RELATED CORRESPONDENCE

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Chicago, Illinois 60690

NRC PUBLIC DOCUMENT ROOM

February 23, 1979

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Zion Station Units 1 and 2
Revision to Proposed Change to Facility
Operating License Nos. DPR-39 and DPR-48
NRC Docket Nos. 50-295 and 50-304

References (a): April 13, 1978 letter from C. Reed to Edson G. Case

(b): January 24, 1979 letter from W. F. Naughton to Harold R. Denton

Dear Mr. Denton:

Per Reference (a), Commonwealth Edison Company submitted technical specification changes to modify the spent fuel storage racks at Zion Station. Subsequent to that submittal, the NRC Staff requested, Reference (b), that Commonwealth Edison revise the proposed technical specification change to provide a limit on fuel assembly loading rather than a limit on enrichment.

Attachment 1 to this letter contains the requested technical specification change. In addition, the limit has been increased from 39.4 grams of Uranium-235 per axial centimeter of fuel assembly (~3.1 w/o U-235) to 40.6 grams (~3.2 w/o U-235). The increase to 3.2 w/o U-235 is necessary because the Zion Unit 1 reload fuel to be received in August 1979 will be enriched to 3.2 w/o U-235. In support of this change, Section 3.3 of the Nuclear Services Corporation (NSC) report submitted with Reference (a) has been modified to reflect an analysis for the 3.2 w/o U-235 fuel. The revised pages of that report are included in Attachment 2 which is an Addendum to the NSC Zion Licensing Report. As was the case in the original report, Reference (a), for normal and abnormal storage and handling of fuel in the storage racks, K_{eff} does not exceed 0.95 even if all uncertainties are applied.

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The revised technical specification change (Attachment 1) and supporting documentation (Attachment 2) have been reviewed and approved by Commonwealth Edison On-Site and Off-Site Review with the conclusion that there are no unreviewed safety questions.

For your information, also included in Attachment 2 are updated pages to the NSC report which reflect minor modifications made in the final design of the storage racks. These modifications include:

1) Pages 3-4, 3-40, and 3-42 which show that on the south and west end of the pool the rack legs rest directly above a steel beam embedded into concrete;

2) Page 3-6 which reflects a longer poisoned length in the absorber tube to increase manufacturing ease; and

3) Page 3-7 which reflects the actual rack height used in the thermohydraulic analysis.

Please address any additional questions that you might have to this office.

Three (3) signed originals and thirty-seven (37) copies of this letter are provided for your use.

Very truly yours,

C. Reed

Cordell Reed
Assistant Vice-President

attachments

SUBSCRIBED and SWORN to
before me this 22nd, day
of February, 1979.

Nancy M Dacenzo
Notary Public

RELATED CORRESPONDENCE

ATTACHMENT 1

ZION STATION UNITS 1 AND 2

NRC DOCKET NOS. 50-295 AND 50-304

PROPOSED TECHNICAL SPECIFICATION CHANGES

The following pages have been revised:

298 and 299

The reactor containment structure for Zion Unit 2 is essentially identical in design and construction to that of Unit 1 except that it is reoriented. Numerous mechanical and electrical systems penetrate the containment wall through welded steel penetrations.(2)

5.4.3 Containment Penetrations Sideways

All containment penetrations (both electrical and piping) are double barrier assemblies consisting of a closed sleeve, in most cases, or a double gasketed closure for special penetrations such as the fuel transfer tube. The space between the double barriers will be continuously pressurized, by the Penetration Pressurization System, to a pressure in excess of the containment design pressure.(3)

References

(1) FSAR Section 5.1.1
(2) FSAR Section 5.1.2
(3) FSAR Section 5.1.4

5.5 Fuel Storage

5.5.1 New Fuel Storage

New fuel assemblies are stored in a separate storage vault which is designed to hold 132 new assemblies. The new fuel storage racks accommodate 2/3 of a core. There are three sections of racks with each station made up of two rows. The two parallel rows in each section have a nominal center to center spacing of 21 inches and each section is separated by a distance of 44". The new fuel storage vault is protected from flooding by its free flood drain.

New fuel may also be temporarily stored in the spent fuel pool in preparation for refueling. The fuel assemblies are stored in racks in parallel rows, having a nominal center to center distance of 10.35 inches in both directions. This spacing is sufficient to maintain a K effective of less than .95 when flooded with unborated water, for fuel having a maximum loading of 40.6 gms. U-235 per axial centimeter of fuel assembly length (about 3.2 weight percent U-235).

