

BABCOCK & WILCOX

a McDermott company

ENGINEERING INFORMATION RECORD

Safety Related:

DOCUMENT IDENTIFIER 51 1146739-04

YES ☐ NO ☒

TITLE DESIGN DESCRIPTION OF THE EQUIPMENT FOR THE FINAL LIFT AND TRANSFER OF THE  
TMI-2 PLENUM ASSEMBLY

PREPARED BY Walter H. Ahlert DATE 3/21/85

REVIEWED BY Steve K. Brown DATE 3/22/85

REMARKS:

This document describes the design of the lift and transfer equipment for the final lift and transfer of the TMI-2 plenum assembly to its storage location.

Revision 04 reflects the as-built form of the equipment. Revisions (04) are denoted by (04) in the right hand margin.

8505010518 850416  
PDR ADDCK 05000320  
PDR

BABCOCK & WILCOX  
NUCLEAR POWER GENERATION DIVISION

## RECORD OF REVISION

NUMBER

51-1146739-04

EV. NO.	CHANGE SECT/PARA.	DESCRIPTION/CHANGE AUTHORIZATION
04	1.0	Corrected lift height; 7 1/4" was 9"
	3.6.1	Revised stress values
	3.6.2	Revised stress values
	4.1.12	Revised source; GPUN was B&W
	6.2.3	Changed wording; removed information concerning spacer plates
	6.2.4, 2nd para.	Changed wording, changed length of cable section; 57" was 13"
	6.2.4, 3rd para.	Changed wording
	6.2.4, 5th para.	Changed wording in the 3rd sub-paragraph
	8.0	Corrected revision levels

PREPARED BY Walter H. Ahlert Sr. Engr. DATE 3/21/85  
(NAME) (TITLE)

REVIEWED BY Steve K. Brown PRIN. ENGR DATE 3/22/85  
(NAME) (TITLE)

APPROVED BY Larry E. Dyer Supervisory ENGR DATE 3/22/85  
(NAME) (TITLE)

DATE:

PAGE 2 of 11

## 1.0 INTRODUCTION

Inspections of the TMI-2 reactor internals, which were performed through the control rod drive mechanisms, have revealed physical conditions ranging from no apparent damage to the upper portions of the plenum assembly to sever damage to the reactor's core. Based on both known and expected physical conditions, special methods and tools are being developed to remove the plenum assembly (PA). The initial 7 1/4" of plenum assembly lifting will be accomplished using hydraulic jacks positioned at the component axes. Subsequent plenum lifts into the refueling canal for transfer to storage will be accomplished using the TMI-2 polar crane, selected components of the internals lifting equipment, and special purpose equipment either purchased or manufactured for this task. (04)

## 2.0 PURPOSE

The purpose of this document is to identify existing and describe the design of new lift and transfer equipment for the final lift and transfer of the TMI-2 PA to its storage location in the flooded deep end of the refueling canal. In addition, design basis information is provided for the equipment.

## 3.0 BASIC DESIGN INFORMATION

3.1 The design of the final lifting equipment is governed by the Bechtel and B&W documents listed in the references.

3.2 The final lift equipment has been designed to meet the NUREG 0612, Reference 13, and ANSI N14.6, Reference 14, stress criteria. The minimum load safety factors are 3 on yield and 5 on ultimate. A dynamic load factor will be applied to the static design load. The components must be load tested to 1.5 times the design load. The methods of analysis will be those given by the AISC Manual, Eighth Edition, Reference 15. In using these methods to meet NUREG/ANSI stress criteria, the allowable AISC stresses will be modified as follows:

Tension:  $F_t \leq .33 S_y \leq .20 S_u$   
 $F_t \leq .25 S_y \leq .15 S_u$ ; for pin connected member

Shear:  $F_v \leq .22 S_y \leq .13 S_u$

Bearing:  $F_p \leq .50 S_y \leq .30 S_u$

Compression: Use  $.56 F_a$

Bending:  $F_b \leq .37 S_y \leq .22 S_u$

Non-load bearing members will be designed to meet allowable AISC stresses.

3.3 Based on the characteristics of the TMI-2 polar crane defined in Reference 1, a dynamic load factor of 1.15 is to be used. The resultant design rated load including the dynamic load factor is 25 tons for each of the three lift points for a total design rated load of 75 tons. Equipment tests are discussed in Section 7.0 below.

- 3.4 The minimum allowable force in a lifting pendant to prevent damage to the lifting equipment should the plenum assembly hang-up and then break-away while making lowering adjustments with the load positioners or the polar crane is  $2W-50,000$ . "W" is the largest load in a pendant at the start of the final lift operation.

The minimum load at the polar crane load cell to prevent the weight of the tripod from creating excessive compression load in the pendant rod is X-1800. "X" is the load at the polar crane load cell with only the tripod and pendants attached.

Therefore, to provide procedural controls to prevent damage to the lifting equipment use the X-1800 criteria when installing or removing the lifting arms and the value of  $2W-50,000$  when making adjustments during plenum assembly removal operations.

- 3.5 Based on the clearance between the keyway on the plenum assembly and the keys on the reactor vessel and the IIF, the plenum assembly can be tilted  $0^\circ 15'$  and  $0^\circ 45'$  respectively without causing binding between the keyway and the keys.

- 3.6 A summary of the stress analysis given in Reference 3 is as follows:

3.6.1 Plenum assembly lift point (rib)

	Actual (Calculated) (KSI)	Allowable (KSI)	
Bearing	25.30	27.00	(04) 
Shear	2.53	6.60	
Bending	8.02	11.10	

3.6.2 Lifting pendant components

	Actual (Calculated) (KSI)	Allowable
Adaptor Plates		
Tension	4.28	6.00
Shear	3.03	5.28
Bearing	8.42	12.00
Bending	2.08	8.88
5-1/4" Diameter Tripod		
Pin (Applied Force 53,030#)		
Tension	Negligible	--
Shear	1.22	15.60
Bearing	2.53	36.00
Bending	5.60	26.40
3" Diameter Tripod Pin		
(Applied Force 3,030#)		
Tension	Negligible	--
Shear	0.21	15.60
Bearing	0.25	36.00
Bending	1.71	26.40

Pendant Rods			
Tension	9.81	9.90	
Shear (clevis)	4.44	10.40	
Shear (threads)	3.00	6.60	
Bearing (clevis)	8.25	24.00	
Bending (during up-ending)	8.40	11.10	
Transfer Block			
Tension	13.54	20.25	
Shear (connecting pin)	11.91	17.55	
Bearing (connecting pin)	11.95	40.50	
Bending	Negligible	--	
Lifting Arm			
Tension	3.63	27.00	(04)
Shear	5.56	17.55	
Bearing	25.20	40.50	
Bending	15.96	29.70	

#### 4.0 EQUIPMENT

The following major items of equipment are required for the plenum assembly final lift and transfer operation:

4.1	<u>ITEM</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>	<u>SOURCE</u>
	4.1.1	Polar Crane	1	GPUN
	4.1.2	Handling Extension	1	GPUN
	4.1.3	Internals Handling Frame (Tripod)	1	GPUN
	4.1.4	Internals Indexing Fixture (IIF)	1	GPUN
	4.1.5	Defueling Work Platform Support Structure with Decking	1	GPUN
	4.1.6	Internals Storage Stand	1	GPUN
	4.1.7	Video Inspection/Monitoring Equipment	1	GPUN
	4.1.8	Load Positioner	2	GPUN
	4.1.9	Elevation Monitor	1	GPUN
	4.1.10	Fixed Length Pendant/Lifting Arm Assembly	1	B&W

<u>ITEM</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>	<u>SOURCE</u>	
4.1.11	Load Positioner Pendant/ Lifting Arm Assembly	2	B&W	
4.1.12	Shepherds Hook on a Long Pole	1	GPUN	(04)

Equipment indicated to be provided by GPUN is assumed to meet the design criteria and to be available without further changes to support and/or perform the handling operations described in Reference 4.

## 5.0 MATERIALS DESCRIPTION

Components of the plenum lifting equipment that will be used in water are stainless steel. Components that will not be used in water are either alloy and/or stainless steel as shown on References 6 through 10.

## 6.0 EQUIPMENT DESCRIPTION

### 6.1 General

All existing PA handling equipment designs were reviewed for use in the removal of the TMI-2 plenum assembly. Due to the transients experienced during the accident, the structural integrity of the plenum lifting lug bolts is questionable. Therefore, different attachment points on the plenum assembly are required and as such, new pendant and lifting arm assemblies will be provided.

