The Light company
Houston Lighting & Power

P.O. Box 1700 Houston, Texas 77001 (713) 228-9211

September 29, 1988
ST-HL-AE-2795
File No.: G20.02.01, M20.1
10CFR50

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

South Texas Project Electric Generating Station
Units 1 and 2
Docket Nos. STN 50-498, STN 50-499
Revised Spacing of the
High Density Spent Fuel Racks

Reference (1): HL&P Letter to USNRC, ST-HL-AE-2417, dated March 8, 1988; Expansion of the Spent Fuel Pool Storage Capacity Using High Density Spent Fuel Racks.

(2): HL&P Letter to USNRC, ST-HL-AE-2738, dated August 10, 1988; Summary of Meeting on July 11 & 12, 1988 to discuss High Density Spent Fuel Racks.

(3): HL&P Letter to USNRC, ST-HL-AE-2750, dated August 9, 1988; Summary of NRC Technical Audit of U. S. Tool & Die, Inc. on July 20 to 21, 1988.

(4): HL&P Letter to USNRC, ST-HL-AE-2756, dated August 19, 1988; Response to NRC Questions.

(5): HL&P Letter to USNRC, ST-HL-AE-2764, dated August 30, 1988; Revised Responses to NRC Questions.

(6): HL&P Letter to USNRC, ST-HL-AE-2775, dated September 21, 1988; Response to Additional NRC Questions in August 22, 1988 meeting.

(7): HL&P Letter to USNRC, ST-HL-AE-2790, dated September 22, 1988; Response to Additional NRC Questions

In discussions between the NRC, Houston Lighting & Power (HL&P), Bechtel Energy Corporation (BEC), and U.S. Tool & Die, Inc. (UST&D) during the week of September 19-23, 1988, it has been determined that the high density spent fuel storage racks will be installed with one (1) inch minimum gap between

L4/NRC/cj

B021
1/1

adjacent racks. Analyses have been performed, as described in the above referenced correspondence, incorporating a one (1) inch rack-to-rack gap in the specific multi-rack analyses. The analyses show there is no rack-to-rack interaction at this spacing.

Accordingly, the licensing submittal (reference 1) has been annotated to incorporate the one (1) inch installation criteria. The annotated pages to the licensing submittal as well as the FSAR are provided in Attachments 1 and 2. The UST&D documents which were previously submitted, shall be revised as required and forwarded to the NRC by October 14, 1988. Attachment 3 provides tables summarizing data from the analyses performed.

If you should have any questions on this matter, please contact Mr. A. W. Harrison at (512) 972-7298.

M. A. McBurnett
Manager,
Operations Support Licensing

RLE/hg

Attachments: (1) Annotated Revisions to the High Density Spent Fuel Racks Safety Analysis Report
(2) Annotated Revision to Section 9.1 of the Final Safety Analysis Report
(3) Summary Tables for Analyses Results

cc:

Regional Administrator, Region IV
Nuclear Regulatory Commission
611 Ryan Plaza Drive, Suite 1000
Arlington, TX 76011

George Dick, Project Manager
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Jack E. Bess
Senior Resident Inspector/Operations
c/o U.S. Nuclear Regulatory
Commission
P. O. Box 910
Bay City, TX 77414

J. I. Tapia
Senior Resident Inspector/Construction
c/o U.S. Nuclear Regulatory
Commission
P. O. Box 910
Bay City, TX 77414

J. R. Newman, Esquire
Newman & Holtzinger, P.C.
1615 L Street, N.W.
Washington, DC 20036

R. L. Range/R. P. Verret
Central Power & Light Company
P. O. Box 2121
Corpus Christi, TX 78403

R. John Miner (2 copies)
Chief Operating Officer
City of Austin Electric Utility
721 Barton Springs Road
Austin, TX 78704

R. J. Costello/M. T. Hardt
City Public Service Board
P. O. Box 1771
San Antonio, TX 78296

Rufus S. Scott
Associate General Counsel
Houston Lighting & Power Company
P. O. Box 1700
Houston, TX 77001

INPO
Records Center
1100 Circle 75 Parkway
Atlanta, GA 30339-3064

Dr. Joseph M. Hendrie
50 Bellport Lane
Bellport, NY 11713

Revised 08/24/88

L4/NRC/cj

ATTACHMENT # 1

ANNOTATED REVISIONS TO THE HIGH
DENSITY SPENT FUEL RACKS
SAFETY ANALYSIS REPORT
(REFERENCE 1, ATTACHMENT 3)

LA/NRC/cj

B. The racks are designed to meet the nuclear requirements of ANSI N210-1976. The maximum effective multiplication factor, k_{eff}, in the spent fuel pool is less than or equal to 0.95, including all uncertainties and under all credible conditions.

