALCULATION SHEET

TITLE AP600 Bounding Analysis Curves			PAGE 1 OF 50
PROJECT: AP600	AUTHOR: [signature] DATE: 6/15/05	CHK'D BY: N/A DATE:	VERIFIED BY: T Schmidt DATE: 6/15/05
S.O.	CALC. NO.	FILE NO.: AP600-950/2A	GROUP: SMT

Purpose:

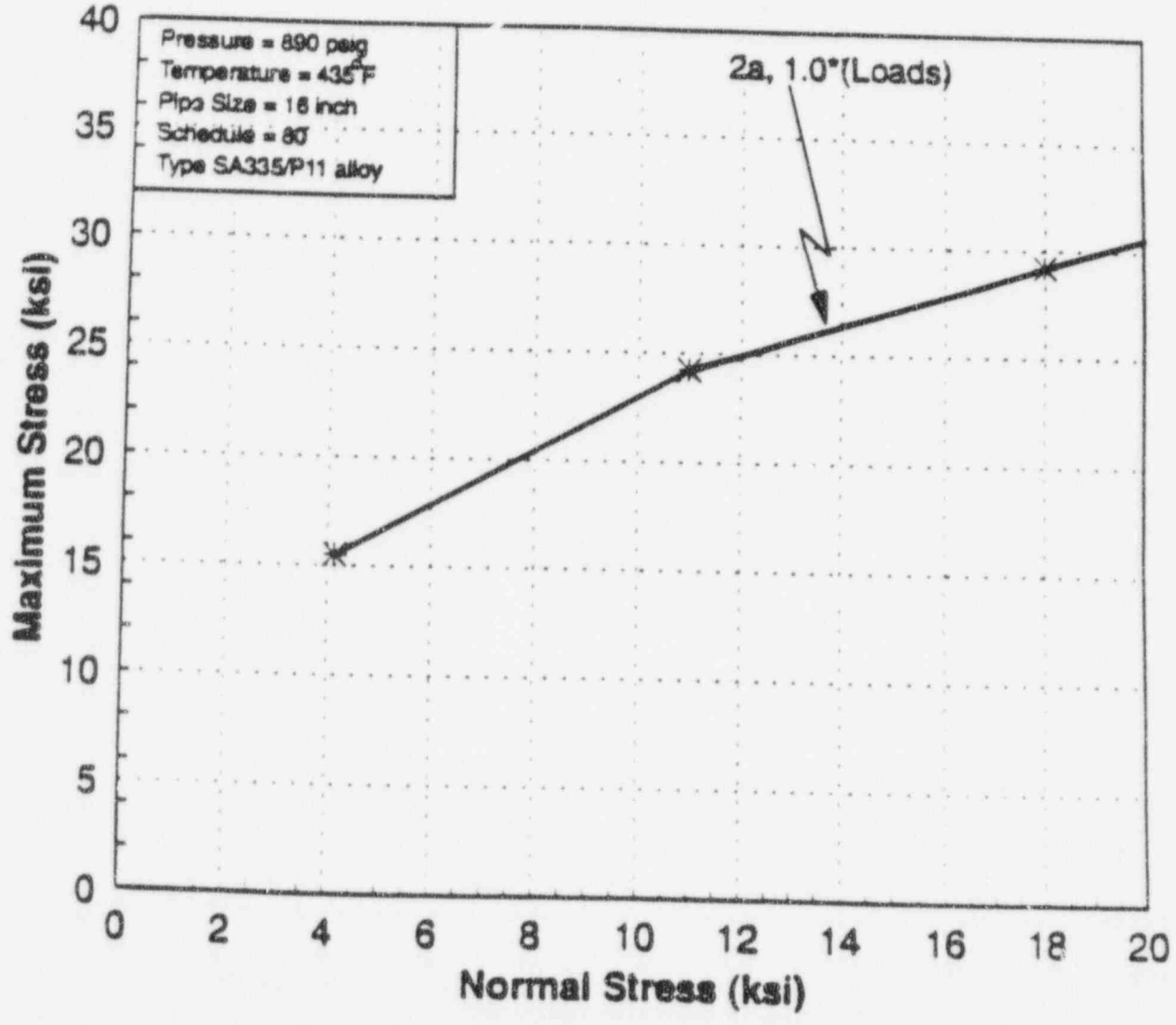
This calculation is assembled to document the Development of the bounding analysis curves for the AP600 Feedwater line. The analysis includes crack opening area, leak rate and J-integral calculations.

