Calculation Cover Sheet (Cont.)

Calc. No: 91-E-0094-01 Unit: 1

Rev. No: 1 Verification Method: Design Review: X

Alternate Calculation: ____ Qualification Testing: ____

Pages Revised and/or Added: REVISED PG. 3, 4, 7 & 19; ADDED PG. 7a
REVISED ATTACHMENT 1 (17 PGS)

Purpose of Revision: TO QUALIFY UNIT-1 CONTROL RM. SLAB FOR 12 IBC CASK DROP W/ 27' SPAN.

Initiating Documents	Resulting Document(s)	Reference Calcs.
		11406-130 (CIVIL)

Amends Calc(s): CIVIL CALC. 11406-130

Supercedes Calc(s): ____

Computer Software(Ver.): ____

By: TONY DIB / TD / 9/19/91 Rvw'd: ____ / ____ / ____

Chk'd: KEITH BANKS / KB / 9/19/91 Apv'd: DOYLE G. ADAMS / DGA / 9 24 91

(Print Name) (Initials) (Date) (Print Name) (Initials) (Date)

Rev. No: ____ Verification Method: Design Review: ____

Alternate Calculation: ____ Qualification Testing: ____

Pages Revised and/or Added: ____

Purpose of Revision: ____

Initiating Documents	Resulting Document(s)	Reference Calcs.

Amends Calc(s): ____

Supercedes Calc(s): ____

Computer Software(Ver.): ____

By: ____ / ____ / ____ Rvw'd: ____ / ____ / ____

Chk'd: ____ / ____ / ____ Apv'd: ____ / ____ / ____

(Print Name) (Initials) (Date) (Print Name) (Initials) (Date)

Check If Additional Revisions ____

REV 4-26-89

Calculation Cover Sheet

Calc. No: 91-E0094-01
Calc. Title: 17 TON CASK DROP ANALYSIS FOR CONCRETE FLOOR ABOVE ANO-1 CONTROL ROOM

Unit: 1 Category: Q
System(s): —
Topic(s): STRU.
Calc. Type: C G.

Component No(s): —

Plt Area: Bldg. IAB Elev. 404
Room _____ Wall _____
Coordinates: _____

Abstract (Include Purpose/Results):

PURPOSE: TO EVALUATE / PERFORM 17 TON (712 mm) CASK DROP ANALYSIS, LIMITED TO 9" DROP FOR THE FLOOR ABOVE THE UNIT-1 CONTROL ROOM.

RESULTS: 1) THE FLOOR IS QUALIFIED FOR MAX. OF 3" DROP WITHOUT HEXAGONAL HONEYCOMB ENERGY OBSOB. MAT'L.
2) THE FLOOR IS QUALIFIED FOR 9" DROP WITH 3" OF HEXAGONAL HONEYCOMB ENERGY OBSOB. MAT'L. (260 PSI)

Rev. No: 0 Verification Method: Design Review: X
Alternate Calculation: ____ Qualification Testing: ____
Pages Revised and/or Added: ALL NEW PG 1 THRU 19

Purpose of Revision: SAME AS ABSTRACT.

Initiating Documents	Resulting Document(s)	Reference Calcs.
—	—	11406-130 (CIVIL)

Amends Calc(s): CIVIL CALC. 11406-130

Supercedes Calc(s): —

Computer Software (Ver.): —

By: Tony Dinh / TD / 5/8/91 Rvw'd: K E J Bolard / KEJB / 5-12-91
Chk'd: Kirby Bushong / KWB / 8/9/91 Apv'd: H. NUGENT / David E. Lind / HN / 8-9-91
(Print Name) (Initials) (Date)

Check if Additional Revisions: ____

APSL ARKANSAS NUCLEAR ONE

TABLE OF CONTENTS

PURPOSE:

To evaluate and perform shipping cask drop analysis for the concrete floor area above the ANO-1 Control Room, with and/or without hexagonal honeycomb, using the following data:

- Shipping cask diameter = 712 mm = 28"
- Shipping cask weight = 17 Ton, use 35 kips
- maximum drop = 9"

REFERENCES:

1) ACI 318-77

2) ACI 318-63

3) Topical Report BC-TOP-9A Rev. 2

1 4) Civil Calculation No. 88 Book 26, Pg. J23-J26 & J70-J73

5) Civil Calculation No. 11406-130

6) Reinforced Concrete Design by Wang & Salmon, Third Ed

7) Drawing No. C-206 Rev. 16

8) Drawing No. C-212 Rev. 9

9) AISC Eighth Edition

1 10) Design of Concrete Structures by Winter & Nilson

1 11) Calculation NO. 83-D-2200-11 Pg. 124 of 555

NOTES AND ASSUMPTIONS:

