71-9073

NUCLEAR PACKAGING
A Pacific Nuclear Company

July 30, 1985

File: OH-142
Ref: RR4376

PDR
Return to 39655

Mr. Charles E. MacDonald, Chief
Nuclear Regulatory Commission
Transportation Certification Branch
Washington, D. C. 20555

Dear Mr. MacDonald:

Enclosed please find eight copies of the revised pages to convert Revision 11 of the OH-142 Safety Analysis Report to Revision 12 of that report.

The changes made to the Safety Analysis Report are in response to some concerns expressed to Stephen Goetsch of our company by your associate, Dick Odegaarden. The changes made to the SAR for revision 12 merely limit the requested revision of foam properties to the OH-142 MK I design with a 16 inch diameter central secondary lid. This smaller, lighter lid requires much less bolt strength to secure it during end impact. The margin of safety of the secondary lid closure bolts on the 16 inch lid is +2.36 against yield criteria, whereas the margin of safety of the other lid designs for the unrevised foam properties is +.27 against ultimate criteria. The margin of safety against yield criteria for the other designs, although not reported in the SAR, would be +.067. Clearly, the margin of safety for the combination of revised foam properties and 16 inch diameter secondary lid is very much greater than the previously acceptable positive margin.

In addition to the analysis previously contained in the SAR, a thread engagement calculation was included in this submittal. To assure that the thread engagement required to fully develop the strength of the bolt is present on packages in service, the required thread engagement has been added to Drawing AL-20-202, as well as a note specifying that the revised foam properties allowed in NPI.F6 foam are allowed only for the 16 inch central secondary lid option.

This revision, including the revised drawings, has been copyrighted. This entire submittal contains proprietary information per the notice on the flyleaf of this report. We are aware of your requirements to place this submittal in the Public Documents Room. This may be cone with our permission; however, this permission should not be construed as a waiver of or in any way prejudicial to our lawful proprietary rights to this material. It is done only to facilitate the issuance of a Certificate of Compliance.

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DESCRIPTION:

enclosed are Copies of the revised pages Convert. Revision 11 to Safety Analysis Report

07/31/85 INITIAL CEC

July 30, 1985

Mr. Charles E. MacDonald, Chief
Nuclear Regulatory Commission

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If you have any questions, please do not hesitate to call either myself or Stephen Goetsch. Thank you very much.

Very truly yours,

NUCLEAR PACKAGING, INC.

Stephen E. Goetsch for

Charles J. Temus
Technical Director

Enclosure: As stated

Insert/Delete Instructions for Rev. 12, OH-142 SAR

Delete Pages	Insert Pages
1-147	1-147
1-150	1-150
1-151	1-151
1-152	1-152
1-153	1-153
1-154	1-154
1-155	1-155
1-156	1-156
Dwg. AL-20-202 Rev. J	Dwg. AL-20-202 Rev. K

APPENDIX 1.10.2

EXPANSION OF ACCEPTABLE STRESS-STRAIN RANGE FOR IMPACT LIMITERS

1.10.2.1 Introduction

Due to minor changes in the formulation of the NPI.F6 polyurethane foam used in the OH-142 overpacks, it has become apparent that some foam placed in accordance with it may not exhibit stress-strain properties as shown in Figure 1 of Section 1.3 above. Some samples of foam taken during fabrication activities indicate that the upper bound of the stress-strain curve in Figure 1 should be raised. The revised limits of the stress-strain curve are shown in Figure 1.10.2-1. An analysis of the effect of this revised upper bound on the package margins of safety is presented below. These revised limits apply to the Model OH-142 MK I design with 16 inch diameter secondary lid opening only.

1.10.2.2 End Impact

The end impact drop orientation is the drop orientation most seriously affected by the revised foam properties. NuPac's EYDROP program is used to evaluate the forces generated from a 31 foot drop onto an unyielding surface. EYDROP, like its sister programs CYDROP and SYDROP, has been used to demonstrate compliance of several other packages (such as the T-3 Spent Fuel Shipping Cask, Certificate of Compliance No. 9132, and the NuP PAS-1 package, Certificate of Compliance No. 9184) to the 10 CFR 71 drop events. Table 1.10.2-1 presents output from EYDROP for the OH-142 using the revised upper bound of the stress-strain curve as shown in Figure 1.10.2-1. The table was generated using the equivalent outside diameter of the package. This equivalent diameter is calculated by determining the actual end area of the overpack and finding that diameter of a circle which has the same end area as the actual overpack. Also, the analysis assumes the entire overpack area is effective, corresponding to both the most conservative assumption presented in the body of this report as well as the results of numerous test programs.

The table predicts that for the revised stress-strain limits, the acceleration experienced by the package would be 117 g's, slightly higher than previous analysis had predicted. The predicted deflection, 3.94 inches, is slightly less than previously predicted.

The 16 inch diameter lid weighs approximately 450 lbs, and the projected weight of the payload on the 16 inch lid is

$$(16^2/66^2)(10000) = 590 \text{ lbs.}$$

Therefore, the 16 inch diameter lid bolts must react 1040 lbs of weight. The force in each bolt may be calculated as below:

$$(1040)(117)/8 = 15210 \text{ lbs.}$$

The yield strength of the A320 L7 bolts is 105000 psi. Since the 7/8 inch bolts have a tensile stress area of .487 in^2, the allowable load in the bolt may be calculated:

$$(105000)(.487) = 51135 \text{ lbs.}$$

The margin of safety for the bolt is then

$$(51135/15210) - 1 = +2.36$$

The thread engagement required to fully develop the strength of the A320 L7 stud may be calculated using the following formula from An Introduction to the Design and Behavior of Bolted Joints, by J. H. Bickford, p. 272, for the case where the nut material is weaker than the bolt material:

$$L_e = S_{st}(2A_S)/((S_{nt})(\pi)(n)(D)[(1/2n) + 0.57735(D - E_{max})])$$

where S_{st} = yield strength of the stud = 105000 psi

A_S = tensile area of the stud = .487 in^2

S_{nt} = yield strength of the nut material = 38000 psi

n = number of threads per inch = 9

D = Stud nominal diameter = .875 in.

E_{max} = pitch diameter of nut = .8028 in.

Substituting into the above equation yields:

$$L_e = (105)(2)(.487)/((38)(\pi)(9)(.875)[(1/(2)(9)) + .57735(.875 - .8028)])$$

$$L_e = 1.12 \text{ in.}$$

The studs are required to have at least 1.25 inches of engagement, so the threads are stronger than the studs themselves. The margin of safety against bolt thread failure can be calculated, assuming that development strength of the lid threads is proportional to the length of engagement:

$$M.\ S. = (1.25/1.12)(51135/15210) - 1 = +2.75$$

Therefore, the revised stress-strain limits do not affect the ability of the package to resist the effects of a 31 foot end impact onto an unyielding surface.