Pendant rods, adaptor plates, lifting arms and, in the case of the positioner pendant, Hydra-Sets are assembled to comprise new lifting pendant assemblies. The lifting arms are held in such a position by the latching and unlatching system (LUS) that they can be placed under 3 ribs in the PA cover. After the lifting arms are in position and the pull rod in the LUS for each of the pendants is pulled to a new position, the lifting arms automatically lock under the PA ribs. After the pendant is slightly raised, the lock plate will clear the rib and the lock plate and pull rod will be positioned to prevent disengagement of the lifting arm assembly. After transfer operations, the pull rod is then positioned to permit movement of the lifting arm and it will then automatically disengage when unloaded and pushed downward. As a contingency, the lifting arms when not under load can be manually disengaged by lifting with a long handled tool through the 2 inch diameter hole provided on the lifting arm.

Final lifting of the PA will be performed using the equipment listed in Section 4.0 and the plenum assembly will be moved to the internal storage stand located in the flooded deep end of the refueling canal.

### 6.2 Lifting Equipment

The B&W supplied lifting equipment consists of one fixed length pendant assembly and two load positioner pendant assemblies. The pendant assemblies are attached to the existing handling fixture (tripod) at a radius of 71-1/2 inches from the crane hook swivel centerline. The fixed length pendant is positioned 15° from the PA Y axis towards the Z axis. The load positioner pendants are separated by 120° from the fixed pendant and each other.



The pendant assemblies are approximately 17 feet long from the tripod pin to the bottom of the lifting arms with the load positioners extended 6 inches. The pendant assemblies are illustrated on Reference 8.

The pendant assemblies consist of the following components:

6.2.1 Adapter plates and spacers

Three adapter plates and twelve spacers as shown on Reference 6 will be needed to attach the pendant assemblies to the tripod. The adapter plate is attached to the tripod by means of the tripod's 5-1/4 inch and 3 inch diameter pins.

The spacers center the adapter plate on the connecting pins. The jaw end connector at the upper end of the pendant or load positioner is attached to the adapter plate by means of 2 inch diameter high strength pin. The 2 inch pin will be centered 71-1/2 inches from the centerline of the polar crane hook. Although the adapter plate is attached to the tripod independently of the actual pendants, the adapter plate is considered part of the pendant assembly.

6.2.2 Pendants

Three pendant rods made of 2-3/4 inch diameter stainless steel bars as shown on Reference 6 will be required. One of the pendant rods is 14 ft 5 3/4 inches long and is for the fixed length pendant assembly. The other two pendant rods are 10 ft 7 1/4 inches long and will be used with load positioners to provide length adjustment. The fixed length pendant has a jaw end connection at both ends. The adjustable length pendants have a jaw end connection for connecting to the transfer blocks and an eye end connection for connecting to the load positioners. Each pendant is connected to a transfer block by means of a 2-1/8 inch diameter pin and the transfer block is connected to the lifting arm by another 2-1/8 inch diameter pin at right angles to the first. This system prevents the transfer of any bending moments to the pendant rods.

6.2.3 Lifting arm assemblies

Three lifting arm assemblies as shown on Reference 8 will be required. Each assembly consists of a transfer block, a lifting arm, a spacer plate, a lock plate assembly and a cable pin assembly. The pendant loads are carried through the transfer blocks and the lifting arms into the bottom side of three of the ribs on the cover of the PA. Also, the lifting arm, when in the loaded position, rests on the top of the adjacent rib which eliminates the rotational twist on the rib being lifted. The lock plate assemblies provide a positive means to prevent the lifting arms from becoming disengaged during subsequent lifting operations. The operation of the lock plate assemblies is described in Section 6.2.4 below.

#### 6.2.4 Latching and unlatching system (LUS)

The LUS equipment is shown on Reference 9 and 10. The components are the cable and pull rod assembly and the cable block assembly for each of the pendants and the termination plate.

The cable and pull rod assembly consists of a cable connected to the pull rod by a connecting pin at the cable block assembly. The other end of the pull rod is attached to the lock plate attached to the lifting arm. The other end of the cable is free to permit pulling the cable and pull rod assembly by using a shepherd's hook on a long pole. The length of the pull rod is determined by the distance from the lock plate pin in its locked position to the cable block assembly pin connection with the pin connection in the slot marked "Lock" on the cable block assembly. The final position of the cable block assembly will be set during equipment checkout to account for any small variations in the length of this pull rod. Each cable is made up from two sections of cable. The first section which is connected to the pull rod by the pin connection in the cable block assembly, is 57 inches long. The second section, which is connected by a quick connect device to the first section during the final assembly, passes through its designated opening in the termination plate and is terminated with a four inch diameter loop. Its length is determined by the distance from the first section to the four inch loop.

(04)

(04)

The cable block assemblies consist of two guide plates, and two spacer plates. There is a cable block assembly for each pendant. The two guide plates are separated by the two spacer plates. As the guide plates and spacer plates are being assembled, the bolt making the pin connection between the pull rod assembly and the first section of the cable assembly is fitted into the slots in the guide plates. The assembly is attached to the pendant by bolts and cable block "C" clamps.

(04)

The termination plate assembly as shown in Reference 7 consists of the termination plate and two bottom plates. The termination plate assembly is attached to the adapter plate for the "A" lifting pendant which is near the "X" axis of the PA.

The operation of the latching and unlatching system is as follows:

- o Lifting equipment has been assembled and attached to the tripod in the assembly area inside the reactor building. The pin connection in the cable block assembly is in the slot marked "Install".
- o The pendants are lowered onto the PA cover ribs with the pin connections in the install slot in the guide plates. In this position, the lifting arms are held in place by the pull rod.



- o Once the lifting arms are in position, each of the cables are pulled to the first stop and released. This operation may be performed by lifting on the pull rod assemblies. The lifting arm will automatically lock under the PA rib and the pull rod will then drop into the slot position marked "Lock" after a slight upward movement of the pendant. The lock plates will then be positioned to prevent the lifting arm from becoming disengaged. (04)
- o After the PA has been transferred to the Internals storage stand, but while the lifting arms are still loaded, each of the cables are pulled to the second stop and released. The pin connection will then drop into the slot position marked "Unlock" and the lock plate will be positioned to permit the lifting arm to rotate and disengage.
- o The pendants are lowered slightly with the polar crane to disengage the lifting arms. After the lifting arms are disengaged, each of the cables are pulled to the third stop and released. The pin connection will drop into the slot position marked "Remove" and the lifting arm will be held in a position to permit its removal from the PA.

### 6.3 Load positioners

An Integral part of the lifting pendants is the load positioners to be provided by GPUN. Since these are to be provided by GPUN, the description of the positioners may vary from that given below.

The load positioners will indicate the load, load direction (up or down) and distance traveled. Each positioner will have 12 inches travel and be capable of re-positioning (raising or lowering) 6 inches. The positioners are capable of remote operation with remote load/movement indication. Two positioners are required, one for each positioner pendant assembly.

### 6.4 Accessory equipment

In addition to the major equipment items, as described in 6.1 through 6.3 above, support or accessory equipment items such as monitoring, viewing, and lighting equipment may be needed for the plenum final lift and transfer to storage. In many instances, equipment used in previous operations should be adequate to be used for the final lift and transfer operation. The equipment required will depend upon the results of the inspections performed during the initial lift.

#### 6.4.1 Level and load monitoring equipment

During the plenum final lift, component levelness, and load, will be monitored to minimize the possibility of component binding and to aid in its correction if necessary. Plenum levelness will be monitored by the device described in Section 4.4.4 of Reference 11.

#### 6.4.2 Cable Pulling Equipment

A shepherds hook attached to a long handled pole will be needed to pull the cables in the LUS described in 6.2.4 above and to manually disengage the lifting arm, if required.

#### 6.4.3 Viewing equipment

Based on the results of the initial inspections, observations may be accomplished visually or by CCTV cameras. The cameras are described in Reference 12.

### 7.0 EQUIPMENT TESTS

Each pendant assembly will be load tested to at least 37.5 tons. This value represents 1.5 times the design rated load of 25 tons, see 3.3 above.

