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TERRY,C.D. Niagara Mohawk Power Corp.
RECIP.NAME RECIPIENT AFFILIATION
Document Control Branch (Document Control Desk)

SUBJECT: Responds to request for addl info re core shroud repair. Suppl 1 to GE-NE-B13-01739-04, "Suppl 1 to Nine Mile Unit 1 Shroud" encl.

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N M NIAGARA MOHAWK

NIAGARA MOHAWK POWER CORPORATION/NINE MILE POINT NUCLEAR STATION, P.O. BOX 63, LYCOMING, N.Y.13093 /TEL. (315) 349-7263
FAX (315) 349-4753

CARL D. TERRY
Vice President
Nuclear Engineering

February 28, 1995
NMP1L 0910

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

RE: Nine Mile Point Unit 1
Docket No. 50-220
DPR-63

Subject: ***Response to Request for Additional Information Regarding the Nine Mile Point Unit 1 Core Shroud Repair (TAC No. M90102)***

Gentlemen:

By letter dated February 23, 1995, the Commission made a request for additional information concerning the Nine Mile Point Unit 1 Core Shroud Repair. Our letter dated February 24, 1995, provided responses to the requested information except for requests 2, 3, 4, 5, and 7. Attachment 1 to this letter provides responses to these remaining items.

Niagara Mohawk Power Corporation has completed an inspection of the core shroud H8 weld. The inspection utilized ultrasonic examination supplemented by enhanced visual examination in areas where access was not possible for the ultrasonic inspection tool. A total of approximately 260 degrees of the weld circumference was inspected by the combination of ultrasonic and visual examination. Two areas containing indications are being evaluated. At this time, Niagara Mohawk Power Corporation believes none of the indications is of structural significance and that Niagara Mohawk Power Corporation's acceptance screening criteria is met with significant margin. Niagara Mohawk Power Corporation, therefore, has decided that repair of the H8 weld by installation of brackets is not necessary. Future reinspection of the areas containing indications will be addressed at a later time consistent with the ongoing BWRVIP work on reinspection scope and frequency.

Very truly yours,

C. D. Terry
Vice President - Nuclear Engineering

CDT/JMT/kab
Enclosure

100022

9503100126 950228
PDR ADOCK 05000220
P PDR

A001

xc: Regional Administrator, Region I
Mr. L. B. Marsh, Director, Project Directorate I-1, NRR
Mr. D. S. Brinkman, Senior Project Manager, NRR
Mr. B. S. Norris, Senior Resident Inspector
Records Management

ATTACHMENT 1

Information Request 2

The summary of the hardware stresses provided with the repair hardware analysis, General Electric (GE) Report No. GE-NE-B13-01739-04, indicates that the stresses in the toggle and lower support are at or near the allowable values for the steamline break and design-basis earthquake (DBE) events. Provide the details of these calculations to demonstrate that the bending stresses in the toggle due to postulated failures of welds H_7 and H_8 have been considered in the evaluations.

Response 2

The details of the lower support (Drawing 112D6585) stress calculations are attached (Attachment 2). The analysis of the lower support includes both tensile and bending stresses and is found acceptable.

The depth of the toggle (Drawing 112D6581) is 3.83 inches, which is large compared to the 7.13 inch span across the hole in the cone, and the traditional beam bending equations are not applicable. "Formulas for Stress and Strain," by R. J. Roark and W. C. Young, Fifth Edition, assume a span to depth ratio of 8 or more for the beam equations to be applicable.

The span to depth ratio of the toggle = 7.13/3.83 = 1.86

The loads on the toggle were evaluated for shear or tearout stresses which are found to be acceptable.

If one considers the loading on the toggles to be in bending, the following calculations show the calculated bending stresses are acceptable.

Bending stress = Mc/I

M = moment
c = distance from centroid to surface
I = section modulus

Assume the toggle is a simply supported beam that pivots about the edge of the hole through the cone and with the load applied at the center of the span. The maximum moment occurs at the center of the span.

Mmax = Pl/4

P = applied load
l = span length

The section modulus at the center of the toggle is at the same location as the pin. The section modulus at this location is that of the toggle less that of the pin.

$$I = 2 \times [(b \times h^3/12) - (b \times D^3/12)]$$

b = width of the toggle
h = depth of toggle
D = pin diameter

The bending stresses calculated are tabulated below.

