NOV 07 1989

SGTB:NLO
71-9238

MEMORANDUM FOR: The Files

FROM: Nancy L. Osgood
Transportation Branch, NMSS

SUBJECT: MEETING SUMMARY CONCERNING TRANSPORT OF PATHFINDER REACTOR VESSEL

Attendees:

Northern States Power	TLG Engineering	Black & Veatch
Al Kuroyama	Iqbal Husain	Mitch Bjeldanes
Ron Meyer	Tom LaGuardia	Mohamed Moussa
Dennis Zercher	Adam Levin	James Stresewski
Shaw, Pittman	**NRC**	
Jay Silberg	Ross Chappell	
	Earl Easton	
	Henry Lee	
	Curt Lindner	
	Dan Martin (part-time)	
	Nancy Osgood	
	Carl Withee	

Introduction

A meeting was held at the request of Northern States Power Company (NSP) at Rockville, Maryland, on September 25, 1989, concerning the transport of the Pathfinder reactor vessel. The Pathfinder plant is being decommissioned. The reactor vessel will be transported intact from Sioux Falls, South Dakota, to Richland, Washington. The fuel has been removed from the reactor vessel, but the reactor internals will remain in place.

Package Configuration

Steel plates will be welded over reactor vessel openings. The head will be bolted on the vessel using the original head studs. The vessel will be filled with gravel and grout to immobilize loose surface radioactivity. A steel plate will be installed around the vessel for radiation shielding. Aluminum honeycomb material will be installed around the package to act as an impact limiter. There are no lifting or tiedown fixtures which are a structural part of the package.

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MEMO TO FILE

Drop Analysis

The vessel will be analyzed for a 1-foot side drop and a drop at an angle with one end suspended one foot. These drop configurations were chosen as the worst case credible drops during transport. Results of the drop analyses are included in the meeting handout.

Contents

An activation analysis has been performed that demonstrates that radioactivity concentrations meet the requirements for low specific activity (LSA). The total radioactivity is estimated at 467 Ci in activated metal components and 95 mCi as loose surface contamination. The radioactivity is primarily Co-60. Since the total radioactivity exceeds two times the A2 valve for Co-60, it was recommended that NSP investigate the potential impact of the 10 CFR Part 71 proposed rule change, which limits radioactivity to two times A2 for LSA Type A packages.

Schedule

An application for the certification of the reactor vessel as a Type A LSA package is expected to be submitted to NRC on October 20, 1989. NSP is hoping for approval by July, 1990. The actual shipping date is expected to be in the fall, 1990.

Original Signed by

Nancy L. Osgood
Transportation Branch, NMSS

Enclosure: Meeting Handout

Distribution: w/o enclosure

NRC File Center	NRC PDR	NMSS r/f	SGTB r/f
CEMacDonald	RChappell	Meeting Attendees	Meeting Notebook

OFC	:SGTB	:SGTB	:SGTB	:	:	:
NAME	:NLOsgood:kds	:CRChappell	:CEMacDonald	:	:	:
DATE	:11/6/89	:11/6/89	:11/7/89	:		

OFFICIAL RECORD COPY

MEMO TO FILE

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

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Nancy L. Osgood
Transportation Branch, NMSS