C. The racks are designed to allow coolant flow so boiling in the water channels between the fuel assemblies in the rack does not occur. Maximum fuel cladding temperatures are calculated for various pool cooling conditions as described in Section 5.3.

D. The racks are designed to Seismic Category I requirements and are classified as ANS Safety Class 3 and ASME Code Class 3 Component Support Structures. The structural evaluation and seismic analyses are performed using the specified loads and load combinations in Section 6.3.

E. The racks are designed to withstand loads which may result from fuel handling accidents and from the maximum uplift force of the fuel handling crane without violating the criticality, k_{eff}, acceptance criteria.

F. The high density racks are engineered to achieve the dual objective of maximum protection against structural loadings (arising from ground motion, thermal stresses, etc.) and the maximization of available storage locations. In general, a greater width-to-height aspect ratio provides greater margin against rigid body tipping. Hence, the modules are made as large as possible within the constraints of transportation and site handling capabilities.

G. Each storage position in the racks is designed to support and guide the fuel assembly in a manner that will minimize the possibility of applying excessive lateral, axial and bending loads to fuel assemblies during fuel assembly handling and storage.

H. The racks are designed to preclude the insertion of a fuel assembly in other than design locations within the rack array. For Region 1 racks, this is accomplished by the close spacing of storage cells. The Region 1 design incorporates a water box on all four sides of each storage cell except on the periphery of the pool. The water box width is less than 2 inches which precludes inadvertently placing a fuel assembly in the water box space. For the Region 2 storage racks, there is no space between storage locations since the cells are welded directly to each other. Also, ~~there is no gap between the fuel racks and a fuel assembly could not be inadvertently placed between the various rack modules.~~ Therefore, a fuel assembly can only be inserted in designated storage locations. Refer to Figures 3.4 and 3.5 for the Region 1 and Region 2 cell dimensions and spacing, respectively.

the installed gap between the fuel racks is not sufficient to allow a fuel assembly to be inadvertantly placed between the various rack modules.

C. The local flexibility of the rack to support interface is modeled conservatively in the analysis.

D. The rack pedestals may slide or lift-off the pool floor.

E. The pool floor has a specified time-history of seismic accelerations along the three orthogonal directions.

F. Fluid coupling between rack and fuel is simulated by including appropriate terms in the hydrodynamic mass matrix.

G. Potential impacts between rack and fuel are accounted for by appropriate "compression only" gap elements between masses involved.

H. Fluid damping between rack and fuel, and between rack and pool wall is ~~considered.~~ conservatively neglected

I. The supports are modeled as "compression only" elements for the vertical direction and as "rigid links" for dynamic analysis. The bottom of a support leg is attached to a frictional element as described in Section 6.5.2.2.2. The cross-section inertial properties of the support legs are computed and used in the final computations to determine support leg stresses.

J. The effect of sloshing is neglected.

K. The racks will be installed with ~~no rack to rack~~ a one-inch rack-to-rack gap. Rack-to-rack hydrodynamic coupling is not modeled because very strong hydrodynamic coupling forces cause the racks to move together.

L. The form drag opposing the motion of the fuel in the storage locations is conservatively neglected in the results reported herein.

M. The form drag opposing the motion of the fuel rack in the water is also conservatively neglected in the results reported herein.

N. The analysis is non-linear to account for potential impacts between the fuel and storage cell walls during seismic events.

Figure 6-12 shows a schematic of the model. Eight degrees-of-freedom are used to track the motion of the rack structure. This includes six horizontal, one vertical, and one rotational degree of freedom. Figure 6-12 shows the fuel/storage cell impact springs.

The production run model for simulating fuel motion incorporates six lumped masses.

The solution procedure described in the following is implemented in computer code RACKOE which is a validated computer code under UST&D's QA program.