5.5.2 Spent Fuel Storage

PROPOSED CHANGE

Irradiated fuel assemblies will be stored prior to offsite shipment in the stainless steel lined fuel pool which is located in the fuel handling building. Borated water is used to fill the spent fuel storage pit at a concentration to match that used in the reactor cavity and refueling canal during refueling operations. The fuel is stored in a vertical array with a nominal center to center spacing of 10.35" between assemblies to assure a K effective of less than 0.95 even if unborated water is used to fill the pit, for fuel having a maximum loading of 40.6 gms. U-235

5.5.2 Spent Fuel Storage (Continued)

per axial centimeter of fuel assembly length (about 3.2 weight percent U-235).

References

1. Fuel Pool Modification Report Revision 2, dated February 3, 1978.

2. Addendum to the Fuel Pool Modification Report dated October 20, 1978 and revised February 1979.

PROPOSED CHANGE

5.6 Seismic Design

The structures, mechanical components and Engineered Safeguards Systems vital to safe shutdown and containment isolation, or whose failure might cause or increase the severity of a loss of coolant accident are designed per the seismic criteria of Design Basis Earthquake (DBE). Design Basis Earthquake is based on ordinary allowable stresses as set forth in applicable codes, plus the additonal requirement that a safe shutdown be made during a horizontal ground acceleration of 0.17g and a veritcal acceleration of 0.11g occurring simultaneously. These systems and equipment are defined as Seismic Class 1.

Other systems and mechanical components in a support or auxiliary function are designed per the seismic criteria of Operational Basis Earthquake (OBE), or per applicable codes. These systems and equipment are defined as either Classes 2 or 3 depending on their function.