EVENT	CALC STRESS, PSI	ALLOWABLE STRESS, PSI
Normal	30,500	71,250
Upset	62,100	71,250*
Emergency	83,000	106,875
Faulted	119,384	142,500

* The actual Code allowable where the pressure differences for Level B Service (Upset) exceed those for Level A Service (Normal) is 110% of the Level A allowables (Ref. NG-3223). Upset Allowable = 110% x 71,250 psi = 78,375 psi.

Information Request 3

The assessment to determine the impact of the tie rod assembly on the stresses at the H_8 weld, provided in Report No. GE-NE-B13-01739-04, Appendix A, is based on an uncracked shroud condition. What would be the impact of the tie rod assembly on the H_8 weld stresses if it were postulated to be cracked through wall in the vicinity of the attachment points of the tie rod assembly?

Response 3

Crack propagation analysis is based on stresses calculated for material in the noncracked condition. Once the uncracked stress is known, the crack propagation is calculated using the appropriate stress intensity factor. The crack growth is entirely determined by the stress in the uncracked condition.

The condition stated where the H8 weld is assumed cracked throughwall in the vicinity of the tie rod location was not specifically analyzed. The crack propagation stress intensity factor was defined for the H8 weld uncracked condition. This analysis is documented in Appendix A of GENE-B13-01739-04 and demonstrated that the tie rods have no significant effect on the stresses in the H8 weld. Since the H8 weld inspection

has demonstrated that the H8 weld has no significant cracking, a detailed analysis of the impact of tie rods on postulated partial throughwall cracking at the tie rod attachment points is not considered required.

Information Request 4

The postulated 360° through wall failures of H_2, H_{6A}, H_7, and H_8 was judged to be the most representative for including gaps in the finite element model as stated in Section 3.5.14 of Report No. GE-NE-B13-01739-04. Provide the rationale for not including postulated failures of welds H_3 and H_{6B} in the analytical model. Also, provide the magnitudes of the calculated gaps at the postulated failed weld locations H_2, H_3, H_{6A}, H_{6B}, H_7, and H_8 for both normal operating and accident conditions.

Response 4

Our intent was to assume a worst case scenario for cracking in all the circumferential welds from H1 through H7. Since cracking at welds H2 and H3 could affect the shroud stiffness, and therefore the preload, additional stress analysis was performed as a supplement to the referenced stress analysis (GE-NE-B13-01739-04) (Attachment 3). The results confirm that there is no gap for normal conditions for welds H1 through H7. For upset conditions, conservative assumptions predict a maximum separation of .030 inches. Realistic assumptions regarding the H2 and H3 fillet weld integrity demonstrate that no separation would occur for bounding 100% rated core flow upset condition pressures. For accident conditions, gaps are predicted and were addressed in the safety evaluation previously submitted. The existence of gaps during conditions other than normal operation does not violate the generic VIP shroud repair guidelines.

The potential crack separation for upset event conditions is temporary and will close following the event. The tie rod assembly stresses remain within elastic limits. The weld separation will close following the upset event since the thermal preload is recovered and the rod will remain tight. The mechanical pre-load is not affected. No inspection of the tie rod or weld is required following an upset event above the normal tie rod and refuel outage shroud ISI plan which is under development.

The supplemental stress report has been prepared to specifically address the issue of weld crack separation during normal/upset operation and accident conditions. The conditions considered include throughwall 360° cracking simultaneously at H2 and H3. The analysis does not postulate cracking at H8, but covers cracking at all other welds (H1 - H7). The results of the H8 weld inspections validate the assumption that the H8 weld is not 360° throughwall cracked. An ANSYS finite element model was prepared that includes details at the top guide support ring and at the conical support. The stabilizer stiffness and the stiffness of the lower support are also included in the preload calculations and the supplemental stress evaluation.

Since welds H2 and H3 affect the shroud stiffness, they are specifically addressed in the supplemental analysis. Welds H2 and H3 are full penetration welds with a 0.63 fillet on the ring side. Fillet welds with 0.6 inch legs are modeled for conservatism.