ATTACHMENT 1
ST-HL-AE-2795
PAGE 3 OF 4

for one-stick models. Thus, with ground accelerations specified every 0.01 seconds, a calculational time step of 0.001 seconds is usually sufficient. However, smaller time steps are often necessary for multi-stick models. It should be noted that using the updated velocity to find the displacement (instead of the velocity from the previous time interval) improves the numerical stability.

F. Steps 1 through 5 are now repeated using the velocities, displacements, and ground accelerations for the n+1 time step.

6.5.2.4.2 Evaluation of Potential for Inter-Rack Impact

All racks are installed with ~~no~~ a one-inch rack-to-rack gap. The racks move together because of the very strong hydrodynamic coupling forces.

6.6 STRUCTURAL ACCEPTANCE CRITERIA

6.6.1 Spent Fuel Pool

6.6.1.1 Criteria

Refer to Section 3.8.4.5 of the South Texas Project FSAR (Reference 1) for the structural acceptance criteria for the Fuel Handling Building (and integral spent fuel pool).

6.6.1.2 Material Properties

Refer to Section 3.8.3.6 of Reference 1 for the materials and the material properties, quality controls, and special construction techniques used for the Fuel Handling Building (and integral spent fuel pool).

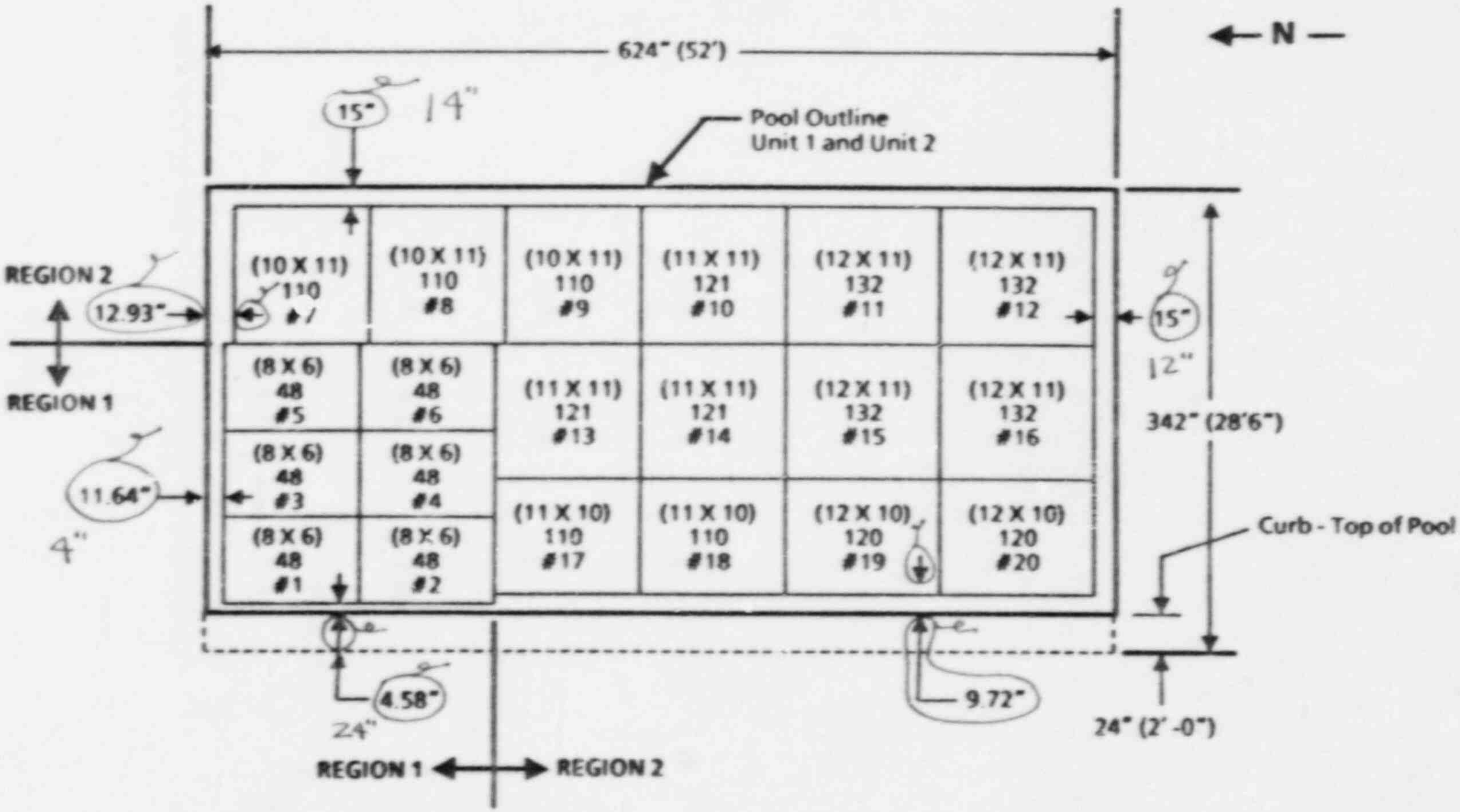
6.6.1.3 Results

Results of the spent fuel pool structural analyses are:

A. Spent Fuel Pool Floor - Conservative combinations of factored normal operating and faulted loads were used to analyze the pool structure. The intent was to maximize the effects of the thermal loads and OBE and SSE rack loads. Based upon these conservative combinations, the strength of the pool floor has not been exceeded. For the primary load case without thermal effects, only a small percentage of the strength of the pool floor was used indicating that the thermal effects dominate.

High Density Spent Fuel Storage Racks
South Texas Electric Generating Station
Houston Lighting & Power Company

ATTACHMENT 1
ST-HL-AE-2795
PAGE 4 OF 4



Region 1 F.A. Storage = 288
Region 2 F.A. Storage = 1681
Total F.A. Storage = 1969

Figure 3-1

SPENT FUEL POOL RACK LAYOUT
(TYPICAL UNIT 1 OR UNIT 2)

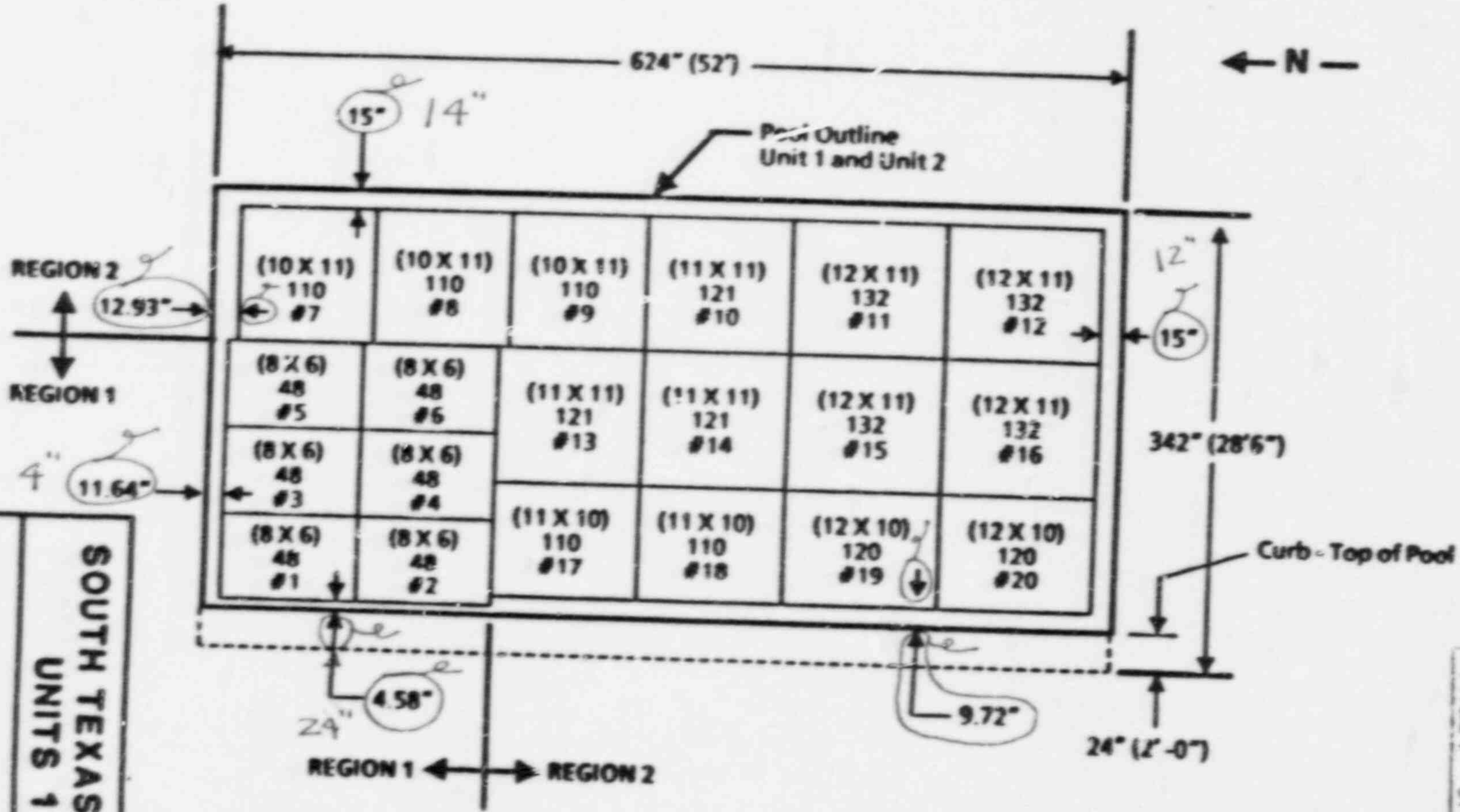
(Reference FSAR Figure 9.1.2-2)