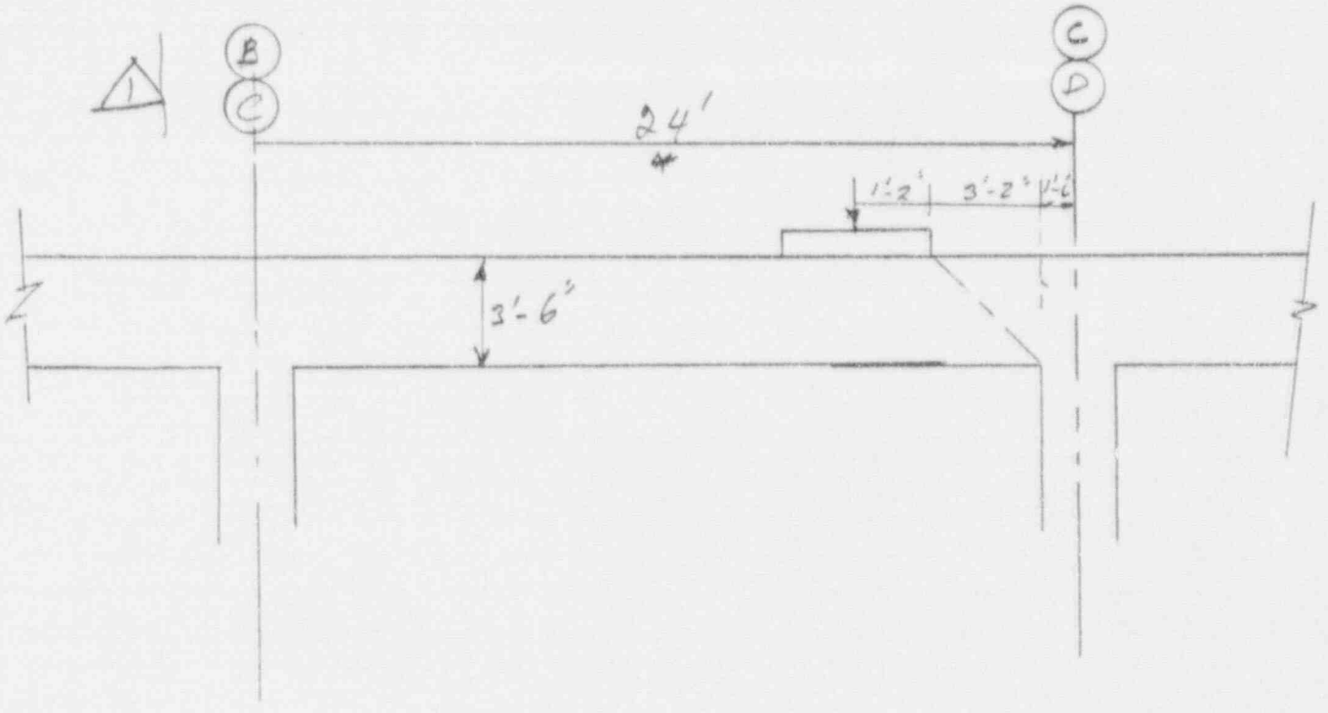
1 1) Shear is the governing factor based on calculation no. 88 (ref. # 4). The maximum shear stress will occur at a distance of on effective depth of the slab from the face of the wall if the cask drop at about 6'-0" from center of Column line C or Column line D.

1 2) f'_c = 4850 psi @ 28 days (Pour No. 517) (Ref. no. 11)
f'_c = 6230 psi @ 90 days (Pour No. 517) (Ref. no. 11)
f'_c = 6230 X 1.1 = 6850 psi @ 4 years (Ref. 10)
Use f'_c = 6500 psi @ 4 years (Conservative)
F_y = 48300 psi per mill test report (Ref. no. 5)

1 3) This calculation is to qualify the slabs between Column Lines A, B, C, D and Column Lines 4 and 5. Since the shear is the governing factor (see note 1) it is conservative to use the smaller span to calculate the maximum shear at a distance 6'-0" from the support. Therefore, use 24'-0" for span length (between Column line C and Column line D which is the most critical span) to qualify all the three referenced spans.

