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

November 17, 1989

Docket No. 50-213

LICENSEE: Connecticut Yankee Atomic Power Company

FACILITY: Haddam Neck Plant

SUBJECT: MID-OUTAGE STATUS MEETING

On October 25, 1989, the NRC staff met with the Connecticut Yankee Atomic Power Company (CYAPCO) to discuss the status of two mid-outage concerns: leaking fuel pins and thermal shield damage. CYAPCO provided a background on the cleaning and testing of the fuel pins. CYAPCO believes 88 assemblies of the 109 assemblies which are to be reused have degraded pins. At the time of the meeting, the number of degraded pins was 286. This is based on ultrasonic testing with a threshold of about 20% thru-wall. CYAPCO assumed that any fuel pin with a detectable flaw is a leaker and will be replaced. In addition, each assembly was visually inspected for degradation. Any pins with visual damage will also be replaced. CYAPCO discovered a significant amount of debris (metal flakes) in the fuel assemblies. Ninety nine percent of the debris was between the bottom nozzle and the first spacer grid. CYAPCO believes all fuel pin damage was debris induced. The debris is believed to have been left over from the milling work done to the thermal shield during the last outage.

CYAPCO is mapping the debris in the core against the fuel pin failure sites. There seems to be a reasonable correlation, and therefore where heavy debris sites exist without fuel pin degradation, CYAPCO is performing additional examinations of the fuel pins in that area. One observation has been that coolant activity was not indicative of the large amount of degraded pins discovered. CYAPCO expected about 6-12 leakers based on increased coolant activity. CYAPCO believes the failures are pin hole failures and the fission product gases could not readily leak out. Normally, fuel failures are due to pellet clad interaction, which results in axial cracks.

CYAPCO is scavaging previously used fuel for fuel pins to be used as donor pins. CYAPCO hopes that enough donor pins can be found with similar burn-up to match the degraded pins. CYAPCO plans to demonstrate that the reload analysis will be bounding for the reconstituted fuel so that the reload analysis will not need to be reperformed.

DFO1
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CYAPCO provided several handouts regarding the thermal shield. A summary of the damage is provided in the handout. ISI is currently being performed and CYAPCO has not drawn any conclusions regarding the thermal shield degradation. CYAPCO noted, however, that the wear in the space limiter keyways is greater than expected. The gaps in the keyways were 1-3 mils after installation and have grown to 5-10 mils. The NRC requested CYAPCO to keep the staff informed of the fuel reconstitution and thermal shield work. Attached are CYAPCO's handouts and the attendance list.

/s/
Alan B. Wang, Project Manager
Project Directorate I-4
Division of Reactor Projects - I/II

Attachments: 1 - CYAPCO's Handouts
2 - Attendance List

cc: w/enclosures
See next page

LA:PDI-4	PM:PDI-4	D:PDI-4
SNorris	AWang:sw	JStolz
11/14/89	11/14/89	11/17/89

DISTRIBUTION FOR MEETING SUMMARY DATED: November 17, 1989

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ATTACHMENT 1

CONNECTICUT YANKEE ATOMIC POWER COMPANY

HADDAM NECK PLANT

MID-OUTAGE STATUS MEETING

WITH NRC STAFF

OCTOBER 25, 1989

ATTENDEES

- C. J. GLADDING
  ENGINEERING SUPERVISOR
  HADDAM NECK PLANT
  CYAPCO

- W. M. HERWIG
  SENIOR ENGINEER
  REACTOR ENGINEERING BRANCH
  NUSCO

- E. P. PERKINS
  SENIOR LICENSING ENGINEER
  GENERATION FACILITIES LICENSING
  NUSCO

AGENDA

I. FUEL ASSEMBLY INSPECTION AND CLEANING

II. CORE SUPPORT BARREL/THERMAL SHIELD WITHDRAWAL AND INSPECTION

III. STEAM GENERATOR TUBE PLUG INSPECTION UPDATE

I. FUEL ASSEMBLY INSPECTION AND CLEANING

- VIDEO PRESENTATION

II. CORE SUPPORT BARREL/THERMAL SHIELD

- DIAGRAMS

- PHOTOGRAPHS

1989 Core Support Barrel Visual Inspection Results

Thermal Shield Displacement Limiter 128 °
Lower Block All 3 dowel pins backed out

Thermal Shield Support Block 210°
Center Dowel backed out
upper right bolt backed out 1/4" to 1/2" post T.S.

Thermal Shield Support Block 270°
upper right bolt, lower support block, missing

RPV near 128°
gouge in cladding

Bottom Head
Misc. pieces found 1 bolt, 18" metal strip, rod

Inspections Completed:

6 displacement limiters examined with an overhead camera and a 90° lens.

5 Thermal Shield Support Blocks lower blocks examined with an overhead camera and a 90° lens.

330° Thermal Shield Support Block lower bolt not examined. Overhead camera inspection of upper bolts revealed no damage.

All Six Support Blocks examined from the ID of Core Barrel using a 90° lens.