Four cases were analyzed which bound the stiffness at the top guide ring are listed below. The Ks term is the shroud stiffness including the top ring and conical support.

Case 1. Welds H2 and H3 have a 360° throughwall crack on the ring side of the fillet weld (Ks = 6.76 x 10^6 lb/in).

Case 2. Welds H2 and H3 have a 360° throughwall crack on the shroud shell side of the fillet weld (Ks = 6.33 x 10^6 lb/in).

Case 3. Welds H2 and H3 have a 360° throughwall cracks and there is no fillet weld (Ks = 2.70 x 10^6 lb/in).

Case 4. Welds H2 and H3 are not cracked (Ks = 68.7 x 10^6 lb/in).

Metallurgical evidence from reactor weld failures analysis suggest Case 1 is the most likely to occur for cracks extending greater than 180°. Cases 1 through Case 3 bound the ring stiffness for the postulated crack scenarios.

The compressive load at welds H6B and H7 are calculated for each case and are shown in the table below. The combined stiffness of the four stabilizers, including the lower supports, is 1.978 x 10^6 lb/in.

COMPRESSIVE LOAD AT WELDS H7B AND H7

CASE NUMBER	THERMAL PRELOAD, LB	NET WEIGHT, LB	TOTAL LOAD, LB
1	237,188	174,910	412,098
2	233,596	174,910	408,506
3	176,954	174,910	351,864
4	298,010	174,910	472,920

During normal operation at 105% core flow, the core support pressure drop, ΔPcs, is 15.9 psi and the shroud head pressure drop ΔPsh, is 5.9 psi. The calculated lift load is 339,836 lb.

The results show there is no crack separation for all the cases considered. The compressive thermal preload plus weight of the internals exceeds the 339,836 lb. load tending to separate the welds for all load cases.

During a main steam line break accident condition, the loads on the stabilizers can exceed the thermal preload and there may be separation at postulated crack locations. The most severe conditions are 360° throughwall cracks at welds H6B, H7 or H8. Failure at one or more of these welds transfers the core ΔP loads to the stabilizers which, when combined with a seismic event results in the 311, 710 lb. stabilizer load. The

maximum separation during this event is 0.63 inches. This displacement is temporary and the stabilizer springback and weight of the internals will close the gap once the event is over.

Information Request 5

Identify the most adverse combination of postulated weld failures and loading conditions in evaluating the shroud conical support deformations and provide documentation to demonstrate that the limiting deformations have been factored in the calculation of the tie rod preloads and the gap calculations requested in question #4 above.

Response 5

A 360° throughwall crack at welds H2 and H3 is the most adverse condition for shroud stiffness and results in the lowest thermal preloads. The analysis does not postulate cracking at H8, but covers cracking at all other welds. The results of the H8 weld inspections validate the assumption that the H8 weld is not 360° throughwall cracked. The cone stiffness is included in the analytical model used to calculate shroud stiffness in the supplemental stress report. As shown in Number 4, there is no crack separation during normal operating conditions. The minimum compressive load at the welds occurs if H6A or H7 is failed and the core ΔP load is restrained by the stabilizer assemblies.

From the viewpoint of applied loads, an infinitely stiff shroud results in the highest thermal loads. The thermal loads calculated in the original stress report are based on the assumption of an infinitely stiff shroud. The shroud and stabilizer thermal stresses, based on the high thermal loads, are shown in the original stress report to meet the required stress limits.

Information Request 7

During a combined steamline break and DBE event, the tie rod load has been determined to be in excess of 300,000 lbs. With postulated failures of welds H_7 and H_8, the H_8 lower weld bracket would impose a bending moment on the H_8 upper weld bracket in the vicinity of the adjustable foot. Provide calculations to demonstrate the structural integrity of the bracket under these loading conditions.

Response 7

The tie rods are restrained by the cone which carries the load to the reactor pressure vessel wall. The H8 weld brackets rest on the cone at different locations from the stabilizer assemblies and are not loaded by the tie rods. In the faulted event referenced where the tie rod loads exceed 300,000 lb., weld separation is predicted below the core support. Since the upper bracket is attached to the shroud below the core support, the brackets become unloaded and the upper bracket is unrestrained in the vertical direction (free to lift). Any postulated cone deflections would not produce significant load on the brackets.