				Entergy Operations	CALCULATION NUMBER
					91-E-0094-01
1	9/19/91	TD		ARKANSAS NUCLEAR ONE	PAGE NUMBER 3 OF 19
REV.	DATE	BY	CHK'D		

CALCULATION:



- t = SLAB THIKNESS = 3'-6" = 42" (Ref # 7, 8)
- d = EFF. DEPTH = 38" (Ref # 7, 8)

- Critical location = 1'-6 + 3'-2 + 1'-2 = 5-10, use 6'-0"
- 3 # 11 / FT REINFORCING REBARS.
- # 5 STIRRUP @ 3'-10" IN E-W (Ref # 7, 8)
  @ 1'-0" IN N-S

1 * ACTUAL FOR (B-C), L = 27', SEE PG. 3 NOTE #3 FOR JUSTIFICATION

REV.	DATE	BY	CHK'D
1	9/19/91	TD	KWB
0	8/8/91	TD	KWB

Entergy Operations

ARKANSAS NUCLEAR ONE

CALCULATION NUMBER

91-E-0094-01

PAGE NUMBER 4 OF 19

CALCULATION:

I. EFFECTIVE WIDTH OF BEAM = B

$b = T + 2d$

T = Dim. OF CASK = 710 mm = 2'-4"

d: distance FROM EXTREME COMPRESSION FIBER TO the Centroid OF the tension reinforcing.

d = 3'-2"

$\therefore b = 2'-4 + 2(3'-2") = 8'-8" = 8.66'$

$= 104$ in

USING BC-TOP-9 (Ref #3 FORMULA 4-2)

$$I_a = \frac{1}{2}(I_g + I_c) = \frac{1}{2}\left(\frac{bt^3}{12} + Fbd^3\right)$$

where:

I_a = AVERAGE MOMENT OF INERTIA

I_g = MOMENT OF INERTIA OF GROSS Concrete

t = THICK. OF The BEAM = 42" = 3.5' (FLOOR)

F = COEFFICIENT FOR MOMENT OF INERTIA OF CRACKED SECTION w/ Tension reinforcing only.

				Entergy Operations	CALCULATION NUMBER
					91-E-0094-01
0	8/8/91	TD	KDB	ARKANSAS NUCLEAR ONE	PAGE NUMBER 5 OF 19
REV.	DATE	BY	CHK'D		

CALCULATION: (Cont.)

$$\rho = \frac{A_s}{bd} \quad (\text{Ref \# 1; chapter 8})$$

where A_s = Area of Tensile reinforcing steel/Ft.
3 # 11 = 3 x 1.56 (PG-4)

$$\rho = \frac{3 \times 1.56}{12 \times 38} = 0.010263$$

$$E_c = w^{1.5}\, 33\sqrt{f'_c} \quad (\text{Ref \# 1, 8.5.1})$$

$$E_c = (145)^{1.5}\, 33\sqrt{4850} = 4012699 \text{ PSI.}$$

$$E_s = 29 \times 10^6 \text{ PSI}$$

$$n = \frac{E_s}{E_c} = \frac{29000.000}{4012699} = 7.23$$

USE $n = 7$

FROM FIG. 4-1 OF BC-TOP-9 (Ref-# 3)

$(\rho = .010263, n = 7) \Rightarrow F = 0.045$

$$\therefore I_a = \tfrac{1}{2}\left(\frac{104(42)^3}{12} + .045 \times 104 \times 38^3\right)$$

$$I_a = \tfrac{1}{2}(642096 + 256801$$

$$I_a = 449498.14$$

REV.	DATE	BY	CHK'D	Entergy Operations ARKANSAS NUCLEAR ONE	CALCULATION NUMBER	
					91-E-0094-01	
0	8/8/91	TD	KDH		PAGE NUMBER	6 OF 19

CALCULATION (cont.)

$M_u = \Phi [A_s f_y (d - a/2)$ (Ref # 6, EQ. 3.3.4)

$\Phi = 0.90$

$a = \frac{A_s f_y}{.85 f'_c b} = \frac{3 \times 1.56 \times 8.66 \times 48.3}{.85 \times 4.85 \times 8.66 \times 12}$

$a = 4.569$ in

$M_u = 0.9\left[3 \times 1.56 \times 8.66 \times 48.3 \left(38 - \frac{4.569}{2}\right)\right] \times \frac{1}{12}$

$= 5243.6$ K'

1 P_u = (SEE PG. 7a FOR EQUATION)

$P_u = \frac{24}{6 \times 18}\left[5243.6 - \frac{1}{2} \times 8.66 \times 3.5 \times .15 \times 18 (24 - 18)\right]$ (MDW) (Ref 9)