REGULATORY DOCKET FILE COPY

ATTACHMENT 2

ZION STATION UNITS 1 AND 2

NRC DOCKET NOS. 50-295 AND 50-304

ADDENDUM

ZION LICENSING REPORT

October 20, 1978

Revised February, 1979

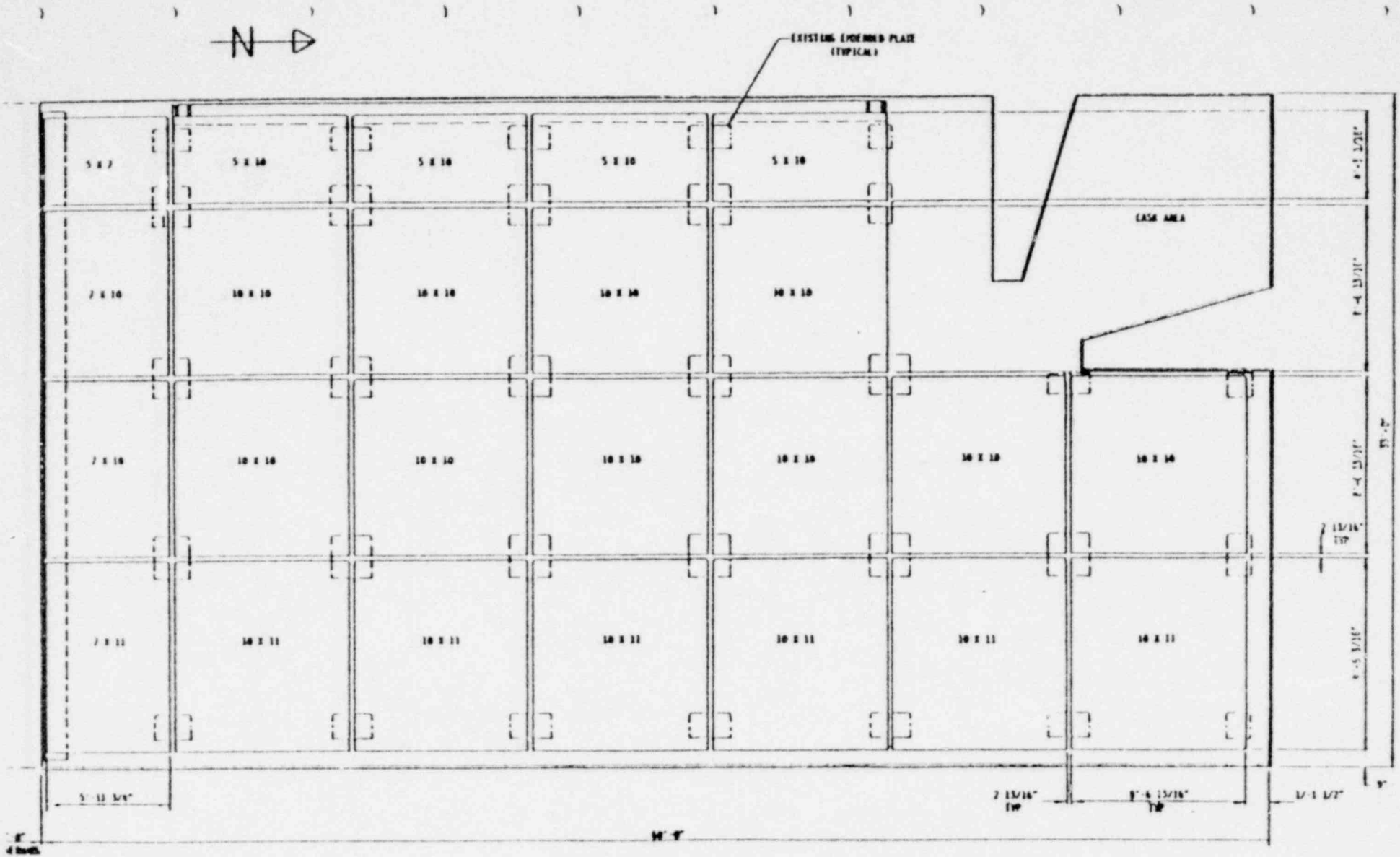
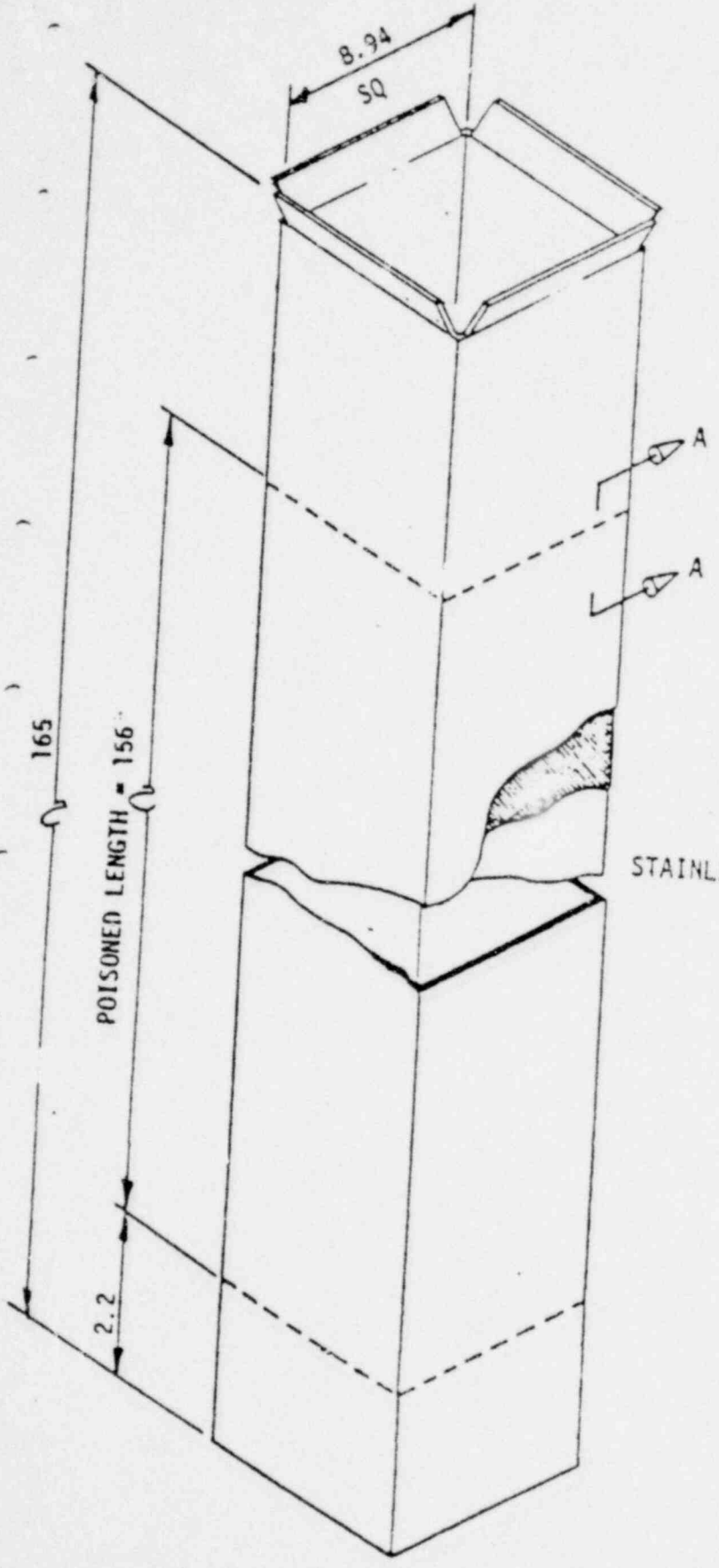