Thermal Shield Lower Support Blocks from ID

30° All 3 dowel pins recessed

90° All 3 dowel pins recessed

150° All 3 dowel pins recessed, lower center bolt, upper right bolt recessed

210° All 3 dowel pins recessed, upper right bolt recessed

270° All 3 dowel pins recessed, upper right bolt missing

330° Lower 2 dowel pins and lower bolt appear recessed

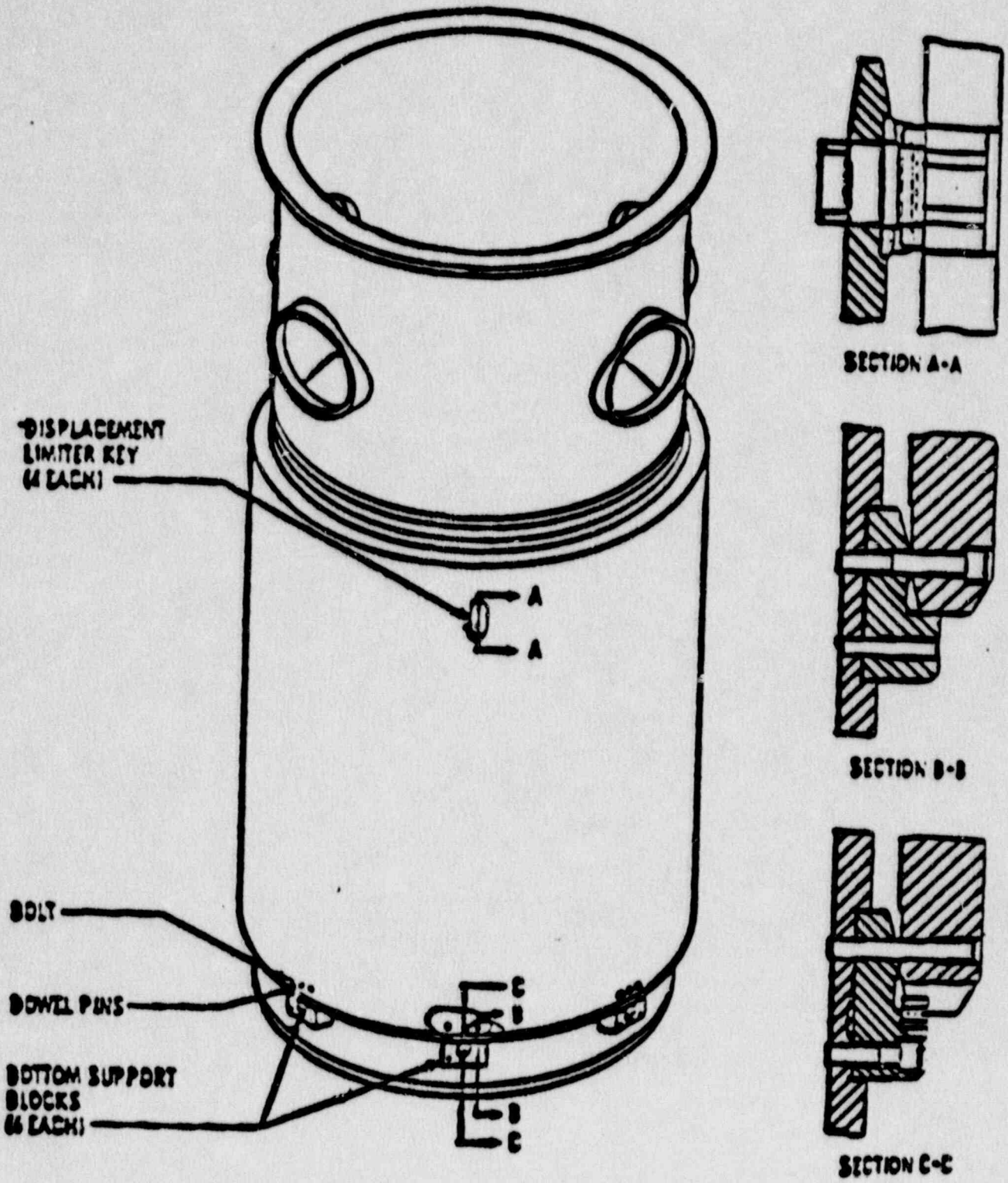


Figure 2-1. Thermal Shield Support Details Without Flexures

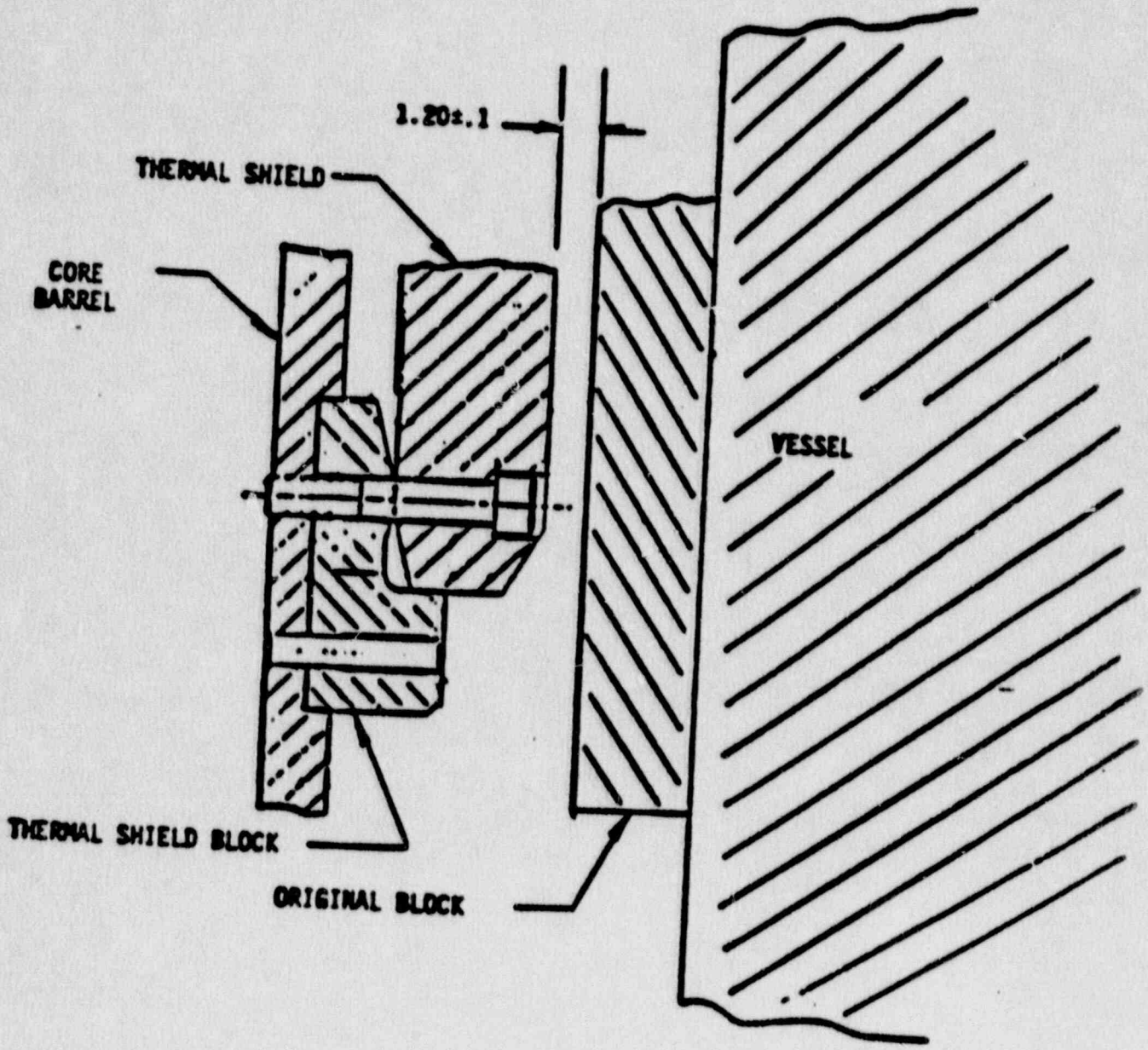
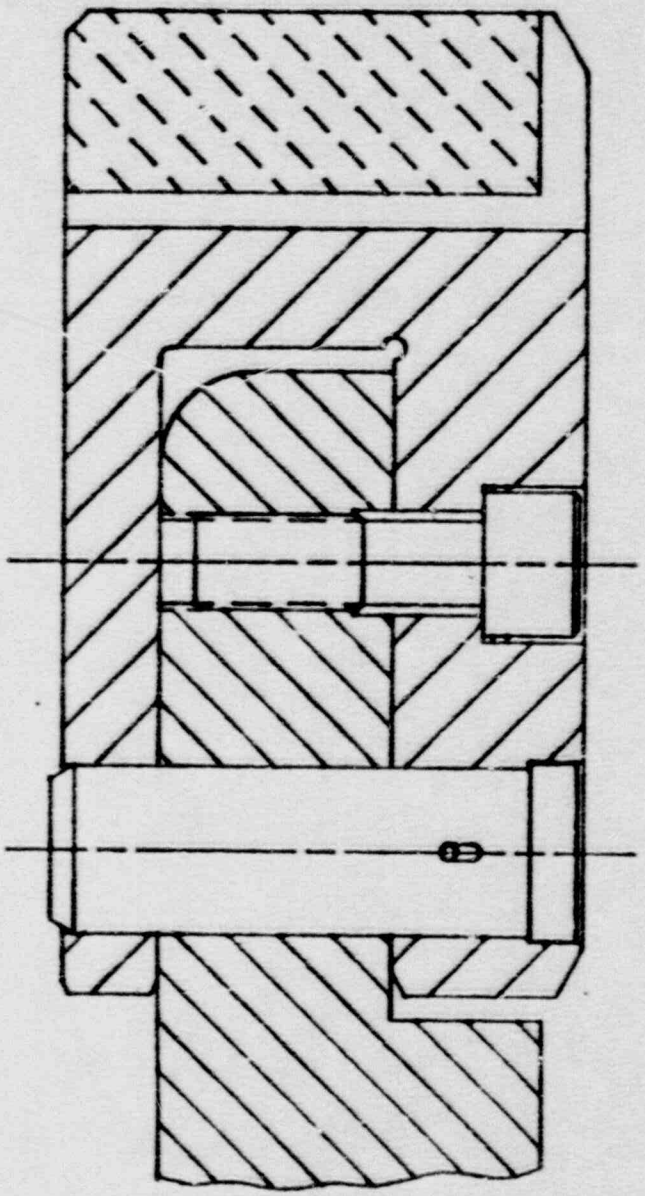
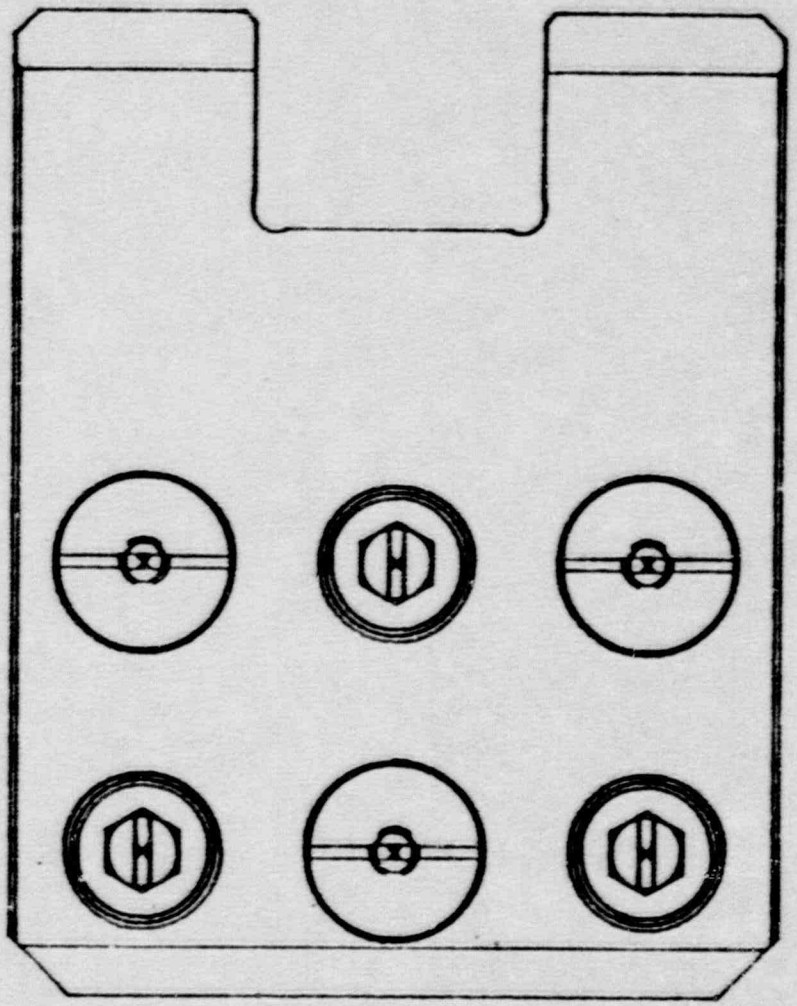