$= 1165.2 - 54.56 = 1110.64$ K

P_o equiv FOR DW = 54.56 K

$\Delta_u = \frac{P a^2 b^2}{3 E_c I \ell} + \Delta_o$ (Ref # 9)

$\Delta_o = \frac{W_o}{24 E_c I}(\ell^3 - 2\ell a^2 + a^3)$ (Ref 9)

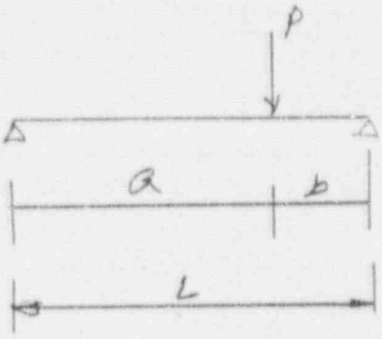
$\Delta_o = \frac{8.66 \times 3.5 \times .15 \times 6}{24 \times 4012.699 \times 449048}\left[(24)^3 - 2 \times 24 \times 6^2 + 6^3\right](12)^3$

$\Delta_o = 0.0134$ in

REV.	DATE	BY	CHK'D	Entergy Operations / ARKANSAS NUCLEAR ONE	CALCULATION NUMBER	
					91-E-0094-01	
1	9/19/91	TD	[illegible]		PAGE NUMBER	7 OF 19
0	8/8/91	TD	[illegible]			

Calculating Pu

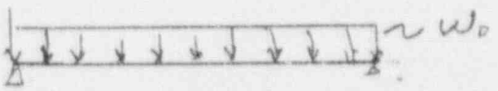
CASE (1)



$$M_u = \frac{P a \times b}{L}$$

$$\Rightarrow P = \frac{M_u L}{a b}$$

CASE (2)



$W_o = B \times H \times .15$

$W = 8.66' \times 3.5' \times .15\ k/ft^2$

M @ dist. a

$$M_a = \frac{w \times a}{2}(L-a) = P_{eq} \times \frac{a \times b}{L}$$

P_u = Case I − CASE 2

$$= \frac{M_u L}{a \times b} - \frac{1}{2} w \times a (L-a) \times \frac{L}{a \times b}$$

$$P_u = \frac{L}{a \times b}\left[M_u - \frac{1}{2} w \times a (L-a)\right]$$

$$\therefore P_u = \frac{24}{6 \times 18}\left[5243.6 - \frac{1}{2} \times 8.66 \times 3.5 \times .15 \times 18 (24-18)\right]$$

This EQ is used on Pg. 7

REV.	DATE	BY	CHK'D	Entergy Operations ARKANSAS NUCLEAR ONE	CALCULATION NUMBER	
					91-E-0094-01	
1	9/19/91	JD	[illegible]		PAGE NUMBER	7a OF 19

CALCULATION: (Cont.)

$$\therefore \Delta u = \frac{1110.6 \times (6 \times 18)^2 (12)^3}{3 \times 4012.699 \times 449448 \times 24} + .0134$$

$$\Delta u = .186$$

II MAX. SHEAR CAPACITY

a) SHEAR CARRIED BY CONCRETE:

$$V_c = \phi\left(1.9\sqrt{f'_c} + 2500\rho\frac{Vd}{m}\right) bd \quad \left(\begin{matrix}\text{Ref \#1}\\ \text{eq. 11-6}\end{matrix}\right)$$

where $\frac{Vd}{m} = 1$ (Ref # 1, section 11)

$$V_C = .85\left(1.9\sqrt{6500} + 2500 \times .010263\right)(104 \times 38)$$

$$V_C = 600{,}760 \text{ lb} < 3.5\sqrt{f'_c} \times bd = 1{,}115{,}171 \text{ lb ok}$$

(Ref # 1, eq. 11-6)

$\therefore V_C = 600.76$ kips

b) SHEAR CARRIED BY WEB REINFORCEMENT

(#5 STIRRUP @ 3'-10" IN E-W, 1'-0" IN N-S.) $\Rightarrow A_V = .31 \text{ in}^2$

$$V'_c = \phi\frac{A_v f_y}{b_w s} bd \quad (\text{Ref \# 6, 5.10.7})$$

REV.	DATE	BY	CHK'D	Entergy Operations ARKANSAS NUCLEAR ONE	CALCULATION NUMBER	
					91-E-0094-01	
0	8/8/91	TD	KDR		PAGE NUMPER	8 OF 19

CALCULATION (CONT.)