### 8.0 REFERENCES

Becthel

1. Specification 15737-2-R-200A(Q)

Technical Specification  
for Plenum Assembly Removal  
System for GPU Nuclear  
Corporation Three Mile  
Island - Unit 2 Nuclear  
Power Plant

B&W

2. 51-1145018-05

Engineering Requirements (04)  
for Plenum Assembly Removal  
Handling Equipment

3. 32-1153534-03

Structural Analysis of (04)  
Plenum Assembly Removal  
Handling Equipment

4. 51-1146737-03

Final Lift and Transfer,  
In - Containment  
Installation/Operation  
Sequence

5. 1143519E-02

General Arrangement Plenum (04)  
Assembly Removal Final  
Lift Equipment

6. 1154112E-05

Lifting Pendant Details (04)

7. 1154164E-02

Lifting Pendant Termination (04)  
Plate Assembly and Details

8. 1154180E-04

Lifting Pendant Assembly (04)  
and Sub-assemblies

9. 1154152E-02

Lifting Pendant Locking (04)  
Device Details

10. 1154184D-03

Cable Block Assembly (04)

11. 51-1142474-02

Engineering Requirements  
for Initial Lifting Jacking  
System and Monitoring

12. 1143214A-1

TMI-2 Final Design Description  
for Video Inspection  
System

Industry Standards

13. NUREG 0612

Control of Heavy Loads  
at Nuclear Power Plants

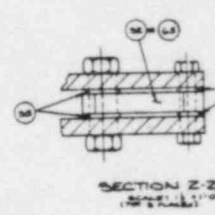
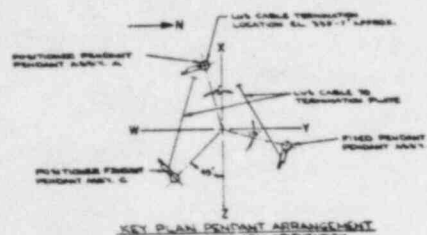
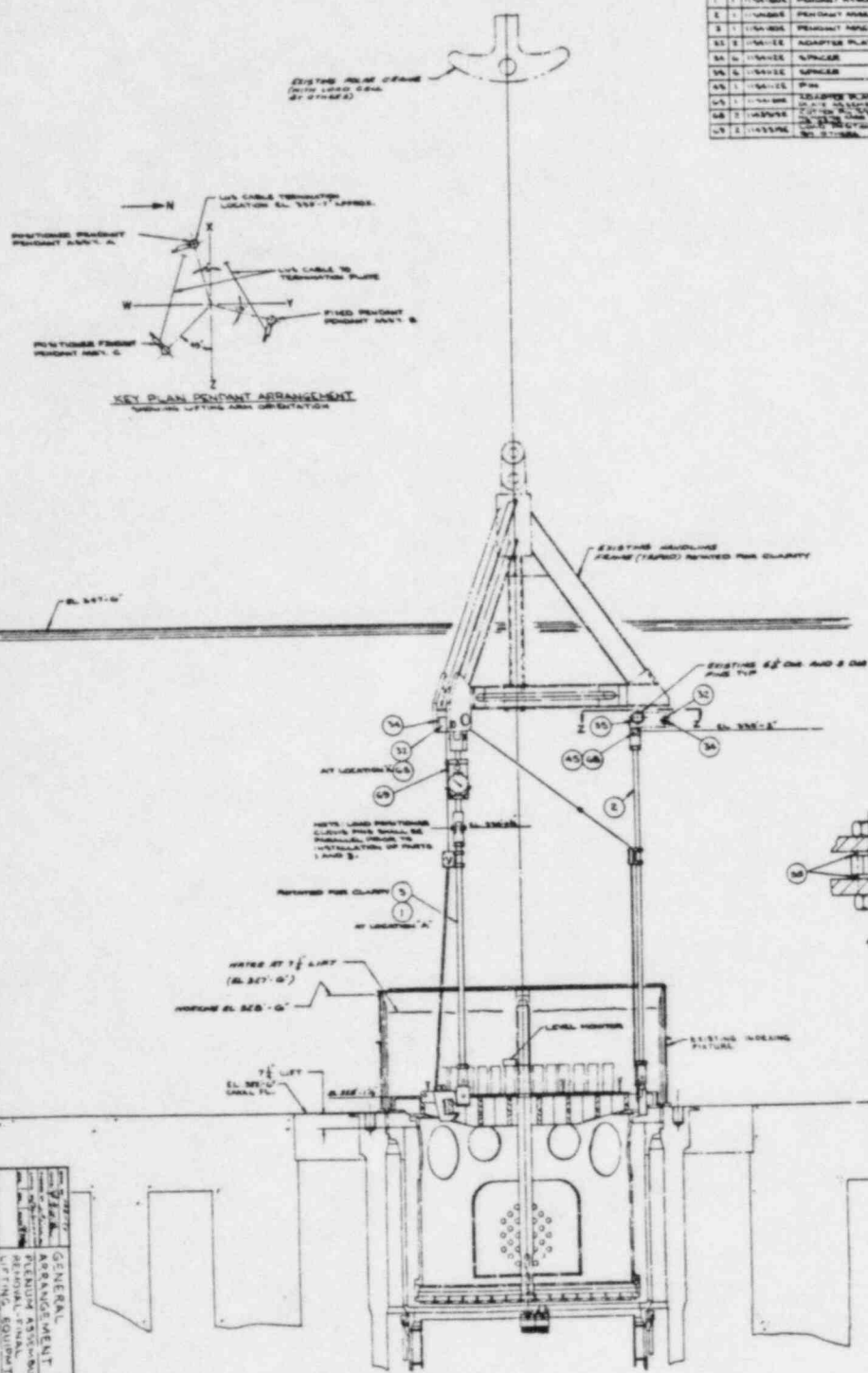
14. ANSI N14.6

American National Standard  
for Special Lifting Devices  
for Shipping Containers  
Weighing 10,000 Pounds  
(4500 kg) or More for  
Nuclear Materials

15. American Institute of  
Steel Construction  
(AISC) Eighth Edition

Manual of Steel Construction

BILL OF MATERIALS			
NO.	QTY.	DESCRIPTION	REMARKS
1	1	TRUSS	TRUSS ASSEMBLY A
2	1	TRUSS	TRUSS ASSEMBLY B
3	1	TRUSS	TRUSS ASSEMBLY C
4	1	TRUSS	TRUSS ASSEMBLY D
5	1	TRUSS	TRUSS ASSEMBLY E
6	1	TRUSS	TRUSS ASSEMBLY F
7	1	TRUSS	TRUSS ASSEMBLY G
8	1	TRUSS	TRUSS ASSEMBLY H
9	1	TRUSS	TRUSS ASSEMBLY I
10	1	TRUSS	TRUSS ASSEMBLY J
11	1	TRUSS	TRUSS ASSEMBLY K
12	1	TRUSS	TRUSS ASSEMBLY L
13	1	TRUSS	TRUSS ASSEMBLY M
14	1	TRUSS	TRUSS ASSEMBLY N
15	1	TRUSS	TRUSS ASSEMBLY O
16	1	TRUSS	TRUSS ASSEMBLY P
17	1	TRUSS	TRUSS ASSEMBLY Q
18	1	TRUSS	TRUSS ASSEMBLY R
19	1	TRUSS	TRUSS ASSEMBLY S
20	1	TRUSS	TRUSS ASSEMBLY T



GENERAL	
1	GENERAL
2	GENERAL
3	GENERAL
4	GENERAL
5	GENERAL
6	GENERAL
7	GENERAL
8	GENERAL
9	GENERAL
10	GENERAL
11	GENERAL
12	GENERAL
13	GENERAL
14	GENERAL
15	GENERAL
16	GENERAL
17	GENERAL
18	GENERAL
19	GENERAL
20	GENERAL

GENERAL	
1	GENERAL
2	GENERAL
3	GENERAL
4	GENERAL
5	GENERAL
6	GENERAL
7	GENERAL
8	GENERAL
9	GENERAL
10	GENERAL
11	GENERAL
12	GENERAL
13	GENERAL
14	GENERAL
15	GENERAL
16	GENERAL
17	GENERAL
18	GENERAL
19	GENERAL
20	GENERAL