Figure 3.2-1
Thermal Shield Lower Support Relative to Original Block

Current Design

PRELIMINARY





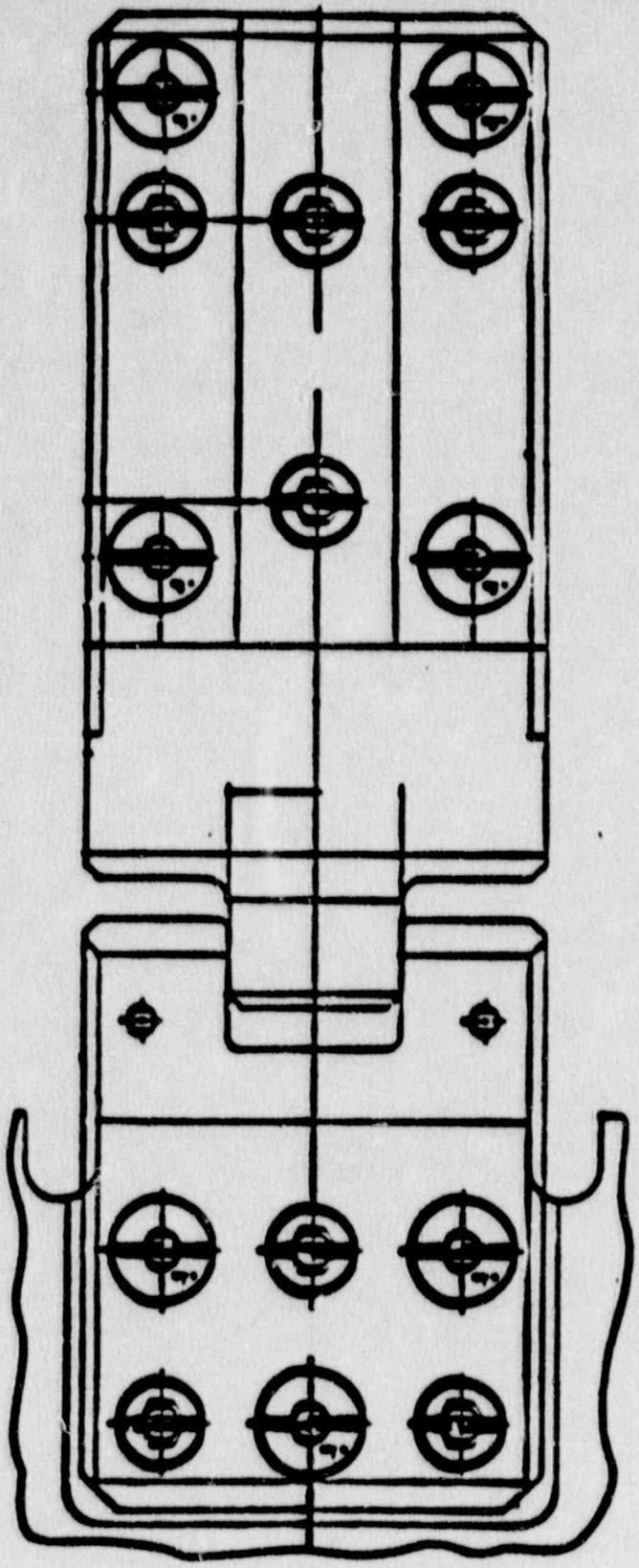


Figure 6-2
CYW Thermal Shield Repair Displacement Limiter Assembly

III. STEAM GENERATOR TUBE PLUG INSPECTION UPDATE

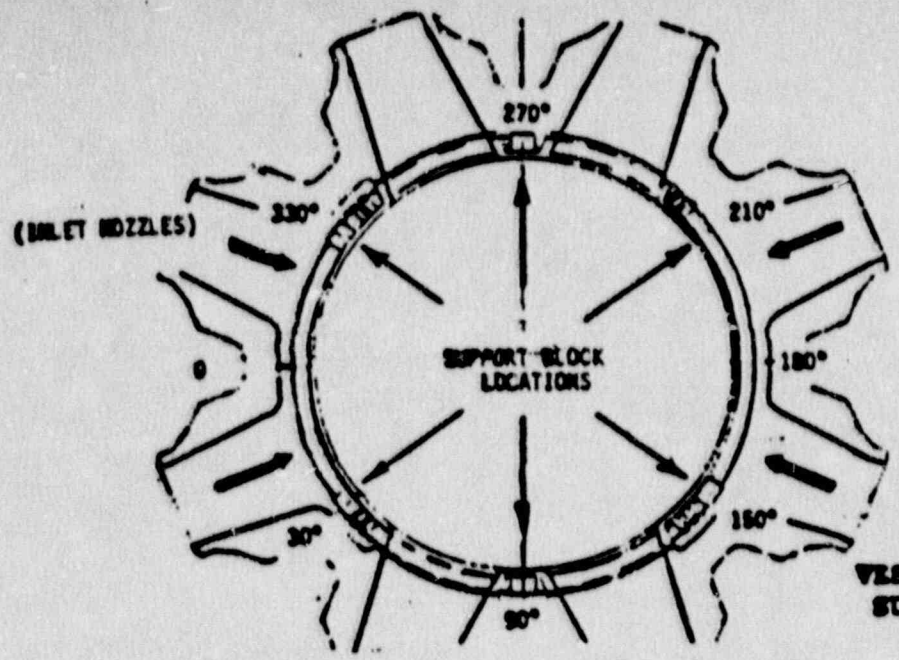
- INSPECTION AND REPAIR WORK IS COMPLETE

- SUMMARY OF RESULTS:

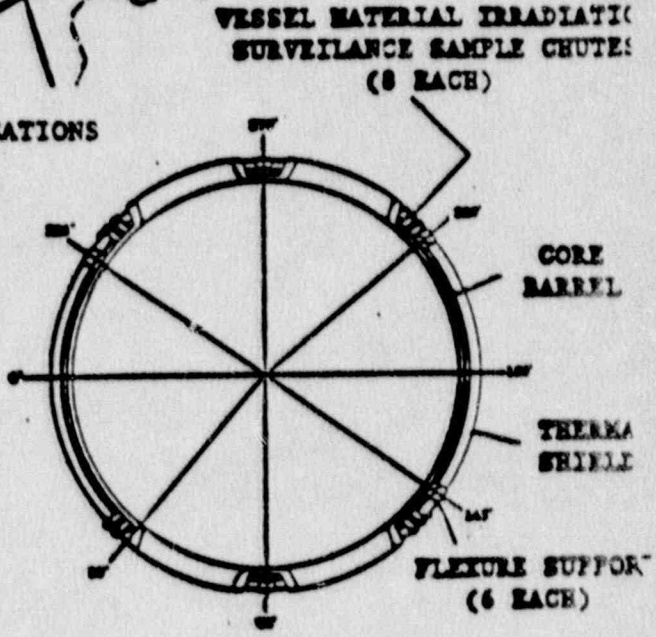
SG	# OF PLUGS INSPECTED	# OF PLUGS UNACCEPTABLE	# OF PLUGS* PAP'D
1	394	3 (HOT LEG)	69
2	602	52 (HOT LEG)	169
3	170	11 (HOT LEG)	58
4	632	33 (HOT LEG)	292

*ALL HOT LEG SIDE PLUGS FROM HEAT #3513 WERE PAP'D;
ALL "UNACCEPTABLE" PLUGS WERE FROM HEAT #3513.

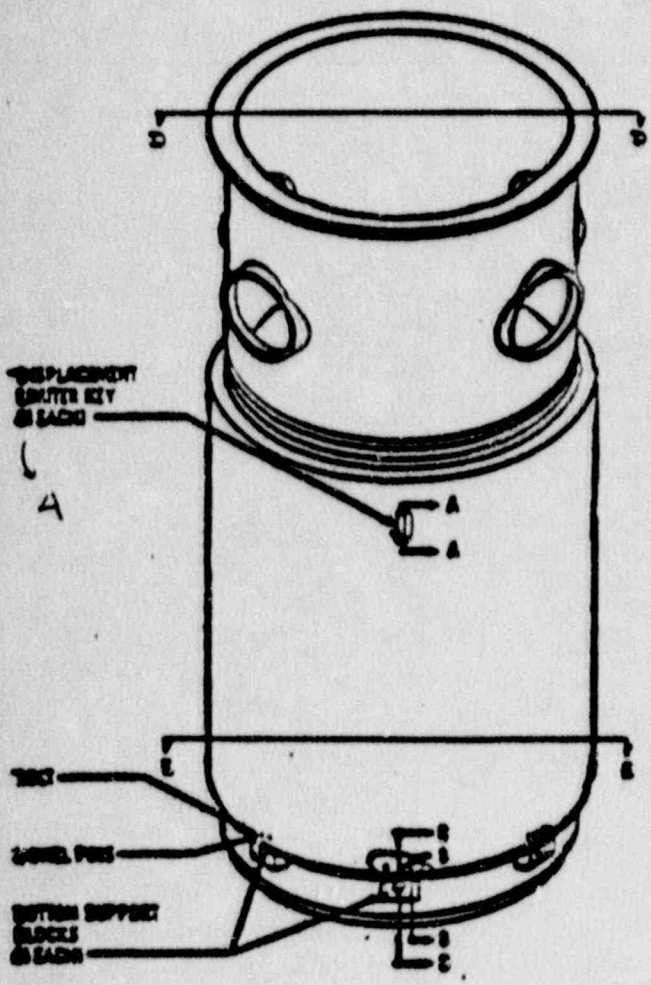
- SLIDES

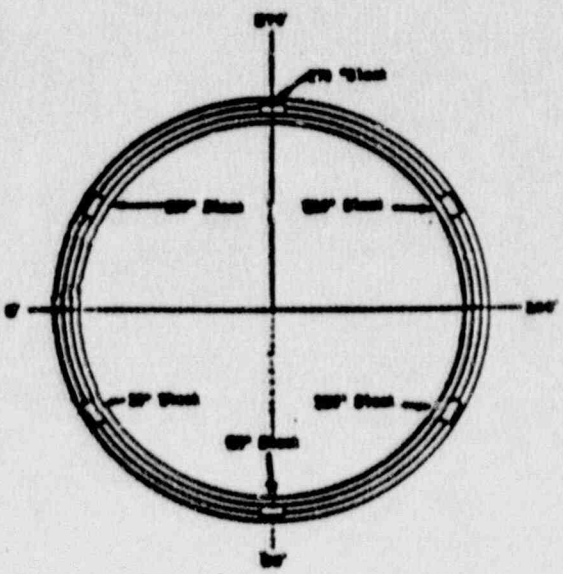


TOP VIEW NOZZLE LOCATIONS



VIEW D-D





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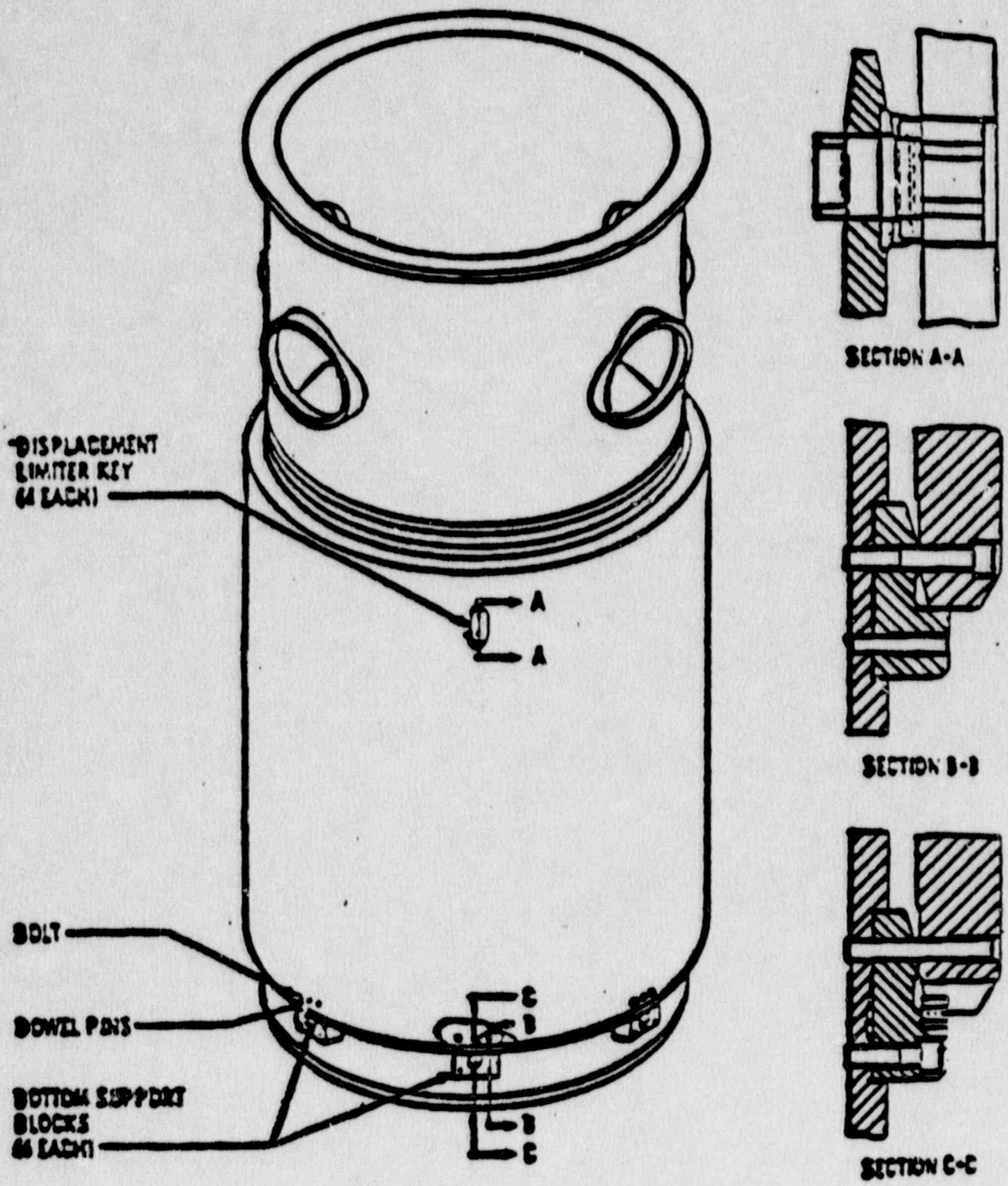