References:

REV	REV DATE	DATE	CHK'D BY	DATE	VERIFIED BY	DATE

TITLE AP600 Bounding Analysis Curves			PAGE 5 OF 52
PROJECT: AP600	AUTHOR: [signature] DATE: 5/14/95	CHK'D. BY: N/A DATE:	VERIFIED BY: D. Brownlie DATE: 5/15/95
S.O.	CALC. NO.	FILE NO.: AP600-950/2A	GROUP: SMT

Figure 1 - Feedwater Line Bounding Analysis Curve (#1), T=435°F



WESTINGHOUSE CALCULATION SHEET

TITLE FEEDWATER LINE			PAGE 2 OF 55
PROJECT AP600	AUTHOR DEGreger DATE 5/14/95	CHK'D BY N/A DATE	VERIFIED BY D. Blanksmith DATE 5/15/95
S.O.	CALC NO	FILE NO	GROUP SMT

TENSILE PROPERTIES (FROM REFERENCE 4)

REV NO	REV DATE	AUTHOR DATE	CHK'D BY DATE	VERIFIED BY DATE

TITLE				PAGE
AP600 Bounding Analysis Curves				5 OF 55
PROJECT	AUTHOR / DATE	CHK'D BY / DATE	VERIFIED BY / DATE	
AP600	5/14/97	—	D. Schmidt 5/15/97	
S/O	CALC NO	FILE NO	GROUP	
			MSE-SMT	

AP600 LBB BOUNDING ANALYSIS CURVE (BAC)

BAC #	:	1
DESCRIPTION	:	Feedwater Line
PIPE SIZE	:	16"
SCHEDULE	:	80
MATERIAL	:	SA335/P11 Alloy
PRESSURE(psig)	:	890
TEMPERATURE	:	435
PIPE O.D(in)	:	16.0
MEAN RAD.(in)	:	7.62
MIN. THICK.(in)	:	0.76
AREA(in^2)	:	36.3872
SEC.MOD.(in^3)	:	132.3784
PRESS.FORCE	:	146.561 kips
PRESS.STRESS	:	4.028 ksi
YIELD STRESS	:	38.145 ksi(average) ; 37.25 ksi (min)
ULTIMATE STRESS	:	67.83 ksi (min)
E VALUE	:	30.20E+6 psi

TITLE			PAGE
AP600 Bounding Analysis Curves			6 OF 53
PROJECT AP600	AUTHOR D E [signature] DATE 5/14/95	CHK'D BY — DATE	VERIFIED BY D. [signature] DATE 5/15/95
S.O.	CALC NO	FILE NO	GROUP MSE-SMT

BAC # : 1

LOW NORMAL CASE :

Fx : 146.561kips

Mb : 0.1 ksi * 132.3784 in^3 = 13.238 in-kips

LEAKAGE FLAW SIZE(a)(in) : [ ]^a

CRITICAL FLAW SIZE(2a)(in) :

NORMAL STRESS : 0.1 + 4.028 = 4.128 ksi

MAX. STRESS : 2051.865 in-kip/132.3874 in^3 = 15.5 ksi

HIGH NORMAL CASE:

Fx : 146.561 kips

Mb : 18 - 4.03 = 13.97 * 132.3874 ≅ 1849.33 in-kips

LEAKAGE FLAW SIZE(a)(in) : [ ]^a

CRITICAL FLAW SIZE(2a)(in) :

NORMAL STRESS : 18.0 ksi

MAX. STRESS : 3865.449 in-kip/132.3874 in^3 = 29.2 ks

TITLE: AP600 Bounding Analysis Curves				PAGE: 7 OF 52
PROJECT: AP600	AUTHOR: [signature] DATE: 5/14/97	CHK'D BY: — DATE:	VERIFIED BY: D. R. [illegible] DATE: 5/15/97	
SO	CALC NO	FILE NO.	GROUP: MSE-SMT	

MIDDLE NORMAL CASE:

Fx : 146.561 kips

Mb : 6.97 * 132.3784 = 922.677 in-kip

LEAKAGE FLAW SIZE(a)(in) : [ ] a

CRITICAL FLAW SIZE(2a)(in) : [ ]

NORMAL STRESS : 4.03 + 6.97 = 11 ksi

MAX. STRESS : 3210.176/132.3784 = 24.25 ksi

REV NO	REV DATE	CHK'D BY	DATE	VERIFIED BY	DAT

TITLE AP600 Bounding Analysis Curves			PAGE 58 OF 59
PROJECT: AP600	AUTHOR: D E Rouger DATE: 5/14/98	CHK'D BY: N/A DATE:	VERIFIED BY: D. R[illegible] DATE: 5/15/98
S.O	CALC NO	FILE NO: AP600-950/2A	GROUP: SMT

Low Normal Maximum Stress Cases for T = 435°F Feedwater Line Bounding Analysis Curve

Maximum Stress (ksi)	Section Modulus (in^3)	Faulted Load (in-kips)	J-Integral ($in\text{-}lb/in^2$)
12	132.3784	1588.541	[a]
14	"	1853.298	
16	"	2118.054	
15	"	1985.676	
15.5	"	2051.865	
Middle Normal Case			
24.5	132.3784	3243.271	
24	"	3177.082	
24.25	"	3210.176	
High Normal Case			
29.5	132.3784	3905.163	
29.0	"	3838.974	
29.25	"	3872.068	
29.2	"	3865.449	

" - J-integral must be below J_{Ic} value of [a]

REV	REV DATE	AUTHOR	DATE	CHK'D BY	DATE	VERIFIED BY	DAT

WESTINGHOUSE CALCULATION SHEET

TITLE AP600 Bounding Analysis Curves			PAGE 39 OF 50
PROJECT	AUTHOR DATE J E Quaye 5/14/97	CHK'D. BY DATE —	VERIFIED BY DATE D Bhowmik 5/15/97
S.O.	CALC. NO.	FILE NO.	GROUP

REFERENCE # 3