The H8 weld brackets are designed to carry the downward load produced by a recirculation line pipe break. Each bracket is designed for a 418,833 lb. vertical load and a 42,715 lb. horizontal load during this event. The bearing, shear and bending stresses produced by these loads have been calculated and found acceptable.

GE Nuclear Energy

ATTACHMENT 2
Engineering Services Verification Cover Sheet
(Reference EOP 42-6.00 and EOP 25-6.00) Sheet 1 of ____

DRF NO./SECTION B13-01739

Subject: LOWER SUPPORT / Toggle

1 **VERIFICATION REQUIREMENT** Designated Verifier Robert Hill

1A APPLICATION. (System/Project/Program)

NMP-1 SHROUD REPAIR

1B METHOD OF VERIFICATION. Checking, Alternate Calc, Indiv. Design Review, Team Design Review, Test (circle as needed); Other (describe)

1C SCOPE. (Identify what is to be verified (e.g., level of detail).

Verify Stress Calculations for lower support 112D6585 and the toggle Per 112D6581

1D INPUTS. Identify any GE and external interfaces and requirements, assumptions, input documents, test analyses, reasons for changes. 112D6581, 112D6585

1E OUTPUTS. Identify output document(s) or analysis results to be verified.

1F Responsible Engineer T. Gleason (Print name and Sign) Date 2/27/95 Comp. 771

2 **INDEPENDENT VERIFICATION**

Comments: [X] No [ ] Yes (See Attached)

2A VERIFICATION STATEMENT: The method and scope of verification as stated in 1B and 1C are appropriate. The inputs as identified in 1D. All comments and technical issues are resolved. The verification establishes that the output identified in 1E is correct and is adequate for its intended application as identified in 1A.

2B Independent Verifier Robert J Hill (Print name and Sign) Date 2/27/95 Comp. 345