Figure 2-1. Thermal Shield Support Details Without Flexures

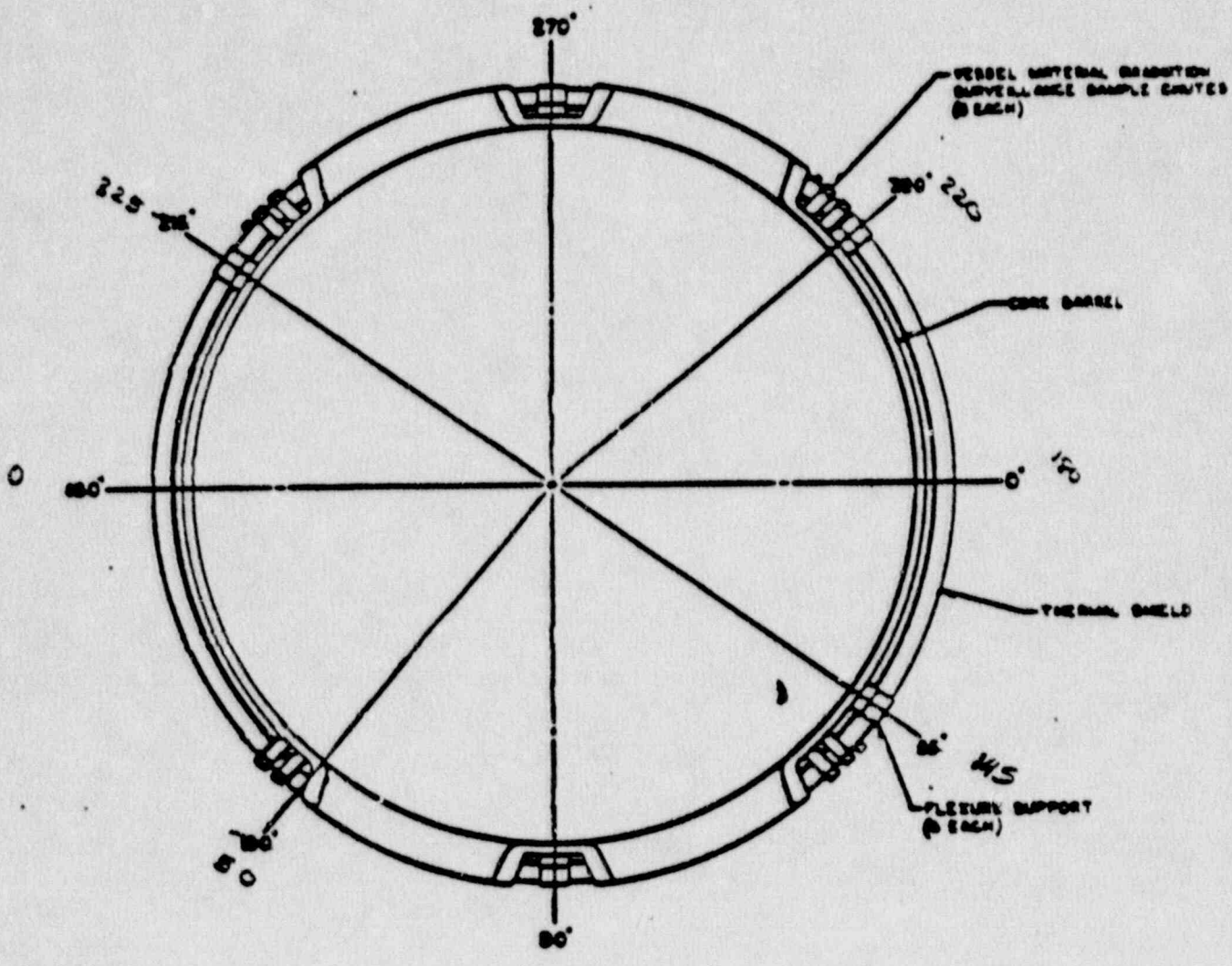

Figure 2-2. Plan View Core Barrel and Thermal Shield

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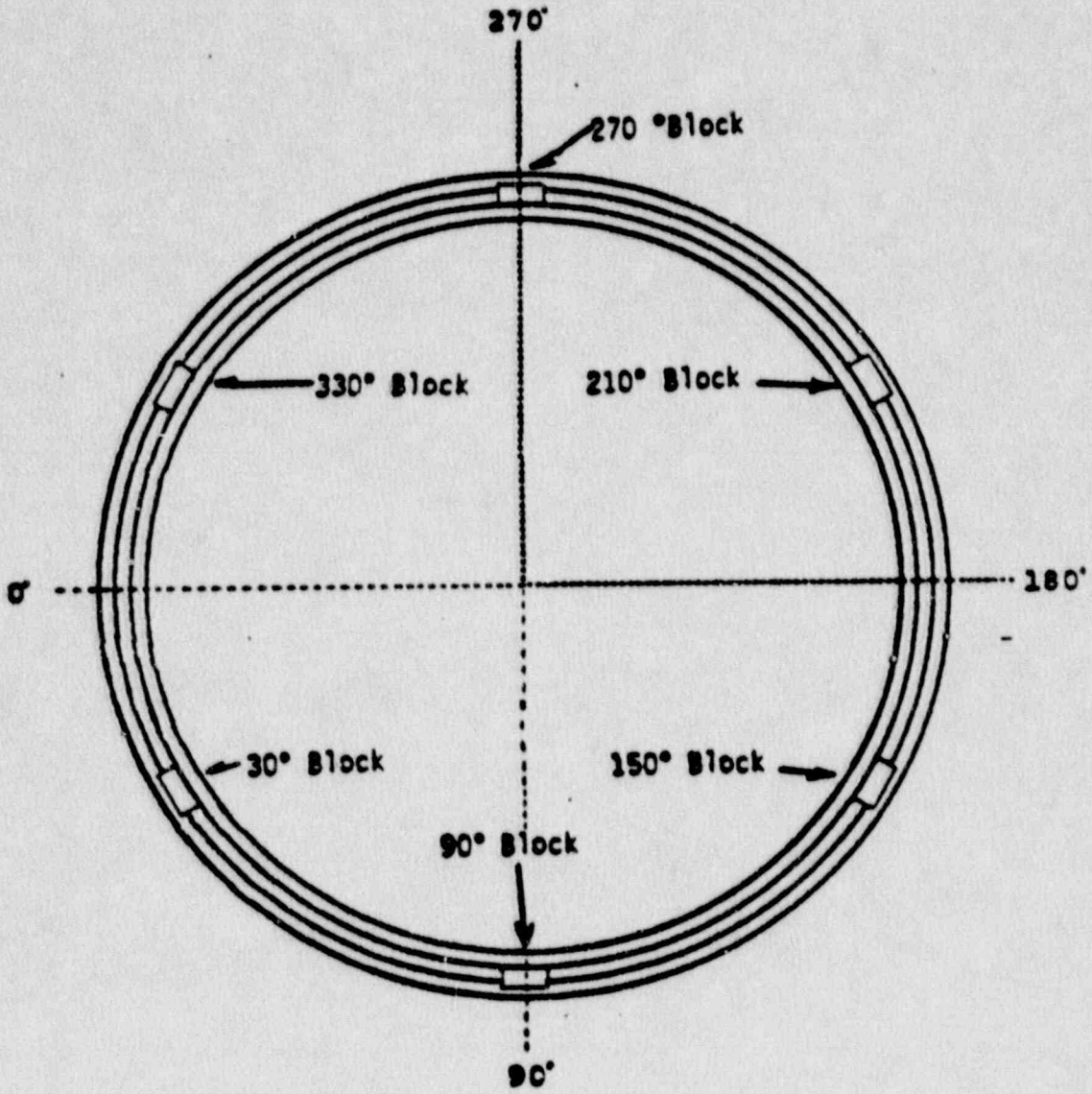