1.10.2.3 Corner Impact

The change in the upper bound of the stress-strain curve causes Cases 3 and 4 discussed in the body of this report to be obsolete. Tables 1.10.2-2 and 1.10.2-3 present the same drop orientation (approximately 40 degrees from vertical) as previously analyzed. From the tables, it can be seen that the maximum acceleration experienced by the package is 77.2 g's, slightly higher than previously used for design. This slight increase in the package acceleration (77.2 g's versus 76.4 g's used previously) will have an affect on the package primary closure device design loads. Using the method shown in the Safety Analysis Report to be very conservative, the loads in the ratchet binders can be calculated:

$$(19900)(77.2)(38.125)\cos 40^{\circ} = (1011660)(15.83)\cos 40^{\circ} + 2(38.125)P_b(3.5)$$

$$P_b = 122{,}195 \text{ lbs. per binder}$$

The margin of Safety for the binder is then:

$$\text{M. S.} = (160{,}000/122{,}195) - 1 = +0.31$$

TABLE 1.10.2-2

PROPRIETARY DAT

CYDROP(CORNER) N U C L E A R P A C K A G I N G P R O P R I E T A R Y 07.19.11 85/06/08

OH-142 FULL 55 INCH HOLE

PACKAGE WEIGHT = 64000. (LBS)
PACKAGE EXTERNAL LENGTH = 120.00 (IN)
PACKAGE EXTERNAL DIAMETER= 101.00 (IN)
PACKAGE EXTERNAL HOLE DIA= 55.00 (IN)
PAYLOAD ENVELOPE LENGTH = 84.50 (IN)
PAYLOAD ENVELOPE DIAMETER= 76.00 (IN)
OVERPACK LENGTH = 40.00 (IN)

DROP HEIGHT = 31.00 (FT)
ORIENTATION ANGLE = 40.090 (DEGREES WRT TO VERTICAL)

PLATEAU CRUSH STRESS = .00 (PSI)
(DEFAULT TAKEN AT 10 PCT STRAIN)

STRESS/STRAIN EVALUATED IN 1/2 CRUSH PLANE ELLIPSE AT:
NX = 25 POINTS PARALLEL TO SEMI-MINOR ELLIPSE AXIS
NY = 25 POINTS PARALLEL TO SEMI-MAJOR ELLIPSE AXIS

EXPERIMENTAL STRAIN VS. STRESS VALUES

PT	STRAIN	STRESS
1	0.00	0.00
2	.05	1100.00
3	.10	1250.00
4	.20	1330.00
5	.30	1490.00
6	.40	1730.00
7	.50	2220.00
8	.60	3470.00
9	.70	7000.00
10	.80	11000.00

CYDROP(CORNER) N U C L E A R P A C K A G I N G P R O P R I E T A R Y 07.19.11 85/06/08

OH-142 FULL 55 INCH HOLE

CRUSH DEPTH (IN)	** CRUSH PLANE ** AREA (IN2)	VOLUME (IN3)	**** IMPACT **** FORCE (LBS)	ACCEL. (G)	****** ENERGY ****** KINETIC (IN-LB)	STRAIN (IN-LB)	RATIO (SE/KE)	DISTRIBUTION OF STRAIN RATIOS BY PERCENT OF CONTACT AREA LE.70	GT.70 LE.80	GT.80 LE.90	GT.90 LE.95	GT.95
.50	11.9	3.	2281.	.0	23840000.	570.	.000	100.00	0.00	0.00	0.00	0.00
1.00	33.6	14.	12940.	.2	23872000.	4375.	.000	100.00	0.00	0.00	0.00	0.00
1.50	61.5	38.	35004.	.5	23904000.	16361.	.001	100.00	0.00	0.00	0.00	0.00
2.00	94.4	77.	66309.	1.0	23936000.	41689.	.002	100.00	0.00	0.00	0.00	0.00
2.50	131.4	134.	105176.	1.6	23968000.	84561.	.004	100.00	0.00	0.00	0.00	0.00
3.00	172.0	209.	150633.	2.4	24000000.	148513.	.006	100.00	0.00	0.00	0.00	0.00
3.50	215.9	306.	201562.	3.1	24032000.	236561.	.010	100.00	0.00	0.00	0.00	0.00
4.00	262.7	426.	257636.	4.0	24064000.	351361.	.015	100.00	0.00	0.00	0.00	0.00
4.50	312.1	570.	318012.	5.0	24096000.	495273.	.021	100.00	0.00	0.00	0.00	0.00
5.00	364.1	739.	382597.	6.0	24128000.	670425.	.028	100.00	0.00	0.00	0.00	0.00
5.50	418.3	934.	450755.	7.0	24160000.	878763.	.036	100.00	0.00	0.00	0.00	0.00
6.00	474.6	1158.	520553.	8.1	24192000.	1121590.	.046	100.00	0.00	0.00	0.00	0.00
6.50	532.9	1409.	590333.	9.2	24224000.	1399511.	.058	100.00	0.00	0.00	0.00	0.00
7.00	593.0	1691.	660629.	10.3	24256000.	1712052.	.071	100.00	0.00	0.00	0.00	0.00
7.50	654.8	2003.	737012.	11.5	24288000.	2061462.	.085	100.00	0.00	0.00	0.00	0.00
8.00	718.2	2346.	805876.	12.6	24320000.	2447184.	.101	100.00	0.00	0.00	0.00	0.00
8.50	783.1	2721.	880539.	13.8	24352000.	2868788.	.118	100.00	0.00	0.00	0.00	0.00
9.00	849.4	3130.	958841.	15.0	24384000.	3328633.	.137	100.00	0.00	0.00	0.00	0.00
9.50	917.1	3571.	1037370.	16.2	24416000.	3827685.	.157	100.00	0.00	0.00	0.00	0.00
10.00	985.9	4047.	1124280.	17.6	24448000.	4368098.	.179	100.00	0.00	0.00	0.00	0.00
10.50	1056.0	4557.	1213475.	19.0	24480000.	4952537.	.202	100.00	0.00	0.00	0.00	0.00
11.00	1127.1	5103.	1299980.	20.3	24512000.	5580900.	.228	100.00	0.00	0.00	0.00	0.00
11.50	1199.2	5685.	1406802.	22.0	24544000.	6257596.	.255	100.00	0.00	0.00	0.00	0.00
12.00	1272.3	6303.	1510291.	23.6	24576000.	6986869.	.284	100.00	0.00	0.00	0.00	0.00
12.50	1346.2	6957.	1627652.	25.4	24608000.	7771554.	.316	100.00	0.00	0.00	0.00	0.00
13.00	1421.0	7649.	1753947.	27.4	24640000.	8616754.	.350	100.00	0.00	0.00	0.00	0.00
13.50	1496.5	8378.	1876395.	29.3	24672000.	9524339.	.386	100.00	0.00	0.00	0.00	0.00
14.00	1572.8	9146.	2038818.	31.9	24704000.	10503143.	.425	100.00	0.00	0.00	0.00	0.00
14.50	1649.6	9951.	2229688.	34.8	24736000.	11570269.	.468	100.00	0.00	0.00	0.00	0.00
15.00	1727.1	10795.	2412030.	37.7	24768000.	12730699.	.514	100.00	0.00	0.00	0.00	0.00
15.50	1805.0	11679.	2650944.	41.4	24800000.	13996442.	.564	100.00	0.00	0.00	0.00	0.00
16.00	1883.5	12601.	2933205.	45.8	24832000.	15392479.	.620	99.77	.23	0.00	0.00	0.00
16.50	1962.4	13562.	3244992.	50.7	24864000.	16937528.	.681	98.41	1.59	0.00	0.00	0.00
17.00	2041.7	14563.	3576385.	55.9	24896000.	18645353.	.749	96.36	3.64	0.00	0.00	0.00
17.50	2121.3	15604.	3985846.	62.3	24928000.	20533890.	.824	95.27	4.73	0.00	0.00	0.00
18.00	2201.2	16685.	4436614.	69.3	24960000.	22639505.	.907	93.67	6.33	0.00	0.00	0.00
18.50	2281.3	17805.	4909119.	76.7	24992000.	24975939.	.999	92.53	6.31	1.16	0.00	0.00
19.00	2361.6	18966.	5417038.	84.6	25024000.	27557478.	1.101	91.00	6.23	2.76	0.00	0.00
19.50	2442.1	20167.	5960785.	93.1	25056000.	30401934.	1.213	88.71	7.14	4.14	0.00	0.00
20.00	2522.7	21408.	6548475.	102.3	25088000.	33529248.	1.336	87.49	7.66	4.62	.24	0.00