* Dimensions from the racks to the edge of the pool are minimums

ATTACHMENT # 2

ANNOTATED REVISION TO SECTION 9.1 OF THE
FINAL SAFETY ANALYSIS REPORT

L4/NRC/cj



Region 1	F.A. Storage =	288
Region 2	F.A. Storage =	1681
Total	F.A. Storage =	1969

* Dimensions from the racks to the edge of the pool are minimums

SOUTH TEXAS PROJECT
UNITS 1 & 2

HIGH DENSITY
SPENT FUEL RACKS

Figure 9.1.2-2

ATTACHMENT 3
ST-HL-AE-2795
PAGE 1 OF 1

ATTACHMENT # 3

SUMMARY TABLES FOR ANALYSES RESULTS

L4/NPC/cj

TABLE 1

SPENT FUEL RACK DATA

Region	Rack Module Number	Storage Cells Per Module	Array Size*
1	1	48	8 x 6
1	2	48	8 x 6
1	3	48	8 x 6
1	4	48	8 x 6
1	5	48	8 x 6
1	6	48	8 x 6
2	7	110	10 x 11
2	8	110	10 x 11
2	9	110	10 x 11
2	10	121	11 x 11
2	11	132	12 x 11
2	12	132	12 x 11
2	13	121	11 x 11
2	14	121	11 x 11
2	15	132	12 x 11
2	16	132	12 x 11
2	17	110	11 x 10
2	18	110	11 x 10
2	19	120	12 x 10
2	20	120	12 x 10

* The array size indicates the number of storage cells in the N-S direction x the number of cells in the E-W direction.

Note: This is the same table as Table 3.2 in Reference 1.

L4/NRC/cj

TABLE 2

RACK MODULE DIMENSIONS AND WEIGHTS

Rack Module Number	Nominal Cross-Section Dimensions (inches) N-S	E-W	Estimated Dry Weight (lbs) Per Module	Estimated Dry Weight (lbs)per Module with Single Density Fuel
1	88	66	26,100	114,516
2	88	66	26,100	114,516
3	88	66	26,100	114,516
4	88	66	26,100	114,516
5	88	66	26,100	114,516
6	88	66	26,100	114,516
7	91	101	23,040	225,660
8	91	101	23,040	225,660
9	91	101	23,040	225,660
10	101	101	25,220	248,102
11	110	101	27,400	270,544
12	110	101	27,220	270,364
13	101	101	25,400	248,282
14	101	101	25,400	248,282
15	110	101	27,600	270,744
16	110	101	27,420	270,564
17	101	91	23,200	225,820
18	101	91	23,200	225,820
19	110	91	25,200	246,240
20	110	91	25,040	246,080

TABLE 3

RACK MODEL PARAMETERS *

Rack Module			11 x 10	12 x 11	8 x 6
K_I	(lb/in)	E-W	$.099 \times 10^6$	$.0871 \times 10^6$	$.0527 \times 10^6$
		N-S	$.099 \times 10^6$	$.0873 \times 10^6$	$.0788 \times 10^6$
			**	**	***
K_d	(lb/in)	E-W	1.77×10^7	1.84×10^7	1.40×10^7
		N-S	1.87×10^7	1.75×10^7	1.40×10^7
h	(in)		13.12	13.12	13.12
H	(in)		201.31	201.31	201.31
W_y	(lb)		22938	27366	26047
W_F	(lb)		386936	463094	88416
L_x	(in)		91.50	100.65	65.70
L_y	(in)		100.65	109.80	87.60