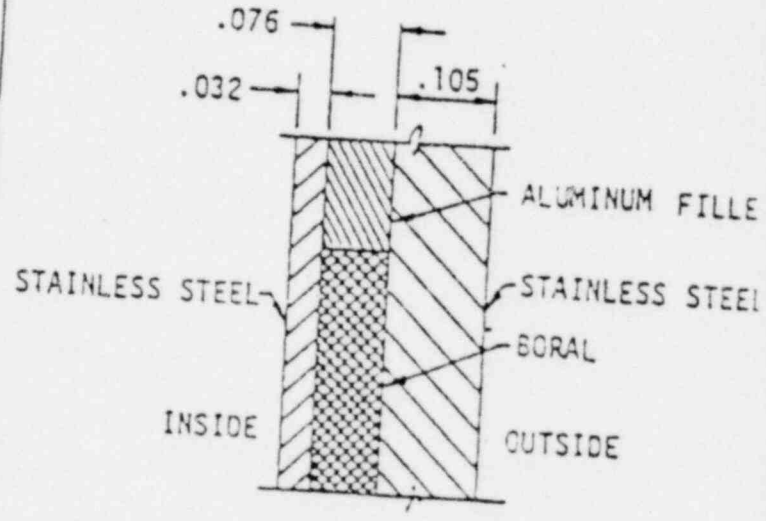
FIGURE 3.1-2. ZION SPENT FUEL POOL ARRANGEMENT (MODIFIED)

6 - 10 X 11 RACKS = 660 SPACES
10 - 10 X 10 RACKS = 1000 SPACES
1 - 7 X 11 RACKS = 77 SPACES
2 - 7 X 10 RACKS = 140 SPACES
1 - 5 X 7 RACKS = 35 SPACES
4 - 5 X 10 RACKS = 200 SPACES