TABLE 1.10.2-3 PROPRIETARY DATA

CYDROP(CORNER) N U C L E A R P A C K A G I N G P R O P R I E T A R Y 07.18.39 85/06/08

OH-142 CENTRAL HOLE FILLED

```
PACKAGE WEIGHT              =  64000. (LBS)
PACKAGE EXTERNAL LENGTH     =  120.00 (IN)
PACKAGE EXTERNAL DIAMETER=  101.00 (IN)
PACKAGE EXTERNAL HOLE DIA=     .00 (IN)
PAYLOAD ENVELOPE LENGTH     =   84.50 (IN)
PAYLOAD ENVELOPE DIAMETER=   76.00 (IN)
OVERPACK LENGTH             =   40.00 (IN)

DROP HEIGHT                 =   31.00 (FT)
ORIENTATION ANGLE           =  40.090 (DEGREES WRT TO VERTICAL)

PLATEAU CRUSH STRESS        =     .00 (PSI)
   (DEFAULT TAKEN AT 10 PCT STRAIN)

STRESS/STRAIN EVALUATED IN 1/2 CRUSH PLANE ELLIPSE AT:
   NX =    25 POINTS PARALLEL TO SEMI-MINOR ELLIPSE AXIS
   NY =    25 POINTS PARALLEL TO SEMI-MAJOR ELLIPSE AXIS
```

EXPERIMENTAL STRAIN VS. STRESS VALUES

PT	STRAIN	STRESS
1	0.00	0.00
2	.05	1100.00
3	.10	1250.00
4	.20	1330.00
5	.30	1490.00
6	.40	1720.00
7	.50	2220.00
8	.60	3470.00
9	.70	7000.00
10	.80	11000.00

CYDROP(CORNER) N U C L E A R P A C K A G I N G P R O P R I E T A R Y 07.18.39 85/06/08

OH-142 CENTRAL HOLE FILLED

CRUSH DEPTH (IN)	** CRUSH PLANE ** AREA (IN2)	VOLUME (IN3)	**** IMPACT **** FORCE (LBS)	ACCEL. (G)	****** ENERGY ****** KINETIC (IN-LB)	STRAIN (IN-LB)	RATIO (SE/KE)	DISTRIBUTION OF STRAIN RATIOS BY PERCENT OF CONTACT AREA LE.70	GT.70 LE.80	GT.80 LE.90	GT.90 LE.95	GT.95
.50	11.9	3.	2281.	.0	23840000.	570.	.000	100.00	0.00	0.00	0.00	0.00
1.00	33.6	14.	12940.	.2	23872000.	4375.	.000	100.00	0.00	0.00	0.00	0.00
1.50	61.5	38.	35004.	.5	23904000.	16361.	.001	100.00	0.00	0.00	0.00	0.00
2.00	94.4	77.	66309.	1.0	23936000.	41689.	.002	100.00	0.00	0.00	0.00	0.00
2.50	131.4	134.	105176.	1.6	23968000.	84561.	.004	100.00	0.00	0.00	0.00	0.00
3.00	172.3	209.	150633.	2.4	24000000.	148513.	.006	100.00	0.00	0.00	0.00	0.00
3.50	215.9	306.	201562.	3.1	24032000.	236561.	.010	100.00	0.00	0.00	0.00	0.00
4.00	262.7	426.	257636.	4.0	24064000.	351361.	.015	100.00	0.00	0.00	0.00	0.00
4.50	312.1	570.	318012.	5.0	24096000.	495273.	.021	100.00	0.00	0.00	0.00	0.00
5.00	364.1	739.	382597.	6.0	24128000.	670425.	.028	100.00	0.00	0.00	0.00	0.00
5.50	418.3	934.	451287.	7.1	24160000.	878896.	.036	100.00	0.00	0.00	0.00	0.00
6.00	474.6	1158.	524453.	8.2	24192000.	1122831.	.046	100.00	0.00	0.00	0.00	0.00
6.50	532.9	1409.	602548.	9.4	24224000.	1404531.	.058	100.00	0.00	0.00	0.00	0.00
7.00	593.0	1691.	684834.	10.7	24256000.	1726327.	.071	100.00	0.00	0.00	0.00	0.00
7.50	654.8	2003.	771236.	12.1	24288000.	2090344.	.086	100.00	0.00	0.00	0.00	0.00
8.00	718.2	2346.	862002.	13.5	24320000.	2498654.	.103	100.00	0.00	0.00	0.00	0.00
8.50	783.1	2721.	957312.	15.0	24352000.	2953482.	.121	100.00	0.00	0.00	0.00	0.00
9.00	849.4	3130.	1057466.	16.5	24384000.	3457177.	.142	100.00	0.00	0.00	0.00	0.00
9.50	917.1	3571.	1162937.	18.2	24416000.	4012277.	.164	100.00	0.00	0.00	0.00	0.00
10.00	985.9	4047.	1274011.	19.9	24448000.	4621514.	.189	100.00	0.00	0.00	0.00	0.00
10.50	1056.0	4557.	1391037.	21.7	24480000.	5287776.	.216	100.00	0.00	0.00	0.00	0.00
11.00	1127.1	5103.	1515054.	23.7	24512000.	6014299.	.245	100.00	0.00	0.00	0.00	0.00
11.50	1199.2	5685.	1646785.	25.7	24544000.	6804759.	.277	100.00	0.00	0.00	0.00	0.00
12.00	1272.3	6303.	1786584.	27.9	24576000.	7663101.	.312	100.00	0.00	0.00	0.00	0.00
12.50	1346.2	6957.	1935875.	30.2	24608000.	8593716.	.349	100.00	0.00	0.00	0.00	0.00
13.00	1421.0	7649.	2096669.	32.8	24640000.	9601852.	.390	100.00	0.00	0.00	0.00	0.00
13.50	1496.5	8378.	2267355.	35.4	24672000.	10692858.	.433	100.00	0.00	0.00	0.00	0.00
14.00	1572.8	9146.	2462304.	38.5	24704000.	11875272.	.481	100.00	0.00	0.00	0.00	0.00
14.50	1649.6	9951.	2684340.	41.9	24736000.	13161934.	.532	100.00	0.00	0.00	0.00	0.00
15.00	1727.1	10795.	2919512.	45.6	24768000.	14562896.	.588	100.00	0.00	0.00	0.00	0.00
15.50	1805.0	11679.	3209064.	50.1	24800000.	16095041.	.649	100.00	0.00	0.00	0.00	0.00
16.00	1883.5	12601.	3537549.	55.3	24832000.	17781694.	.716	99.77	.23	0.00	0.00	0.00
16.50	1962.4	13562.	3904930.	61.0	24864000.	19642219.	.790	98.43	1.57	0.00	0.00	0.00
17.00	2041.7	14563.	4278481.	66.9	24896000.	21687966.	.871	96.45	3.55	0.00	0.00	0.00
17.50 *(17.8)*	2121.3	15604.	4733638.	74.0 *(77.2)*	24928000.	23940996.	.960 *(1.000)*	95.40	4.60	0.00	0.00	0.00
18.00	2201.2	16685.	5236176.	81.8	24960000.	26433449.	1.059	93.89	6.11	0.00	0.00	0.00
18.50	2281.3	17805.	5786982.	90.4	24992000.	29189239.	1.168	92.86	6.04	1.10	0.00	0.00
19.00	2361.6	18966.	6384137.	98.8	25024000.	32232019.	1.288	91.42	5.95	2.64	0.00	0.00
19.50	2442.1	20167.	7022691.	109.7	25056000.	35583726.	1.420	89.30	6.77	3.93	0.00	0.00
20.00	2522.7	21408.	7675759.	119.9	25088000.	39258338.	1.565	88.27	7.18	4.33	.22	0.00

