Westinghouse Electric Corporation
Energy Systems

Box 355
Pittsburgh Pennsylvania 15230-0355

AW-94-605

March 31, 1994

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

ATTENTION: MR. R. W. BORCHARDT

APPLICATION FOR WITHHOLDING PROPRIETARY INFORMATION FROM PUBLIC DISCLOSURE

SUBJECT: PRESENTATION MATERIALS FROM THE MARCH 28 & 29, 1994 MEETING ON THE AP600 CONTAINMENT

Dear Mr. Borchardt:

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-94-605 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-94-605 and should be addressed to the undersigned.

Very truly yours,

N. J. Liparulo, Manager
Nuclear Safety And Regulatory Activities

/nja

cc: Kevin Bohrer NRC 12H5

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In order to conform to the requirements of 10 CFR 2.790 of the Commission's regulations concerning the protection of proprietary information so submitted to the NRC, the information which is proprietary in the proprietary versions is contained within brackets, and where the proprietary information has been deleted in the non-proprietary versions, only the brackets remain (the information that was contained within the brackets in the proprietary versions having been deleted). The justification for claiming the information so designated as proprietary is indicated in both versions by means of lower case letters (a) through (f) contained within parentheses located as a superscript immediately following the brackets enclosing each item of information being identified as proprietary or in the margin opposite such information. These lower case letters refer to the types of information Westinghouse customarily holds in confidence identified in Section (4)(ii)(a) through (4)(ii)(f) of the affidavit accompanying this transmittal pursuant to 10 CFR2.790(b)(1).

AW-94-605

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 & Licensing

Sworn to and subscribed
before me this 8 day
of April, 1994

Notary Public

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

1611A

(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-94-4089, March 31, 1994, being transmitted by Westinghouse Electric Corporation (W) letter and Application for Withholding Proprietary Information from Public Disclosure, N. J. Liparulo (W), to Mr. R. W. Borchardt, 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 applicable in other licensee submittals in response to certain NRC requirements for justification of licensing advanced nuclear power plant designs.

This information is part of that which will enable Westinghouse to:

(a) Demonstrate the design and safety of the AP600 Passive Safety Systems.

(b) Establish applicable verification testing methods.

(c) Design Advanced Nuclear Power Plants that meet NRC requirements.

(d) Establish technical and licensing approaches for the AP600 that will ultimately result in a certified design.

(e) Assist customers in obtaining NRC approval for future plants.

Further this information has substantial commercial value as follows:

(a) Westinghouse plans to sell the use of similar information to its customers for purposes of meeting NRC requirements for advanced plant licenses.

(b) Westinghouse can sell support and defense of the technology to its customers in the licensing process.

Public disclosure of this proprietary information is likely to cause substantial harm to the competitive position of Westinghouse because it would enhance the ability of competitors to provide similar advanced nuclear power designs and licensing defense services for commercial power reactors without commensurate expenses. Also, public disclosure of the information would enable others to use the information to meet NRC requirements for licensing documentation without purchasing the right to use the information.

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 1

NTD-NRC-94-4089

AP600 Containment Meeting

Meeting with the NRC

March 28 and 29, 1994

AP600 Containment Meeting
March 28 and 29, 1994
Agenda

Introduction	R. Orr
Purpose of meeting Transmittal of design information to NRC consultants SSAR and RAI status for Section 3.8.2	
Containment Design Basis Function	D. McDermott
Containment Severe Accident Function	J. Scobel
Containment Design Specification	R. Orr
Containment Structural Design and analysis	T. Ahl
Analyses of capacity for severe accidents	T. Ahl
Seismic Margin	R. Orr
Information for independent analyses	

WESTINGHOUSE AP600 CONTAINMENT VESSEL

CONTAINMENT DESIGN AND ANALYSIS PERFORMED BY CBI

- CBI CONTAINMENT CONFIGURATION SKETCHES
- MATERIAL PROPERTIES
- CONTAINMENT SHELL - FREE FIELD AND GROSS STRUCTURAL DISCONTINUITIES ANALYSIS
- LOCAL EFFECTS ANALYSIS AT MAJOR PENETRATIONS AND ATTACHMENTS

CONTAINMENT SHELL - FREE FIELD AND GROSS STRUCTURAL DISCONTINUITIES ANALYSIS

- DESIGN CASE - 45 PSIG at 280 DEGREES F.
- SERVICE LEVEL C CASE at 320 DEGREES F.
- SEVERE ACCIDENT CAPACITY ASSESSMENT at 70 DEGREES F
- STRESS EVALUATION DUE TO REPRESENTATIVE THERMAL GRADIENTS
- BUCKLING ANALYSIS AT SEVERE ACCIDENT PRESSURE
- SEISMIC MODELING

Table 3.8.2-1

Load Combinations and Service Limits For Containment Vessel

Load Description		Load combination and service limit									
		Test	Design	A	A	C	C	C	D	A	C
Dead	D	x	x	x	x	x	x	x	x	x	x
Live	L	x	x	x	x	x	x	x	x	x	x
Wind	W			x							
SSE	E_s					x	x		x		
Tornado	W_t							x			
Test pressure	P_t	x									
Test temperature	T_t	x									
Operating pressure	P_o			x							
Normal reaction	R_o			x			x	x		x	x
Normal thermal	T_o			x			x	x		x	x
Design pressure	P_d		x		x	x			x		
External pressure (2.5 psid)	P_e									x	
External pressure (3.0 psid)	T_o										x
Accident thermal	T_a		x		x	x			x		
Accident thermal reactions	R_a		x		x	x			x		
Accident pipe reactions	Y_r								x		
Jet impingement	Y_j								x		
Pipe impact	Y_m								x		

Notes:

1. Service limit levels are per A3948-NE.

2. Where any load reduces the effects of other loads, that load shall be taken as zero, unless it can be demonstrated that the load is always present or occurs simultaneously with the other loads.

STRESS-STRAIN CURVE (UNIAXIAL)

Assume elastic-perfectly plastic material properties.

Ignoring strain-hardening is conservative.

Yield strain, $\varepsilon_Y = \frac{\sigma_Y}{E} = \frac{60000}{29.5 \times 10^6} = 2.0339 \times 10^{-3}$ in/in.

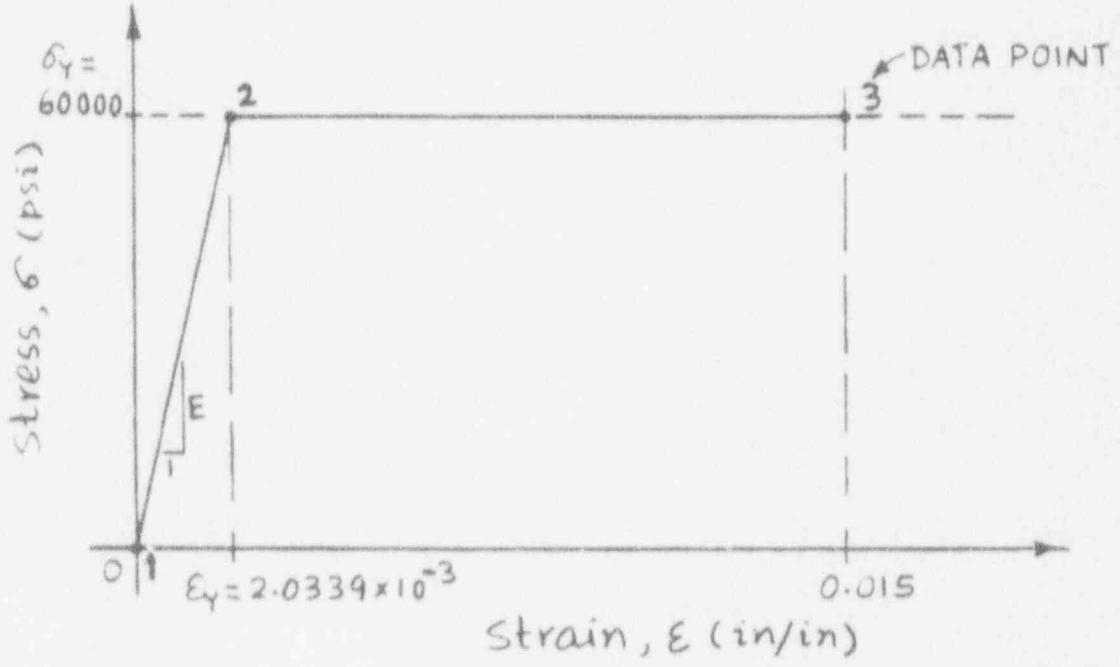


FIG. 3-2: STRESS-STRAIN CURVE FOR ANALYSIS

NOTE:

Effective stress at data point 3 has been modified by 'BOSORS' program internally in order to obtain a minimum tangent modulus of 0.001E = 29500 psi. (σ_{eff} at data point 3 used in 'BOSORS' is 60382 = 60000 + 29500[0.015 - 0.0020339].) This is normally done to improve the rate of convergence. This 'negligible' strain hardening will not have any significant effect on the results.