TOTAL = 2112 SPACES

POOR ORIGINAL





SECTION A-A

ALL DIMENSIONS IN INCHES

FIGURE 3.2-1. STAINLESS STEEL TUBE WITH BORAL CORE FOR ZION FUEL STORAGE

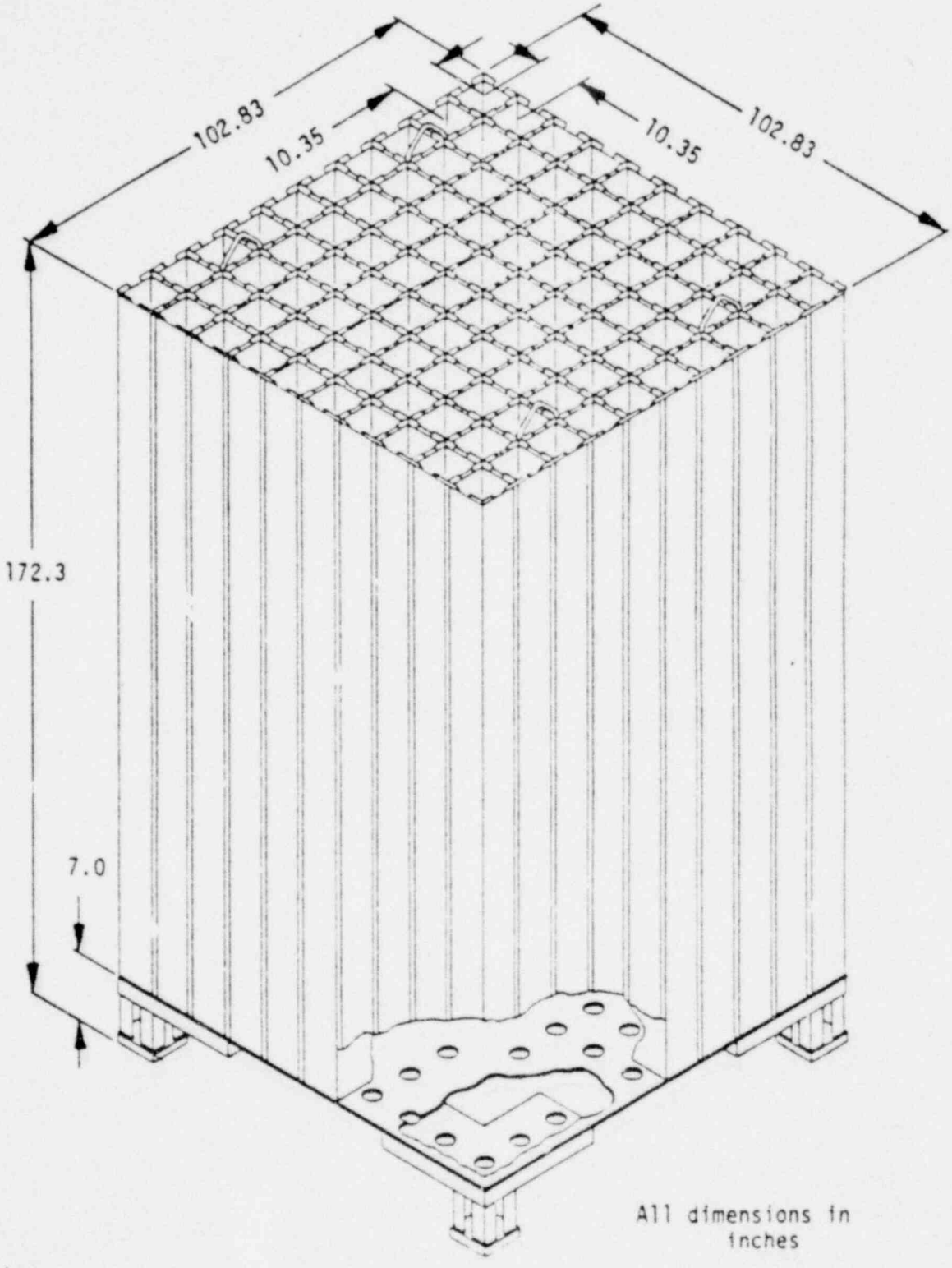


FIGURE 3.2-2. 10 X 10 SPENT FUEL RACK
ZION UNITS 1 AND 2

3.3 Nuclear Design (for 3.2 w/o U_{235})

The 10.35 x 10.35 inch spacing of the fuel assemblies is sufficient to maintain k_{eff} below 0.95 for all normal and abnormal fuel storage conditions. The analysis results are described below.

3.3.1 Summary of Results

The value of k_{eff} is determined as follows:

$$k_{eff} \leq k_0 + \Delta k_1 + \Delta k_2 + \Delta k_3 + \Delta k_4 + (\Delta k_5^2 + \Delta k_6^2 + \Delta k_7^2)^{1/2}$$

where

k_0 = nominal calculated k_{eff} (2-D diffusion theory)
Δk_1 = transport correction
Δk_2 = tube positioning effect
Δk_3 = rack spacing tolerance effect
Δk_4 = methods bias
Δk_5 = uncertainty in methods bias (95% confidence level)
Δk_6 = channel thickness tolerance effect
Δk_7 = fuel fabrication tolerance effect

The value of k_{eff} is maintained below 0.95 for all normal and abnormal storage conditions in accordance with Standard Review Plan 9.1.2. Results are summarized in Table 3.3-1.

3.3.2 Method of Calculation

Verification of k_{eff} is obtained using a two dimensional (X-Y) diffusion theory computer code calculation. The calculational model covers both finite and infinite arrays of stored fuel assemblies. Fuel neutron cross sections are developed for a four group energy range using the CHEETAH code which is an adaptation of the LEOPARD-CINDER code. XSDRN, which is a one dimensional discrete ordinates spectral averaging code, was used for

TABLE 3.3-1

ZION, UNIT #1&2

k_{eff} RESULTS

TERM	VALUE	METHOD
k_0	0.92629	Calculated for cell
Δk_1	.005	Estimated from similar design
Δk_2	0.00436	Calculated from sensitivity analysis
Δk_3	0	Since rack pitch errors cannot accumulate, cannot justify nonzero value
Δk_4	-0.0048	Critical experiment calculations
Δk_5	.0084	Critical experiments results, 95% confidence level
Δk_6	0	Minimum values of B^{10} density and thickness are used for absorber plate (.02 gm/cm^2)
Δk_7	.0007	Calculated for 0.01 w/o enrichment increase

$$k_{eff} \leq k_0 + \Delta k_1 + \Delta k_2 + \Delta k_3 + \Delta k_4 + (\Delta k_5^2 + \Delta k_6^2 + \Delta k_7^2)^{1/2}$$

$$= 0.93928$$

TABLE 3.3-4

FUEL DESIGN PARAMETERS

Fuel Assembly Array	15 x 15
No. of Fuel Rods	204
No. of Water Rods	21
Rod Pitch	0.563"
Fuel Pellet O.D.	0.3659"
Clad O.D.	0.422"
Clad Thickness	0.0243"
Clad Material	Zircaloy 4
Pellet Density, % T.D.	94.95 T.D.
Max. Bundle Enrichment, wt % U^{235}	3.2
Nominal Active Fuel Length	144"

"Abnormal" refers to a single operator error. Included as an abnormal condition is dropping of a fuel assembly. The effect of missing absorber plates is also considered.