$$V'c = .85 \times \frac{.31 \times 48300}{46" \times 12} \times 104 \times 38 = 91118^{\#} = 91.1^{K}$$

$$V_{max} = V_c + V'c = 600.76 + 91.1 = 691.86^{K}$$

$$P_s MAX \frac{\times 18}{24} + \frac{1}{2} \times 24 \times 8.66 \times 3.5 \times .15 - 4.7 \times 8.66 \times 3.5 \times .15 = 691.86^{K}$$

(ref 9)

* dist. d FROM THE EDGE = 1'-6" + 38" = 56" = 4.7'

$$P_{S\,MAX} \times \frac{18}{24} + 33.2 = 691.86^{K}$$

$$P_S = 878.2 \text{ KIPS.}$$

FOR $P = 1110.64^{K} \Rightarrow \Delta = .186"$

$P = 878.2^{K} \Rightarrow \Delta = \frac{878.2}{1110.64} \times .186 = .147"$

$P = 54.56^{K} \Rightarrow \Delta = .0134$

CHECK BOND STRESS @ FACE OF COLUMN

$$u_u = \frac{V}{(N \pi d_b) jd} \leq \frac{9.5\sqrt{f'c}}{d_b} \leq 800 \text{ PSI} \quad \left(\text{Refs } \begin{cases} (6.3.2) \\ 6.4.2 \\ 9, \text{TABLE } 6.9.2 \end{cases}\right)$$

N = NO. OF BARS
d_b = DIA. OF BAR

dist. d FROM THE FACE

$$u_u = \frac{691.86 + 3.5 \times 8.66 \times 3.2 \times .15 \times 1000}{(3 \times \pi \times 1.41)(.852 \times 38)(846)} = 189.6 \text{ PSI}$$