Figure 2-4. Thermal Shield Support Block Locations

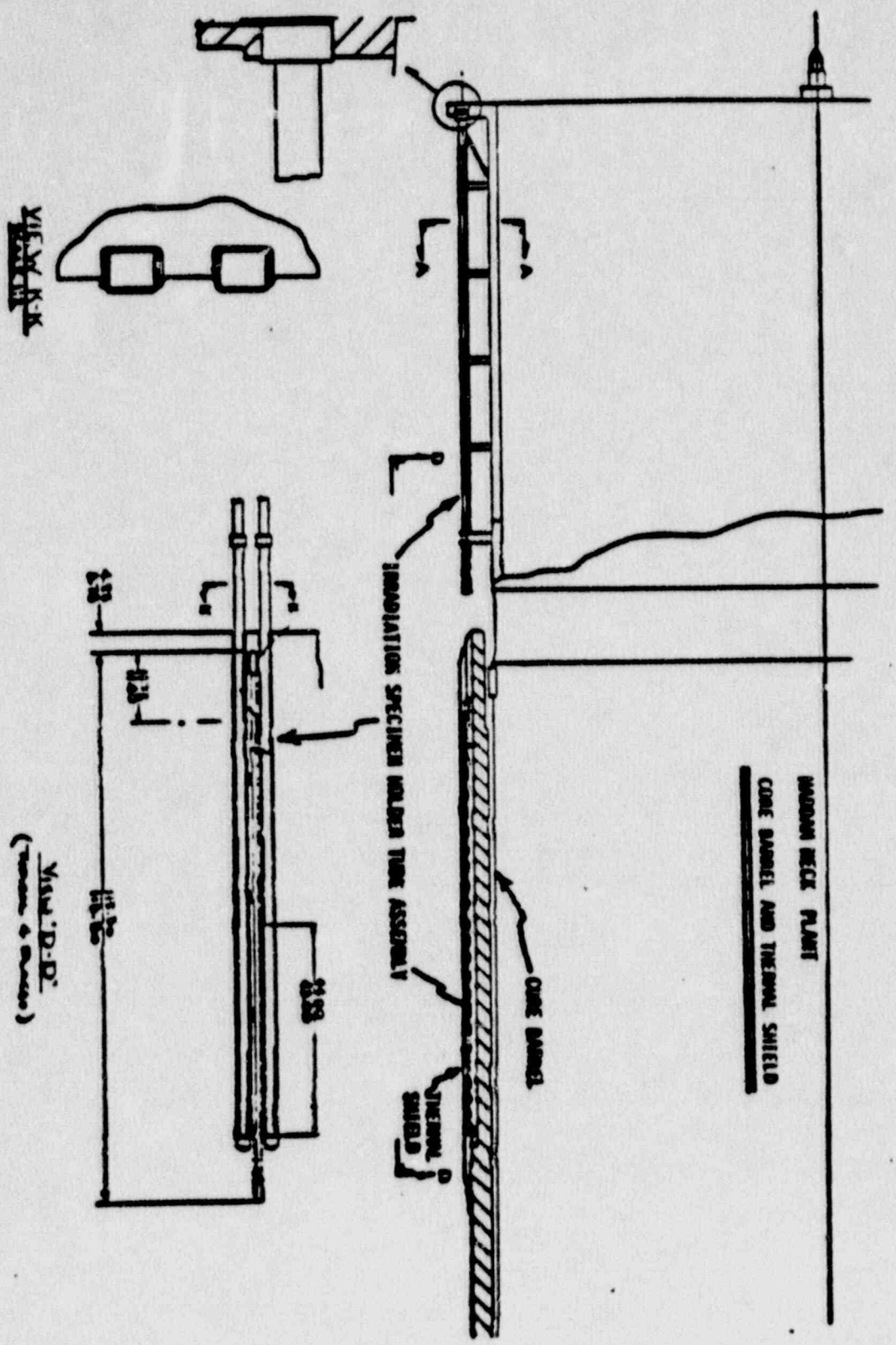
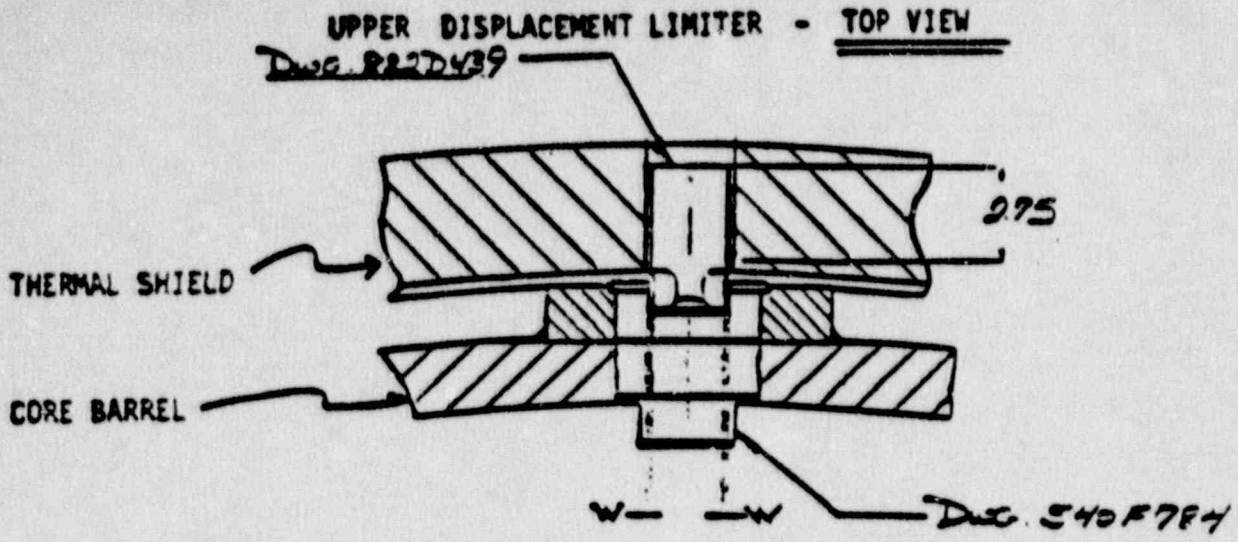