SUBJECT	OFFICE	REVISION		REFERENCE NO
BUCKLING CAPACITY EVALUATION	CBI NOE-A			902657
TASK #3, CBI PHASE 3 STUDY	MADE BY: RSR / VERIFIED BY: TJA	MADE BY	VERIFIED BY	SHT 3-5 OF
AP600, WESTINGHOUSE	DATE: 12/17/91 / DATE: 2/18/92	DATE	DATE	

AP600 CONTAINMENT VESSEL

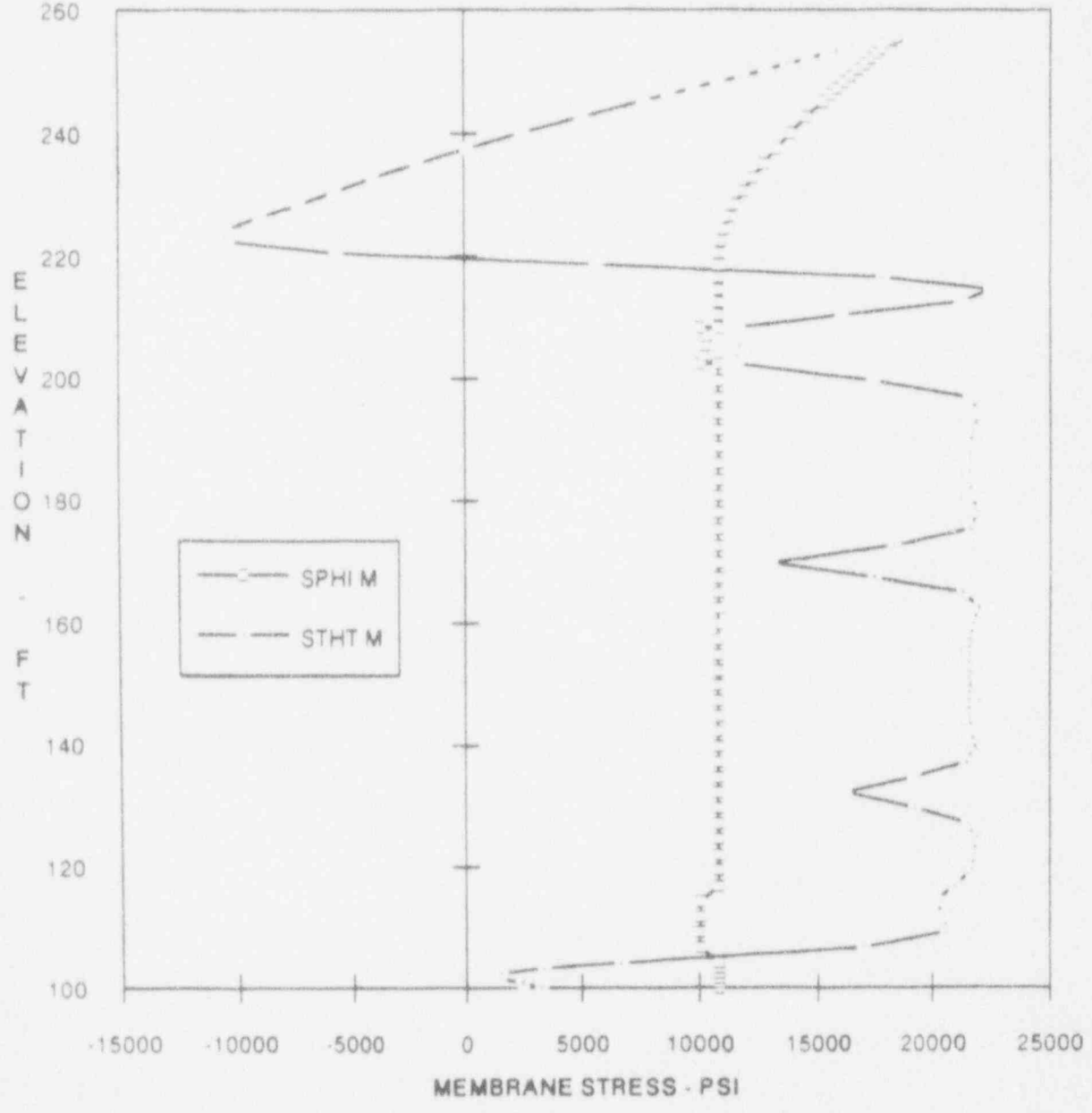


FIGURE 2 CONTAINMENT VESSEL RESPONSE TO INTERNAL DESIGN PRESSURE OF 45 PSIG - MEMBRANE STRESSES (SPHI = MERIDIONAL, STHT = CIRCUMFERENTIAL)

SUBJECT	OFFICE	REVISION	REFERENCE NO
TASK #1992-2, AP600, WESTINGHOUSE	NOE-A		902657
MADE BY / VERIFIED BY / MADE BY / VERIFIED BY	RSR / TJA		2B-15
DATE / DATE / DATE / DATE	5/15/92 / 5/20/92		SHT ___ OF ___

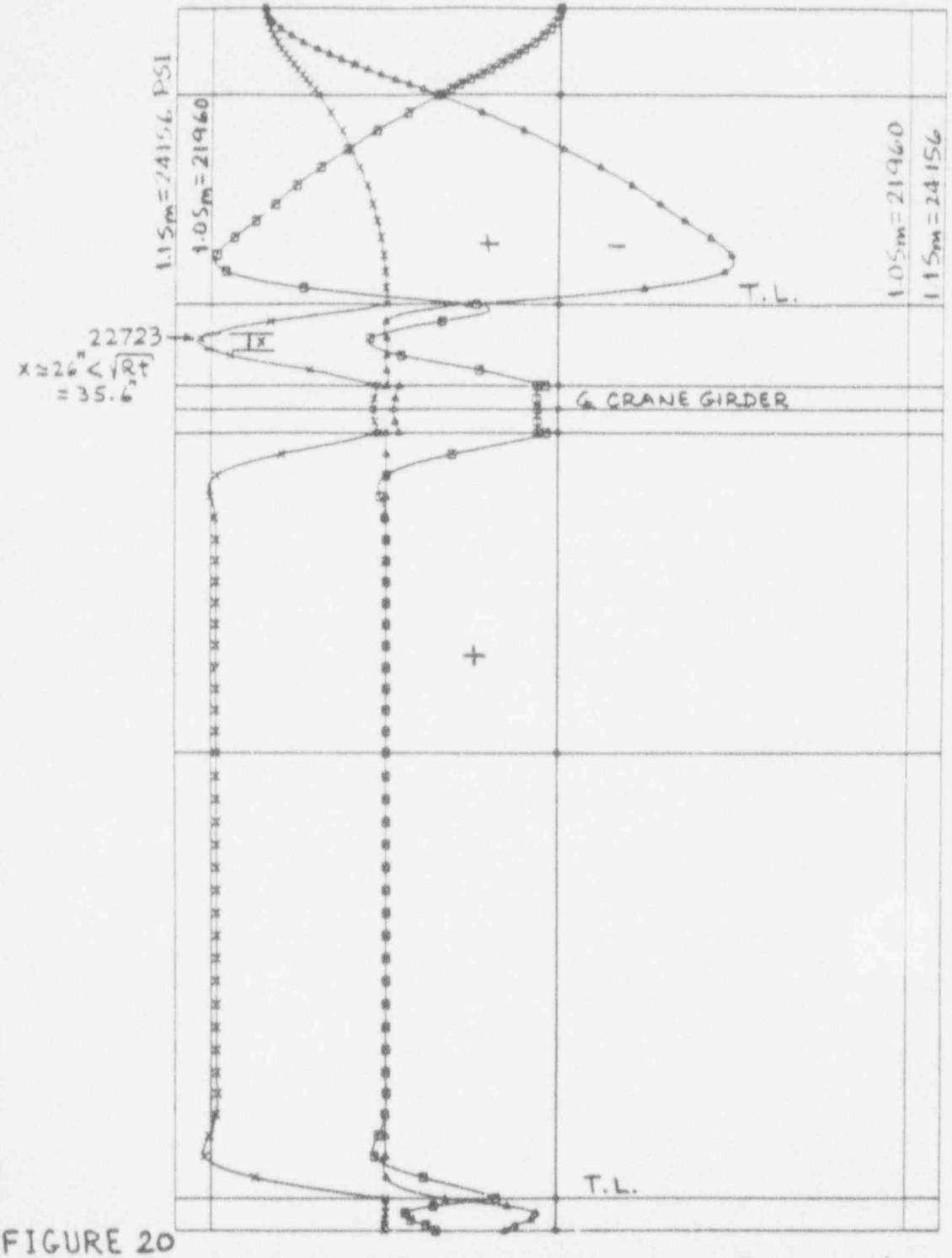


FIGURE 20
MEMBRANE PRINC. STRESS DIF. ALONG MERIDIAN -- □:S1-S2, Δ:S1-S3, X:S2-S3
902657 AP600 WESTINGHOUSE. PR: INTERNAL PRESSURE OF 45 PSI 9/19/91
MAXIMA 21718. 18644. 22723. PSI

