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DENTON,H.R.	Office of Nuclear Reactor Regulation

SUBJECT: Responds to A Schwencer 790530 ltr requesting addl info re spend fuel storage capacity extension program.Submits revised pages to 781122 ltr re refined dimension of spent fuel rack storag cells.

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June 29,1979
AEP:NRC:00213

Donald C. Cook Nuclear Plant Unit Nos. 1 and 2
Docket Nos. 50-315 and 50-316
License Nos. DPR-58 and DPR-74
Spent Fuel Storage Capacity Expansion Program

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

Reference: (1) Letter A. Schwencer to John E. Dolan dated May 30, 1979
(2) Letter AEP:NRC:00105 dated November 22, 1978

Dear Mr. Denton:

Attachment 1 provides additional information on the spent fuel storage capacity expansion program for the Donald C. Cook Nuclear Plant. This information was requested by Mr. A. Schwencer, in Reference (1), as a result of the Staff review of our April 16, 1979 submittal Number AEP:NRC:00169.

Attachment 2 includes revised pages for Reference (2). These revisions reflect refined dimensions developed in the course of final design to facilitate fabrication of the spent fuel rack storage cells for the Donald C. Cook Nuclear Plant. Exxon Nuclear has redone the criticality analysis and has found that these slight dimension changes do not change the results of the previous analysis as submitted to you in Reference (2).

Very truly yours,

John E. Dolan
John E. Dolan
Vice Chairman
Engineering and Construction

JED/emc
Attachment

Sworn and subscribed to before me
this 29th day of June , 1979 in
New York County, New York

Kathleen Barry
Notary Public

KATHLEEN BARRY
NOTARY PUBLIC, State of New York
No. 41-606792
Qualified in Queens County
Certificate filed in New York County
Commission Expires March 30, 1981

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7907100470

cc: R. C. Callen
G. Charnoff
D. V. Shaller
R. W. Jurgensen
P. W. Steketee
R. J. Vollen
R. Walsh

ATTACHMENT 1

QUESTION NO. 1

Provide the number of modules and the size of each module to be installed in the spent fuel pool. Include a drawing showing the arrangement of the racks in the pool.

RESPONSE

Twenty modules will be installed in the spent fuel pool as follows:

15 - 10x10 array - 15' 4" high, 9' 1" square,

5 - 10x11 array - 15' 4" high, 9' 1" wide,
9' 11" long.

Figure 3.6.6 shows the arrangement of the racks in the pool.