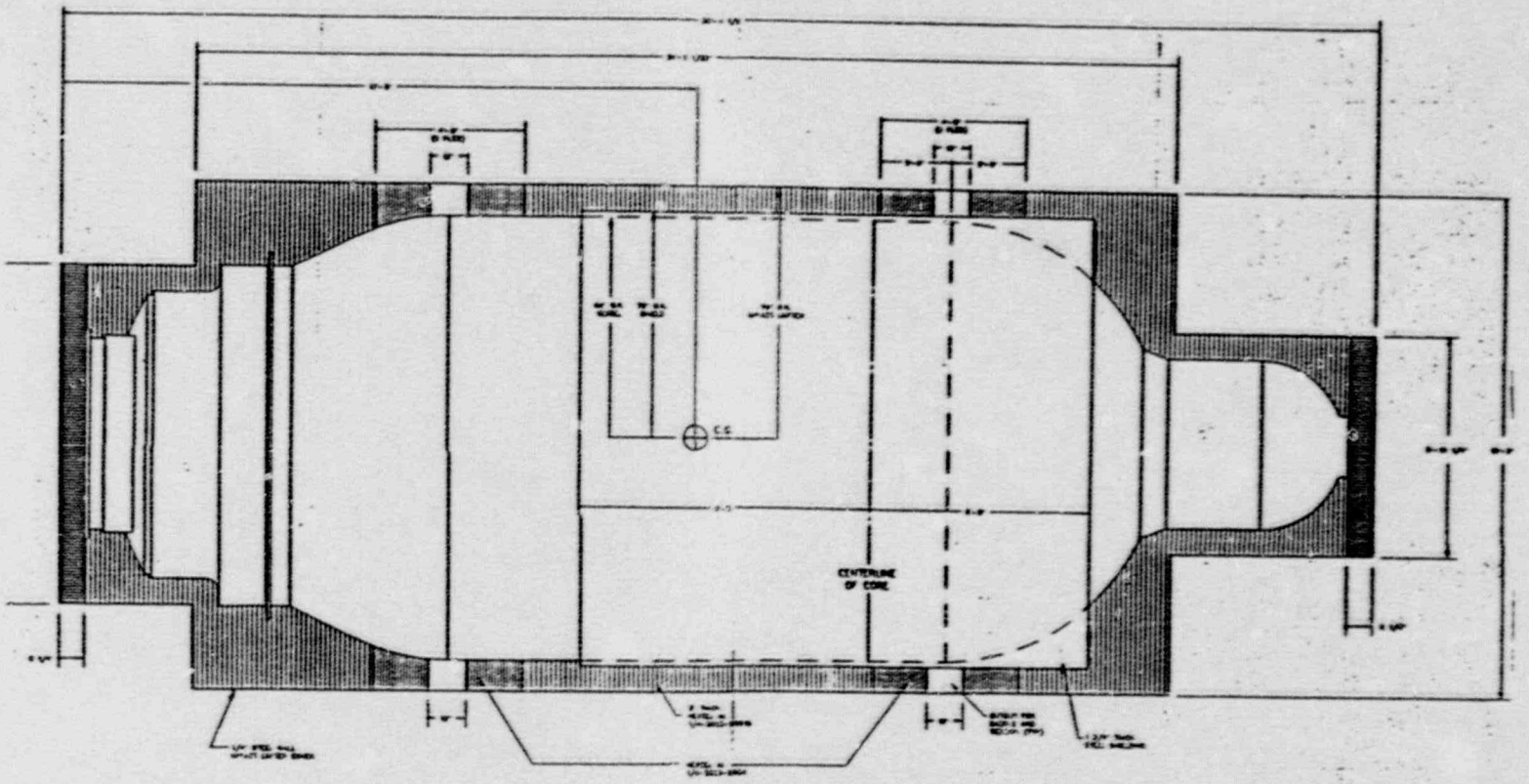
Enclosure: Meeting Handout

PATHFINDER VESSEL TRANSPORTATION ANALYSIS

NORTHERN STATES POWER COMPANY
Minneapolis, MN

prepared by
TLG ENGINEERING, INC.
Bridgewater, CT

1.2 PACKAGE DESCRIPTION



2.2 WEIGHTS AND CENTER OF GRAVITY

TABLE 2.2.1 - RPV PACKAGE CALCULATED WEIGHTS

COMPONENT	CALCULATED WEIGHT, LBS
RPV	155,000
RPV INTERNALS	43,000
SHIELDING/IMPACT LIMITER	64,000
GRAVEL AND GROUT	320,000
GROSS WEIGHT	592,000

2.3 MECHANICAL PROPERTIES OF MATERIALS

SPECIFIED MINIMUM PROPERTIES OF STEEL

Material	Application	Youngs Modulus	Yield Strength	Tensile Strength
ASME SA-212 Grade B	Shell and Hemi. Head	28,000	38,000	70,000

2.3 MECHANICAL PROPERTIES (CONT.)

SUMMARY OF DESIGN STRESS INTENSITY VALUES, Sm

Stress Intensity, ksi (multiply by 1,000 to obtain psi)

	100	200	300	400	500	600	700
ASME SA-36	12.6	12.6	12.6	12.6	12.6	12.6	12.6
ASTM A-212 Grade B	(Conservatively assumed same as AS-36 per Section 2.1.2.3.1)						

Based on ASME, Sect III, Sub NA, App I, Tbl I-7.1

2.3.4 BRITTLE FRACTURE EVALUATION

CRITERIA AND METHOD OF APPROACH - NUREG/CR-1815

RESULTS OF EVALUATION -

Minimum Charpy V-notch test Cv>15 ft-lb at 10 deg. F.
Therefore, package meets the fracture toughness requirements associated with Safety Category III.

2.6 NORMAL CONDITIONS OF TRANSPORT

2.6.1 HEAT /2.6.2 COLD

DESIGN CRITERIA

Initial Conditions -
Ambient temperature at -20 deg. F with no insolation, and ambient temperature at 100 deg F with maximum insolation.