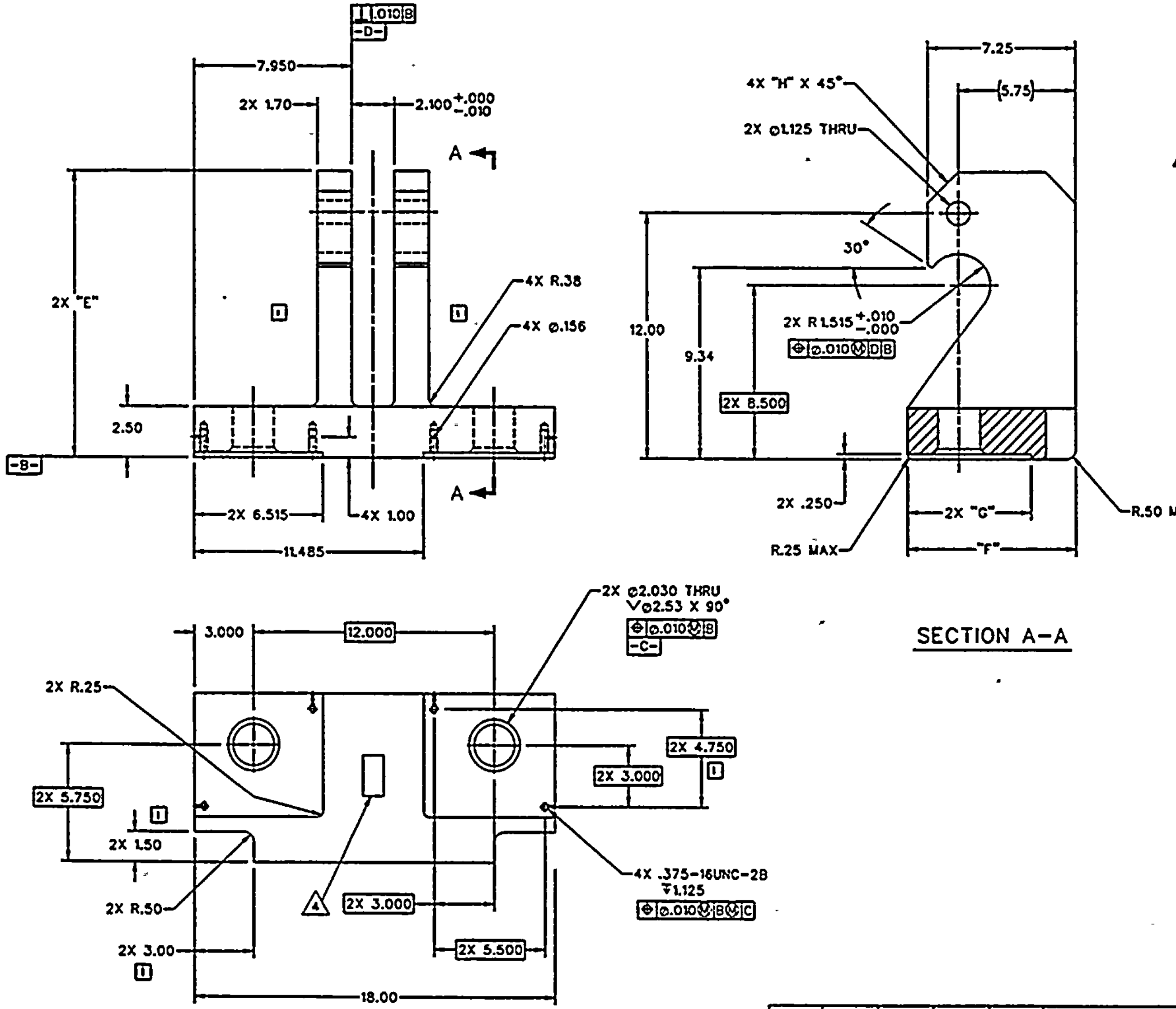
3 **APPROVAL OF VERIFICATION**

3A MANAGER'S APPROVAL: All design requirements have been identified and all technical issues are adequately resolved. The verification described in the above sections 1 and 2 is sufficient to issue/apply the results.

3B Resp. Manager or Delegate: ____________ (Print name and Sign) Date____ Comp.____

4A Are there attached sheets for 1A,1B,1C,1D,1E,2A,3A? (circle as applicable)

SD-036B (1/92)



NOTES:

1. UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES.
2. GEOMETRIC DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1982.
3. FABRICATE PER SPEC 25A5584.
4. (Δ4) MARK PART IDENTIFICATION "112D6585P001" OR "112D6585P002" AND SERIAL NO. "SNXXXX" IN .25±.06 HIGH CHARACTERS IN LOCATION SHOWN USING INTERRUPTED DOT LOW STRESS STAMP.

PT. NO.	"E"	"F"	"G"	"H"	MATERIAL
1	14.00	8.25	6.015	1.50	ASTM B637, UNS N07750 TYPE 3
2	12.70	8.00	5.765	.50	

112D6585 | 1

REVISIONS

A	PRELIMINARY ISSUE	
B	10 NOV, 1994 R. MOKLER	RJA
	1.70 DIM WAS 1.50 ADDED 1.00 THK GUSSETS RM-01662 CHK BY: R. MOKLER	
1	DEC 12 1994 R. MOKLER	RJA
	REMOVED 1.00 GUSSETS ADDED 3.00 X 1.50 CUTOUTS TO BASE PLATE ADDED PT. NO. 2 WITH TABULATION 2X 4.750 WAS 2X 5.000 RM-01716 CHK BY: R. MOKLER T. GLEASON	