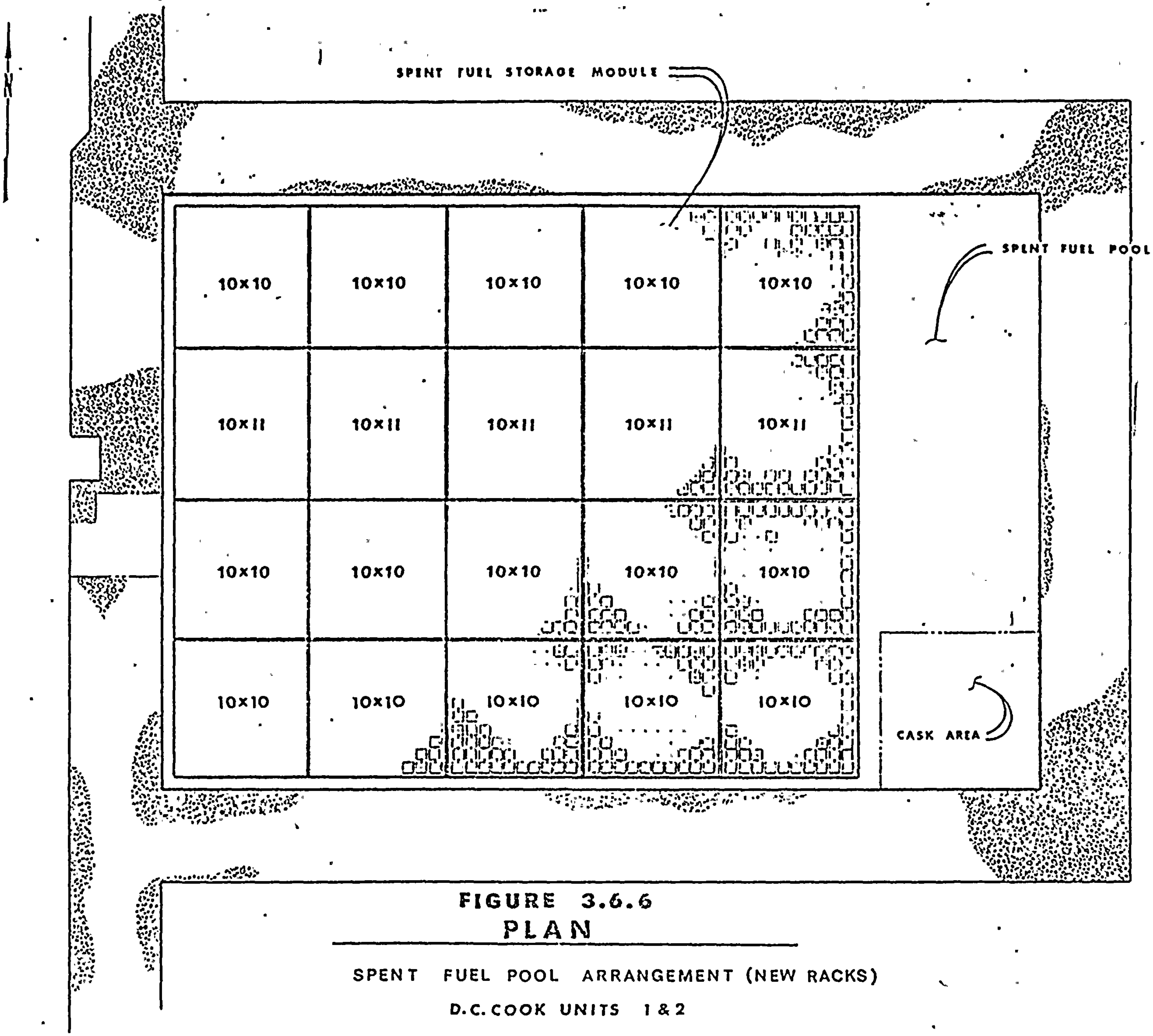


FIGURE 3.6.6
PLAN

SPENT FUEL POOL ARRANGEMENT (NEW RACKS)

D.C. COOK UNITS 1 & 2

QUESTION NO. 2

Describe the procedures used during the installation of the new racks to prevent damage to existing racks containing spent fuel. Include a description and details of any temporary seismic bracing of the existing racks required during the installation.

RESPONSE

Step-by-step procedures will be used by the installation contractor, which will control the order of removal of each of the old racks and the order of installation of the new racks. These procedures will specifically prohibit the movement of racks over spent fuel stored in the pool.

Fuel now stored in the north-west corner of the spent fuel pool will be moved to the south-east corner to facilitate the first phase of the new spent fuel rack installation and to place the fuel as far away as possible from the work area. The empty northern spent fuel rack modules will then be removed by moving each rack directly east such that it does not pass over any spent fuel. New racks will then be installed by bringing them into the pool areas again from the north-eastern side such that they do not pass over any spent fuel. After complete installation and testing of these new racks, the spent fuel will then be moved into them. The removal of the remainder of the now vacant old racks and the installation of the rest of the new racks will take place on either the east or south side of the pool which precludes movement of the racks over the spent fuel which was transferred to the northern section of the pool.

There are no requirements for temporary seismic bracing of the old racks since they are of the open lattice design and are bolted directly to the floor embedments.

QUESTION NO. 3

Provide damping values used in the non-linear analysis and include justification for any values higher than those specified in the FSAR.