The effect of losing the capability of one of the ratchet binders prior to the drop event is analyzed in a more realistic manner, which results in a ratchet binder load approximately one third of that used for design. It is inconceivable that the slight change in the foam stress-strain curve would affect that analysis such that the resulting margin of safety would be less than that calculated conservatively above.

The binder retaining pins are calculated to have a capacity of 261,316 lbs. The resulting margin of safety is therefore:

$$M.\ S. = (261{,}316/122{,}195) - 1 = +1.14$$

The Mark I overpack retainer pins have a capacity of 32,800 lbs. in double shear. The body of the report demonstrates that shear of the pin is the controlling condition rather than shear out. The pin load is calculated as below:

$$P_o = (122195\ \text{lbs.})(3000\ \text{lbs.})/(19900\ \text{lbs.}) = 18421\ \text{lbs.}$$

The margin of safety is then:

$$M.\ S. = 32{,}800\ \text{lbs.}/18{,}421\ \text{lbs.} - 1 = +0.78$$

Bearing stresses in the overpack attachment lugs (p. 1-75) can be calculated as follows:

$$f_{brg} = 122{,}195/((1.50)(1.625)) = 50{,}131\ \text{psi}$$

The margin of safety is then:

$$M.\ S. = (90{,}000/50{,}131) - 1 = +0.80$$

The weld capability of the Mark I hold-down lug weld is 157,500 lbs. The margin of safety is then:

M. S. = (157,500/122,195) - 1 = +0.29

The shear-out capacity of the binder attachment lugs is calculated to be 197,350 lbs. Therefore, the margin of safety is:

M. S. = (197,350/122,195) - 1 = +0.62

All of the margins of safety calculated in Section 1.7.1.2 of the report that are affected by the revised stress-strain limit on the foam have been presented above. None of the margins have been affected significantly, and all remain positive, even with very conservative analysis techniques. Therefore, the revised stress-strain limits do not affect the ability of the package to resist the effects of a 31 foot corner drop onto an unyielding surface.

1.10.2.4 Side Impact

NuPac's SYDROP program was used to evaluate the effects of a 31 foot drop onto the package side. Analyses were performed assuming the the entire length of the overpack is effective in resisting the impact and assuming that only that portion of the overpack between the cask shield and the impact surface is effective in resisting the impact. The latter assumption was made to develop a very conservative prediction of acceleration. Tests have shown that this assumption does not accurately model the actual response of an overpack to impact loads.

The results of the analyses are presented in Tables 1.10.2-4 and 1.10.2-5. The tables show that the more rigorous integration techniques employed by the SYDROP program result in predicted accelerations less than those used for design. As a result, the margins of safety presented in the body of this report under predict the actual margins of safety, even with the revised foam data. Therefore, the revised stress-strain limits do not affect the ability of the package to resist the effects of 31 foot side drop onto an unyielding surface.

NOTES: UNLESS OTHERWISE SPECIFIED

1. MATERIAL: LOW CARBON HOT ROLLED STEEL:
   : PLATE & SHAPES CONFORM TO ASTM-A516, GR70
   : SHEETS CONFORM TO ASTM-A36 OR 304 SST PER ASTM-A240 WHERE NOTED.

2. MATERIAL : ASTM-A514 OR A517

3. FOAM: 1,000 PSI CRUSH STRENGTH RIGID POLYURETHANE, PER NUPAC FOAM SPECIFICATION NPI-F6. REVISED FOAM PROPERTIES ALLOWED FOR 16 INCH DIAMETER CENTRAL LID OPTION.