SUBJECT	OFFICE	REVISION		REFERENCE NO
ASME LEVEL C PRESSURE	CBI NOE-A			902657
TASK #1, CBI PHASE 3 STUDY	MADE BY: RSD / VERIFIED BY: TJA	MADE BY	VERIFIED BY	1-36 SHT ___ OF ___
AP600, WESTINGHOUSE	DATE: 9/30/91 / DATE: 10/15/91	DATE	DATE	

BUCKLING STRESS EVALUATION

AT THE BOTTOM T. L. (EL. 104'-1 1/2)

THE LOAD COMBINATION, 'D + L - SSE' RESULTS INTO MERIDIONAL COMPRESSION AND TANGENTIAL SHEAR. (SET 1: σ_φ = -2.7 KSI AND $\tau_{\varphi\theta}$ = 0.4 KSI; SET 2: σ_φ = -1.7 KSI AND $\tau_{\varphi\theta}$ = 1.1 KSI)

BUCKLING EVALUATION IS PERFORMED USING ASME III CODE CASE N-284 (PROPOSED REVISION). ALLOWABLES: $\sigma_{\varphi a}$ = -5.5 KSI AND $\tau_{\varphi\theta a}$ = 6.0 KSI.

MAXIMUM VALUE OF THE INTERACTION EQUATION FOR COMBINED 'AXIAL COMPRESSION + SHEAR' IS 0.5 (SET 1 CONTROLS), THE ALLOWABLE VALUE IS 1.0.

IN THE KNUCKLE

THE LOAD COMBINATION, 'P_d + T_a' = 'P_d' RESULTS INTO MERIDIONAL TENSION AND CIRCUMFERENTIAL COMPRESSION. (DUE TO P_d[a]: σ_φ = 11.0 KSI AND σ_θ = -10.5 KSI; DUE TO T_a[b]: σ_φ = 0.0 AND σ_θ = -0.1 KSI, NOTE THAT STRESSES DUE TO T_a ARE VERY SMALL)

BUCKLING EVALUATION IS PERFORMED BY BOSOR5 ANALYSIS USING INTERNAL PRESSURE ONLY AND A FACOR OF SAFETY FROM ASME III CODE CASE N-284.

THEORETICAL BUCKLING INTERNAL PRESSURE IS 174 PSIG. USING A FACTOR OF SAFTY OF 2.0, THE ALLOWABLE DESIGN PRESSURE IS 87 PSIG. ACTUAL DESIGN PRESSURE IS 45 PSIG.

[a]DESIGN PRESSURE OF 45 PSIG (INTERNAL).

[b]ACCIDENT THERMAL (SHELL BELOW EL. 132'-3, 70°F AND SHELL ABOVE EL. 132'-3 AND STIFFENERS, -40°F, AND CRANE GIRDER AT 50°F).

SUBJECT	OFFICE		REVISION		REFERENCE NO
STRESS EVALUATION AT THE MAJOR STRUCTURAL DISCONTINUITIES FOR THE DESIGN LOADS AP600, WESTINGHOUSE	NOE-A				902657
	MADE BY	VERIFIED BY	MADE BY	VERIFIED BY	SHT ____ OF ____
	DATE	DATE	DATE	DATE	

STRESS COMPONENTS AND STRESS INTENSITY EVALUATION AT THE BASE (EL. 100'-0)

P_d DESIGN PRESSURE OF 45 PSIG (INTERNAL)
T_a ACCIDENT THERMAL (SHELL BELOW EL. 100'-0, 70°F AND SHELL ABOVE EL. 100'-0, 280°F)

NOTE: STRESSES DUE TO D, L, AND SSE ARE NOT REPORTED HERE AS THEY ARE NOT EXPECTED TO BE CRITICAL FOR BUCKLING IN COMPARISON WITH THE STRESSES DUE TO T_a.

LOAD	LOCATION	TYPE	σ_φ	σ_θ	$\tau_{\varphi\theta}$	σ_1	σ_a
P_d	θ = 0° AND 90°	I	-6.2	-1.9	0		
		M	10.8	3.3	0		
		O	27.9	8.4	0		
T_a	θ = 0° AND 90°	I	67.2	-16.8	0		
		M	0.3	-36.9	0		
		O	-66.7	-57.0	0		
P_d	θ = 0° AND 90°	M	10.8	3.3	0	10.8	33[a]
		I / O	27.9	8.4	0	27.9	80[b]
P_d + T_a	θ = 0° AND 90°	M	11.1	-33.6	0	44.7	80[b,c]
		I / O	61.0	-18.7	0	79.7	80[b]

[a] 1.5 TIMES S_{mc} FOR 'P_L' OR '$P_L + P_b$'.

[b] 3.0 TIMES S_{m1} FOR '$P_L + P_b + Q$'.

[c] BUCKLING EVALUATION IS NOT YET COMPLETE.

SUBJECT	OFFICE		REVISION		REFERENCE NO.
STRESS EVALUATION AT THE MAJOR STRUCTURAL DISCONTINUITIES FOR THE DESIGN LOADS AP600, WESTINGHOUSE	NOE-A				902657
	MADE BY	VERIFIED BY	MADE BY	VERIFIED BY	SHT ____ OF ____
	DATE	DATE	DATE	DATE	

Table 3.8.2-2

Containment Vessel Pressure Capabilities

Containment Element	Pressure Capability at Ambient Temperature	
	Deterministic Severe Accident Capacity(1)	Minimum Specified Yield(2)
Cylinder	125 psig ①	144 psig ②
Ellipsoidal Head	104 psig ③	146 psig ④ 174 — for buckling F.S. = 1.0
22 foot equipment hatch	117 psig ⑤	196 psig ⑥
16 foot equipment hatch	96 psig ⑦	161 psig ⑧
Personnel airlocks(3)	>163 psig ⑨ Test ②	>300 psig ⑩ Test ⑤

F.S. =

(1) The buckling capacity of the ellipsoidal head is taken as sixty percent of the critical buckling pressure calculated by the BOSOR-5 non-linear analyses. Evaluations of the other elements are according to ASME Service Level C and include use of Code Case N284.

(2) The estimated maximum pressure capability is based on minimum specified material properties.

(3) The capacities of the personnel airlock are estimated from test results.

① Based on tensile stress $p = \frac{St}{R} = \frac{60000 \times 1.625}{780} = 125$ psi

② Based on von Mises - tensile stress $p = \frac{St}{R}\frac{2}{\sqrt{3}} = 144$ psi

③ Based on buckling $p = \frac{173}{1.67} = 104$ psi $\quad 1.67 = \frac{2}{1.2}$

④ Based on tensile stress at crown (von Mises) $p = \frac{2St}{R} = \frac{60000 \times 1.625}{1247} \simeq 146$ Basa, 145 longitud