RESPONSE

The damping values used in the non-linear analysis were 2% of critical for the rack structural components in accordance with the FSAR. This is the same value used in the linear analysis. The damping values used for the fuel assembly were taken from test results obtained by ENC for ENC supplied reload fuel for Westinghouse PWR's.*

* XN-76-47(P) "Combined Seismic-Loca Mechanical Evaluation for Exxon Nuclear 15x15 Reload Fuel for Westinghouse PWR's." April, 1977. (Proprietary)

QUESTION NO. 4

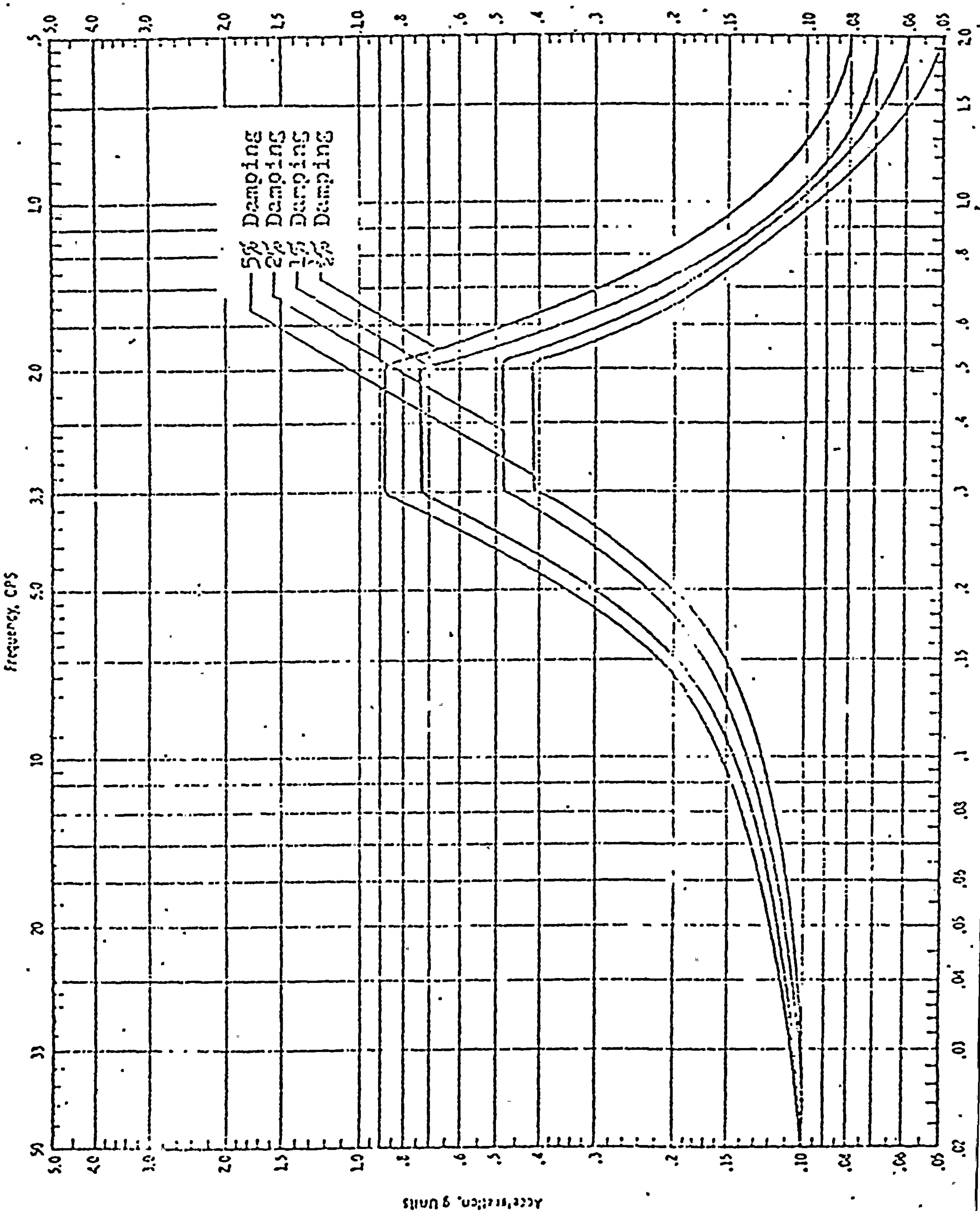
Provide details of the artificial time history showing a Fourier decomposition including a phase angle plot. Also, specify which floor response spectra was used in the analysis.

RESPONSE

The floor response spectra used in the structural analysis is given in our submittal of April 16, 1979 Section 3.6.4.1 (sixth paragraph). For clarification the fuel pool floor response spectrum at El. 606' - 2½" was obtained by linear interpolation of the response spectra at El. 587' - 0" and El. 633' - 0". These floor response spectra were submitted to the NRC in Attachment IV of the response to the Seismic Qualification Review Team dated November 17, 1977, Docket No. 50-316, CPPR No. 61. Figures 3.6.7 through 3.6.10 are the floor response spectra used for interpolation.