Hot environment - Hot ambient temp of 130 deg F in still air with max. insolation

Cold environment - Cold ambient temperature of -40 deg F in still air and shade

Internal heat generation - 5 watts per hour

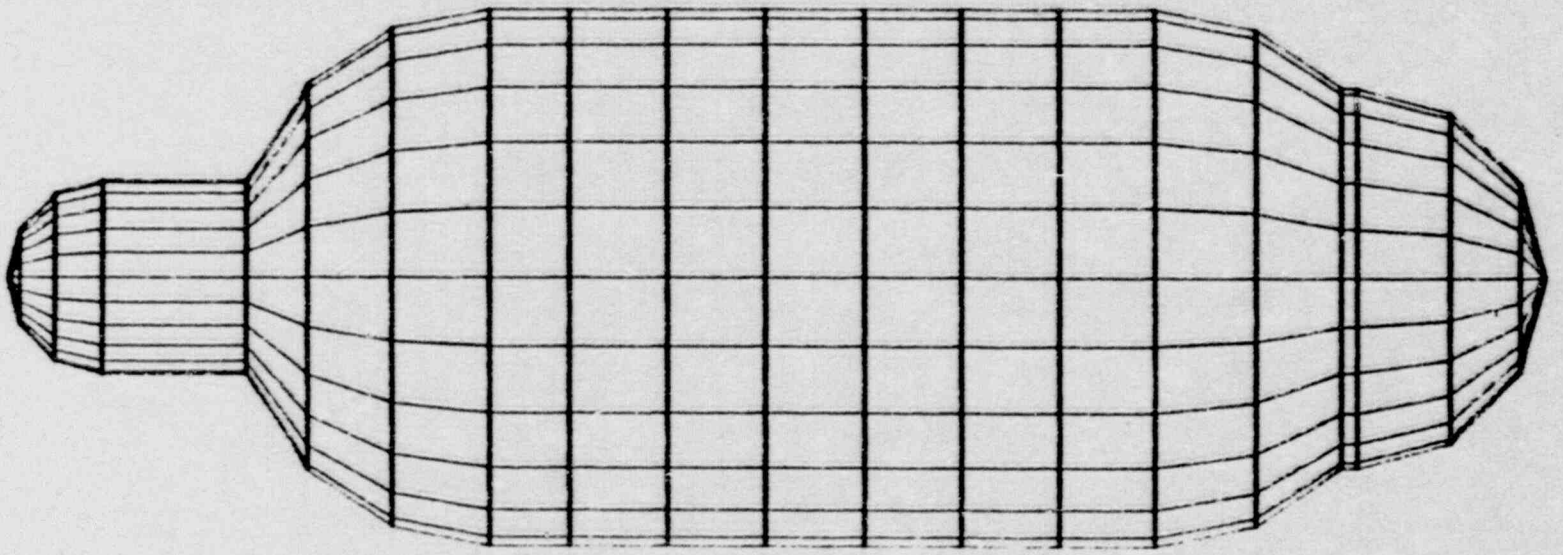
Results of evaluation - No constraints to RPV expansion or contraction,and internal heat load is insegnificant. Therefore, maximum stresses will be small.

Allowable stress - 3 Sm = 37.8 ksi

Margin of safety - High

2.6.3 REDUCED EXTERNAL PRESSURE

Design Criteria - 3.5 psi Absolute
Method of Analysis - Axisymmetric finite element analysis of RPV and ASME Code calculations.
Results of Analysis - Maximum stress intensity = 0.25 ksi
Allowable value Sm = 12.60 ksi
Margin of Safety = 50.00



FINITE ELEMENT MODEL OF VESSEL

2.6.4 INCREASED EXTERNAL PRESSURE

Design Criteria - 20.0 psi
Method of Analysis - ASME Code, Section III, Para. NB-3133
Results of Analysis - Minimum allowable pressure = 437.0 psi
Margin of safety = 20.9

2.6.5 VIBRATION

Design Criteria - Acceleration 2g vertical
2g horizontal lateral
10g horizontal longitudinal

Results of Analysis

Maximum stress in vessel wall = 1.51 ksi
Allowable stress 3 Sm = 37.80 ksi
Margin of safety = 24.00

2.6.6 WATER SPRAY, 2.6.8 CORNER DROP AND 2.6.9 COMPRESSION

Results of evaluation -

Water spray will not have a significant effect on package.

Corner drop not applicable per 10 CFR 71(c)(8).