02-26-85  
MICROFILMED BY  
BETW LYNCHBURG, VA



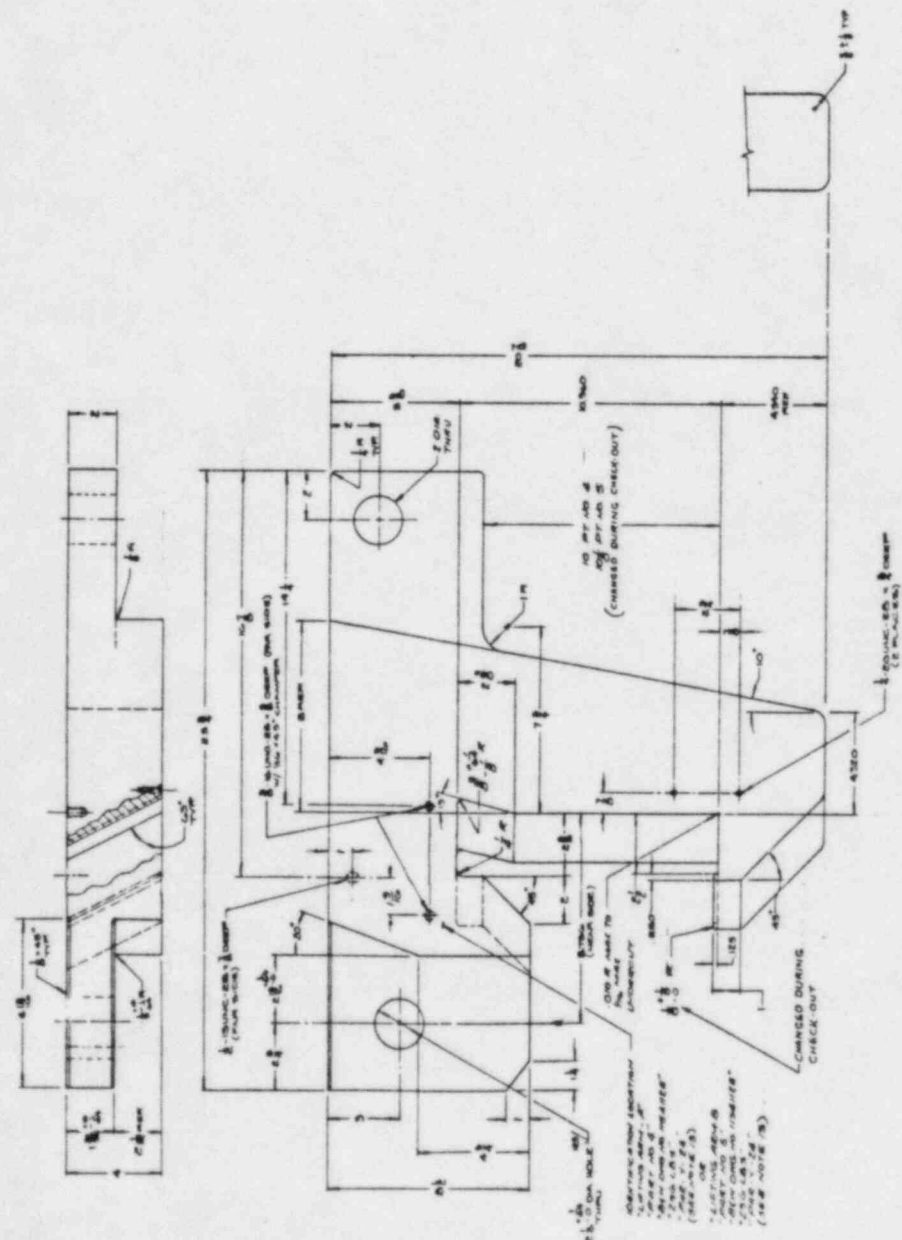




2211451

REV	DESCRIPTION	DATE	BY
1	AS PER		
2	AS PER		
3	AS PER		
4	AS PER		
5	AS PER		

REV	DESCRIPTION	DATE	BY
1	AS PER		
2	AS PER		
3	AS PER		
4	AS PER		
5	AS PER		



- ② LIFTING ARM-A (SEE NOTE 1)
- ⑤ LIFTING ARM-B (SEE NOTE 2)

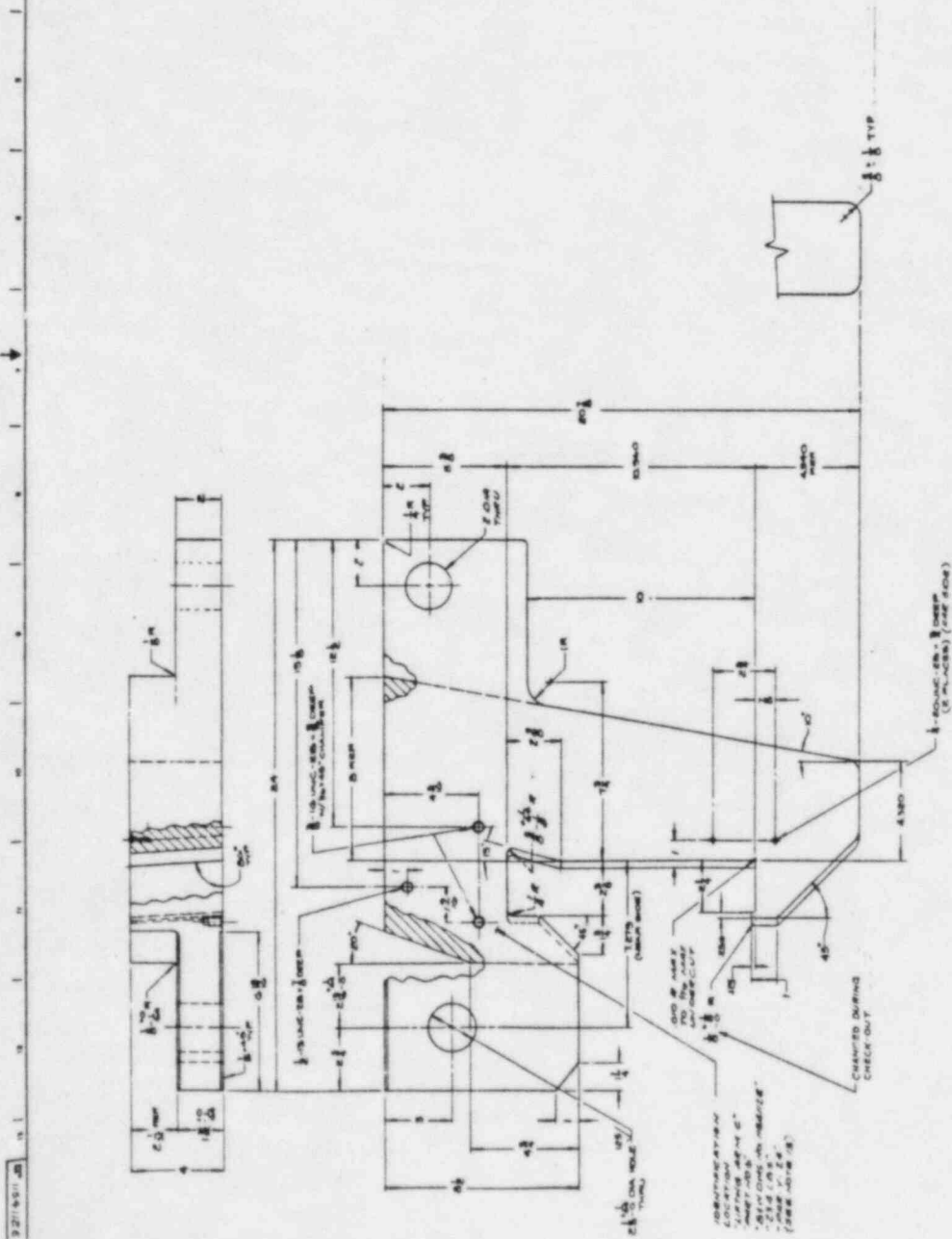
SCALE: 1/4"=1'-0"

REVISIONS		DATE		BY	
1	AS PER				
2	AS PER				
3	AS PER				
4	AS PER				
5	AS PER				

REV	DESCRIPTION	DATE	BY
1	AS PER		
2	AS PER		
3	AS PER		
4	AS PER		
5	AS PER		

1154112 E 5

321451-00



⑥ LIFTING ARM-C  
SCALE: 3/16" = 1"