$$< \frac{9.5\sqrt{4500}}{1.41} = 543.2^{PSI}$$

OK

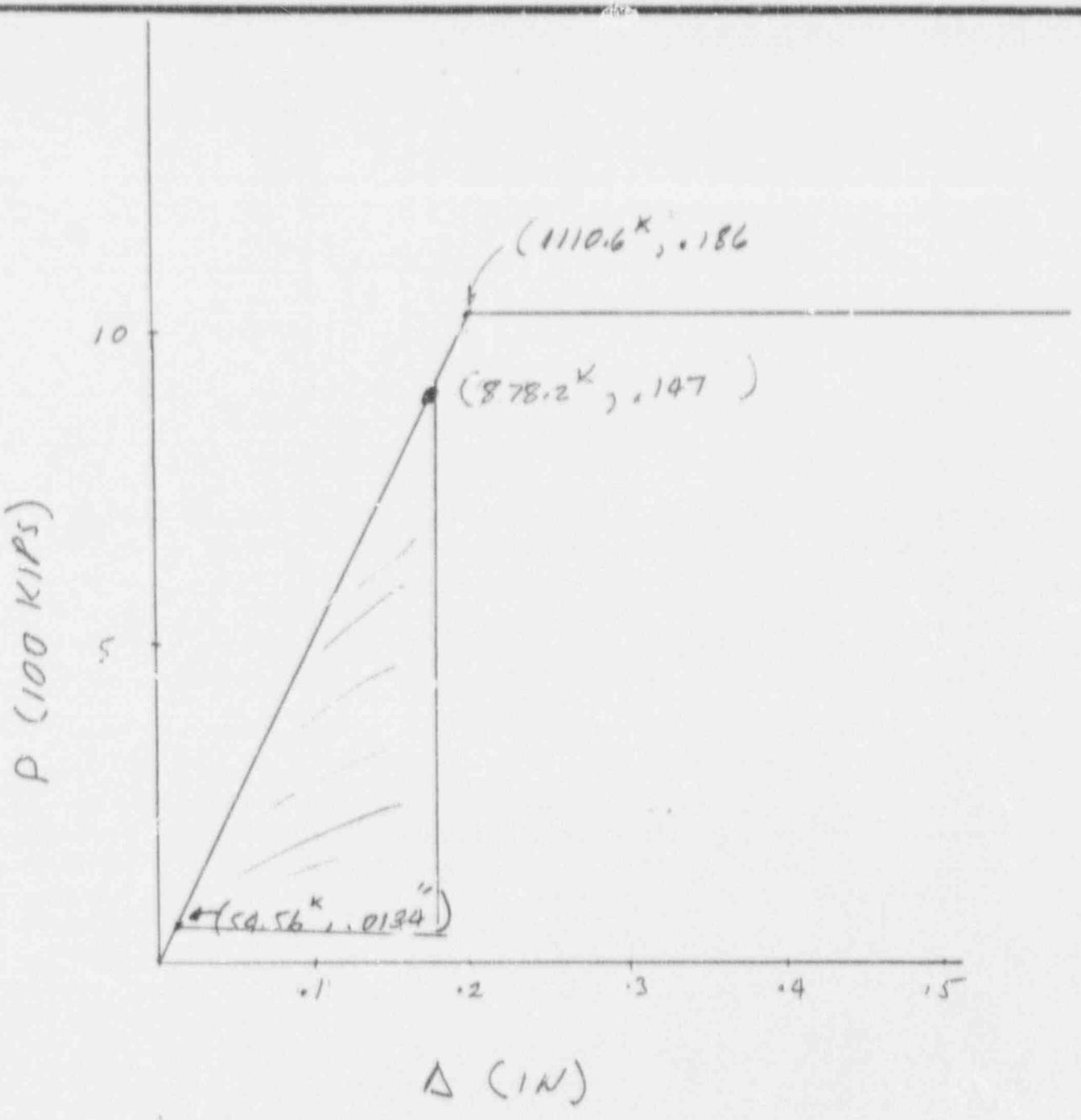
REV.	DATE	BY	CHK'D
0	8/8/91	TD	KMB

Entergy Operations

ARKANSAS NUCLEAR ONE

CALCULATION NUMBER: 91-E-0094-01

PAGE NUMBER: 9 OF 19



REV.	DATE	BY	CHK'D	Entergy Operations ARKANSAS NUCLEAR ONE	CALCULATION NUMBER	
					91-E-0094-01	
0	8/8/91	TD	KDR		PAGE NUMBER	10 OF 19

CALCULATION (CONT.)

II ALLOWABLE HEIGHT OF DROP

$V_s^2 = 29h$ (Ref # 3)

Where

V_s = CASK STRIKING VELOCITY

h = MAX. HEIGHT

$M_m = \frac{35^k}{g}$ = MASS OF CASK

M_e = Average effective MASS

$= \frac{\gamma_c T}{g}(D_x + 2T)(D_y + 2T)$ (Ref #3 Eq. 3-15)

Since THE CASK IS CIRCLE

$\Rightarrow M_e = \frac{\gamma_c T}{g}\left(\frac{\pi (D+2T)^2}{4}\right)$

where

γ_c = Weight per unit volume OF Concrete = .15 K/ft²

T = Thickness OF FLOOR

$M_e = \frac{.15 \times 3.5}{g} \times \frac{\pi}{4}(2.33+7)^2 =$

$M_e = \frac{35.92}{g}$

				Entergy Operations	CALCULATION NUMBER
					91-E-0094-01
2	8/8/91	TD	K.DHZ	ARKANSAS NUCLEAR ONE	PAGE NUMBER 11 OF 19
REV.	DATE	BY	CHK'D		

CALCULATION (CONT.)

$$E_s = \frac{M_m^2 V_s^2}{2(m_m + m_c)}$$ Ref # 3 (EQ. 3-8)

E_s = STRAIN ENERGY = Σ KINETIC ENERGY

$$E_s = \frac{\left(\frac{35}{9}\right)^2 (29h)}{2\left(\frac{35}{9} + \frac{35.9}{9}\right)} = \frac{1}{2}(878.2 - 54.56)(0.147 - .0134)$$

$$= \frac{\frac{1225}{9^2} \times 29h}{2\left(\frac{70.9}{9}\right)} = 55$$

$$= 17.278h = 55$$

$$\Rightarrow h = 3.2''$$

∴ HONEYCOMB ENERGY ABSORPTION MAT. IS REQUIRED FOR 9" DROP.

III CALCULATE THE REQUIRED THICKNESS OF HEXCELL HONEYCOMB:

REV.	DATE	BY	CHK'D	Entergy Operations ARKANSAS NUCLEAR ONE	CALCULATION NUMBER	
					91-E-0094-01	
0	8/8/91	TD	KDB		PAGE NUMBER	12 OF 19

CALCULATION

$K.E. = F_{cr} A (.7) t_c$ (R of #5) PG-20 [1]

USE $F_{cr} = 260$ PSI

$\Rightarrow K.E. = \frac{M_m V_s^2}{2}$

$t_c = \frac{\frac{1}{2}\left(\frac{35000}{g}\right)(2)(9)(9)}{260\ (28)^2 \left(\frac{\pi}{4}\right)(.7)}$

$t_c = 2.80''$ USE 3" Lm

REV.	DATE	BY	CHK'D	Entergy Operations ARKANSAS NUCLEAR ONE	CALCULATION NUMBER	
1	9/19/91	TD	VJS		91-E-0094-01	
0	8/8/91	TD	KWB		PAGE NUMBER	13 OF 19

CALCULATION (CONT.)