EQUIPMENT CLASS CODE P

SAFETY RELATED: THIS ITEM IS OR CONTAINS A SAFETY RELATED ITEM ☒ YES ☐ NO

IEEE CLASS 1E NUCLEAR SAFETY RELATED ☐ YES ☒ NO

SIGNATURES	DAY	MO	YR
R. MOKLER	14	10	94
R. MOKLER	24	10	94
R. AHMANN	24	10	94
T. GLEASON	24	10	94

APPLIED PRACTICES Y1010A3

UNLESS OTHERWISE SPECIFIED TOLERANCES ON:
2 PLACE DECIMALS ±.02 FRACTIONS ± —
3 PLACE DECIMALS ±.010 ANGLES ±2°

GE Nuclear Energy — GENERAL ELECTRIC COMPANY San Jose CA

DETAIL

LOWER SUPPORT

for NMP1 SHROUD

25 OCT 1994 | 112D6585 | 1

RM-01560 | C | 1 | F

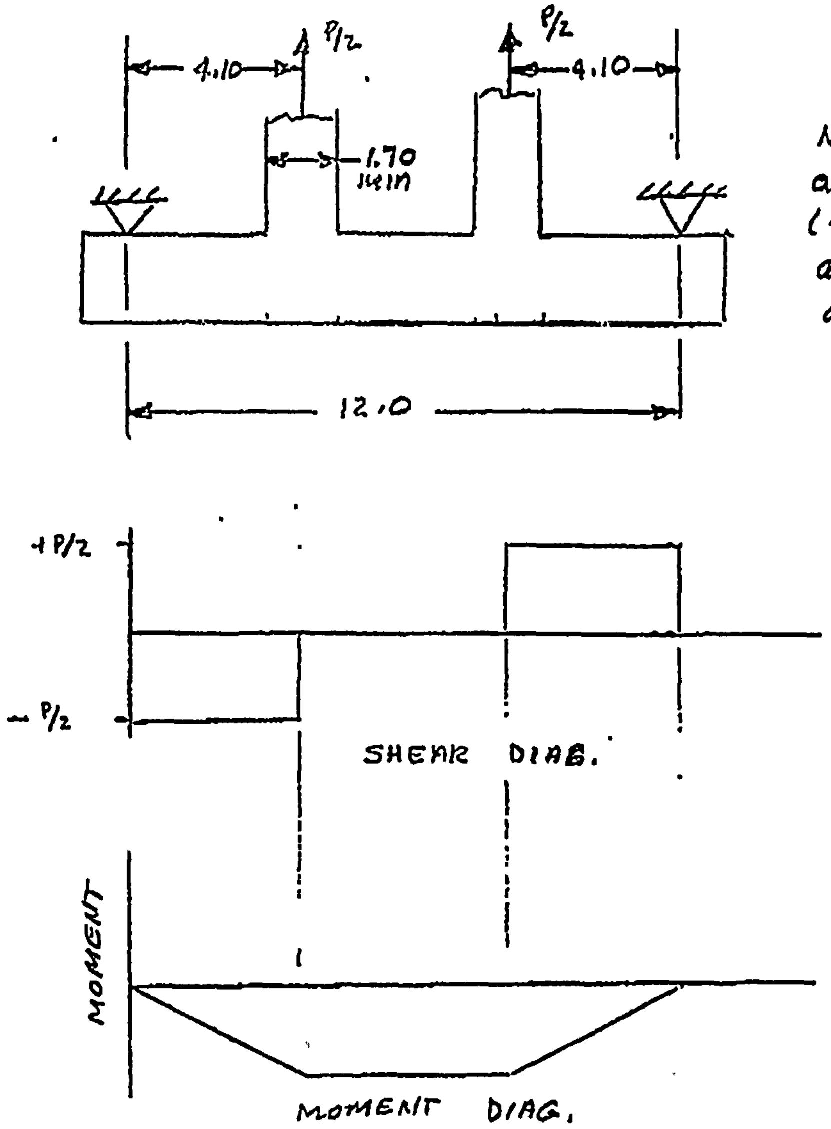
DIST TO

AP 84545R1

Subject	Originator	Date
NMP-1	[signature]	
Number	**Verifier**	**Date**
Lower Support		

LOWER SUPPORT

112D6585 rev 1
Inconel X-750



NOTE: The toggle bolts are lightly torqued (40 ft-lb per 107E5679) and the supports are assumed as pivots.

MAX SHEAR = P/2

P = TIE ROD LOAD

MAX MOMENT = P/2 (4.10)

Subject	Originator	Date
NMP-1	[illegible]	
Number	**Verifier**	**Date**
Lower Support		

MINIMUM SECTION WIDTH = 8.00 − 0.02 = 7.98 in

MINIMUM SECTION THICKNESS = (2.5 − 0.02) − 0.26 = 2.220 in

$$\text{Bending Stress} = \frac{6M}{bh^2} = \frac{6\left(\frac{P}{2}\right)(4.10)}{(7.98in)(2.22in)^2} = 0.3127P$$