Figure 2-8. Irradiation Specimen Holder Tube Assembly

5



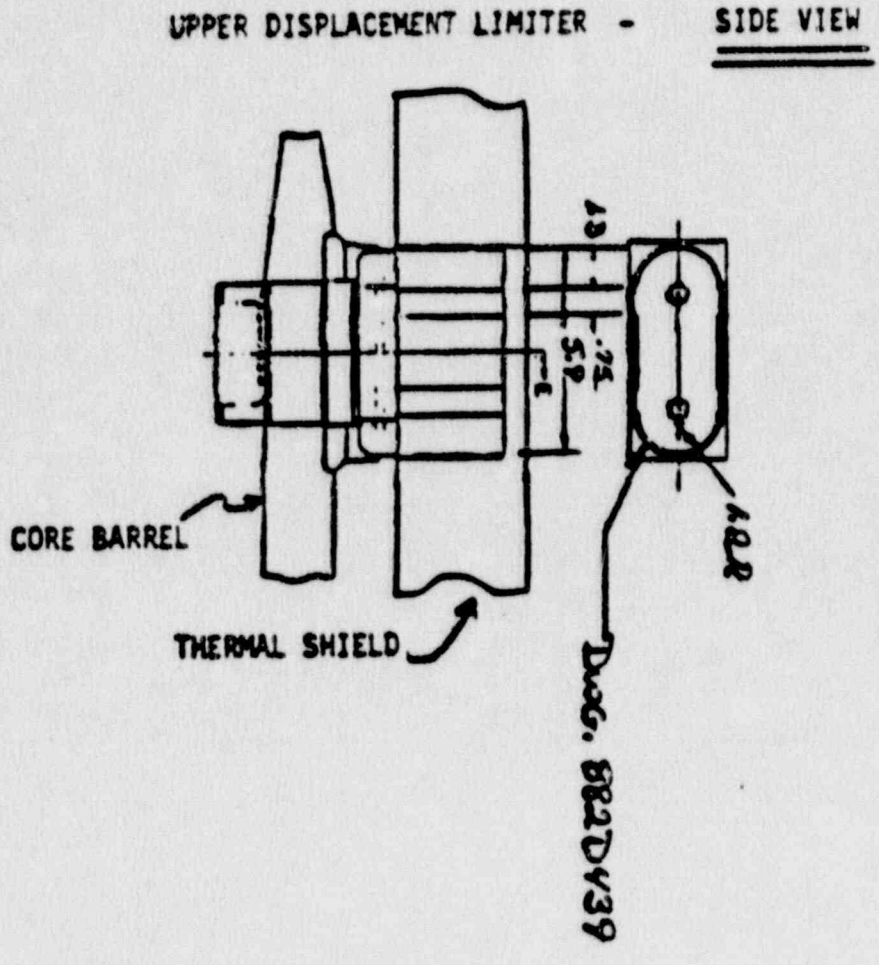


Figure 2-9. Upper Displacement Limiter

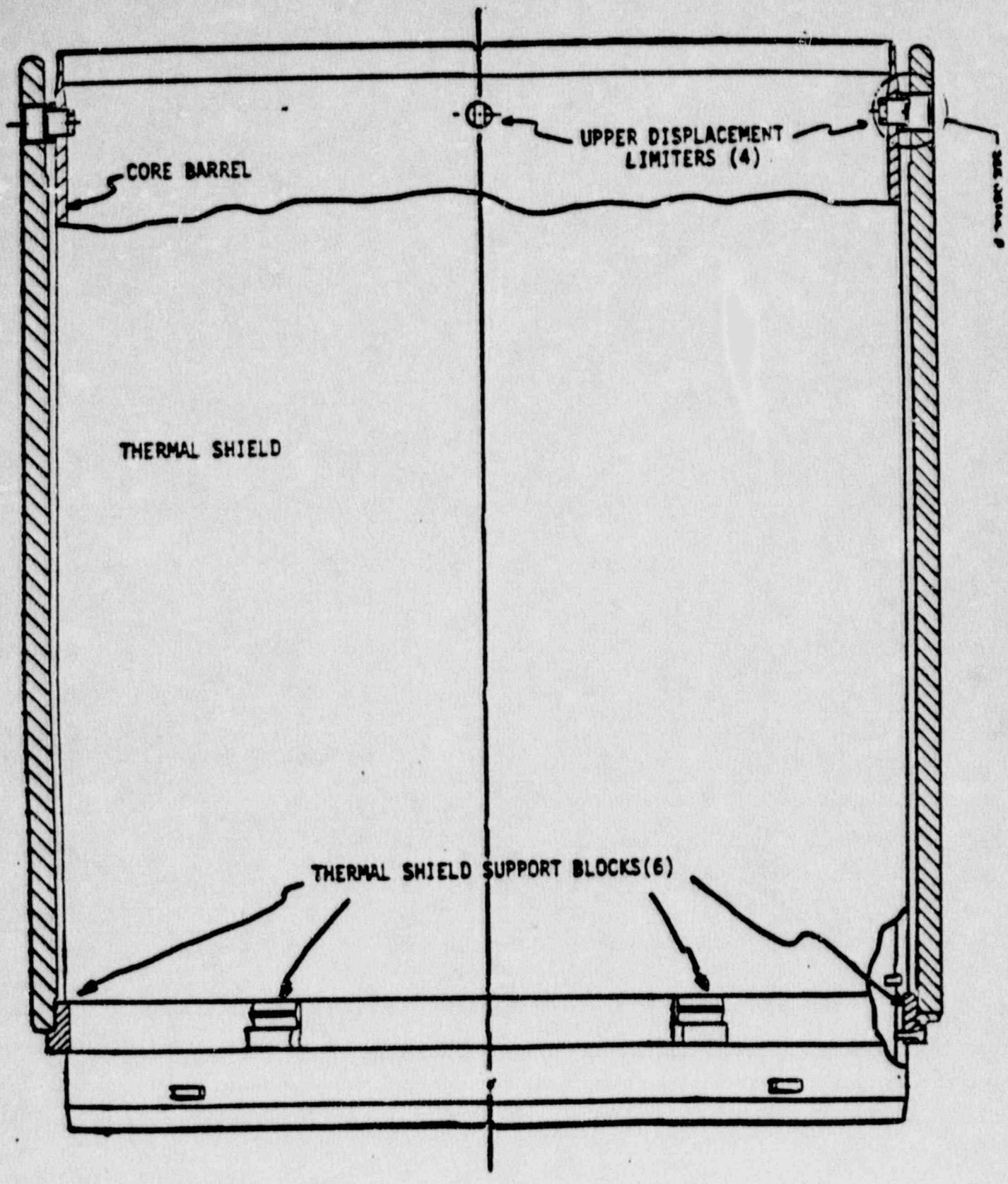


Figure 2-3. Thermal Shield and Lower Core Barrel Fit-Up

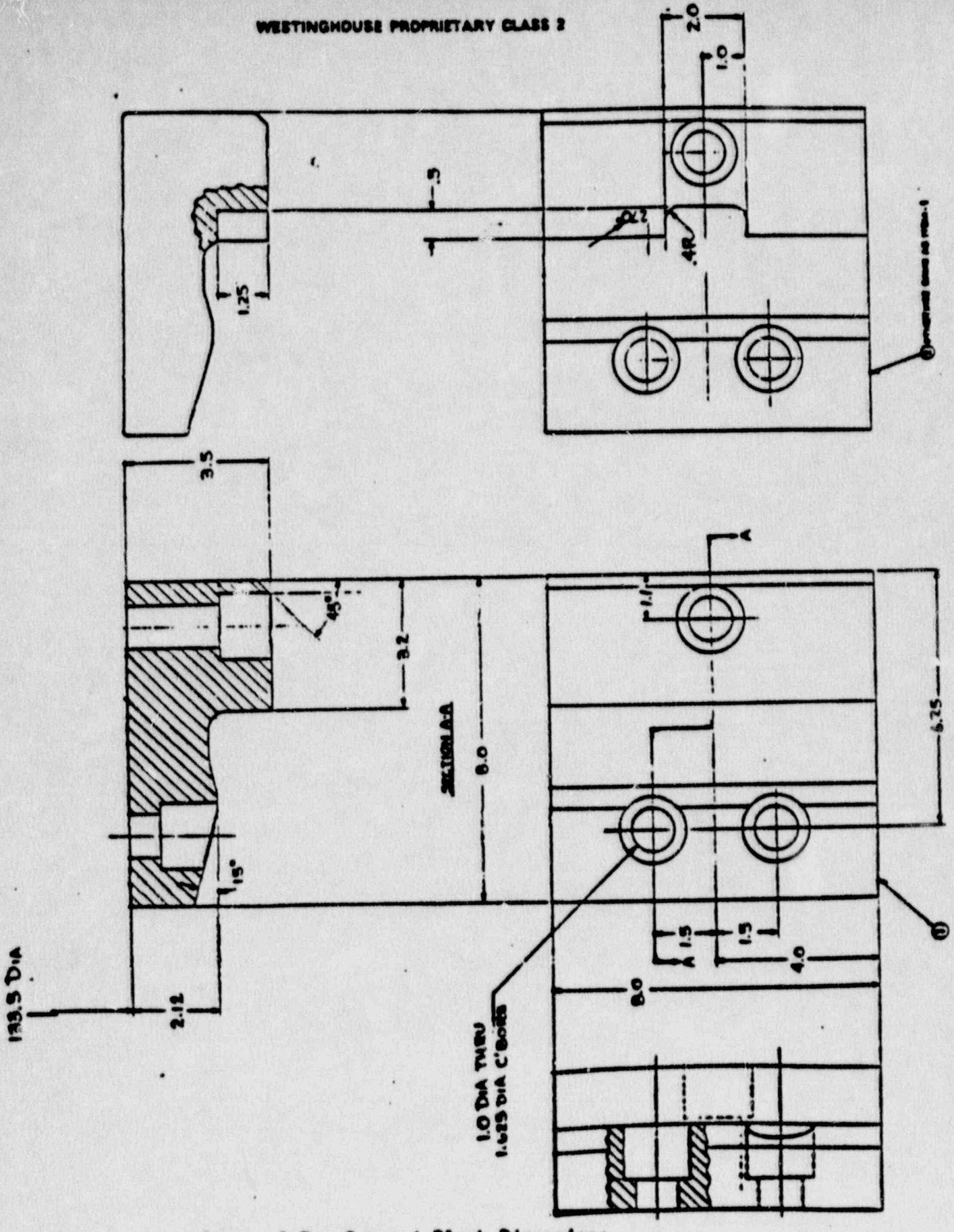


Figure 2-7. Support Block Dimensions

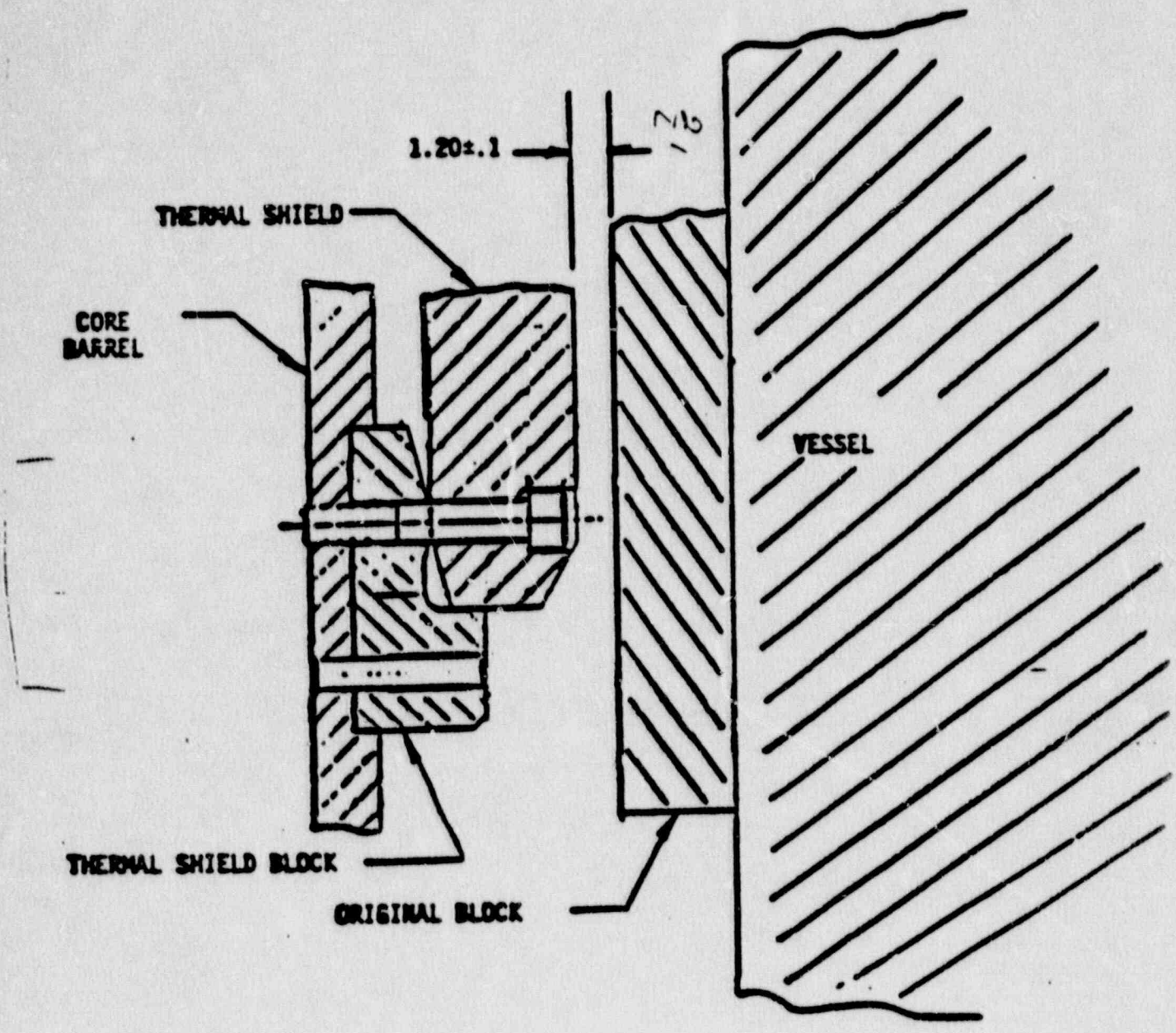


Figure 3.2-1
Thermal Shield Lower Support Relative to Original Block

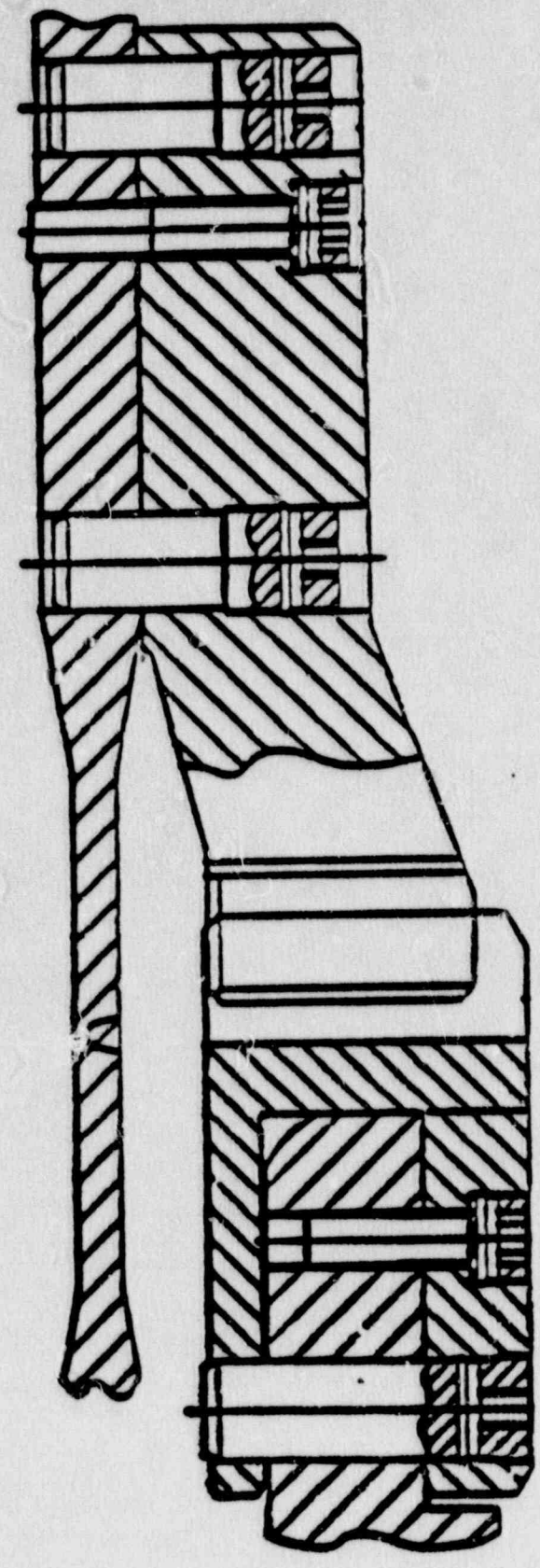


Figure 6-1
CYW Thermal Shield Repair Displacement Limiter Assembly

10