3.3.5 Results of Calculations

The nominal results of the k_{eff} calculations for normal storage and handling are listed as follows:

	CONDITION	k_{eff}
1.	Normal positioning in the spent fuel storage array See Figure 3.3-1, 3.3-2	0.92629
2.	Eccentric positioning in the spent fuel storage array (clumped in groups of four) with fuel at corners of the channels. See Figure 3.3-3A	0.91700
3.	Normal positioning in the spent fuel storage array with the channel offset 0.15" (.381 cm) in both X and Y See Figure 3.3-3B	0.93065
4.	One extra fuel assembly at side of rack See Figure 3.3-4	0.93272

The value of k_{eff} is not expected to change significantly under abnormal storage situations. Consideration was given to a fuel assembly lying on top of a rack. Due to the small axial neutron leakage reactivity of 0.002 Δk, and the separation of the fuel assembly from active fuel in the rack, the increase in reactivity is <0.002.

The drop of a fuel assembly onto the rack was considered. The fuel rack is designed to prevent any plastic deformation in the fuel region for these loads. Therefore, the reactivity effect of these abnormal loading conditions is insignificant.

The fact that the B_4C in the BORAL core is not mixed with Al homogeneously is also considered. The effect is found to be small. Coupled with the positive bias of our method of calculation, we believe that the slight reactivity effect of this so-called "grain effect" can be neglected without losing conservatism.

The effect of "missing" absorber plates was evaluated (see Figures 3.3-5, 3.3-6). The reactivity worth of 1 "missing" absorber plate per 4 tubes (16 plates) is 0.0092 ($\Delta k = 0.0079$). The reactivity worth of 1 "missing" absorber plate per 32 plates is 0.0052 ($\Delta k = 0.0045$), see Figure 3.3-7. The Quality Assurance Program for the manufacture of the boron plates and the fabrication of the absorber tubes will confirm and document that each absorber tube includes absorber plates of the required boron content.

This rack design is able to satisfy $k_{eff} < 0.95$, even if condition 4 and all other uncertainties shown in Table 3.3-1 are applied at the same time ($k_{eff} \leq 0.94571$). Although Paragraph II.1.2 of the NRC "Position for Review and Acceptance of Spent Fuel Storage and Handling Applications" issued April 14, 1978, allows consideration of the presence of soluble boron in the pool water for condition 4, this analysis conservatively does not take credit for the soluble boron.

Sensitivity studies were performed to evaluate the influence on k_{eff} of fuel tube spacing and pool temperature. The results of these analyses are summarized below.

TABLE 3.3-5

k_{eff} VERSUS SPACING, 40°F

Cell Pitch, in.	k_{eff}
9.956 x 9.956	0.9814
10.35 x 10.35	0.9263
10.743 x 10.743	0.8849
11.137 x 11.137	0.8538