⑤ N-284 F.S = 1.67

⑥ N-284 F.S. = 1.00

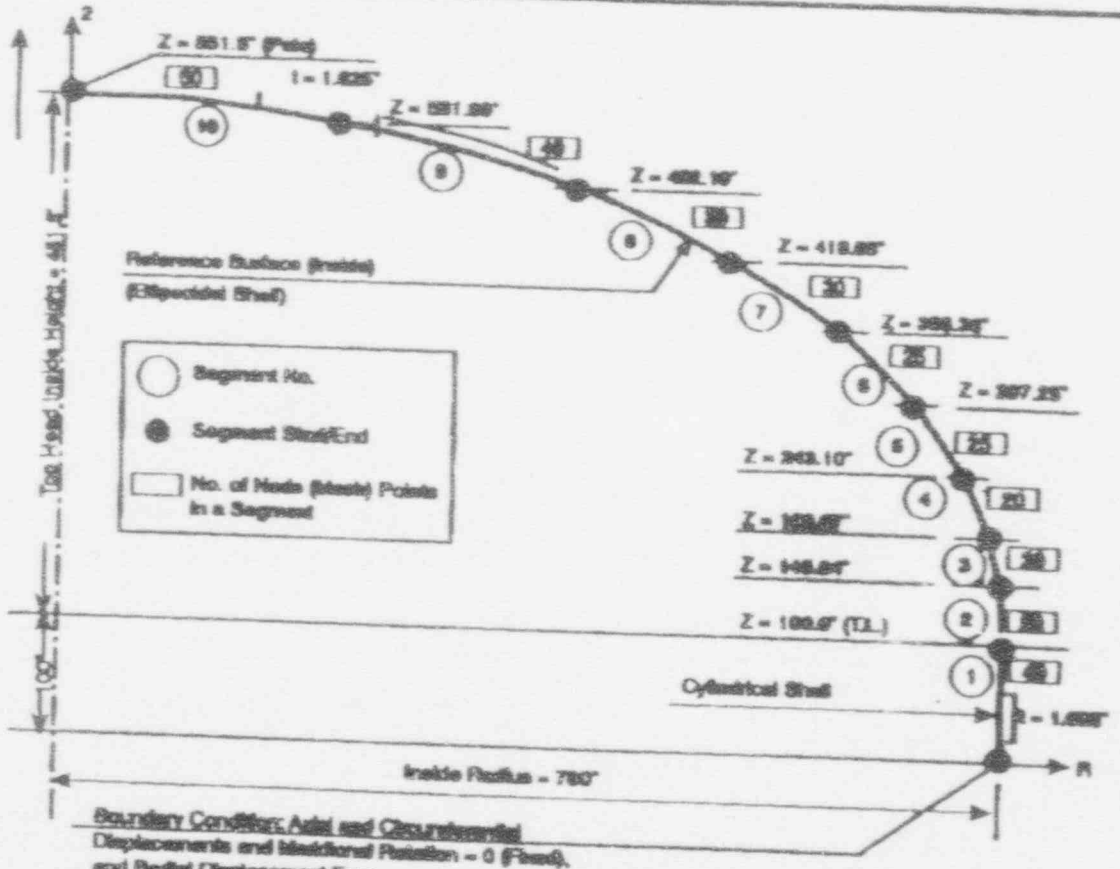
⑦ N-284 F.S = 1.67

⑧ N-284 F.S. = 1.0

⑨ Based on $\frac{S_u}{S_y} = \frac{70000}{38000} = 1.84 \quad \frac{300}{1.84} = 163$