4. LEAD: PER FEDERAL SPECIFICATION QQ-L-171E, GRADE A OR C.

5. REMOVED

6. REFERENCE DATA: CASK WT: 54,000LBS.
   PAY LOAD: 10,000LBS.
   GROSS WT: 64,000LBS.

7. REMOVED

8. ALL WELDING PROCEDURES AND PERSONNEL SHALL BE QUALIFIED IN ACCORDANCE WITH ASME CODE, SECTION IX.

9. ALL WELDS SHALL BE INSPECTED VIA NDT METHODS AS FOLLOWS:
   LIFTING LUG AND CIRCUMFERENTIAL CONTINUOUS WELDS: MAGNETIC PARTICLE PER ASME CODE SECTION III, DIVISION I, SUBSECTION NB, ARTICLE NB-5000 AND SECTION V, ARTICLE 7.
   LONGITUDINAL SHELL WELD: RADIOGRAPHIC PER ASME CODE SECTION III, DIVISION I, SUBSECTION NB, ARTICLE NB-5000 AND SECTION V, ARTICLE 2.

10. AS AN OPTION, 12 GA. NO. 304 STAINLESS STEEL CLADDING MAY BE INSTALLED ON THE INTERIOR & EXTERIOR SURFACES OF THE FLASK BODY & INTERIOR SURFACES OF THE UPPER LID, & SEAL WELDED ALONG ALL EDGES & SEAMS.

11. PAINT ALL EXPOSED CARBON STEEL SURFACES WITH ONE COAT CARBROZINC II & ONE COAT PHENOLINE 305, OR ONE PRIMER COAT (5 MILS) MOBIL CHEM EPOXY NO. 89W9 & ONE FINISH COAT (5 MILS) MOBIL CHEM EPOXY NO. 89W9.

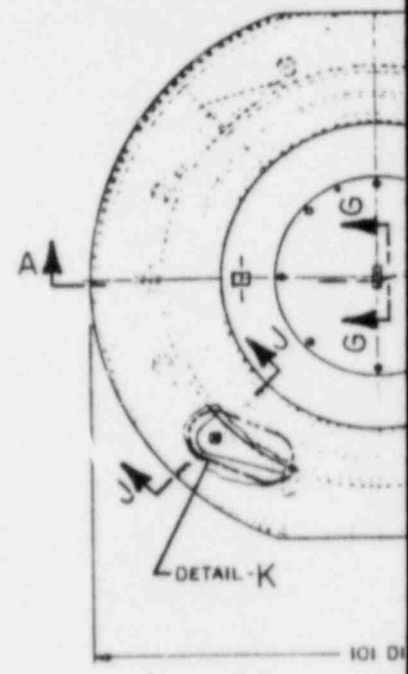
12. COAT ALL EXPOSED EXTERIOR SURFACES OF FLASK BETWEEN UPPER AND LOWER OVERPACKS WITH ONE (1) COAT (MIN 3/16 THK) "ALBI-CLAD" NO. 89. AS AN OPTION, A 10 GA. NO. 304 STAINLESS STEEL THERMAL SHIELD MAY BE INSTALLED BETWEEN THE OVERPACKS.

13. FLASKS FABRICATED PRIOR TO 3/84 MAY BE MADE USING ASTM-A36 MATERIAL. (FLASK BODY OUTER SHELL SHALL BE 1 1/8 IN. THICK, WITH FULL PENETRATION DOUBLE SIDED V GROOVE WELD FOR VERTICAL SEAM.)

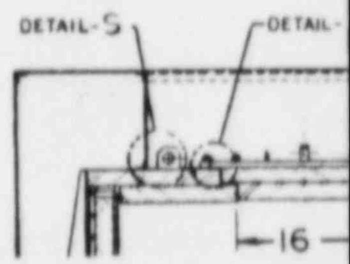
14. NOMINAL AIR GAP (MINIMUM .05,MAXIMUM .42 in.)

15. PACKAGE SHALL BE MARKED & IDENTIFIED IN ACCORDANCE WITH THE REQUIREMENTS OF 10 CFR 71.85(c)

16. PRIMARY & SECONDARY LIDS & DRAIN SHALL BE EQUIPPED WITH TAMPER INDICATING DEVICES IN ACCORDANCE WITH 10 CFR 71.43(b)

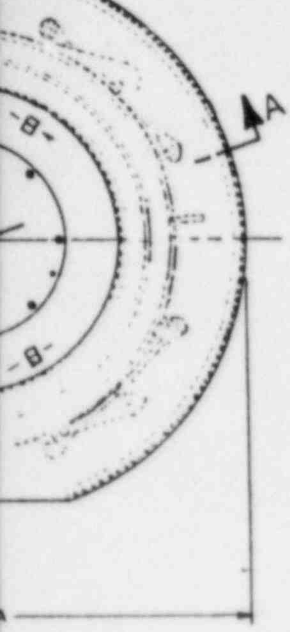


TOP VIEW SHOWING OPTIONAL

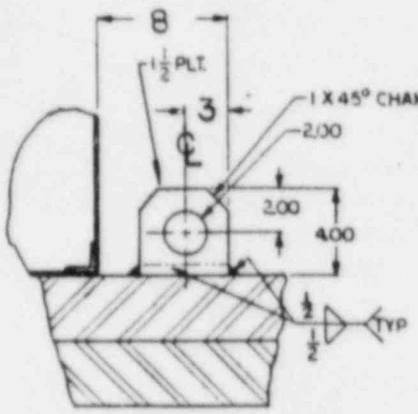


PARTIAL SECT A. A SHOWING OPTIO

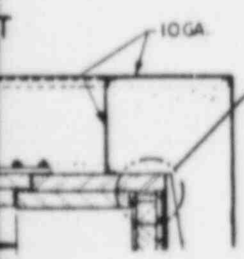
REVISIONS		
LTR	DESCRIPTION	DATE / APPROVED
K	SEE DCN	7-85