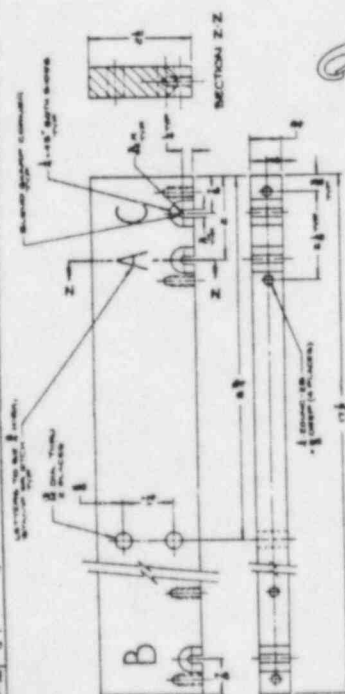
NO.	DESCRIPTION	QTY	UNIT
1	ARM-C	1	EA
2	ARM-B	1	EA
3	ARM-A	1	EA
4	ARM-D	1	EA
5	ARM-E	1	EA
6	ARM-F	1	EA
7	ARM-G	1	EA
8	ARM-H	1	EA
9	ARM-I	1	EA
10	ARM-J	1	EA
11	ARM-K	1	EA
12	ARM-L	1	EA
13	ARM-M	1	EA
14	ARM-N	1	EA
15	ARM-O	1	EA
16	ARM-P	1	EA
17	ARM-Q	1	EA
18	ARM-R	1	EA
19	ARM-S	1	EA
20	ARM-T	1	EA
21	ARM-U	1	EA
22	ARM-V	1	EA
23	ARM-W	1	EA
24	ARM-X	1	EA
25	ARM-Y	1	EA
26	ARM-Z	1	EA
27	ARM-AA	1	EA
28	ARM-AB	1	EA
29	ARM-AC	1	EA
30	ARM-AD	1	EA
31	ARM-AE	1	EA
32	ARM-AF	1	EA
33	ARM-AG	1	EA
34	ARM-AH	1	EA
35	ARM-AI	1	EA
36	ARM-AJ	1	EA
37	ARM-AK	1	EA
38	ARM-AL	1	EA
39	ARM-AM	1	EA
40	ARM-AN	1	EA
41	ARM-AO	1	EA
42	ARM-AP	1	EA
43	ARM-AQ	1	EA
44	ARM-AR	1	EA
45	ARM-AS	1	EA
46	ARM-AT	1	EA
47	ARM-AU	1	EA
48	ARM-AV	1	EA
49	ARM-AW	1	EA
50	ARM-AX	1	EA
51	ARM-AY	1	EA
52	ARM-AZ	1	EA
53	ARM-BA	1	EA
54	ARM-BB	1	EA
55	ARM-BC	1	EA
56	ARM-BD	1	EA
57	ARM-BE	1	EA
58	ARM-BF	1	EA
59	ARM-BG	1	EA
60	ARM-BH	1	EA
61	ARM-BI	1	EA
62	ARM-BJ	1	EA
63	ARM-BK	1	EA
64	ARM-BL	1	EA
65	ARM-BM	1	EA
66	ARM-BN	1	EA
67	ARM-BO	1	EA
68	ARM-BP	1	EA
69	ARM-BQ	1	EA
70	ARM-BR	1	EA
71	ARM-BS	1	EA
72	ARM-BT	1	EA
73	ARM-BU	1	EA
74	ARM-BV	1	EA
75	ARM-BW	1	EA
76	ARM-BX	1	EA
77	ARM-BY	1	EA
78	ARM-BZ	1	EA
79	ARM-CA	1	EA
80	ARM-CB	1	EA
81	ARM-CC	1	EA
82	ARM-CD	1	EA
83	ARM-CE	1	EA
84	ARM-CF	1	EA
85	ARM-CG	1	EA
86	ARM-CH	1	EA
87	ARM-CI	1	EA
88	ARM-CJ	1	EA
89	ARM-CK	1	EA
90	ARM-CL	1	EA
91	ARM-CM	1	EA
92	ARM-CN	1	EA
93	ARM-CO	1	EA
94	ARM-CP	1	EA
95	ARM-CQ	1	EA
96	ARM-CR	1	EA
97	ARM-CS	1	EA
98	ARM-CT	1	EA
99	ARM-CU	1	EA
100	ARM-CV	1	EA
101	ARM-CW	1	EA
102	ARM-CX	1	EA
103	ARM-CY	1	EA
104	ARM-CZ	1	EA
105	ARM-DA	1	EA
106	ARM-DB	1	EA
107	ARM-DC	1	EA
108	ARM-DD	1	EA
109	ARM-DE	1	EA
110	ARM-DF	1	EA
111	ARM-DG	1	EA
112	ARM-DH	1	EA
113	ARM-DI	1	EA
114	ARM-DJ	1	EA
115	ARM-DK	1	EA
116	ARM-DL	1	EA
117	ARM-DM	1	EA
118	ARM-DN	1	EA
119	ARM-DO	1	EA
120	ARM-DP	1	EA
121	ARM-DQ	1	EA
122	ARM-DR	1	EA
123	ARM-DS	1	EA
124	ARM-DT	1	EA
125	ARM-DU	1	EA
126	ARM-DV	1	EA
127	ARM-DW	1	EA
128	ARM-DX	1	EA
129	ARM-DY	1	EA
130	ARM-DZ	1	EA
131	ARM-EA	1	EA
132	ARM-EB	1	EA
133	ARM-EC	1	EA
134	ARM-ED	1	EA
135	ARM-EE	1	EA
136	ARM-EF	1	EA
137	ARM-EG	1	EA
138	ARM-EH	1	EA
139	ARM-EI	1	EA
140	ARM-EJ	1	EA
141	ARM-EK	1	EA
142	ARM-EL	1	EA
143	ARM-EM	1	EA
144	ARM-EN	1	EA
145	ARM-EO	1	EA
146	ARM-EP	1	EA
147	ARM-EQ	1	EA
148	ARM-ER	1	EA
149	ARM-ES	1	EA
150	ARM-ET	1	EA
151	ARM-EU	1	EA
152	ARM-EV	1	EA
153	ARM-EW	1	EA
154	ARM-EX	1	EA
155	ARM-EY	1	EA
156	ARM-EZ	1	EA
157	ARM-FA	1	EA
158	ARM-FB	1	EA
159	ARM-FC	1	EA
160	ARM-FD	1	EA
161	ARM-FE	1	EA
162	ARM-FG	1	EA
163	ARM-FH	1	EA
164	ARM-FI	1	EA
165	ARM-FJ	1	EA
166	ARM-FK	1	EA
167	ARM-FL	1	EA
168	ARM-FM	1	EA
169	ARM-FN	1	EA
170	ARM-FO	1	EA
171	ARM-FP	1	EA
172	ARM-FQ	1	EA
173	ARM-FR	1	EA
174	ARM-FS	1	EA
175	ARM-FT	1	EA
176	ARM-FU	1	EA
177	ARM-FV	1	EA
178	ARM-FW	1	EA
179	ARM-FX	1	EA
180	ARM-FY	1	EA
181	ARM-FZ	1	EA
182	ARM-GA	1	EA
183	ARM-GB	1	EA
184	ARM-GC	1	EA
185	ARM-GD	1	EA
186	ARM-GE	1	EA
187	ARM-GF	1	EA
188	ARM-GG	1	EA
189	ARM-GH	1	EA
190	ARM-GI	1	EA
191	ARM-GJ	1	EA
192	ARM-GK	1	EA
193	ARM-GL	1	EA
194	ARM-GM	1	EA
195	ARM-GN	1	EA
196	ARM-GO	1	EA
197	ARM-GP	1	EA
198	ARM-GQ	1	EA
199	ARM-GR	1	EA
200	ARM-GS	1	EA
201	ARM-GT	1	EA
202	ARM-GU	1	EA
203	ARM-GV	1	EA
204	ARM-GW	1	EA
205	ARM-GX	1	EA
206	ARM-GY	1	EA
207	ARM-GZ	1	EA
208	ARM-HA	1	EA
209	ARM-HB	1	EA
210	ARM-HC	1	EA
211	ARM-HD	1	EA
212	ARM-HE	1	EA
213	ARM-HF	1	EA
214	ARM-HG	1	EA
215	ARM-HH	1	EA
216	ARM-HI	1	EA
217	ARM-HJ	1	EA
218	ARM-HK	1	EA
219	ARM-HL	1	EA
220	ARM-HM	1	EA
221	ARM-HN	1	EA
222	ARM-HO	1	EA
223	ARM-HP	1	EA
224	ARM-HQ	1	EA
225	ARM-HR	1	EA
226	ARM-HS	1	EA
227	ARM-HT	1	EA
228	ARM-HU	1	EA
229	ARM-HV	1	EA
230	ARM-HW	1	EA
231	ARM-HX	1	EA
232	ARM-HY	1	EA
233	ARM-HZ	1	EA
234	ARM-IA	1	EA
235	ARM-IB	1	EA
236	ARM-IC	1	EA
237	ARM-ID	1	EA
238	ARM-IE	1	EA
239	ARM-IF	1	EA
240	ARM-IG	1	EA
241	ARM-IH	1	EA
242	ARM-II	1	EA
243	ARM-IJ	1	EA
244	ARM-IK	1	EA
245	ARM-IL	1	EA
246	ARM-IM	1	EA
247	ARM-IN	1	EA
248	ARM-IO	1	EA
249	ARM-IP	1	EA
250	ARM-IQ	1	EA
251	ARM-IR	1	EA
252	ARM-IS	1	EA
253	ARM-IT	1	EA
254	ARM-IU	1	EA
255	ARM-IV	1	EA
256	ARM-IW	1	EA
257	ARM-IX	1	EA
258	ARM-IY	1	EA
259	ARM-IZ	1	EA
260	ARM-JA	1	EA
261	ARM-JB	1	EA
262	ARM-JC	1	EA
263	ARM-JD	1	EA
264	ARM-JE	1	EA
265	ARM-JF	1	EA
266	ARM-JG	1	EA
267	ARM-JH	1	EA
268	ARM-JI	1	EA
269	ARM-JJ	1	EA
270	ARM-JK	1	EA
271	ARM-JL	1	EA
272	ARM-JM	1	EA
273	ARM-JN	1	EA
274	ARM-JO	1	EA
275	ARM-JP	1	EA
276	ARM-JQ	1	EA
277	ARM-JR	1	EA
278	ARM-JS	1	EA
279	ARM-JT	1	EA
280	ARM-JU	1	EA
281	ARM-JV	1	EA
282	ARM-JW	1	EA
283	ARM-JX	1	EA
284	ARM-JY	1	EA
285	ARM-JZ	1	EA
286	ARM-KA	1	EA
287	ARM-KB	1	EA
288	ARM-KC	1	EA
289	ARM-KD	1	EA
290	ARM-KE	1	EA
291	ARM-KF	1	EA
292	ARM-KG	1	EA
293	ARM-KH	1	EA
294	ARM-KI	1	EA
295	ARM-KJ	1	EA
296	ARM-KK	1	EA
297	ARM-KL	1	EA
298	ARM-KM	1	EA
299	ARM-KN	1	EA
300	ARM-KO	1	EA
301	ARM-KP	1	EA
302	ARM-KQ	1	EA
303	ARM-KR	1	EA
304	ARM-KS	1	EA
305	ARM-KT	1	EA
306	ARM-KU	1	EA
307	ARM-KV	1	EA
308	ARM-KW	1	EA
309	ARM-KX	1	EA
310	ARM-KY	1	EA
311	ARM-KZ	1	EA
312	ARM-LA	1	EA
313	ARM-LB	1	EA
314	ARM-LC	1	EA
315	ARM-LD	1	EA
316	ARM-LE	1	EA
317	ARM-LF	1	EA
318	ARM-LG	1	EA
319	ARM-LH	1	EA
320	ARM-LI	1	EA
321	ARM-LJ	1	EA
322	ARM-LK	1	EA
323	ARM-LL	1	EA
324	ARM-LM	1	EA
325	ARM-LN	1	EA
326	ARM-LO	1	EA
327	ARM-LP	1	EA
328	ARM-LQ	1	EA
329	ARM-LR	1	EA
330	ARM-LS	1	EA
331	ARM-LT	1	EA
332	ARM-LU	1	EA
333	ARM-LV	1	EA
334	ARM-LW	1	EA
335	ARM-LX	1	EA
336	ARM-LY	1	EA
337	ARM-LZ	1	EA
338	ARM-MA	1	EA
339	ARM-MB	1	EA
340	ARM-MC	1	EA
341	ARM-MD	1	EA
342	ARM-ME	1	EA
343	ARM-MF	1	EA
344	ARM-MG	1	EA
345	ARM-MH	1	EA
346	ARM-MI	1	EA
347	ARM-MJ	1	EA
348	ARM-MK	1	EA
349	ARM-ML	1	EA
350	ARM-MN	1	EA
351	ARM-MO	1	EA
352	ARM-MP	1	EA
353	ARM-MQ	1	EA
354	ARM-MR	1	EA
355	ARM-MS	1	EA
356	ARM-MT	1	EA
357	ARM-MU	1	EA
358	ARM-MV	1	EA
359	ARM-MW	1	EA
360	ARM-MX	1	