Westinghouse

BOSOR-5 Model of Containment Vessel Head



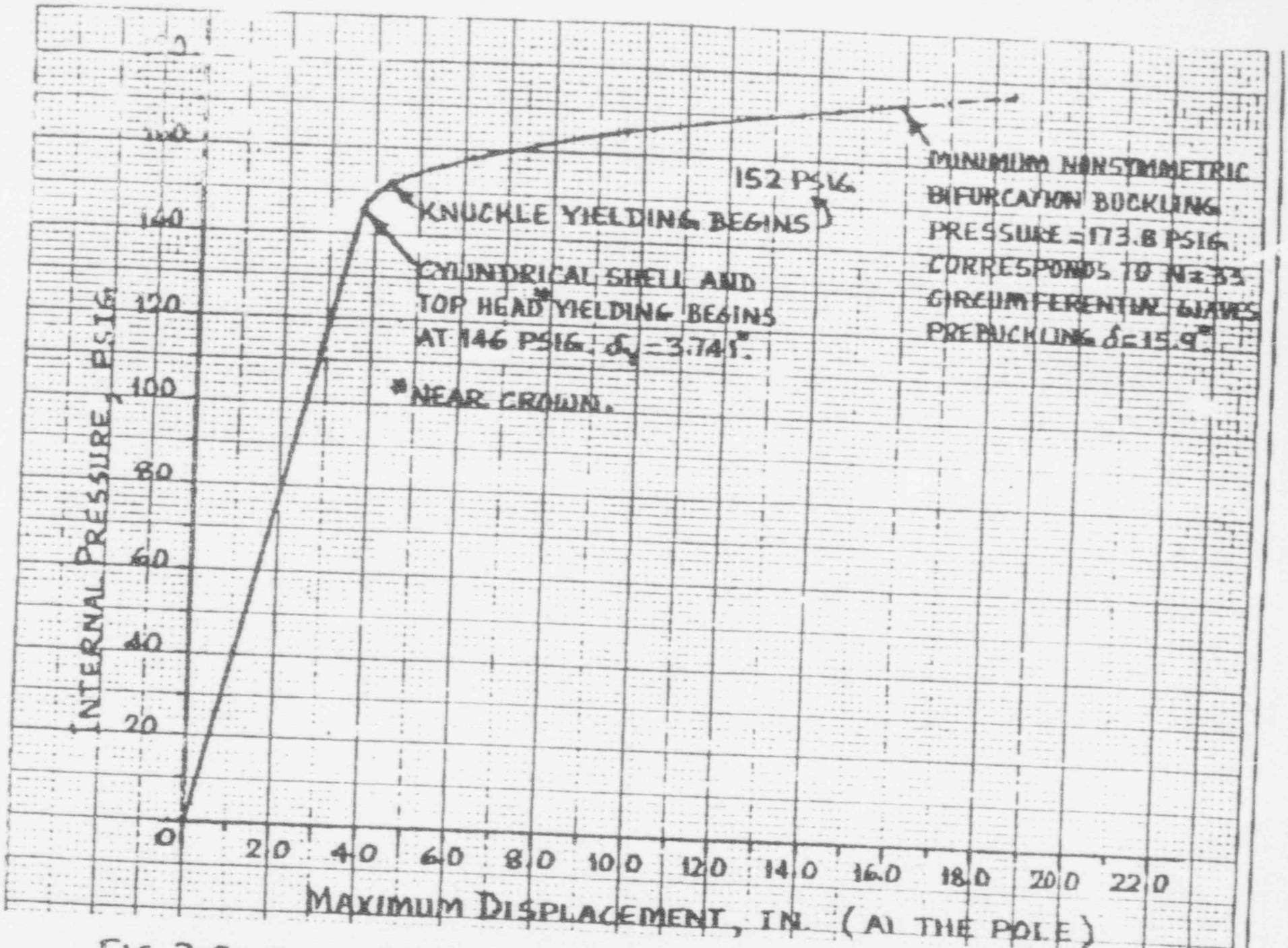


FIG. 3-5: INTERNAL PRESSURE – MAXIMUM DISPLACEMENT CURVE

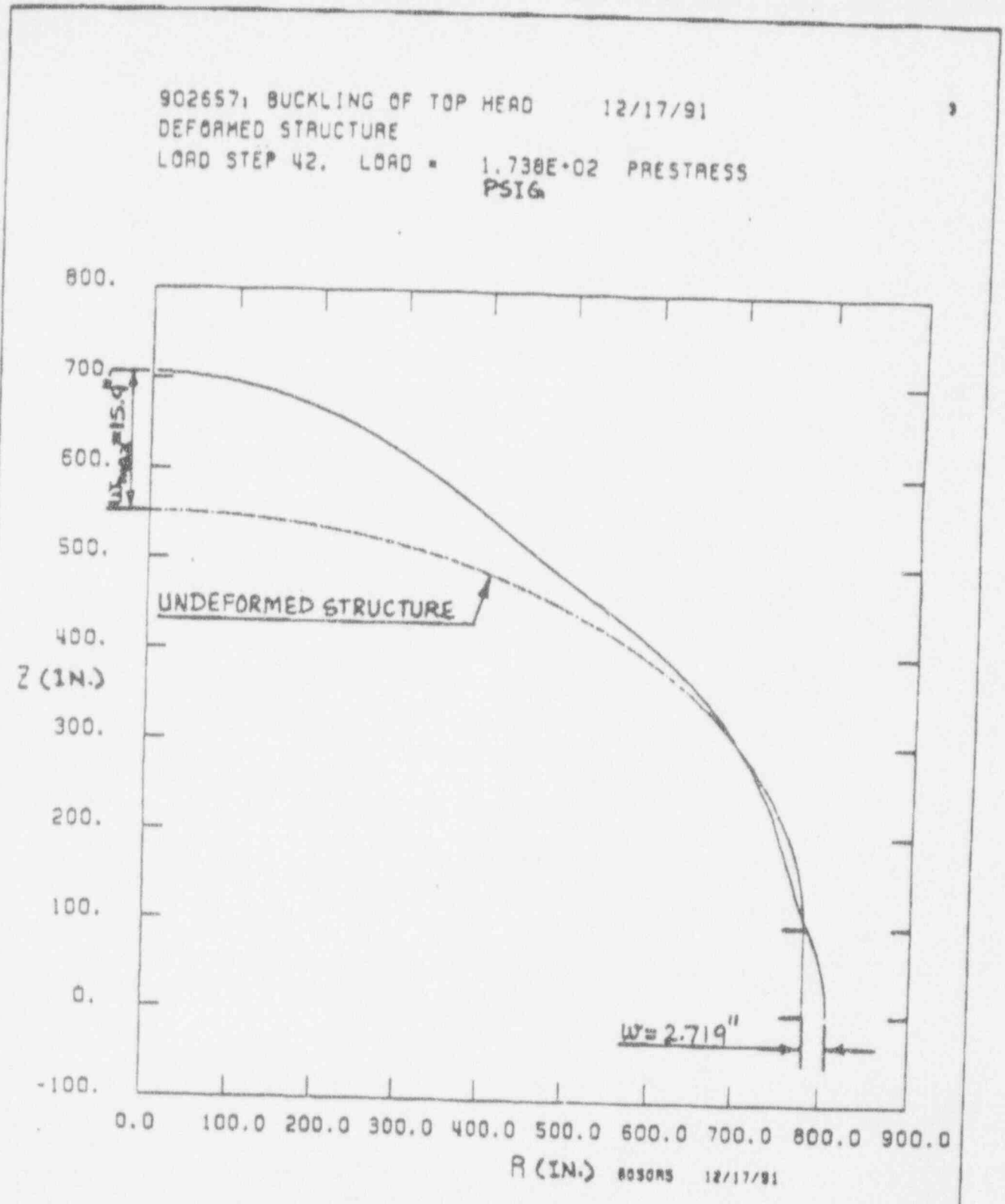


FIG. 3-6: PREBUCKLING DISPLACEMENTS AT $P_{cr\,min}$ = 173.8 PSIG (BOSOR5)

SUBJECT	OFFICE	REVISION		REFERENCE NO.
BUCKLING CAPACITY EVALUATION TASK #3, CBI PHASE 3 STUDY AP600, WESTINGHOUSE	CBI NOE-A			902657
MADE BY: RSR	VERIFIED BY: RA	MADE BY	VERIFIED BY	SHT 3-12 OF
DATE: 12/17/91	DATE: 2/12/96	DATE	DATE	

Printed in USA

GO 84 A AUG 87

STRESS COMPONENTS AND STRESS INTENSITY EVALUATION AT THE TOP T. L. (EL. 218'-8 1/2)

P_d DESIGN PRESSURE OF 45 PSIG (INTERNAL)
T_a ACCIDENT THERMAL (SHELL BELOW EL. 132'-3, 70°F AND SHELL ABOVE EL. 132'-3 AND STIFFENERS, -40°F, AND CRANE GIRDER AT 50°F)

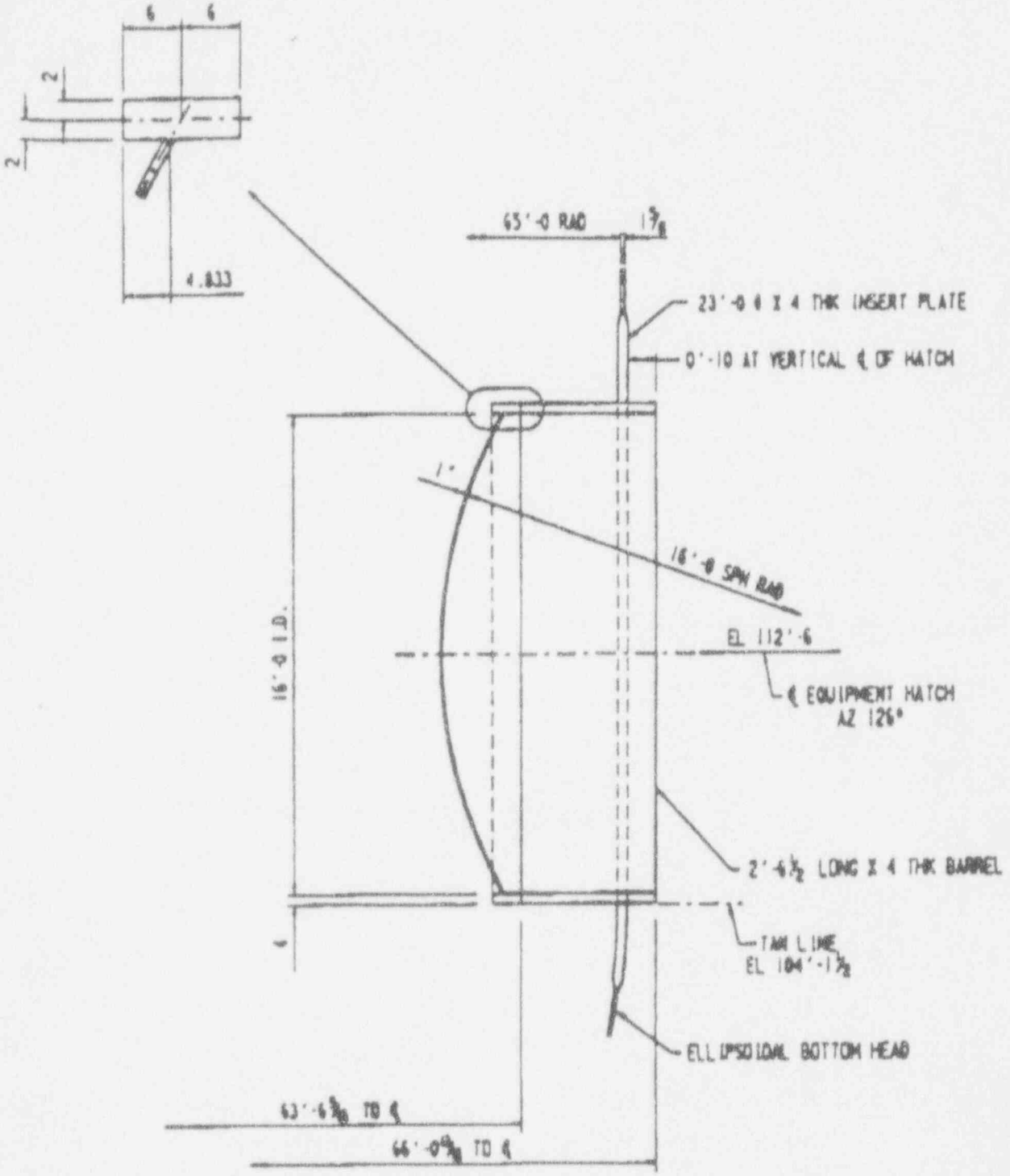
ASSUMPTION: STRESSES DUE TO D, L, AND SSE ARE SMALL.

LOAD	LOCATION	TYPE	σ_ϕ	σ_θ	$\tau_{\phi\theta}$	σ_I	σ_a
P_d	θ = 0° AND 90°	I	11.2	5.8	0		
		M	10.8	5.6	0		
		O	10.4	5.5	0		
T_a	θ = 0° AND 90°	I	-0.1	-0.2	0		
		M	0.0	-0.1	0		
		O	0.1	-0.1	0		
P_d	θ = 0° AND 90°	M	10.8	5.6	0	10.8	33[a]
		I / O	11.2	5.8	0	11.2	80[b]
P_d + T_a	θ = 0° AND 90°	M	10.8	5.5	0	10.8	80[b]
		I / O	11.1	5.6	0	11.1	80[b]

[a] 1.5 TIMES S_{mc} FOR 'P_L' OR '$P_L + P_b$'.

[b] 3.0 TIMES S_{m1} FOR '$P_L + P_b + Q$'.

SUBJECT	OFFICE		REVISION		REFERENCE NO.
STRESS EVALUATION AT THE MAJOR STRUCTURAL DISCONTINUITIES FOR THE DESIGN LOADS	NOE-A				902657
	MADE BY	VERIFIED BY	MADE BY	VERIFIED BY	SHT ____ OF ____
AP600, WESTINGHOUSE	DATE	DATE	DATE	DATE	



16'-0 I.D. EQUIPMENT HATCH

LOCAL EFFECTS AT MAJOR PENETRATIONS AND ATTACHMENTS

- CRANE GIRDER
- PERSONNEL AIRLOCK
- EQUIPMENT HATCHES
- MAIN STEAM AND FEEDWATER PENETRATIONS
- ROOF CONSTRUCTION SUPPORTS