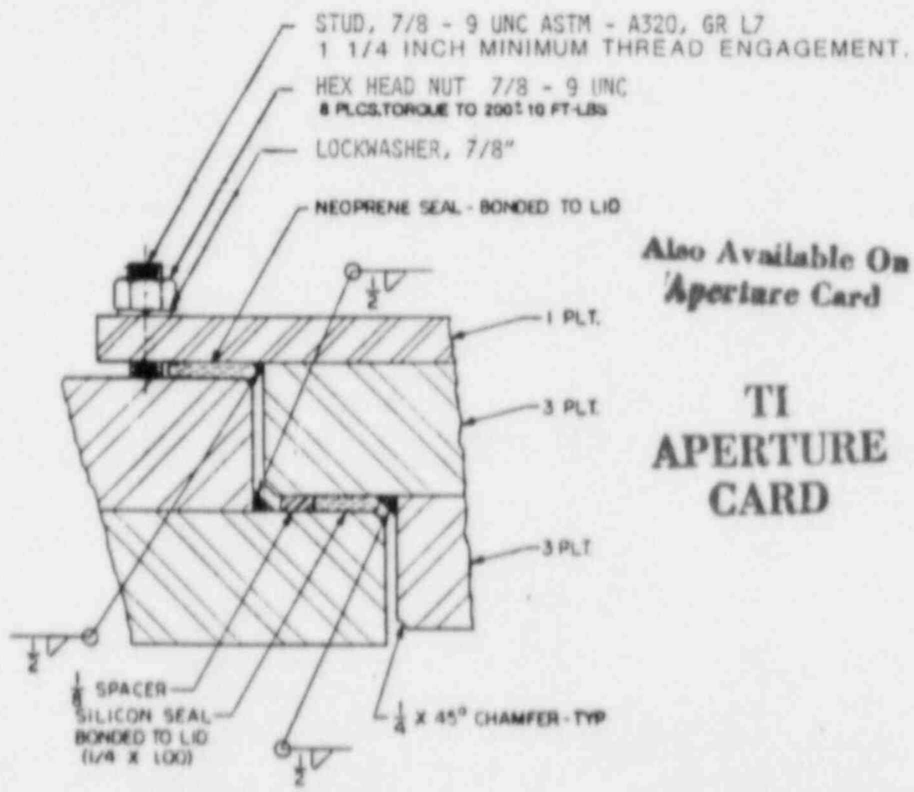
16" DIA SECONDARY LID



DETAIL - S



AL 16" DIA SECONDARY LID



Also Available On Aperture Card

TI APERTURE CARD

DETAIL - T

8508150624-01

ITEM	PART NO	DESCRIPTION
ASSEMBLY & QUANTITY		LIST OF MATERIAL

NUCLEAR PACKAGING
FEDERAL WAY WA

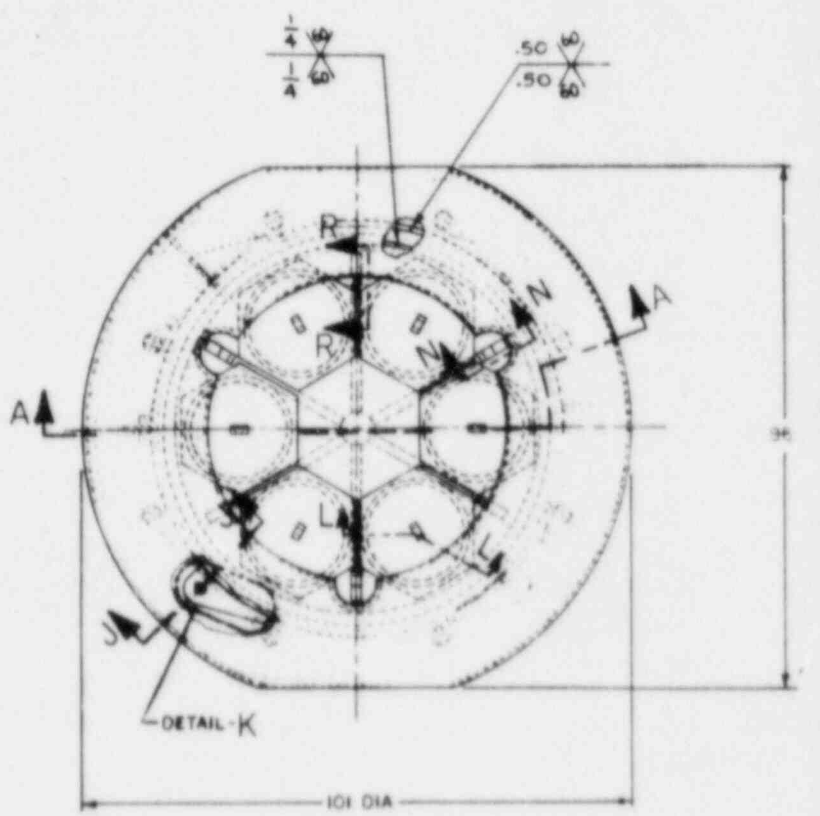
BULK RESIN SHIPPING FLASK
MODEL OH142 MK-I

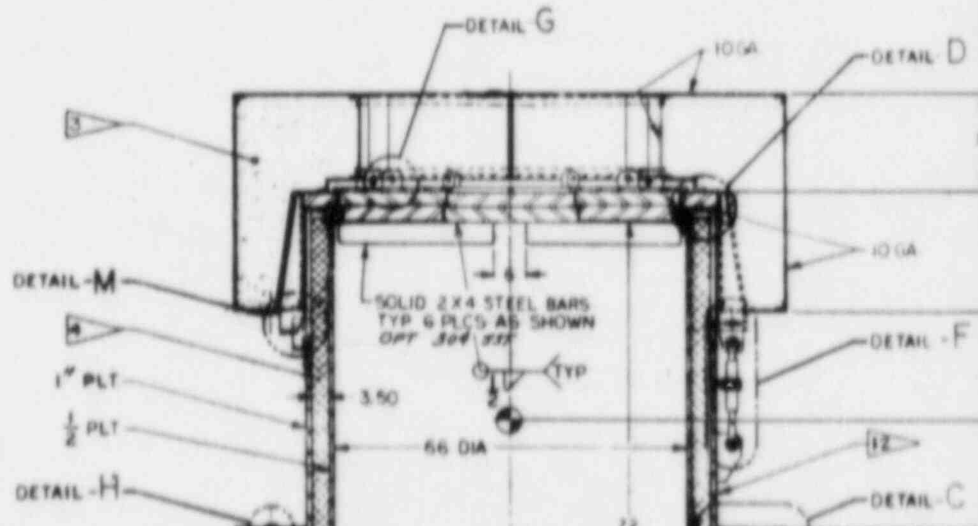
APPD
APPD
APPD
APPD
QA
CHECK
DRAWN

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES
FRACTIONS ±
ANGLES ±
3 PLACE DECIMALS ±
2 PLACE DECIMALS ±
1 PLACE DECIMALS ±