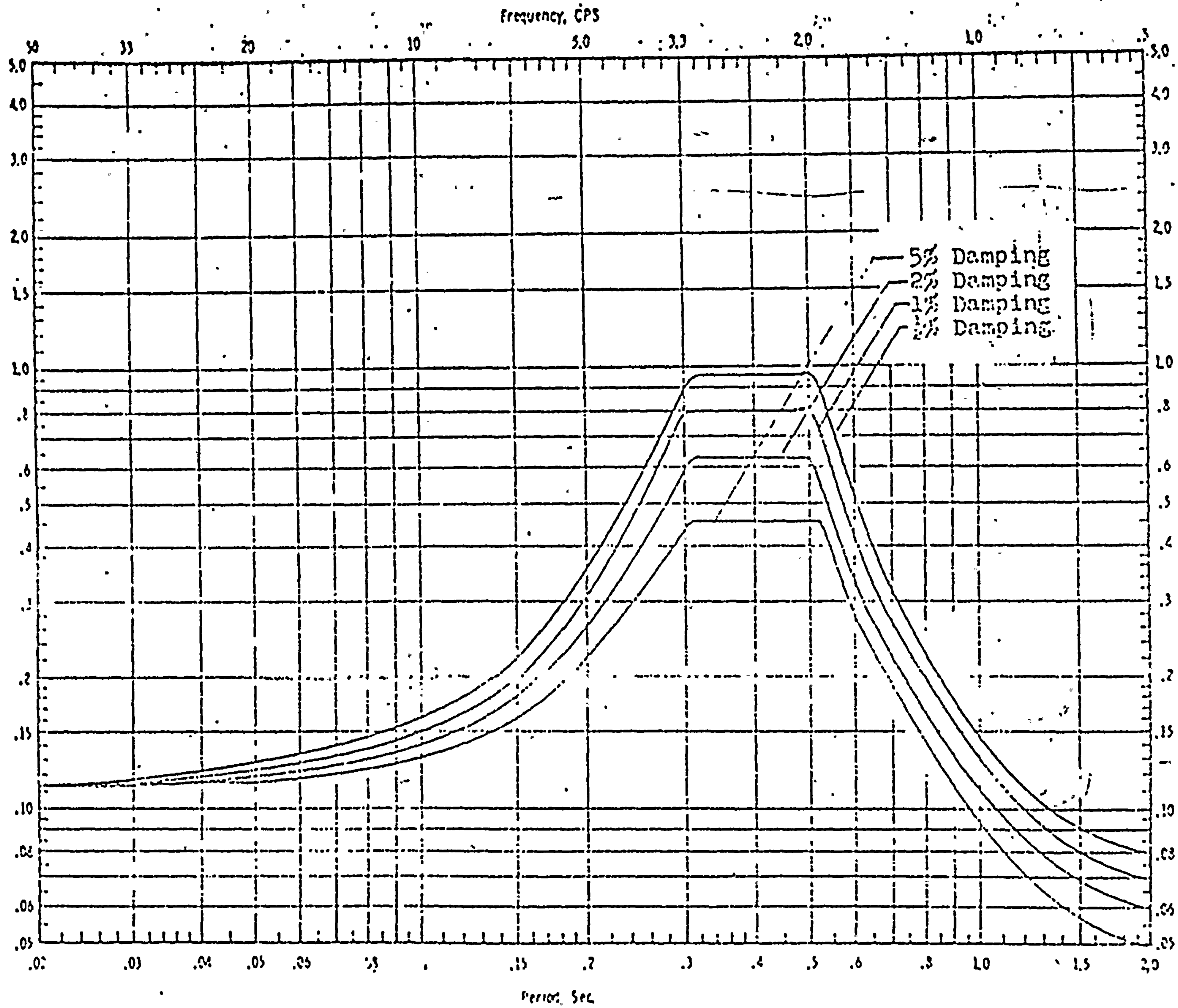
The decomposition of the artificial acceleration time history is shown in Figure 3.6.11 for the Fourier coefficient amplitude and in Figure 3.6.12 for the phase angle.