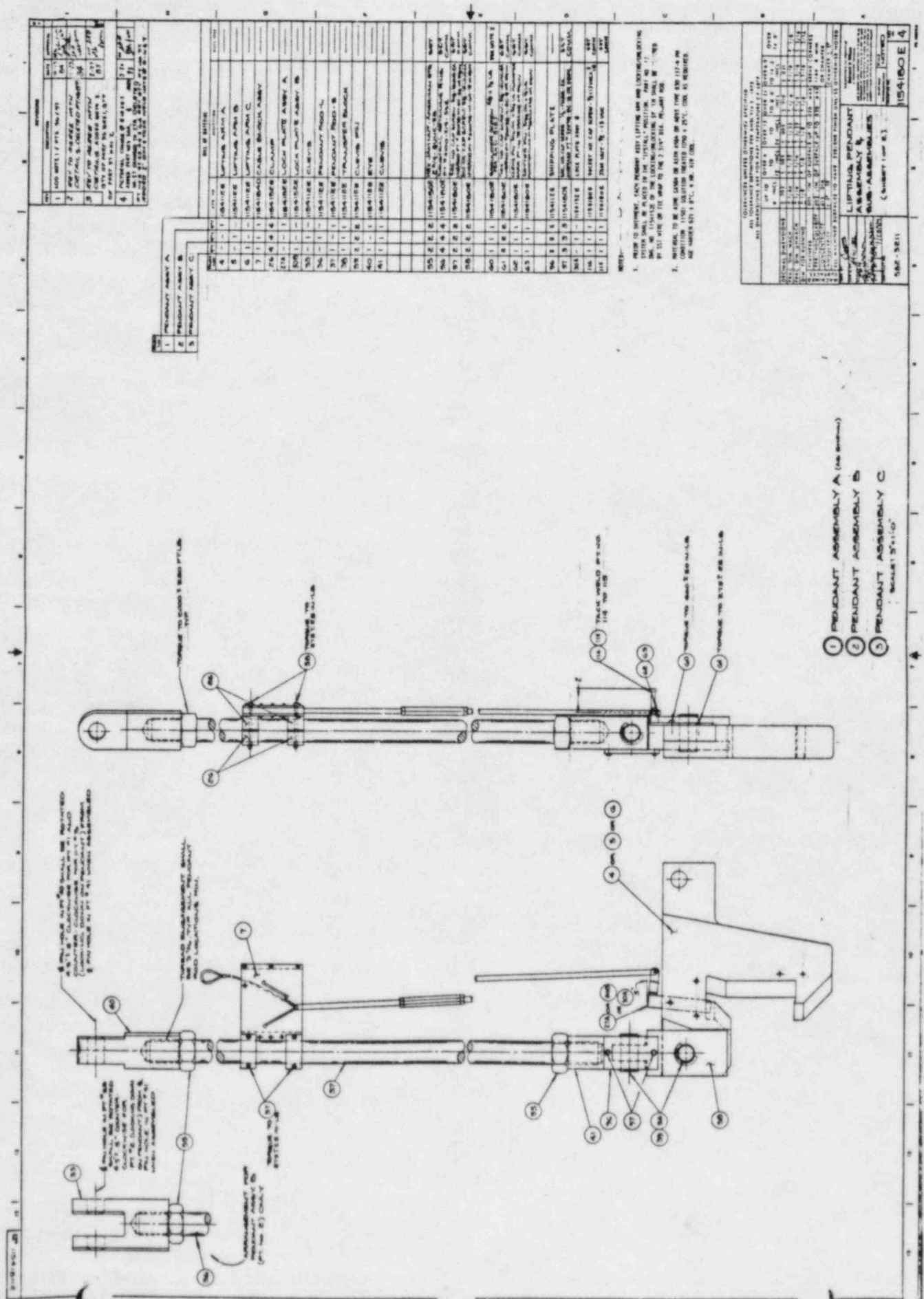
REV	DATE	BY	CHKD	DESCRIPTION
1	08-27-60	WJ	WJ	INITIAL DESIGN
2	09-01-60	WJ	WJ	REVISIONS
3	09-01-60	WJ	WJ	REVISIONS
4	09-01-60	WJ	WJ	REVISIONS
5	09-01-60	WJ	WJ	REVISIONS
6	09-01-60	WJ	WJ	REVISIONS
7	09-01-60	WJ	WJ	REVISIONS
8	09-01-60	WJ	WJ	REVISIONS
9	09-01-60	WJ	WJ	REVISIONS
10	09-01-60	WJ	WJ	REVISIONS

REV	DATE	BY	CHKD	DESCRIPTION
1	08-27-60	WJ	WJ	INITIAL DESIGN
2	09-01-60	WJ	WJ	REVISIONS
3	09-01-60	WJ	WJ	REVISIONS
4	09-01-60	WJ	WJ	REVISIONS
5	09-01-60	WJ	WJ	REVISIONS
6	09-01-60	WJ	WJ	REVISIONS
7	09-01-60	WJ	WJ	REVISIONS
8	09-01-60	WJ	WJ	REVISIONS
9	09-01-60	WJ	WJ	REVISIONS
10	09-01-60	WJ	WJ	REVISIONS

REV	DATE	BY	CHKD	DESCRIPTION
1	08-27-60	WJ	WJ	INITIAL DESIGN
2	09-01-60	WJ	WJ	REVISIONS
3	09-01-60	WJ	WJ	REVISIONS
4	09-01-60	WJ	WJ	REVISIONS
5	09-01-60	WJ	WJ	REVISIONS
6	09-01-60	WJ	WJ	REVISIONS
7	09-01-60	WJ	WJ	REVISIONS
8	09-01-60	WJ	WJ	REVISIONS
9	09-01-60	WJ	WJ	REVISIONS
10	09-01-60	WJ	WJ	REVISIONS







ITEM INVENTORY			
ITEM	DESCRIPTION	QTY	UNIT
1	100 WTS. 1/2" / 1/4" / 1/8" / 1/16"	100	Box
2	100 WTS. 1/2" / 1/4" / 1/8" / 1/16"	100	Box
3	100 WTS. 1/2" / 1/4" / 1/8" / 1/16"	100	Box
4	100 WTS. 1/2" / 1/4" / 1/8" / 1/16"	100	Box