See Figure 3.3-8

TABLE 3.3-6

k_{eff} Infinite Lattice	Temperature, °F
0.92629	40
0.91756	130
0.90566	212

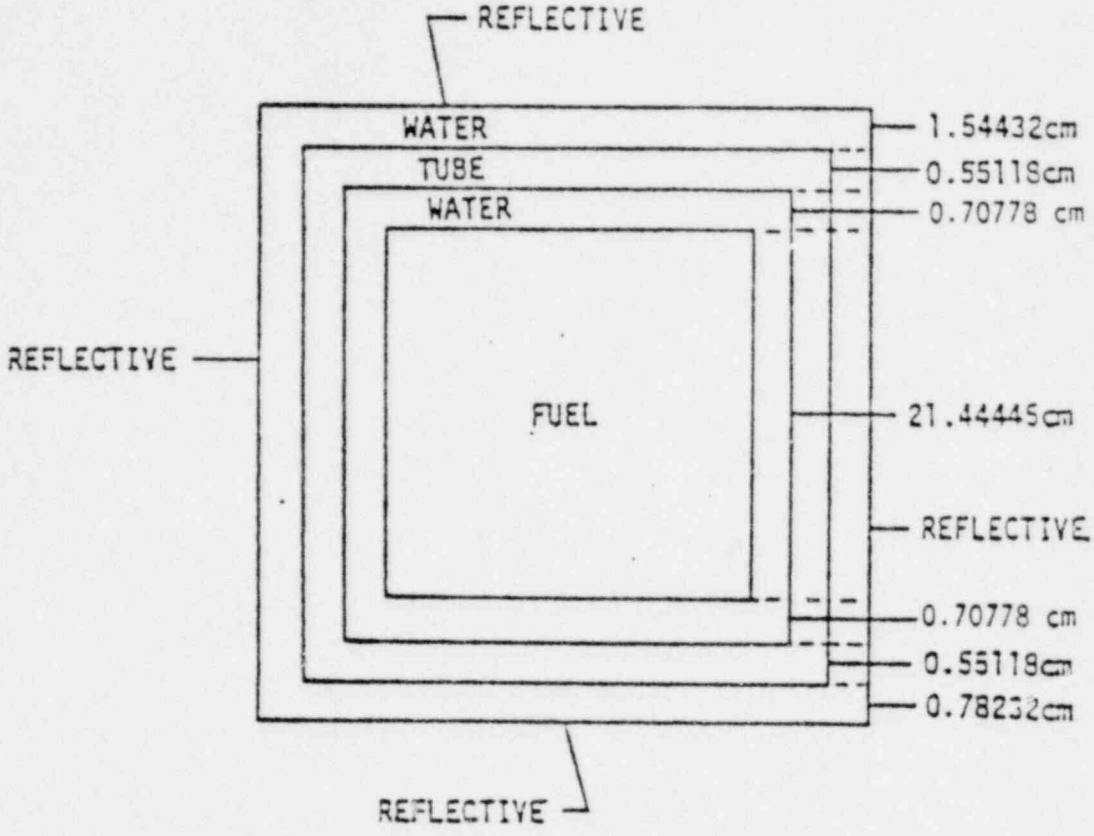


FIGURE 3.3-38. RACK TUBE OFFSET

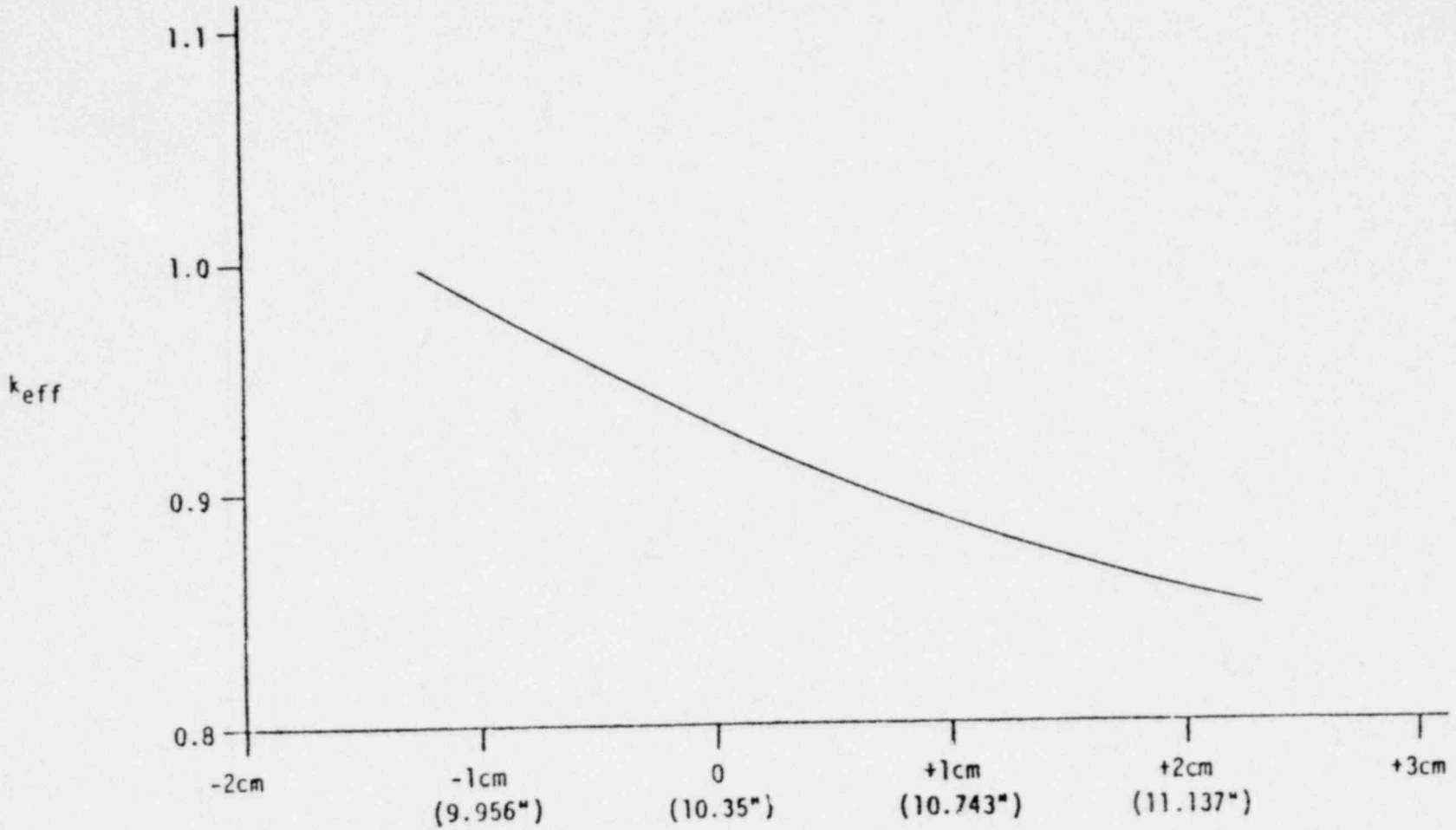


Figure 3.3.8 k_{eff} vs. Change in Pitch for 3.2 w/o U^{235}

TABLE 3.4-2

STRESS EVALUATION FOR MOST CRITICAL RACK ELEMENTS

Rack Component	Critical Stress Type	Critical Load Combination	Allowable Stress (ksi)	Computed Stress (ksi)
Tube Wall	P_m	D + B + E	18.60	9.10
		D + B + E'	27.90	11.29
	$P_m + b$	D + B + E	27.90	9.23
		D + B + E'	41.85	11.31
	$P_m + b + P_e$	D + B + Q + T_o + E (1)	55.80 (1)	13.83
		D + B + Q + T_o + E' (2)	--- (2)	15.92
Base Plate	P_m	D + B + E	18.60	5.29
		D + B + E'	27.90	7.01
	$P_m + b$	D + B + E	27.90	5.37
		D + B + E'	41.85	7.09
	$P_m + b + P_e$	D + B + Q + T_o + E (1)	55.80 (1)	5.44
		D + B + Q + T_o + E' (2)	--- (2)	7.32
Rack Leg	P_m	D + B + E	18.60	9.54
		D + B + E'	27.90	10.88
	$P_m + b$	D + B + E	27.90	15.17
		D + B + E'	41.85	19.70

Notes:

(1) For ASME Class 2 support structures, evaluation is not required for this load combination. However, evaluation was performed conservatively using criteria similar to those for ASME Class 1 support structures.

(2) Evaluation is not required for component support structures designed according to ASME, Section III, Subsection NF. However, stresses were computed for comparison purposes and to show additional margin of safety.

3.5 EVALUATION OF POOL STRUCTURES

3.5.1 Description of Pool Structures

The spent fuel pool is a rectangular box-type structure open at the top (see Figure 3.1-2). The structural part of the pool consists of a concrete floor and four thick reinforced concrete walls. The cask handling area is located at the north-west corner of the pool and is separated from the storage area by two thick walls. The inside of the pool including the cask handling area is 63 feet long in the north-south