SUMMARY OF STRESSES FOR 17.5 TON CASK DROP

DATA: f'_c = 6500 PSI @ 4 YEARS

f_y = 48,300 PSI (MILL CERTIFICATE)

CRITICAL DROP LOCATION: 6'-0" FROM THE END SUPPORT WHICH GIVES MAX. FAILURE SHEAR

(1) BASED ON 3" DROP WITH NO HEXCELL

- MAX. SHEAR FORCE AND SAFETY FACTOR

$$E_s = \frac{M_m^2 V_s^2}{2(M_m + M_c)} = \tfrac{1}{2}(P - 54.56)(\Delta_p - .0134) \quad (\text{PG. 11, 14})$$

$$M_m = \frac{35}{g}$$

$$V_s^2 = 29h$$

$$M_c = \frac{35.92}{g}$$

$$\Rightarrow \frac{\left(\frac{35}{g}\right)^2 * 29(3)}{2\left(\frac{25}{g} + \frac{35.9}{g}\right)} = \tfrac{1}{2}\left(P - 54.56\right)\left(\frac{P}{1110.69}(.186) - .0134\right)$$

$$51.83 = \frac{.186}{2221.3}P^2 - \frac{25}{2221.3}P + \frac{812}{2221.3}$$

$$0.186P^2 - 25P - 114318 = 0$$

REV.	DATE	BY	CHK'D	Entergy Operations ARKANSAS NUCLEAR ONE	CALCULATION NUMBER	
					91-E-0094-01	
0	8/8/91	TD	KDE		PAGE NUMBER	14 OF 19

CALCULATION (cont.)

$$P = \frac{25 + \sqrt{(25)^2 + 4(.186)(114318)}}{2(.186)}$$

$P = 854$ KIP

V_{max} = shear @ 28" FROM FACE OF WALL

$$V_{max} = \frac{18}{24}(854) + \frac{1}{2}(24)(8.66)(3.5)(.15) - 4.7 \times 8.66 \times 3.5 \times .15$$

$V_{max} = 673.7^{k}$

ALLOWABLE COMBINED SHEAR CAPACITY OF CONCRETE & WEB REINFOREMENT = 691.86 (PG 9)

SAFETY FACTOR : $\frac{691.86}{673.7} = \underline{1.027}$

— MAX. MOMENT AND SAFETY FACTOR

M AT DROP POINT = MAX. moment

$$M = \frac{854 \times 18 \times 6}{24} + (\tfrac{1}{2})(8.66 \times 3.5 \times .15 \times 18(24-18)$$

$$= 3843 + 245.5 = 4088.5\ k'$$

ALLOW. moment CAPACITY = 5243.6 k' (PG 7)

SAFETY FACTOR = $\frac{5243.6}{4088.5} = \underline{1.282}$

				Entergy Operations	CALCULATION NUMBER
					91-E-0094-01
0	8/6/91	TD	KDB	ARKANSAS NUCLEAR ONE	PAGE NUMBER 15 OF 19
REV.	DATE	BY	CHK'D		

CALCULATION (CONT.)

- BOND STRESS: (@ FACE OF WALL)

$$u_u = \frac{V}{N \pi d_b j d}$$

$$V = \frac{18}{24}(.854) + \tfrac{1}{2}(24)(8.66)(3.5)(.15) - 1.5 \times 8.66 \times 3.5 \times .15$$

$$V = 688.23^{K.I.P}$$

$$u_u = \frac{688.23 \times 1000}{3 \times \pi \times 1.41 \times 8.66 \times .852 \times 38} = 184.7 \text{ PSI}$$

$$\text{ALLOW. } u = \frac{9.5\sqrt{f'_c}}{d_b} = \frac{9.5\sqrt{6500}}{1.41} = 543.2 \text{ PSI}$$ (PG. 9)

$$\text{SAFETY FACTOR} = \frac{543.2}{184.7} = \underline{\underline{2.94}}$$

REV.	DATE	BY	CHK'D	Entergy Operations ARKANSAS NUCLEAR ONE	CALCULATION NUMBER	
					91-E-0094-01	
0	8/8/91	TD	[illegible]		PAGE NUMBER	16 OF 19

CALCULATION (cont.)