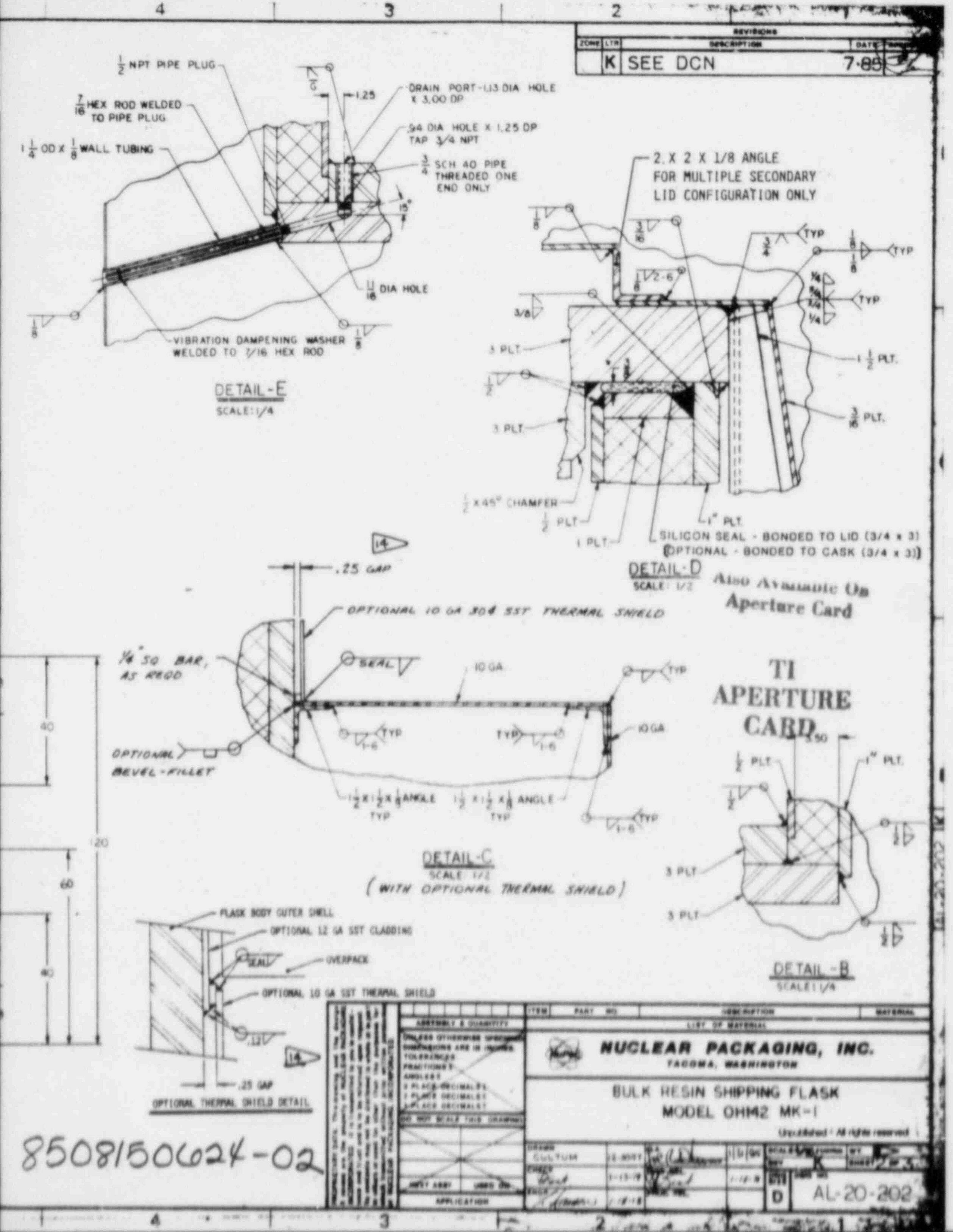
IT QTY | NEXT ASSY

SCALE | WT
REV K | SHEET | OF 3
DWG SIZE B | DWG NO AL-20-202


DETAIL-K
101 DIA
96


DETAIL G
10 GA
DETAIL D
10 GA
DETAIL-M
SOLID 2X4 STEEL BARS
TYP 6 PLCS AS SHOWN
1" PLT
3.50
½ PLT
66 DIA
DETAIL-F
DETAIL-H
72
DETAIL-C
DETAIL-B
DETAIL E
56 DIA
78 DIA
101 DIA