direction and 33 feet in the east-west direction. Depth of pool is 41 feet. Pool floor and walls are lined with 3/16 inch continuously welded stainless steel liner anchored rigidly to the concrete floor. There are 31 stainless steel plates embedded in the floor concrete, and the proposed racks would be placed on these plates as shown in Figure 3.1-2. These plates would transfer the loads from the racks to the concrete floor slab. At the south and west ends of the pool, where there are no embedded plates, the proposed rack arrangement is such that the legs of racks would rest directly above a steel beam embedded into concrete.

3.5.2 Loads, Load Combinations and Structural Acceptance Criteria

3.5.2.1 Loads - Fuel pool structures were evaluated for the following loads:

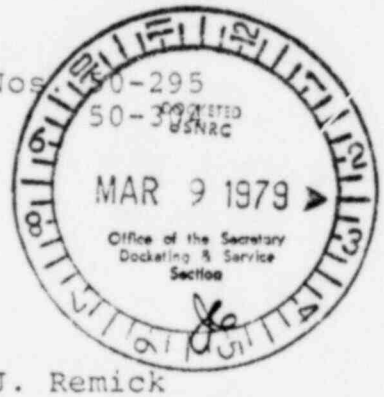
a) Deadweight (D) -- Weight of pool structure components including the buoyant weight of the proposed spent fuel racks.

b) Live Load (L) -- Live load on the operating floors which are supported on the pool walls.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

RELATED CORRESPONDENCE

In the Matter of	)	
	)	
COMMONWEALTH EDISON COMPANY	)	
	)	
(Zion Station Units 1 and 2)	)	Docket Nos. 50-295
	)	50-304
Proposed Amendments to	)	
Increase Spent Fuel Storage	)	
Capacity	)	
(43 F.R. 30938)	)	



March 2, 1979

Edward Luton, Chairman
Atomic Safety and Licensing
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U.S. Nuclear Regulatory
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Washington, DC 20555

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To Members of the Licensing Board and All Parties of Record:

Attached is a copy of a revision to Commonwalth Edison Company's license amendment request in the above matter. This revision makes a minor change in the enrichment limit for fuel which will be stored in the Zion Spent Fuel Pool.

Sincerely,

Philip P. Steptoe

PPS/bjn
Enclosure