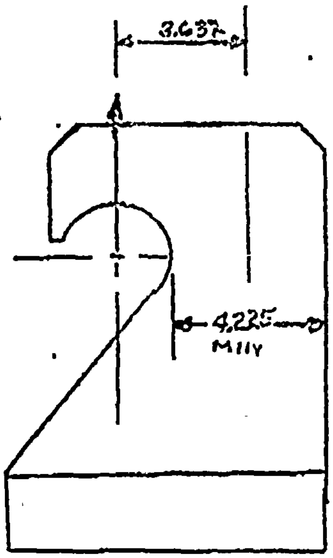
$$\text{Shear Stress} = \frac{P}{2A} = \frac{P}{2(7.98)(2.220)} = 0.0282P$$

NOTE: Bending and shear stress act in different directions and are evaluated separately.

EVENT	TIE ROD LOAD (P), LB	STRESS, PSI BENDING / SHEAR	ALLOWABLE BENDING / SHEAR
Normal	79,670	24,912 / 2246	71,250 (1.5Sm) / 28,500 (0.6Sm)
THERMAL UPSET	188,638	58,986 / 5,319 × 2 = 10,638	142,500 (3Sm) / 142,500 (3Sm)
SEISMIC UPSET	162,076	50,681 / 4570	71,250 (1.5Sm) / 28,500 (0.6Sm)
EMERGENCY	216,520	67,705 / 6110	106,800 (2.25Sm) / 42,750 (1.5x.6Sm)
FAULTED	311,710	97,471 / 8800	142,500 (3Sm) / 57,000 (2x.6Sm)

Subject	Originator	Date
NMP-1	[signature]	~~11/16/94~~
Number	**Verifier**	**Date**
Lower Support		1-18-95

LOWER SUPPORT (112D6585 rev. 1)
INCONEL X-750



$M = (P/2)(3.637) =$

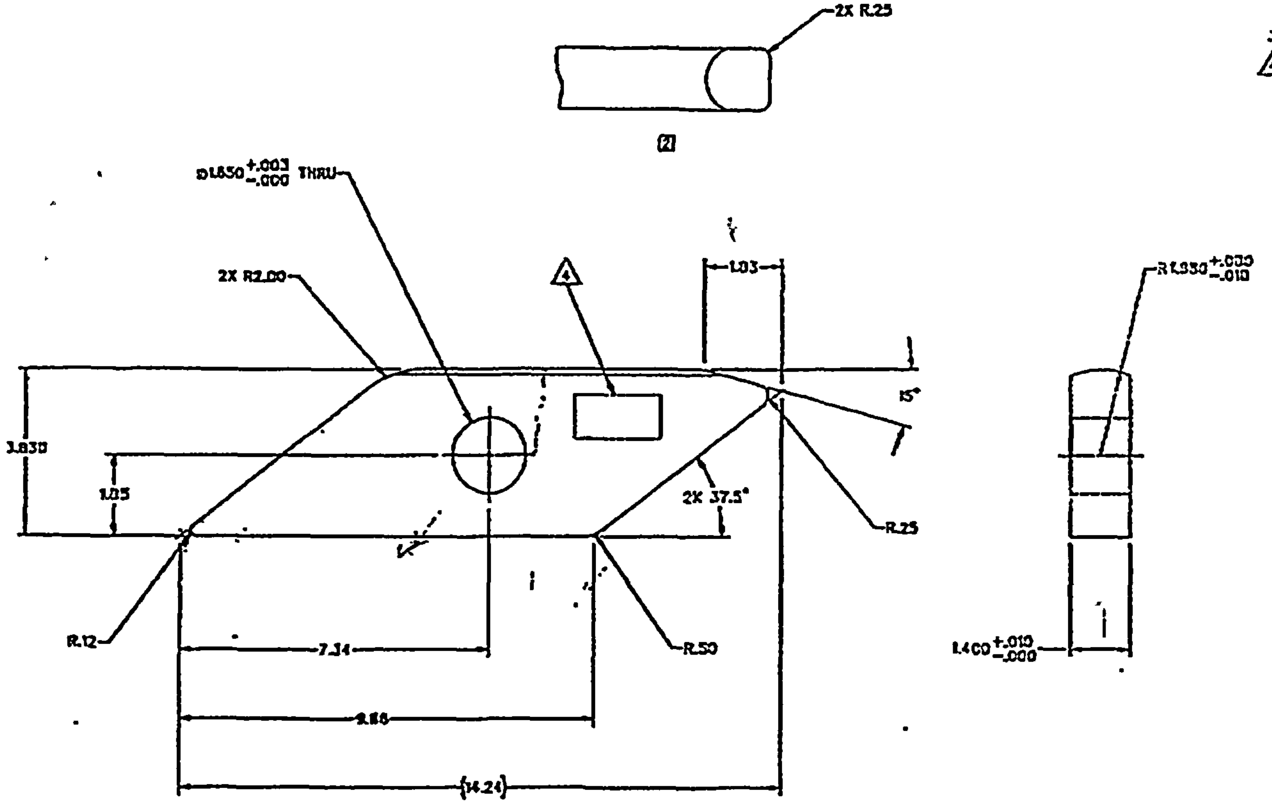
$\sigma_B = \frac{6M}{bh^2} = \frac{6(P/2)(3.637)}{(1.68)(4.225)^2}$