SEISMIC MODELING

SEVERE ACCIDENT CASE - DETERMINE CAPACITY

- LONGHAND CALCULATIONS BASED ON TENSILE STRESSES REACHING YIELD
- BUCKLING CONSIDERATIONS

ATTACHMENT 3

NTD-NRC-94-4089

AP600

PASSIVE CONTAINMENT COOLING SYSTEM

JANUARY 20, 1994
DAN MCDERMOTT

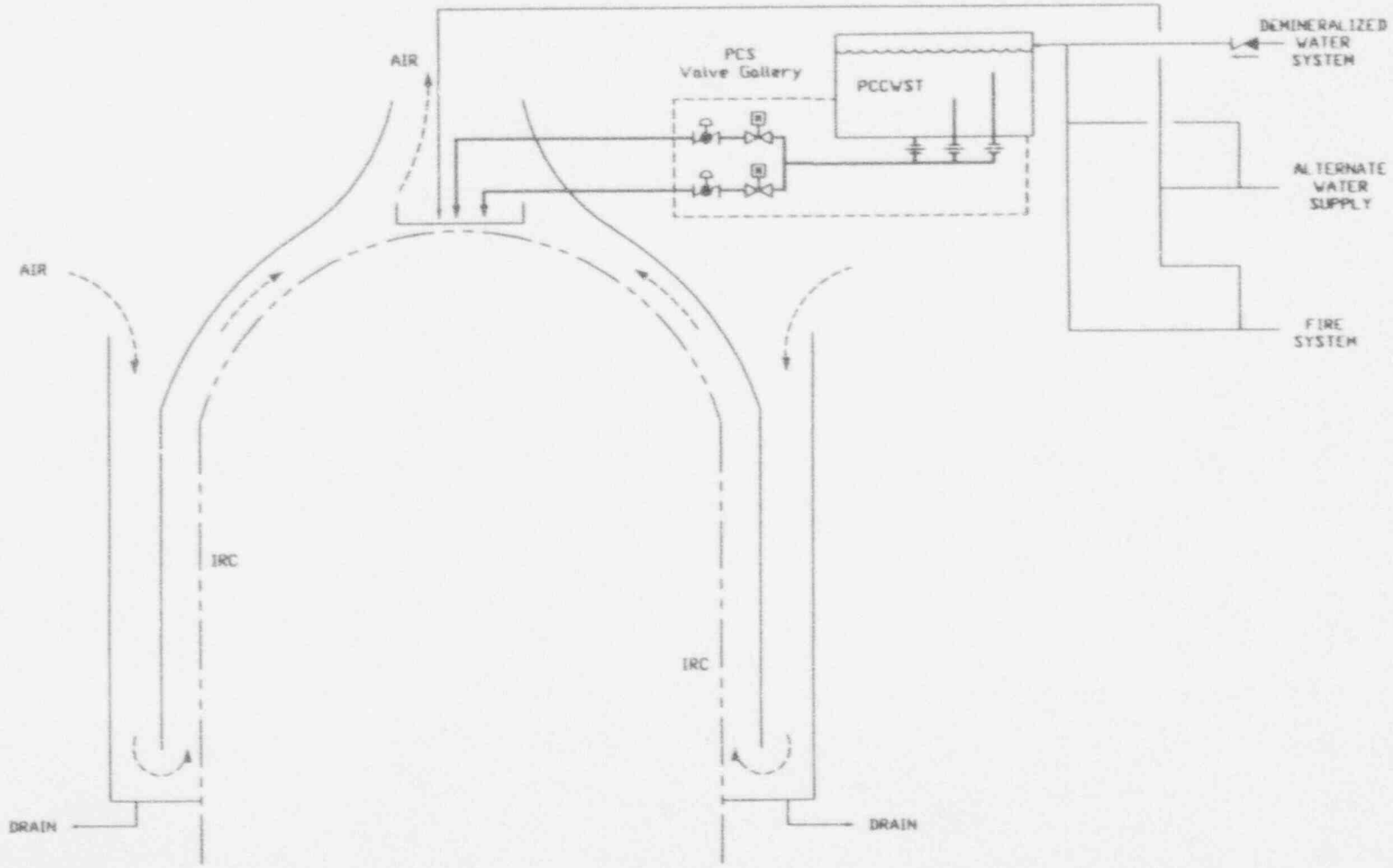
PASSIVE CONTAINMENT COOLING SYSTEM DESIGN BASIS

- Limit peak containment pressure to less than 45 psig design pressure for design basis events (large LOCA, steamline break)
- Reduce containment pressure to 1/2 peak pressure within 24 hours
- Cooling water supplied for 3 days with no operator action or outside assistance, provisions for simple actions to replenish water supply within 3 days
- As a goal, limit containment pressure to <45 psig for an indefinite time, even if no action is taken to replenish water supply

PASSIVE CONTAINMENT COOLING SYSTEM DESIGN BASIS

- Automatically actuated
- Once actuated, operation shall not be dependent on electrical power, continuous operation of mechanical components
- Meets single failure criteria for design basis events
- System reliability consistent with plant CMF and SRF criteria

PCS - SIMPLIFIED SKETCH

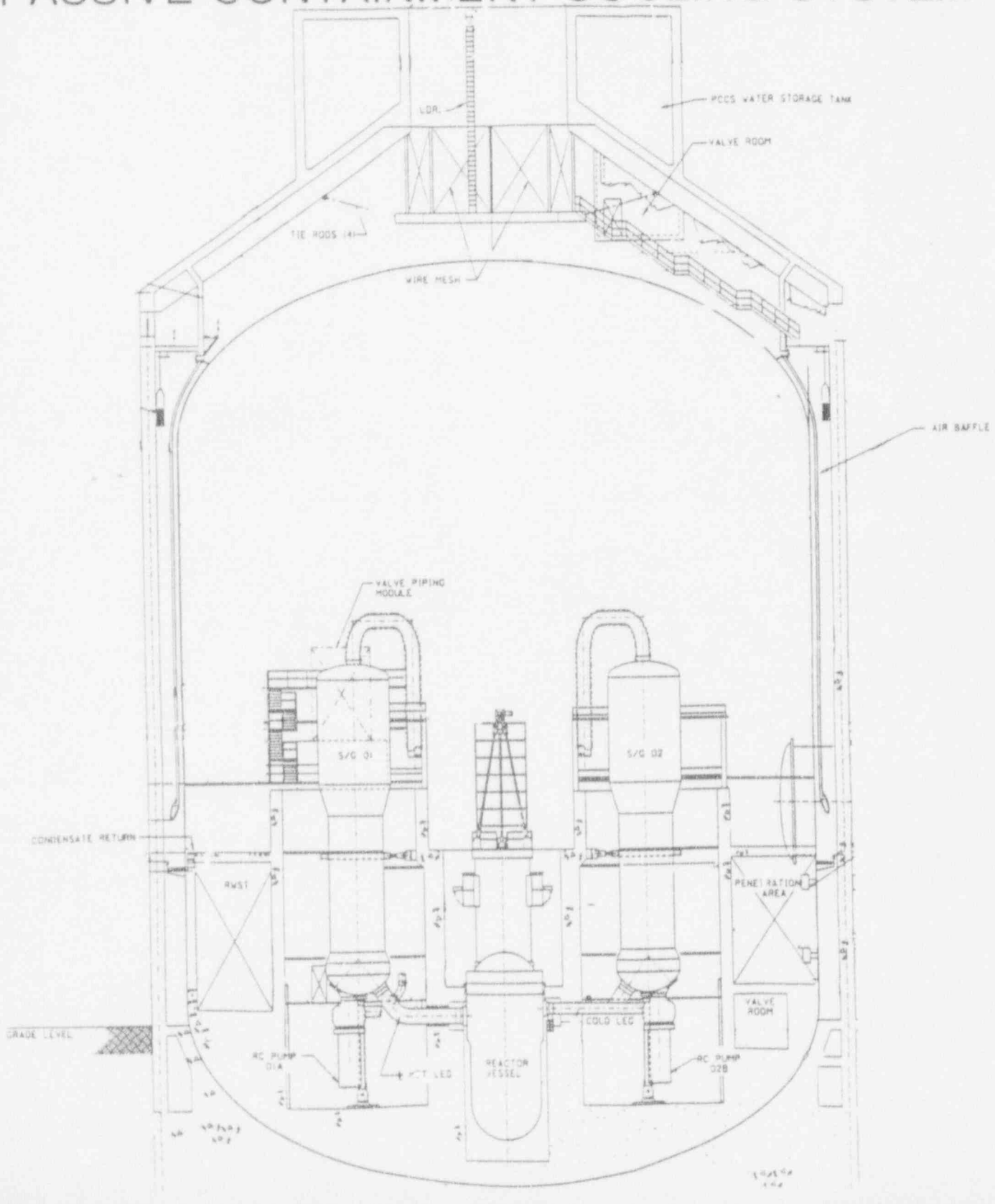


PASSIVE CONTAINMENT COOLING SYSTEM SYSTEM FEATURES

- Containment wetting for evaporative cooling
  - Water storage tank
    - Integrated into the Shield Building
    - 400,000 gallons useable volume
    - Gravity Drain
  - Parallel Fail Open Isolation Valves
    - Leakage Detection
  - Water distribution bucket (30" Diameter)
  - Water distribution features
    - Two Acceptable Configurations
    - Distribution Arms
    - Weir Water Distributers (Coverage 90% to 35%)
  - Annulus Drains
  - Long Term makeup water (Beyond 72 hours)