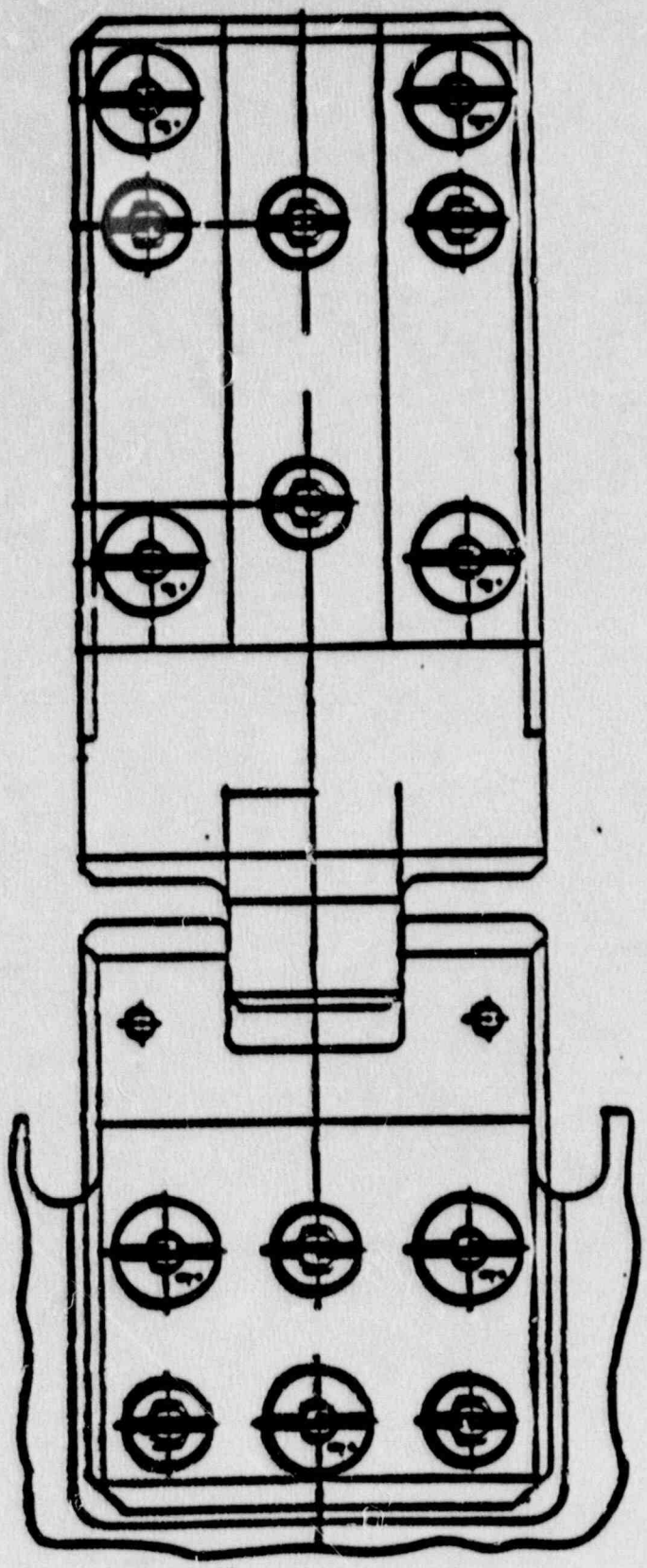


Figure 6-2
CYW Thermal Shield Repair Displacement Limiter Assembly

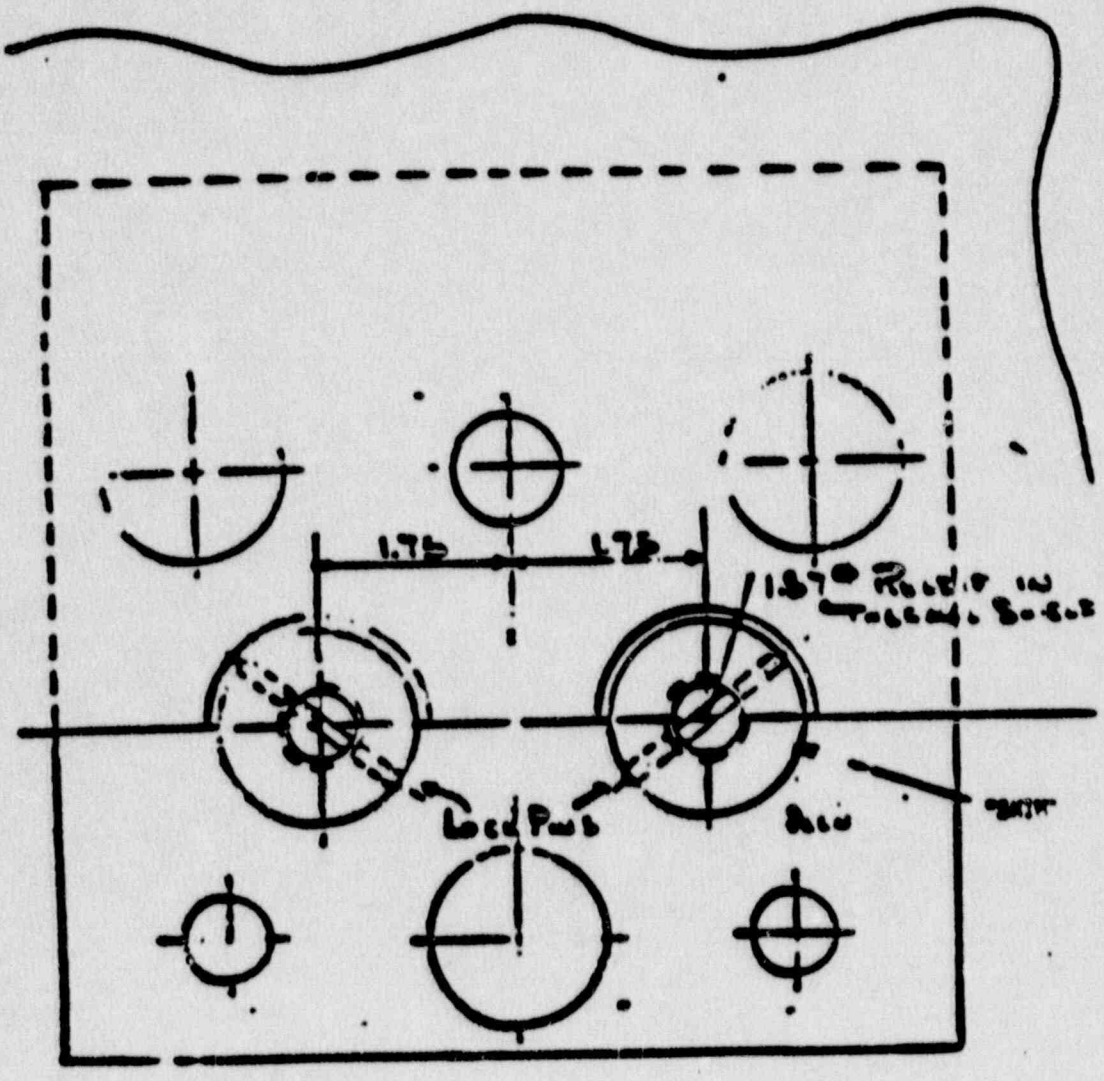


Figure 6-4
90 Degree Dowel Pins, Radial View

12

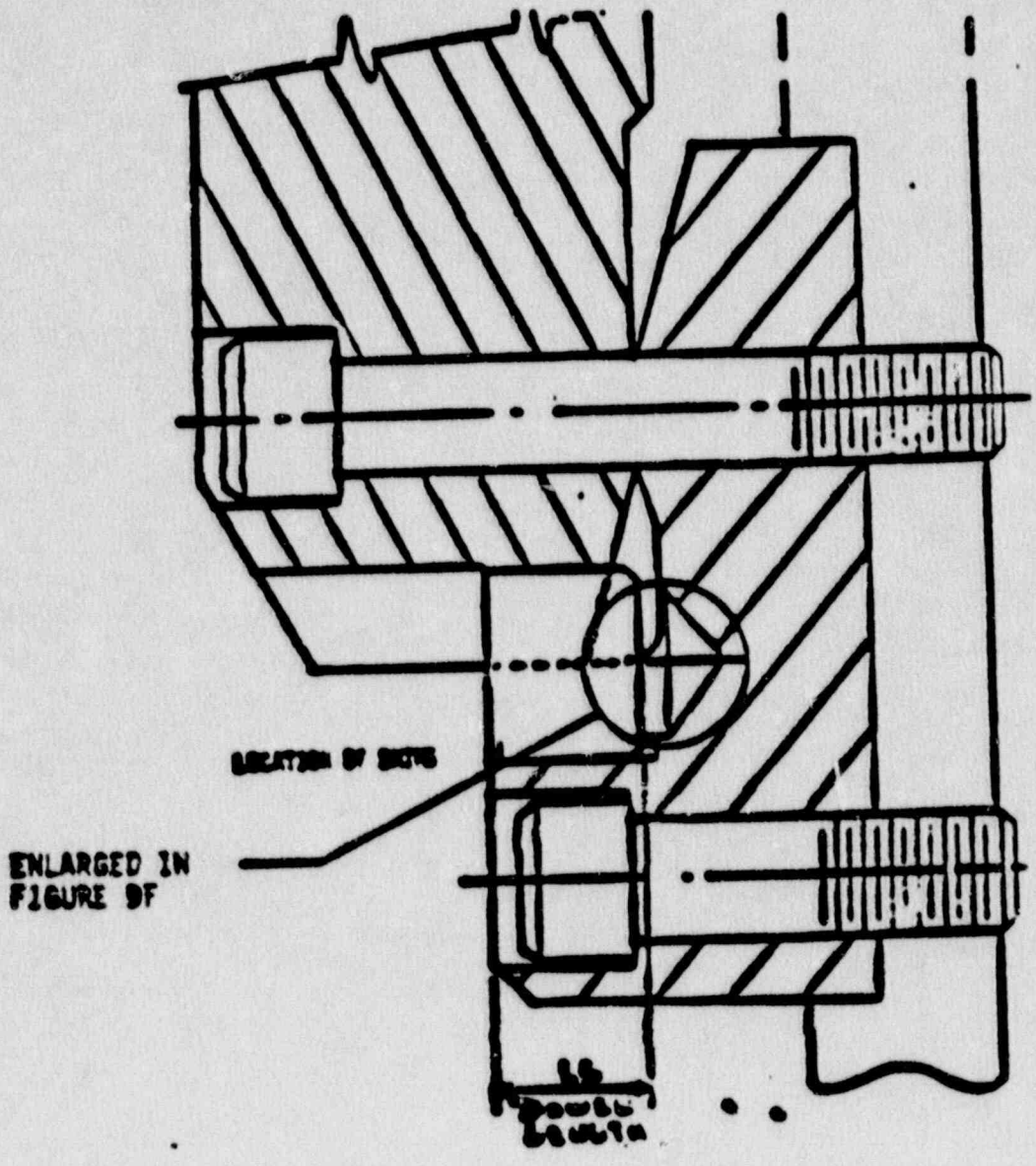


Figure 6-5
90 Degree Dowel Pins, Elevation View

13

1989 Core Support Barrel Visual Inspection Results

- with Core Support Barrel in RPV

Thermal Shield Displacement Limiter 128 °
Lower Block All 3 dowel pins backed out

Thermal Shield Support Block 210°
Center Dowel backed out
upper right bolt backed out 1/4" to 1/2" past T.S.