Compression not applicable as the package weighs more than 10,000 lbs.

2.6.10 PENETRATION and 2.6.11 LOAD RESISTANCE

Penetration Design Criteria - 10 CFR 71 F (e)(10)
- 13.0 lb steel cylinder 1.25 in. dia dropping from 40.0 inches

Method of Approach - Ballistic Research Laboratory (BRL) and Stanford Research Institute (SRI) analytical equations

Results of Analysis - max. depth of penetration = 0.015 in.
- Available thickness = 3.0 in.
- Margin of safety = high

Load Resistance Design Criteria - Acceleration 5g vertical downward

Method of Approach - Classical beam analysis supported at its ends.

Results of Analysis - maximum stress = 3.78 ksi
- allowable stress 3 Sm = 37.8 ksi
- margin of safety 9.0

2.6.7 FREE DROP

Design Criteria - 10 CFR 71 - One foot drop onto a flat essentially unyeilding horizontal surface.

Method of Approach -

Case 1 - Drop of the vessel along its length. Package weight and kinetic energy distributed along its length.

Case 2 - Drop of the vessel at its edge wherein 50% of package weight and associated kinetic energy is transmitted on one edge of the vessel.

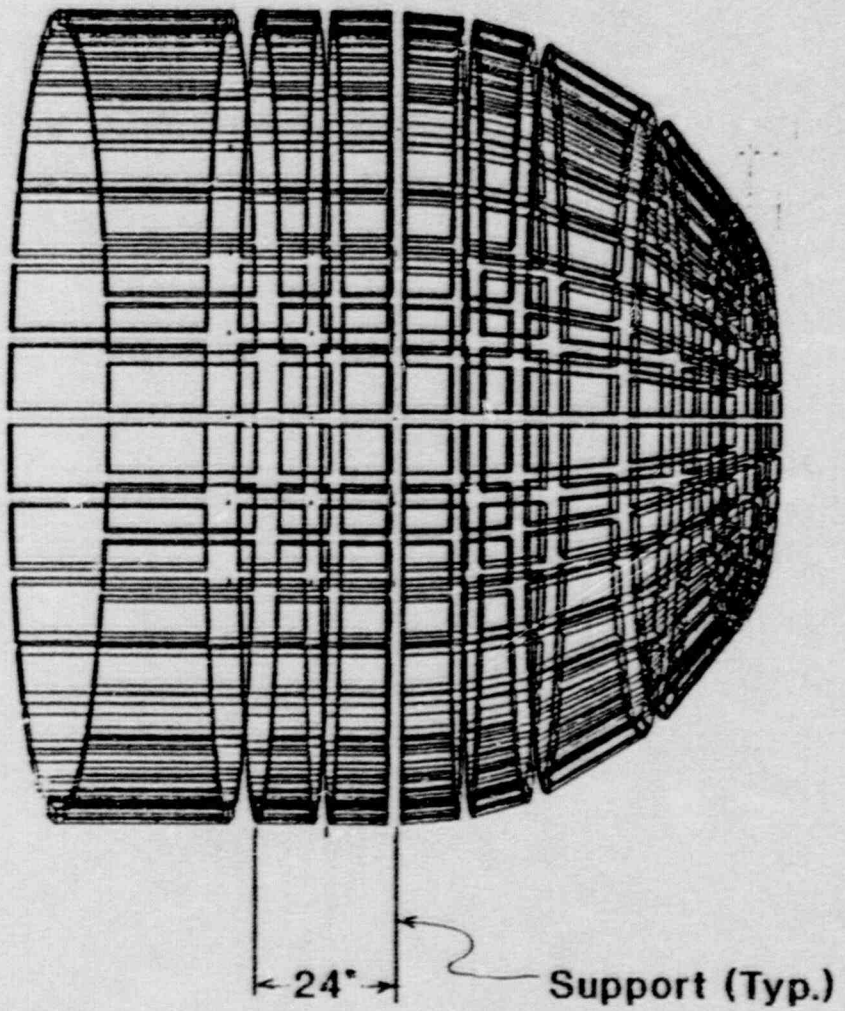
Impact Limiter - Precrushed HEXCEL energy absorbing material.