1	100 WTS. 1/2"
2	100 WTS. 1/2"
3	100 WTS. 1/2"

ITEM	QTY	UNIT	DESCRIPTION	REMARKS
4	1	100 WTS.	100 WTS. 1/2" & 1/4" & 1/8" & 1/16" & 1/32" & 1/64" & 1/128" & 1/256" & 1/512" & 1/1024" & 1/2048" & 1/4096" & 1/8192" & 1/16384" & 1/32768" & 1/65536" & 1/131072" & 1/262144" & 1/524288" & 1/1048576" & 1/2097152" & 1/4194304" & 1/8388608" & 1/16777216" & 1/33554432" & 1/67108864" & 1/134217728" & 1/268435456" & 1/536870912" & 1/1073741824" & 1/2147483648" & 1/4294967296" & 1/8589934592" & 1/17179869184" & 1/34359738368" & 1/68719476736" & 1/137438953472" & 1/274877906944" & 1/549755813888" & 1/1099511627776" & 1/2199023255552" & 1/4398046511104" & 1/8796093022208" & 1/17592186044416" & 1/35184372088832" & 1/70368744177664" & 1/140737488355328" & 1/281474976710656" & 1/562949953421312" & 1/1125899906842624" & 1/2251799813685248" & 1/4503599627370496" & 1/9007199254740992" & 1/18014398509481984" & 1/36028797018963968" & 1/72057594037927936" & 1/144115188075855872" & 1/288230376151711744" & 1/576460752303423488" & 1/1152921504606846976" & 1/2305843009213693952" & 1/4611686018427387904" & 1/9223372036854775808" & 1/18446744073709551616" & 1/36893488147419103232" & 1/73786976294838206464" & 1/147573952589676412928" & 1/295147905179352825856" & 1/590295810358705651712" & 1/1180591620717411303424" & 1/2361183241434822606848" & 1/4722366482869645213696" & 1/9444732965739290427392" & 1/18889465931478580854784" & 1/37778931862957161709568" & 1/75557863725914323419136" & 1/151115727451828646838272" & 1/302231454903657293676544" & 1/604462909807314587353088" & 1/1208925819614629174706176" & 1/2417851639229258349412352" & 1/4835703278458516698824704" & 1/9671406556917033397649408" & 1/19342813113834066795298816" & 1/38685626227668133590597632" & 1/77371252455336267181195264" & 1/154742504910672534362390528" & 1/309485009821345068724781056" & 1/618970019642690137449562112" & 1/1237940039285380274899124224" & 1/2475880078570760549798248448" & 1/4951760157141521099596496896" & 1/9903520314283042199192993792" & 1/19807040628566084398385987584" & 1/39614081257132168796771975168" & 1/79228162514264337593543950336" & 1/158456325028528675187087900672" & 1/316912650057057350374175801344" & 1/633825300114114700748351602688" & 1/1267650600228229401496703205376" & 1/2535301200456458802993406410752" & 1/5070602400912917605986812821504" & 1/10141204801825835211973625643008" & 1/20282409603651670423947251286016" & 1/40564819207303340847894502572032" & 1/81129638414606681695789005144064" & 1/162259276829213363391578010288128" & 1/324518553658426726783156020576256" & 1/649037107316853453566312041152512" & 1/1298074214633706907132624082305024" & 1/2596148429267413814265248164610048" & 1/5192296858534827628530496329220096" & 1/10384593717069655257060992658440192" & 1/20769187434139310514121985316880384" & 1/41538374868278621028243970633760768" & 1/83076749736557242056487941267521536" & 1/166153499473114484112975882535043072" & 1/332306998946228968225951765070086144" & 1/664613997892457936451903530140172288" & 1/1329227995784915872903807060280345728" & 1/2658455991569831745807614120560691456" & 1/5316911983139663491615228241121382912" & 1/10633823966279326983230456482242765824" & 1/21267647932558653966460912964485531648" & 1/42535295865117307932921825928971063296" & 1/85070591730234615865843651857942126592" & 1/170141183460469231731687303715884253184" & 1/340282366920938463463374607431768506368" & 1/680564733841876926926749214863537012736" & 1/1361129467683753853853498429727074025472" & 1/2722258935367507707706996859454148050944" & 1/5444517870735015415413993718908296101888" & 1/10889035741470030830827987437816592203776" & 1/21778071482940061661655974875633184407552" & 1/43556142965880123323311949751266368815104" & 1/87112285931760246646623899502532737630208" & 1/174224571863520493293247799005065472610416" & 1/348449143727040986586495598010130945220832" & 1/696898287454081973172991196020261890441664" & 1/13937965749081639463459823920405237808832" & 1/27875931498163278926919647840810475617664" & 1/55751862996326557853839295681620951235328" & 1/111503725992653115707678591363241902470656" & 1/223007451985306231415357182726483804941312" & 1/446014903970612462830714365452967609882624" & 1/892029807941224925661428730905935219765248" & 1/1784059615882449851322857461811870439530496" & 1/3568119231764899702645714923623740879060992" & 1/7136238463529799405291429847247481758121984" & 1/14272476927059598810582859694494963516243968" & 1/28544953854119197621165719388989927032487936" & 1/57089907708238395242331438777979854064975872" & 1/114179815416476790484662877555959708129951744" & 1/228359630832953580969325755111919416259903488" & 1/456719261665907161938651510223838832519806976" & 1/913438523331814323877303020447677665039613952" & 1/182687704666362864775460604089535533007922784" & 1/365375409332725729550921208179071066015845568" & 1/730750818665451459101842416358142132031691136" & 1/1461501637330902918203684832716284264063382272" & 1/2923003274661805836407369665432568528126764544" & 1/5846006549323611672814739330865137056253529088" & 1/11692013098647223345629478661730274112507058176" & 1/23384026197294446691258957323460548225014116352" & 1/46768052394588893382517914646921096450028232704" & 1/93536104789177786765035829293842192900056465408" & 1/187072209578355573530071658587684385800112930816" & 1/374144419156711147060143317175368771600225861632" & 1/748288838313422294120286634350737543200451723264" & 1/1496577676626844588240573268701475086400903446528" & 1/2993155353253689176481146537402950172801806893056" & 1/5986310706507378352962293074805900345603613786112" & 1/11972621413014756705924586149611800691207227572224" & 1/23945242826029513411849172299223601382414455144448" & 1/47890485652059026823698344598447202764828910288896" & 1/95780971304118053647396689196894405529657820577792" & 1/191561942608236107294793378393788811059315641155584" & 1/383123885216472214589586756787577622118631282311168" & 1/766247770432944429179173513575155244237262564622336" & 1/1532495540865888858358347027150310488474525129244672" & 1/3064991081731777716716694054300620976949050258489344" & 1/6129982163463555433433388108601241953898100516978688" & 1/12259964326927110866866776217202483907796201033957376" & 1/24519928653854221733733552434404967815592402067914752" & 1/49039857307708443467467104868809935631184804135829504" & 1/98079714615416886934934209737619871262369608271659008" & 1/196159429228833773869868419475239742524739216543318112" & 1/392318858457667547739736838950479485049478433086636224" & 1/784637716915335095479473677900958970098956866173272448" & 1/1569275433830670190958947355801917940197913732346544896" & 1/313855086766134038191789471160383588039582746469308992" & 1/627710173532268076383578942320767176079165492938617984" & 1/1255420347064536152767157884641534352158330985877235968" & 1/2510840694129072305534315769283068704316661971754471936" & 1/5021681388258144611068631538566137408633323943508943872" & 1/1004336277651628922213726307713227801726664788701788744" & 1/2008672555303257844427452615426455603453329577403577488" & 1/4017345110606515688854905230852911206906659154807154976" & 1/8034690221213031377709810461705822413813318309614309952" & 1/1606938044242606275541962092341164482762663661922861984" & 1/32138760884852125510839241846823289655253273238457139872" & 1/6427752176970425102167848369364657931050654647694275968" & 1/12855504353940850204335696738729315822101309295388551936" & 1/25711008707881700408671393477458631644202618590777103872" & 1/51422017415763400817342786954917263288405237181554207744" & 1/10284403483152680163468557390983452657681047436310841488" & 1/20568806966305360326937114781966905315362094872621682976" & 1/41137613932610720653874229563933810630724189745243365952" & 1/82275227865221441307748459127867621261448379490486731904" & 1/164550455730442882615496918255735242522896798980973463808" & 1/329100911460885765230993836511470485045793597961946927616" & 1/658201822921771530461987673022940970091587195923893855232" & 1/1316403645843543060923975346045881940183174391847787710464" & 1/2632807291687086121847950692091763880366348783695575420928" & 1/5265614583374172243695901384183527760732697567391150841856" & 1/10531229166743544487391802768367055201465395134782301683712" & 1/21062458333487088974783605536734110402930790269564603367424" & 1/42124916666974177949567211073468220805861580539129206734848" & 1/84249833333948355899134422146936441611723161078258413469696" & 1/168499666677896711798268844293872883223446322176516826938912" & 1/336999333355793423596537688587745766446892644353033677827824" & 1/673998666711586847193075377175491532893785288706067355655648" & 1/1347997333423173693986150754350830065787570577412134711311296" & 1/269599466684634738797230150870166013157514115482426942622592" & 1/539198933369269477594460301740332026315028230964853885245184" & 1/1078397866738538955188920603480664052630056461929707770490368" & 1/2156795733477077910377841206961328105260112923859415540980736" & 1/4313591466954155820755682413922656210520225847718831081961472" & 1/8627182933908311641511364827845312421040451695437662163922944" & 1/17254365867816623283022729655690624842080903390875324327845888" & 1/34508731735633246566045459311381249684161806781750648655691776" & 1/69017463471266493132090918622762499368323613563501297311383552" & 1/13803492694253298626418183724552499873664722712700259462276704" & 1/27606985388506597252836367449104999747329445425400518924553408" & 1/55213970777013194505672734898209999494658890850801037849106816" & 1/110427941554026389011345469796419998989317781701602075698213632" & 1/220855883108052778022690939592839997978635563403204151396427264" & 1/441711766216105556045381879185679995957271126806408302792854528" & 1/883423532432211112090763758371359991914542253612816605585709056" & 1/1766847064864422224181527516742719983829084507225633211171418112" & 1/3533694129728844448363055033485439967658169014451266422342836224" & 1/7067388259457688896726110066970879353316338028902532844685672448" & 1/141347765189153777934522201339417587066326760578050656937134448" & 1/282695530378307555869044402678835174132653521156101313874268896" & 1/565391060756615111738088805357670348265307042312202627748537792" & 1/1130782121513230223476177610715340696530614084624405255497075584" & 1/2261564243026460446952355221430681393061221689248810510994151168" & 1/4523128486052920893904710442861622786122443378497621021988302336" & 1/9046256972105841787809420885723245572244886756995242043976604672" & 1/18092513944211683575618841771446491144449773513990484087953209344" & 1/36185027888423367151237683422892982288899547027980968157906418688" & 1/72370055776846734302475366845785964577799094055961936315812837376" & 1/144740111553693468644950733691571889155598180111923872631625674752" & 1/289480223107386937289901467383143778311196360223847745263251349504" & 1/578960446214773874579802934766287556622392720447695490526502699008" & 1/1157920892429547749159605869532575113244785440895390981053005398016" & 1/2315841784859095498319211739065150226489570881790781962066010796032" & 1/4631683569718190996638423478130300452979141763581563924132021592064" & 1/9263367139436381993276846956260600905958283527163127848264043184128" & 1/18526734278872763986553693912521201811916567054326255695528086368256" & 1/37053468557745527973107387825042403623833134108652511391056172736512" & 1/74106937115491055946214775650084807247666268217305022782112345473024" & 1/148213874230982111892429551300168014495332536434610045564224690946048" & 1/296427748461964223784859102600336028990665072869220091128493781892096" & 1/592855496923928447569718205200672057981330145738440182256987563784192" & 1/1185710993847856895139436410401344115962660291476880364539751267568384" & 1/2371421987695713790278872820802688231925320582953760729079502535136768" & 1/4742843975391427580557745641605376463850641165907521458159005070273536" & 1/9485687950782855161115491283210752927701282331815042916318010140547072" & 1/18971375901565710322230982566421505855402564663630085832636020281094144" & 1/3794275180313142064446196513284301171080512932726017	