Thermal Shield Support Block 270°
upper left bolt missing

RPV near 128° - Hot Leg Nozzle
gouge in cladding

Bottom Head
Misc. pieces found 1 bolt, 18" metal strip, rod

Inspections Completed:

6 displacement limiters examined with an overhead camera and a 90° lens.

5 Thermal Shield Support Blocks lower blocks examined with an overhead camera and a 90° lens.

330° Thermal Shield Support Block lower bolt not examined. Overhead camera inspection of upper bolts revealed no damage.

All Six Support Blocks examined from the ID of Core Barrel using a 90° lens.

Thermal Shield Lower Support Blocks from ID

30°	All 3 dowel pins recessed
90°	All 3 dowel pins recessed
150°	All 3 dowel pins recessed, lower center bolt, upper right bolt recessed
210°	All 3 dowel pins recessed, upper right bolt recessed
270°	All 3 dowel pins recessed, upper right bolt missing
330°	Lower 2 dowel pins and lower bolt appear recessed

POTENTIAL ROOT CAUSES

I. Loose Dowels At 128 degree Limiter Inserts Backed Out

A. Degradation of the 128 degree Limiter Insert Results in Increased Vibratory Loads at the Lower Support Blocks

1. Preliminary Vibratory Evaluations Show Highest Loads at:
   a. 210 degree block
   b. 90 degree block

2. Analysis Results Show That For A 10 mil or Even A 27 mil Limiter Key Gap, Lower Support Top Bolts Should Not Crack due to High Cycle Fatigue During One Cycle of Operation

B. If Lower Support Top Dowel Pin Backs Out, The Top Bolt Loads are Expected to Increase

1. The Visual Inspection of the 210 degree Block Shows:
   a. Top Dowel Pin Out
   b. Top Right Bolt Could be Out Slightly

2. Some Degradation at 90 degree Block Appears to be Present ie, Shims have Rotated

C. Assuming the 210 Degree Block Degraded as Well as the 128 degree Limiter Vibratory Evaluations Were Performed

1. Loads at the Lower Support Blocks Increased Only Slightly Over the Case Assuming Only the 128 Limiter was Degraded

Scenario I Conclusions

For this Scenario the Degradation of the 128 degree Limiter has the Greatest Influence on the Lower Support Block Loads.

However, the Resulting Loads, by themselves, are Not Large Enough To Produce Cracks in the Lower Support Block Bolts for Limiter Key Gap Sizes Up to 27 mils for One Cycle of Operation.

The Top Bolts at the 210 degree Lower Support Block may be Cracked due to the Movement of the Top Center Dowel Pin Coupled with the Increase in Loads

The Results of this Scenario do not Provide Any Conclusions on Why the One Bolt is Missing from the 270 degree Block Location.

II. Dowel Pin Backed Out at the 210 degree Lower Support Block

A. The Degradation of the 210 degree Lower Support Block was Considered in the Vibratory Evaluations

1. Compared to an Undegradated Case

a. At the 270 degree Block:
- Radial Loads Increased by ~ 26 %
- Vertical Loads Increased by < 5 %

b. Displacements at the 128 degree Limiter Location Increased Only Slightly in the Radial Direction

Conclusion

The Increased Loads at the 270 degree Block do not Appear to be Sufficient Enough to Cause a Bolt to Crack.

III. A Top Bolt is Missing from the 270 degree Block

A. Vertical Gap Between Shield/Support Block and Support Block/ Core Barrel May Be Larger Than Initial As-Built Value of .000/.002 Inch

1. A Larger Gap will Reduce the Effective Preload Needed for a Tight Joint and Increase Top Bolt Loads. Using the Nominal Torque Coefficient (c= .177) the Calculated Preload may not be Sufficient to Close a Gap of 14 mils or Greater

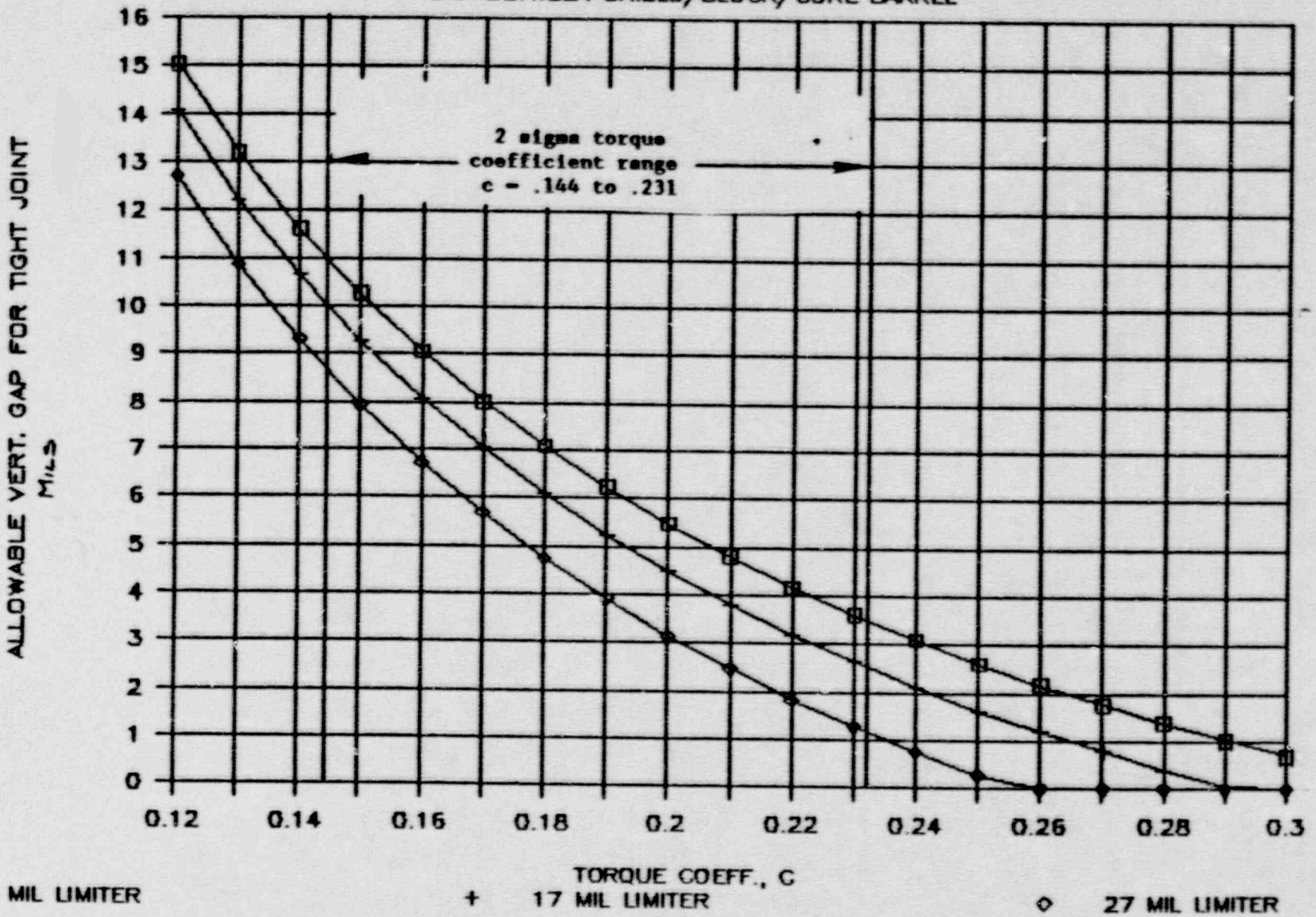
a. Previously (last outage) Bolts Were Missing from the 270 degree Block and Wear may have Occurred at the Interfaces

Conclusion

Increased Radial Loads at the 270 degree Block Coupled with an Increased Vertical Gap Between the Shield/Block/Core Barrel Could Degrade a Top Bolt

ALLOWABLE VERTICAL GAP vs TORQUE COEFF.

GAP BETWEEN SHIELD/BLOCK/CORE BARREL



IV. Loose Dowel Pins At 128 Limiter Inserts Backed Out

A Top Bolt may be Missing from the 270 degree Block Based on the In-Vessel Internals Visual Inspection

A. A Vibratory Evaluation was Performed Assuming the Above Conditions

1. Lower Support Loads were not Significantly Different for this Case than for the Case With Only the 128 degree Limiter Degraded

V. Bolt Over Torque During Installation

A. Bolt Over Torque could Initiate a Crack in the Bolt that could Propagate During Operation and Lead to Bolt Failure

POTENTIAL ROOT CAUSES

1. The Degradation of the 128 Limiter, due to Dowel Pins Backing Out, Increased the Loads At the Lower Supports

2. The Higher Loads At the 210 degree Block Helped in Backing Out the Dowel Pin.

3. The Decreased Capacity of the Dowel Pin Probably Caused the 210 degree Top Right Bolt to Start to Back Out, Which Degrades this Block Even Further.

4. The Degradation of the 128 Limiter and 210 degree Block Increased the Loads on the 270 degree Block

5. The Bolt at the 270 degree Block may have Degraded if One of the Following Conditions Exists Coupled with the Predicted Increased Loads from Condition 4:

   a. A Large Vertical Gap Between the Thermal Shield and Support Block and/or Between the Support Block and Core Barrel.

   b. Over-Torque of the Bolt Initiated a Crack

   c. The Banana Pin was not Securely Engaged into the Base Metal

6. If Significant Wear Occurrs at the Limiter Keys then Cracking of the Bolts at the Lower Supports may Occur

Attachment 2

CONNECTICUT YANKEE ATOMIC POWER COMPANY

DOCKET NO. 50-213

Meeting of October 25, 1989

STATUS OF DEGRADED FUEL

Attendance List

Name	Company	Phone
Alan Wang	NRC	301-492-1313
Bill Herwig	NUSCO	203-665-3198
E.P. (Chip) Perkins	NUSCO	203-665-3110
Clint Gladding	Conn. Yankee	203-267-3628
Richard Lobel	NRC	301-492-1157
C. D. Sellers	NRC	301-492-0930
Larry Phillips	NRR/DST/SRXB	301-492-3235
Shih-Liang Wu	NRR/DST/SRXB	301-492-1065

Document Name:
MID-OUTAGE STATUS MEETING

Requestor's ID:
MITCHELL

Author's Name:
Wang,A

Document Comments:
Haddam Neck - re. Leaking Fuel Pins & Thermal Shield Damage