Step-by-step evaluation of maximum stress in RPV at each incremental depth of crushing. At each step, determine:

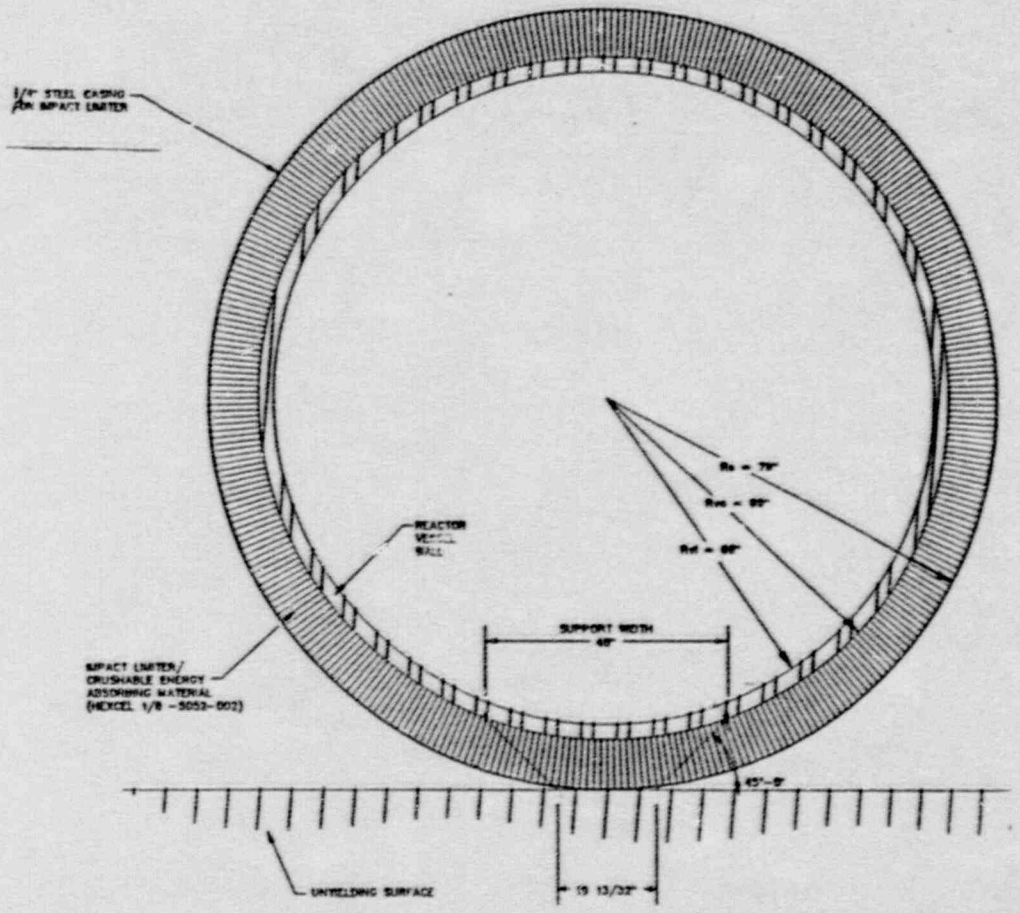
- Resistance offered by HEXCEL core
- Energy absorbed by HEVCEL core
- Maximum stress in RPV wall.

Repeat process until external energy = 0.