1. PRIOR TO SHIPMENT, EACH PENDANT ASSEMBLY MUST BE INSPECTED AND CERTIFIED BY THE MANUFACTURER'S QUALITY CONTROL DEPARTMENT. THE INSPECTION REPORT MUST BE ATTACHED TO THE SHIPMENT. THE INSPECTION REPORT MUST BE DATED AND SIGNED BY THE QUALITY CONTROL MANAGER. THE INSPECTION REPORT MUST BE DATED AND SIGNED BY THE QUALITY CONTROL MANAGER. THE INSPECTION REPORT MUST BE DATED AND SIGNED BY THE QUALITY CONTROL MANAGER.

2. MATERIALS TO BE USED MUST BE OF THE FOLLOWING GRADES AND SPECIFICATIONS: STEEL, 100 WTS. 1/2\"/>

4000 1000	
---	--

- 1 PENDANT ASSEMBLY A (see drawing)
- 2 PENDANT ASSEMBLY B
- 3 PENDANT ASSEMBLY C

SCALE: 1\"/>



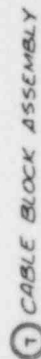
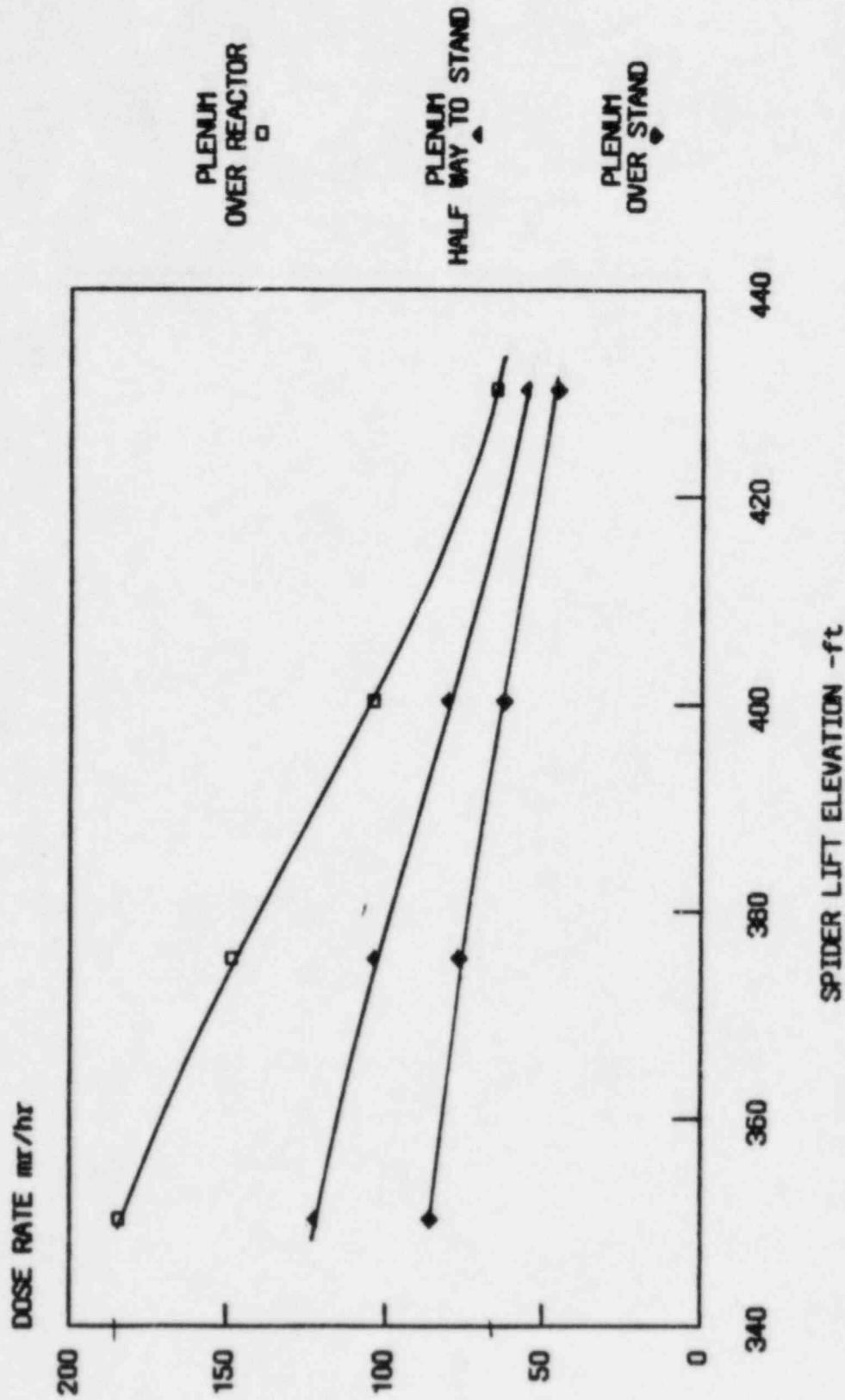
[illegible]

FIGURE 1  
(4410-85-L-0101)

DOSE RATE VS SPIDER LIFT ELEVATION



Dose rate from plenum calculated when the bottom of the plenum is at the maximum transfer elevation 333'11-3/4".