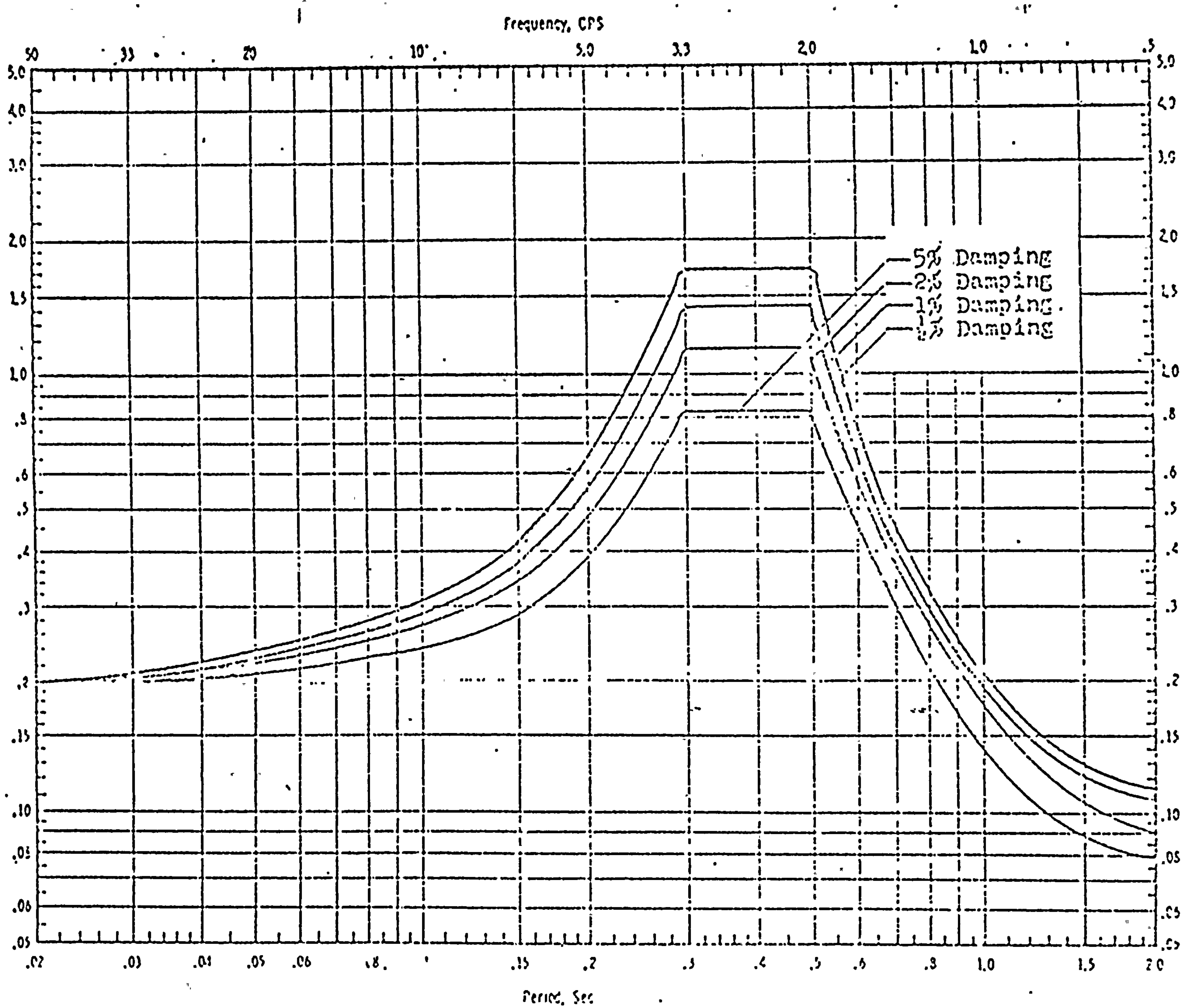
FIGURE 3.6.7



RESPONSE SPECTRA
COOK AUXILIARY [illegible]
FLOOR EL. [illegible]
OPERATING [illegible]