(2) BASED ON 9" DROP W/ 3" THICK f_{cr} = 250 PSI HEXCELLS

K.E. = f_{cr} A x.7 tc

$$f_{cr} = \frac{KE}{A \times .7\, tc}$$

$$K.E = \frac{M_m V_s^2}{2} = \frac{1}{2} \times \frac{35000}{9} (2)\, 9(9)$$

KE = 315000 k-in

$$f_{cr} = \frac{315000}{(28)^2 \frac{\pi}{4} \times .7 \times 3} = 243.6 \text{ PSI} < 250 \text{ PSI}$$

$$P = 250 \times (28)^2 \times \frac{\pi}{4} = 160095^{\#} = 160.1^{K}$$

- MAX. SHEAR FORCE AND SAFETY FACTORS.

V @ 38" FROM FACE OF WALL = V_{max}

$$V_{max} = \frac{18}{20}(160.1) + \frac{1}{2}(24)(8.66)(3.5)(.15) - 4.7 \times 8.66 \times 3.5 \times .15$$

$$= 153.26$$

ALLOW. combined shear CAPACITY = 691.86 (PG 9)

$$\text{SAFETY FACTOR} = \frac{691.86}{153.26} = \underline{\underline{4.51}}$$

				Entergy Operations	CALCULATION NUMBER
					91-E-0094-01
0	8/8/91	TD	KDB	ARKANSAS NUCLEAR ONE	PAGE NUMBER 17 OF 19
REV.	DATE	BY	CHK'D		

CALCULATION (cont.)

- MAX. MOMENT AND SAFETY FACTOR:

M_{max} @ DATA Pt.

$$M_{max} = \frac{160.1 \times 18 \times 6}{24} + \frac{1}{2} \times 8.66 \times 3.5 \times .15 \times 18 (24-18)$$

$$M_{max} = 965.96 \text{ K}'$$

ALLOW. MOMENT CAPACITY = 5243.6 K' (PG 7)

$$\text{SAFETY FACTOR} = \frac{5243.6}{965.96} = \underline{\underline{6.42}}$$

(C) BOND STRESS

$$u = \frac{V}{n \pi d_b j d}$$

$$V = \frac{18}{24}(160.1) + \frac{1}{2} \times 24 \times 8.66 \times 3.5 \times .15 - 1.5 \times 8.66 \times 3.5 \times .15$$

$$V = 167.813 \text{ K}$$

$$u = \frac{167813}{3 \times \pi \times 1.41 \times 8.66 \times .852 \times 38} = 45.0 \text{ PSI}$$

ALLOW BOND STRESS = 543.2 PSI (PG. 9)

$$\text{SAFETY FACTOR} = \frac{543.2}{45.0} = \underline{\underline{12.06}}$$

REV.	DATE	BY	CHK'D	Entergy Operations ARKANSAS NUCLEAR ONE	CALCULATION NUMBER	
					91-E-0094-01	
0	3/8/91	TD			PAGE NUMBER	18 OF 19

CONCLUSION:

Drop evaluation summaries for the 17 Ton handling cask (28" diameter) at elevation 404 (Over the U-1 Control Room) are listed below:

CASE-I - A drop evaluation for 3" travel height with no hexagonal honeycomb.

CASE-II - A drop evaluation for 9" travel height with 3" of hexagonal honeycomb.

	CASE-I		CASE-II	
$\frac{\text{Shear Capacity}}{\text{Shear Computed}}$	$= \frac{691.86 \text{ kips}}{673.0 \text{ kips}}$	$= 1.027$;	$\frac{691.86 \text{ kips}}{153.26 \text{ kips}}$	$= 4.51$
$\frac{\text{Moment Capacity}}{\text{Moment Computed}}$	$= \frac{5243.6 \text{ kip-ft}}{4088.5 \text{ kip-ft}}$	$= 1.282$;	$\frac{5243.6 \text{ kip-ft}}{966.0 \text{ kip-ft}}$	$= 5.42$
$\frac{\text{Bond Stress Capacity}}{\text{Bond Stress Computed}}$	$= \frac{543.20 \text{ psi}}{184.7 \text{ psi}}$	$= 2.94$;	$\frac{543.20 \text{ psi}}{45.0 \text{ psi}}$	$= 12.06$
$\frac{\text{Development Length Provided (Ref. \# 5)}}{\text{Development Length Required (Ref. \# 5)}}$	$= \frac{33 \text{ in.}}{30 \text{ in.}}$	$= 1.10$;	$\frac{33 \text{ in.}}{30 \text{ in.}}$	$= 1.10$