* Rack model parameters are for the consolidated fuel except the 8 x 6 size which only will store single density spent fuel.
** Nominal gap between cell wall & fuel assembly = 0.185"
*** Nominal gap between cell wall & fuel assembly = 0.237"

K_I - Fuel assembly-to-cell wall impact spring rate
K_d - Vertical axial spring rate for concrete, pedestal, base plate and cell deformation.
h - Length of support leg
H - Height of rack above base plate
W_y - Weight of rack without fuel
W_F - Weight of fuel
L_x - Platform dimension (x - Direction = East)
L_y - Platform dimension (y - Direction = North)

L4/NRC/cj

TABLE 4

SUMMARY OF SAFETY FACTORS IN
CRITICAL FUEL RACK LOCATIONS

Item/Location	Safety Factor * *	Comments
Support Footing (Pedestal) to Baseplate Weld Stress	1.97	Table 6.6*
Cell to Baseplate Weld Stress	1.06	Table 6.6*
Cell to Cell Weld stress	1.12	Thermal Plus Seismic Stress Due to Effects of Isolated Hot Cell.
Impact Load Between Fuel Assembly and Cell Wall	1.20	Standard Fuel
Shear Load on Baseplate Near a Support Footing	1.07	Table 6.6*
Compressive Stress in Cell Wall	4.23	Based on Local Buckling Considerations (Standard Fuel)
Rack to Wall Impact Loads	-	No Impact with Pool Walls occur at any Location

* Table 6.6, Licensing Submittal, ST-HL-AE-2417; See Table 6 6 for other related Safety Factors.

** All Safety Factors are for consolidated fuel unless otherwise noted.

TABLE 5

RESULTS OF MULTIPLE RACK STUDIES
FULLY LOADED, HALF LOADED & EMPTY;
RACK WITH FRICTION COEF. = 0.2; SLIDING CASE

ITEM	MULTI-RACK MODEL* (lbs)	SINGLE RACKS** DESIGN BASIS MODEL (lbs)
RACK/WALL TOP IMPACT LOAD	0	0
RACK/RACK TOP IMPACT LOAD	0	0
RACK/WALL BOT IMPACT LOAD	0	0
RACK/FUEL ASSEMBLY IMPACT LOAD PER CELL	301	333
VERTICAL LOAD ON POOL FLOOR FROM ONE FOOT	1.237×10^5	1.65×10^5
RACK/RACK AT BASE PLATE IMPACT LOAD	0	0
MAX. E-W RACK DISPLACEMENT AT TOP OF RACK REL. TO GROUND	0.471 (inch)	0.467(inch)

* - 3-110 CELL RACKS CONSOLIDATED FUEL
** - 1-132 CELL RACK CONSOLIDATED FUEL

TABLE 6

RESULTS OF MULTIPLE RACK STUDIES
FULLY LOADED, HALF LOADED & EMPTY;
FRICTION COEF. = 0.8; NON-SLIDING CASE

ITEM	MULTI-RACK MODEL* (lbs)	SINGLE RACK** DESIGN BASIS MODEL (lbs)
RACK/WALL TOP IMPACT LOAD	0	0
RACK/RACK TOP IMPACT LOAD	0	0
RACK/WALL BTM IMPACT LOAD	0	0
RACK/FUEL ASSEMBLY IMPACT LOAD PER CELL	321	450
VERTICAL LOAD ON POOL FLOOR FROM ONE FOOT	1.92×10^5	3.80×10^5
RACK/RACK AT BASE PLATE IMPACT LOAD	0	0
MAX E-W RACK DISPLACEMENT AT TOP OF RACK REL. TO GROUND	0.379 (inch) ***	.774 (inch)

* - 3-110 CELL RACKS CONSOLIDATED FUEL
** - 1-132 CELL RACK CONSOLIDATED FUEL
*** - 3-132 CELL RACK UNCONSOLIDATED FUEL

L4/NRC/cj