AP600

PASSIVE CONTAINMENT COOLING SYSTEM



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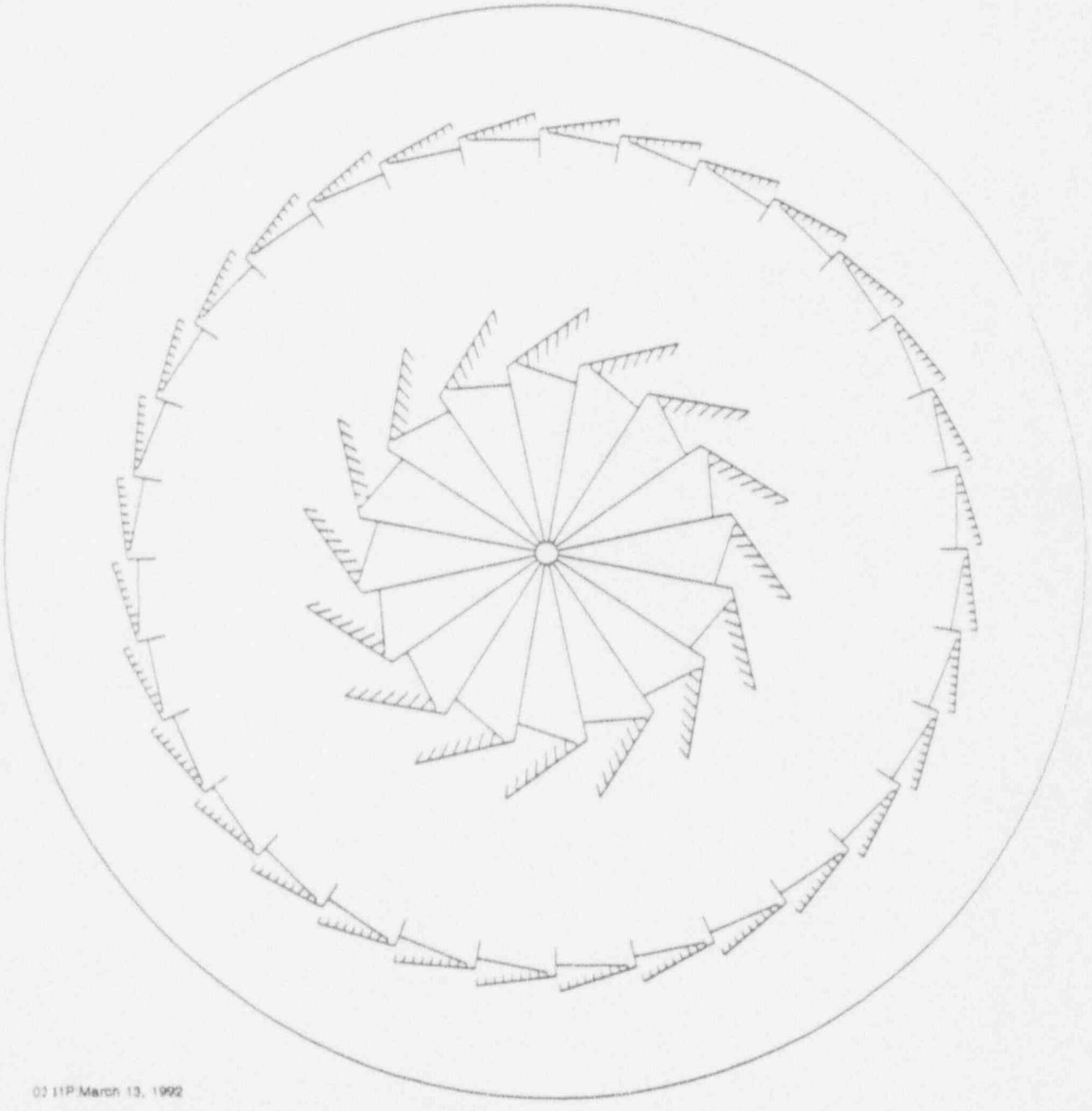
PASSIVE CONTAINMENT COOLING SYSTEM WATER DISTRIBUTION

Containment dome plan view

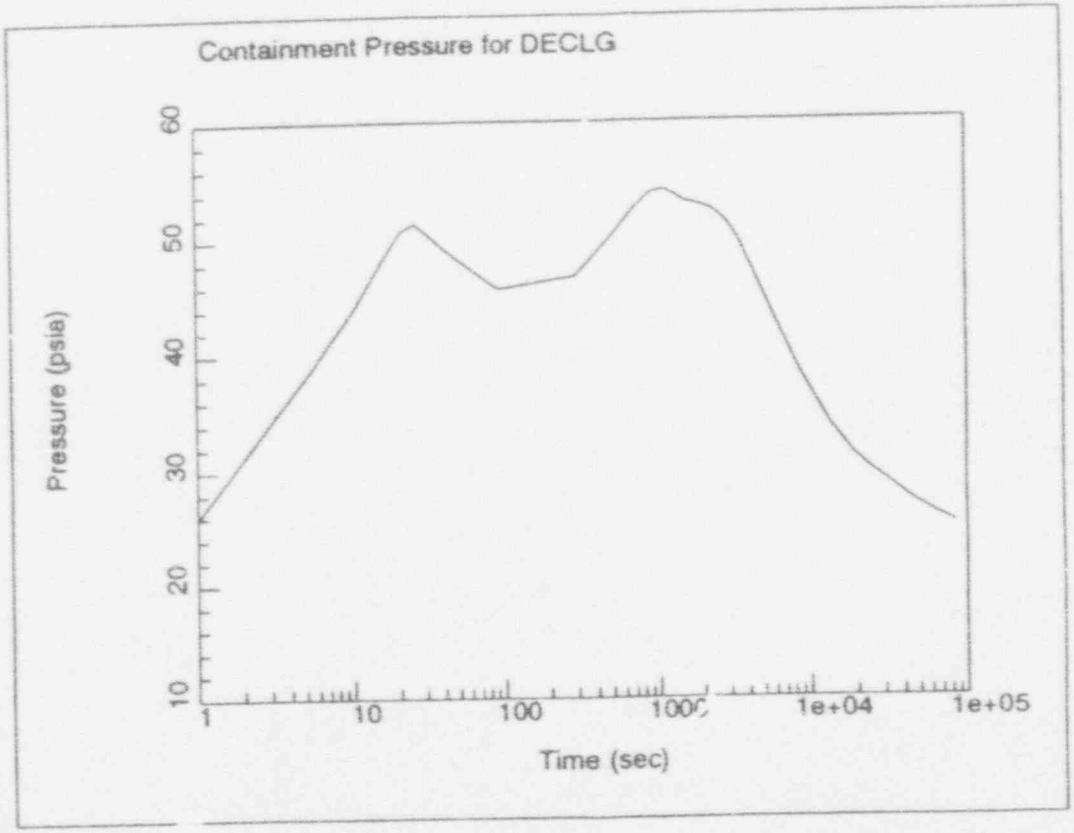


03 11P March 13, 1992

CONTAINMENT COOLING SCENARIOS

- Loss of Coolant Accident
- Steam Line Break
- Passive Residual Heat Removal Transients
- Negative Pressure Transients