SECTION A-A


REVISIONS
ZONE LTR DESCRIPTION DATE
K SEE DCN 7-85
1/2 NPT PIPE PLUG
7/16 HEX ROD WELDED TO PIPE PLUG
1 1/4 OD X 1/8 WALL TUBING
DRAIN PORT-1.13 DIA HOLE X 3.00 DP
.94 DIA HOLE X 1.25 DP TAP 3/4 NPT
3/4 SCH 40 PIPE THREADED ONE END ONLY
11/16 DIA HOLE
VIBRATION DAMPENING WASHER WELDED TO 7/16 HEX ROD
DETAIL-E
SCALE: 1/4
2 X 2 X 1/8 ANGLE FOR MULTIPLE SECONDARY LID CONFIGURATION ONLY
3 PLT.
1 1/2 PLT.
3/16 PLT.
1/2 X 45° CHAMFER
1/2 PLT.
1 PLT.
1" PLT.
SILICON SEAL - BONDED TO LID (3/4 x 3)
(OPTIONAL - BONDED TO CASK (3/4 x 3))
DETAIL-D
SCALE: 1/2
Also Available On Aperture Card
.25 GAP
OPTIONAL 10 GA 304 SST THERMAL SHIELD
1/4" SQ BAR, AS REQD
SEAL
10 GA
OPTIONAL BEVEL-FILLET
1 1/2 X 1 1/2 X 1/8 ANGLE TYP
DETAIL-C
SCALE 1/2
(WITH OPTIONAL THERMAL SHIELD)
TI APERTURE CARD
DETAIL-B
SCALE: 1/4
FLASK BODY OUTER SHELL
OPTIONAL 12 GA SST CLADDING
OVERPACK
OPTIONAL 10 GA SST THERMAL SHIELD
.25 GAP
OPTIONAL THERMAL SHIELD DETAIL
NUCLEAR PACKAGING, INC.
TACOMA, WASHINGTON
BULK RESIN SHIPPING FLASK
MODEL OH142 MK-I
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D
AL-20-202
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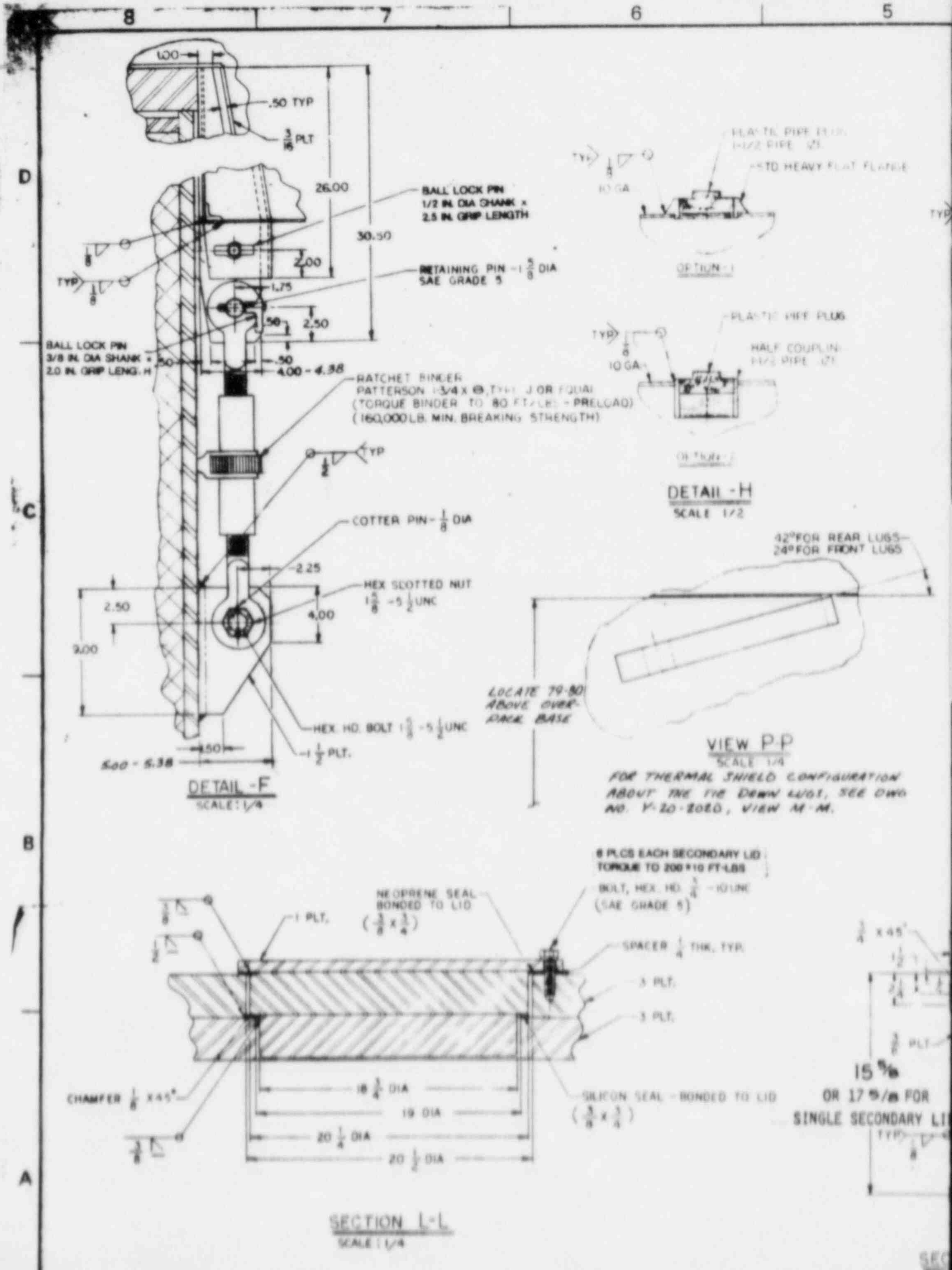
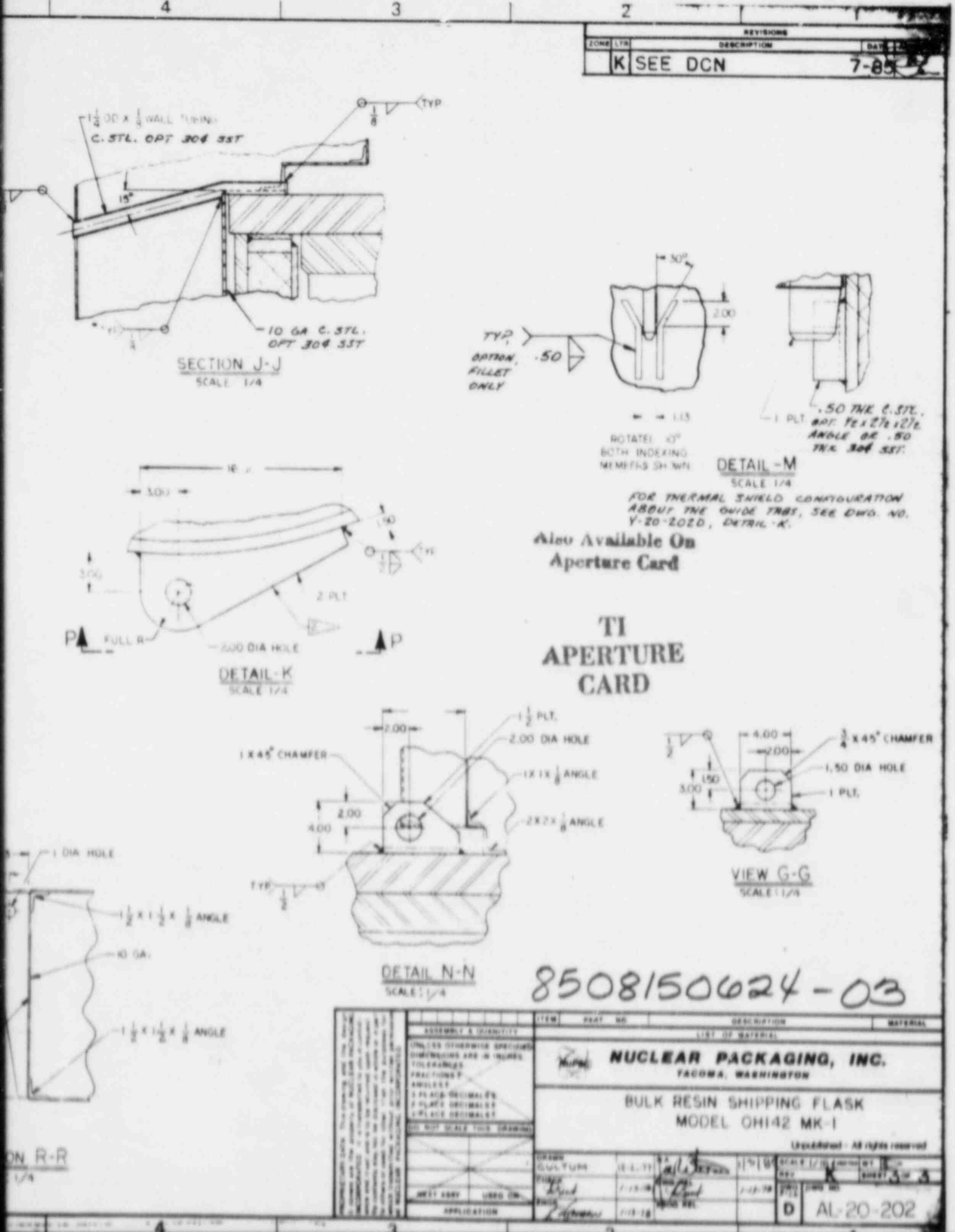


NOTES: UNLESS OTHERWISE SPECIFIED



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Also Available On Aperture Card

TI APERTURE CARD

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

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AUG 0 6 1985

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Document Management Branch, TIDC

FROM: Charles E. MacDonald, Chief
Transportation Certification Branch, FC, NMSS

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The following application and/or drawings marked "Proprietary/Copyrighted" should be placed in the NRC Public Document Room:

Nuclear Packaging, Inc. (NUPAC) application dated July 30, 1985.

Authorization:

NUPAC letter dated July 30, 1985.

Charles E. MacDonald, Chief
Transportation Certification Branch
Division of Fuel Cycle and
Material Safety, NMSS

Enclosure: NUPAC
ltr dtd 07/30/85