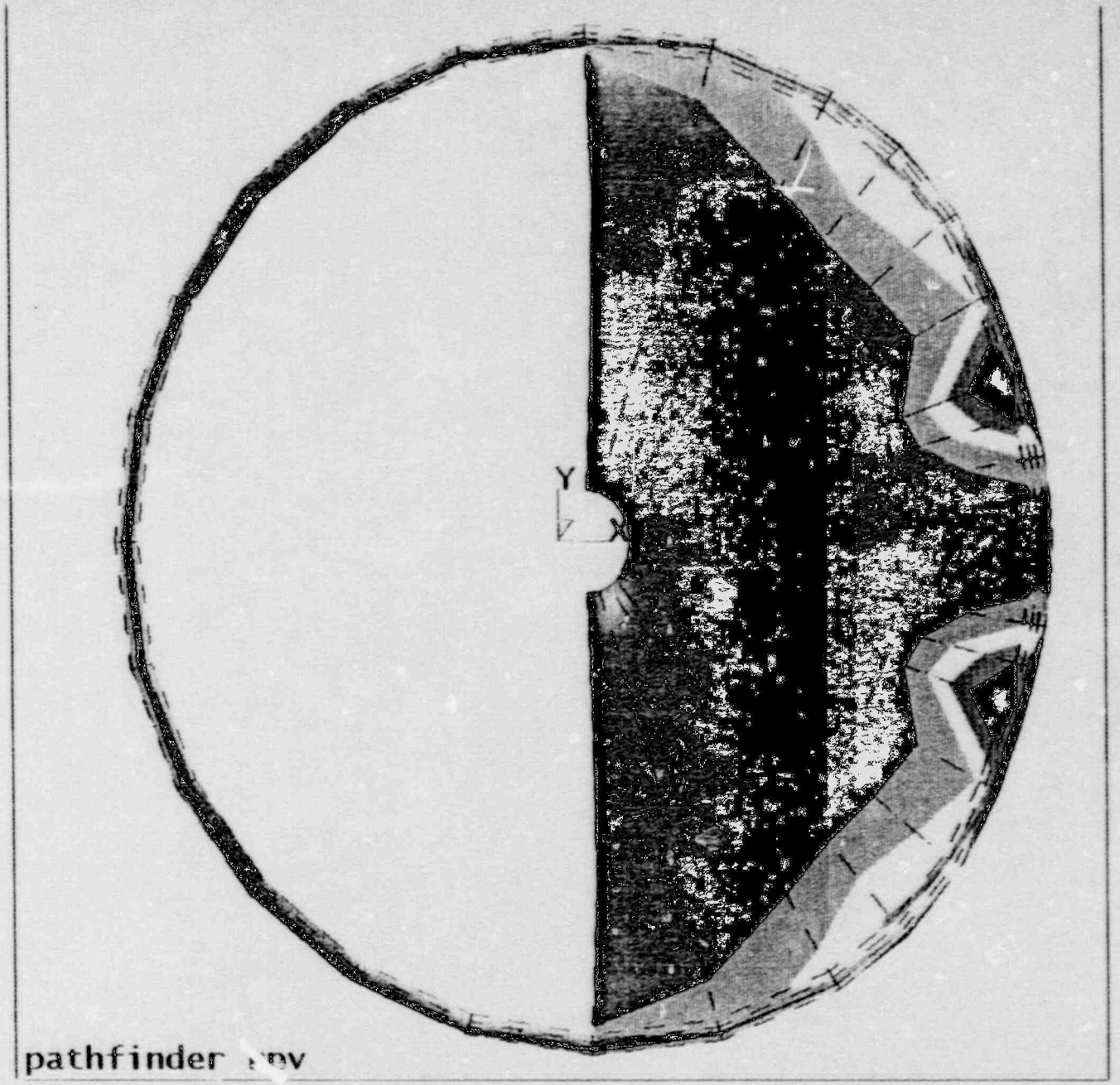
FINITE ELEMENT MODEL OF RPV - CORNER DROP



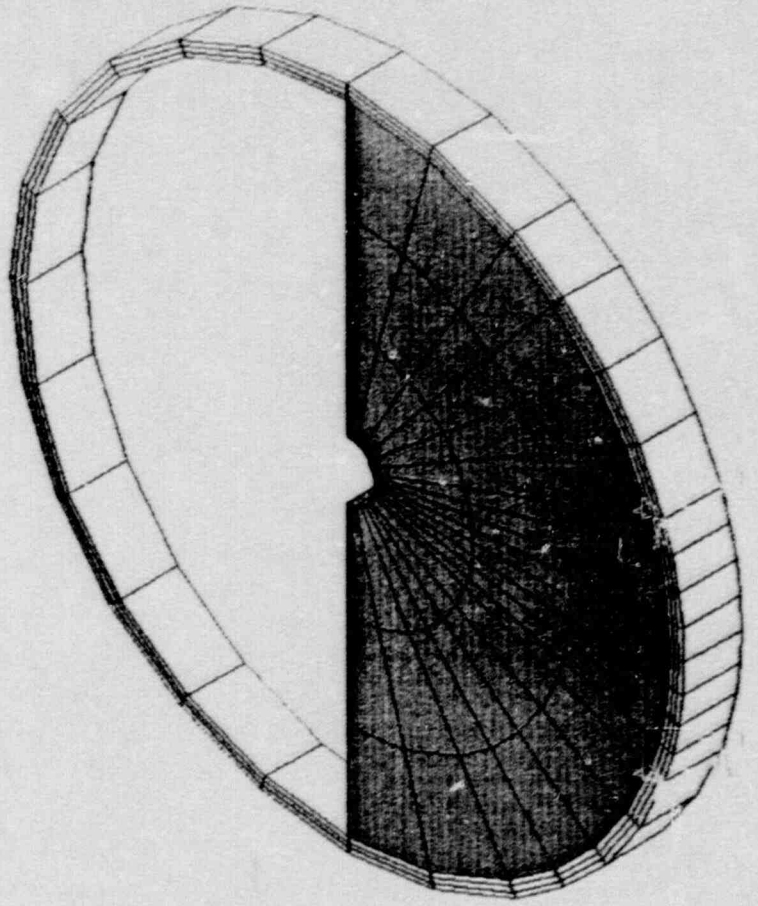
FINITE ELEMENT MODEL OF RPV - LENGTH DROP