$\sigma_B = 0.364P$

$\sigma_P = \frac{P}{2A} = \frac{P}{2(1.68)(4.225)} = 0.0704P$

$\sigma_P + \sigma_B = 0.4344P$

EVENT	TIE ROD LOAD	$\sigma_P + \sigma_B$	ALLOWABLE
Normal	79,670	34,612	71,250 (1.5Sm)
THERMAL UPSET	188,670	81,966	142,500 (3 Sm)
SEISMIC UPSET	162,076	70,412	71,250 (1.5 Sm)
Emergency	216,520	94,065	106,875 (2.25 Sm)
Faulted	311,717	135,423	142,500 (3 Sm)



NOTES:

1. UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES.
2. GEOMETRIC DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1982.
3. FABRICATE PER SPEC 25A5584.
4. MARK PART IDENTIFICATION "112D6581P001" AND SERIAL NO. "SNXXXX" IN .25±.05 INCH CHARACTERS IN LOCATION SHOWN USING INTERRUPTED DOT LOW STRESS STAMP.

(1) MATL: ASTM B637, UNS N07750 TYPE 3

112D6581 | 1

REVISIONS

2 NOV 1984 R. KOHLER

12 DEC 1984 R. KOHLER

CHK BY: R. KOHLER, L. GLEASON

GE Nuclear Energy, San Jose CA

DETAIL

TOGGLE

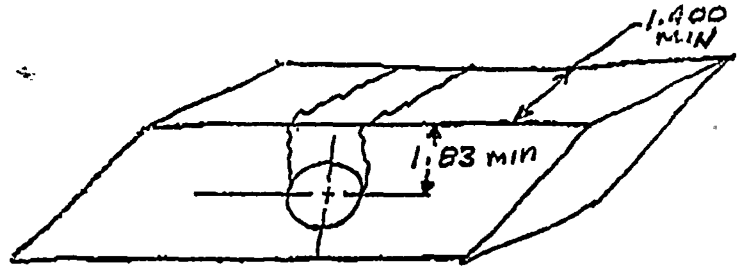
13 OCT 1984

112D6581 | 2

C | 1

Subject	Originator	Date
NMP-1	[illegible]	
Number	**Verifier**	**Date**
Toggle		

TOGGLE   112D6581 rev. 1
INCONEL X-750



MIN. SHEAR AREA = $2(1.83)(1.40) = 5.124$

LOAD = $\frac{\text{TIE ROD LOAD}}{2\ (0.74)}$

Shear stress = $P/A = \frac{P_{TR}}{(2)(0.74)(5.124)} = \frac{P_{TR}}{7.5835}$

EVENT	LOAD LB	SHEAR STRESS, PSI	ALLOWABLE STRESS, PSI
NORMAL	79,670	10,505	28,500 (0.6Sm)
THERMAL UPSET	188,638	24,874 X2 = 49,749	142,500 (3Sm)
SEISMIC UPSET	162,076	21,372	28,500 (0.6 Sm)
EMERGENCY	216,520	28,551	42,750 (1.5x.6 Sm)
FAULTED	311,710	41,100	57,000 (2 x 0.6Sm)