CONTAINMENT COOLING SCENARIOS
LOSS OF COOLANT ACCIDENT



CONTAINMENT COOLING SCENARIOS
LOSS OF COOLANT ACCIDENT - TEMPERATURE PROFILES

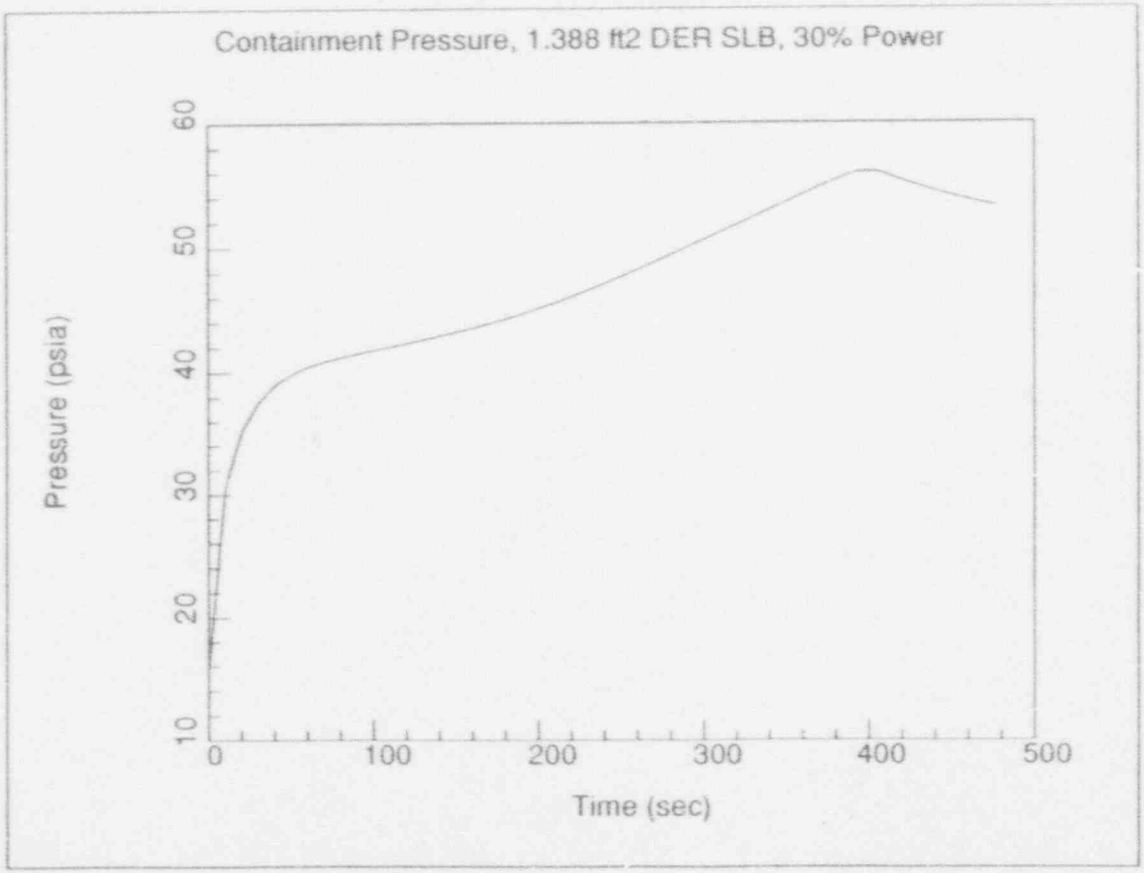
Containment Shell Temperature Profiles for Cold Leg Break

Time		Dome		Spring Line		Operating Deck[1]	
		Wet	Dry	Wet	Dry	Wet	Dry
0.	I						
	O						
100.	I						
	O						
700.	I						
	O						
1300.	I						
	O						
1900.	I						
	O						
3100.	I						
	O						
7600.	I						
	O						
19600.	I						
	O						
31600.	I						
	O						
86400.	I						
	O						

Notes: 1 w/phenolic coating inside
I - Inside shell
O - Outside shell

CONTAINMENT COOLING SCENARIOS

STEAM LINE BREAK



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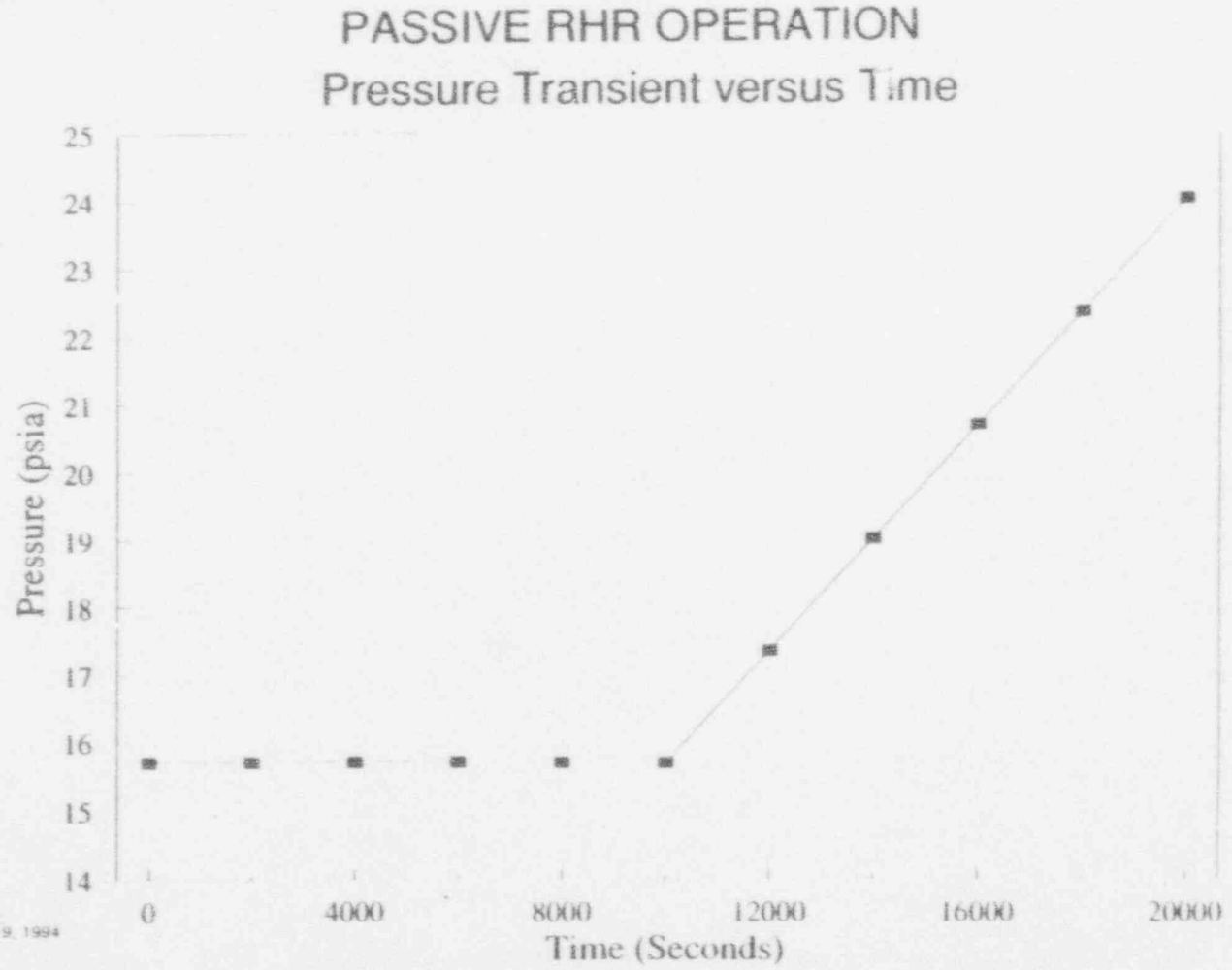
CONTAINMENT COOLING SCENARIOS
PASSIVE RESIDUAL HEAT REMOVAL TRANSIENTS



CONTAINMENT COOLING SCENARIOS
NEGATIVE PRESSURE TRANSIENTS

- Events Considered
  - PCS actuation
  - IRWST Pumpout
  - Failed Fan Cooler Control
  - Purge System Maloperation
  - Loss of all AC @ Limiting Environmental Conditions

- Environmental Conditions (-40 F/45 mph wind)
- Results (hand calculations) <3.0 psid @ 30 minutes
- Event Termination

AP600

CONTAINMENT COOLING SCENARIOS
CONTAINMENT TESTING PROGRAMS

CONTAINMENT WATER DISTRIBUTION TESTS

OBJECTIVES: CHARACTERIZE WATER DISTRIBUTION FOR

- RANGE OF FLOWS
- VARIETY OF DISTRIBUTION MECHANISMS
- WORST CASE SURFACE DEFECTS
- ESTABLISHMENT OF WATER DISTRIBUTION DESIGN

LARGE SCALE CONTAINMENT COOLING SYSTEM TESTS

OBJECTIVES: TO PROVIDE DATA TO VERIFY CONTAINMENT COMPUTER CODES AND MODELS USED TO ASSESS PCS PERFORMANCE OVER

- RANGE OF VESSEL PRESSURES
- RANGE OF WATER DISTRIBUTIONS
- RANGE OF AIR VELOCITIES

WIND TUNNEL TESTS

OBJECTIVES:

- DETERMINE WORST CASE PRESSURE DISTRIBUTION DEVELOPED ACROSS THE AIR BAFFLE
- DEMONSTRATE INTERACTIONS OF WIND AND BUILDINGS WILL NOT CAUSE A DECREASE IN NATURAL CIRCULATION COOLING

INTEGRAL CONTAINMENT COOLING TEST

OBJECTIVE: CONFIRM THE OPERATION AND HEAT REMOVAL CAPABILITY OF THE PASSIVE CONTAINMENT COOLING DURING ACCIDENT CONDITIONS