CASE 1



FINITE ELEMENT MODEL- CASE 1



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SEP 22 1989
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MAT NUM
BC SYMBOLS

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YV =1
ZV =1
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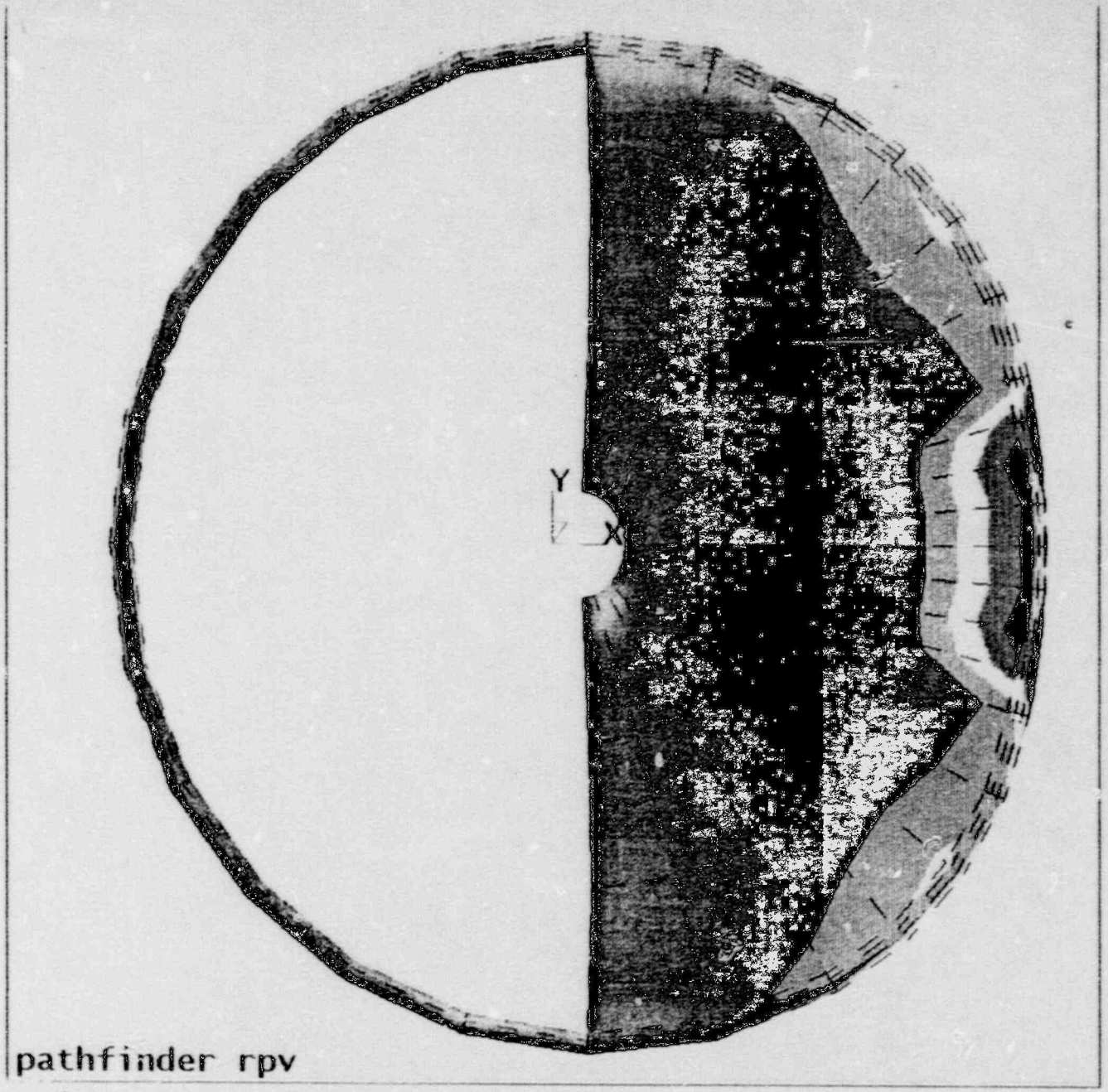
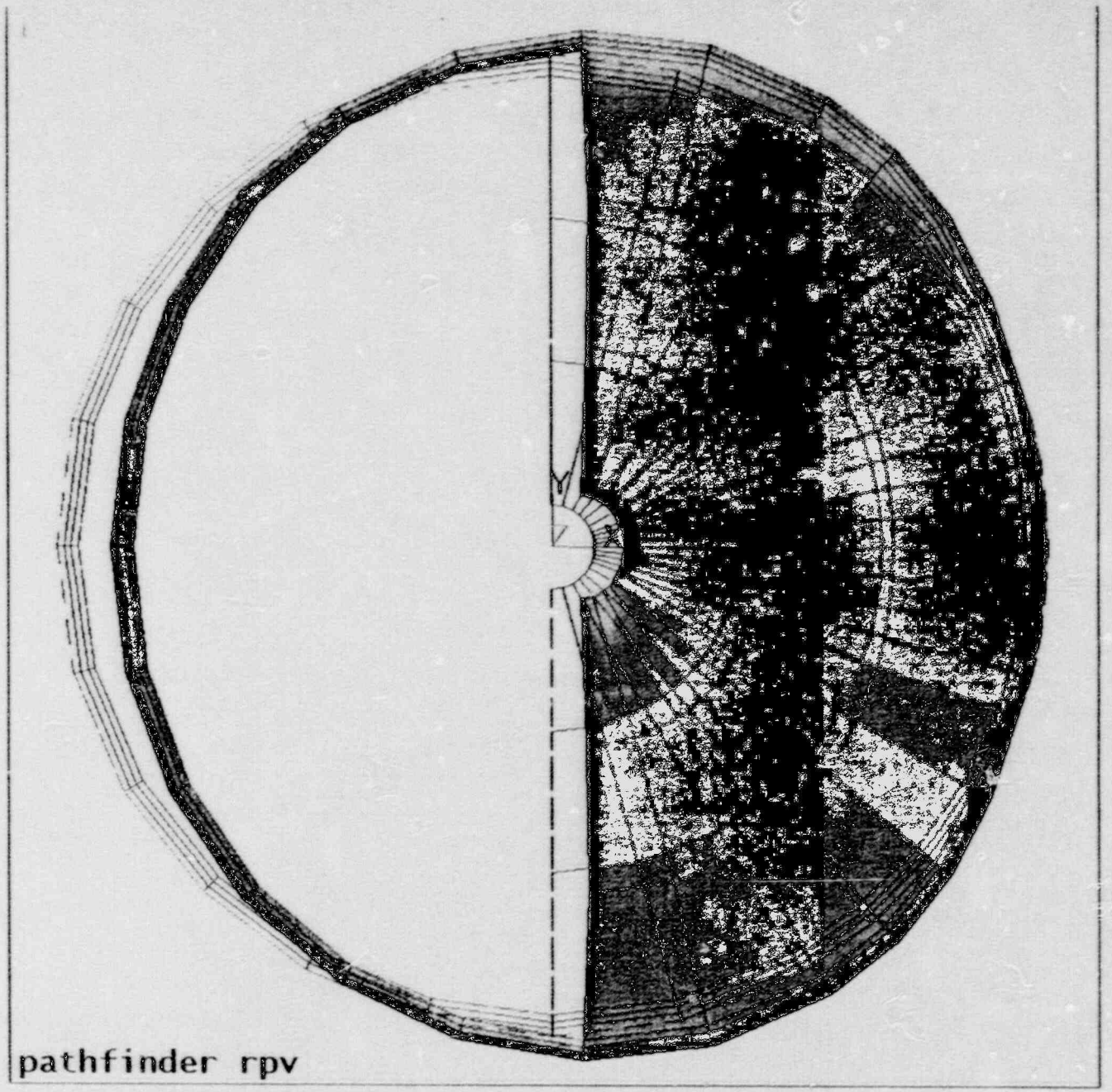
ZF =6
PRECISE HIDDEN

pathfinder rpv

FINITE ELEMENT MODEL- CASE 1 TWO SUPPORTS @ 20°



FINITE ELEMENT MODEL - CASE 3 TWO SUPPORTS @ 10°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SEP 22 1989
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ZV =1
DIST=75.9
ZF =6
pathfinder rpv

2.6.7 FREE DROP (CONT.)

RESULTS OF ANALYSIS

Depth of Crushing	Avail Crush Thkns, %	Margin of Safety
Case 1 = 5.17 in	64.6 < 70%	
Case 2 = 5.11 in	63.9 < 70%	
Max Stress RPV wall	Allowable Stress=3Sm	
Case 1 = 7.56 ksi	37.8 ksi	4.00
Case 2 = 16.21 ksi	37.8 ksi	1.33