RESPONSE SPECT
COOK AUX
FLOOR EL.
OPERATING

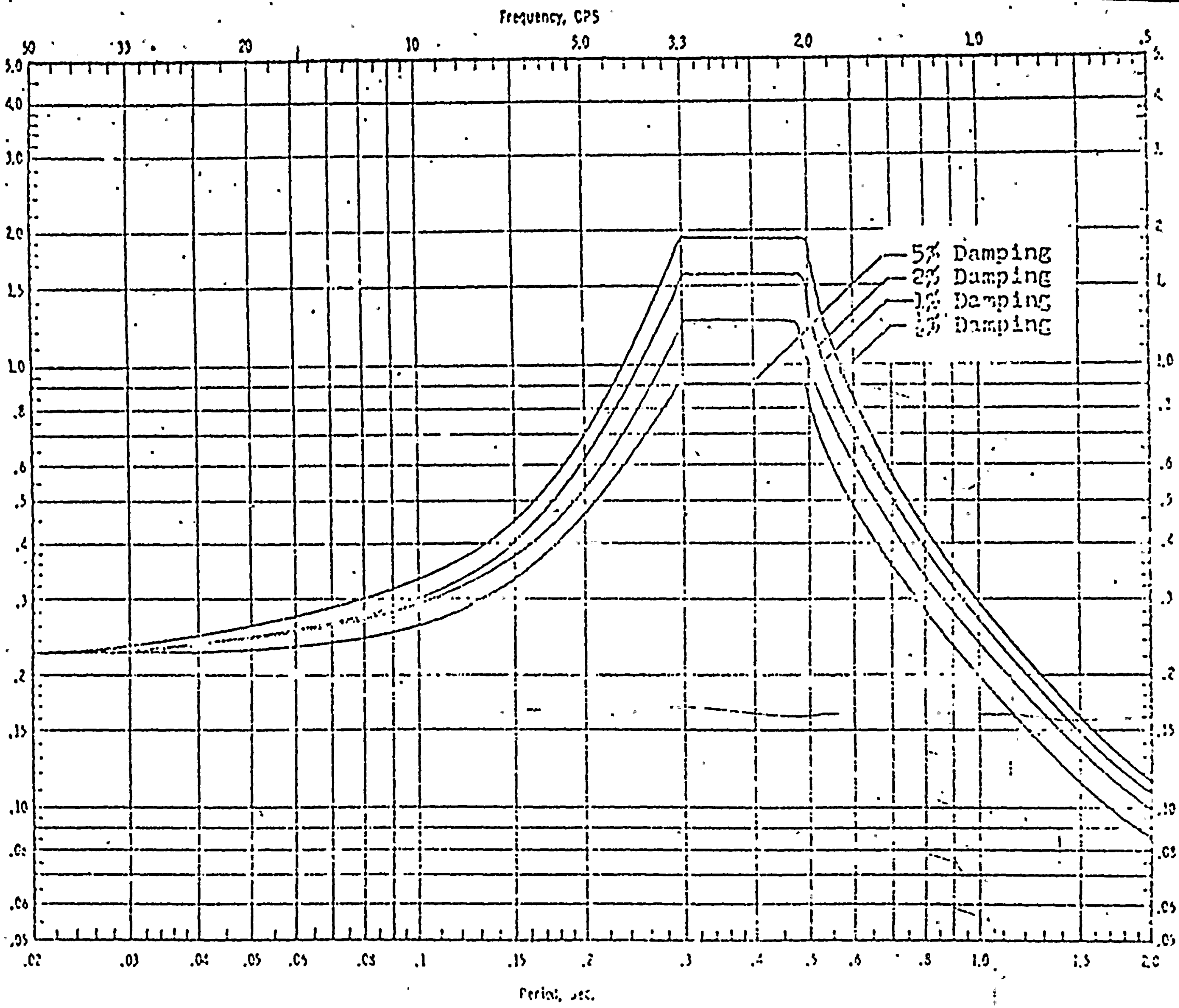




RESPONSE SPECTRA
COOK AUXILIARY BUILDING
FLOOR EL. 587'-0"
DESIGN BASIS EARTHQUAKE

FIGURE

RESPONSE SPECTRA
COOK AUXILIARY BUILDING
FLOOR EL. 633'-6"
DESIGN BASIS EARTHQUAKE



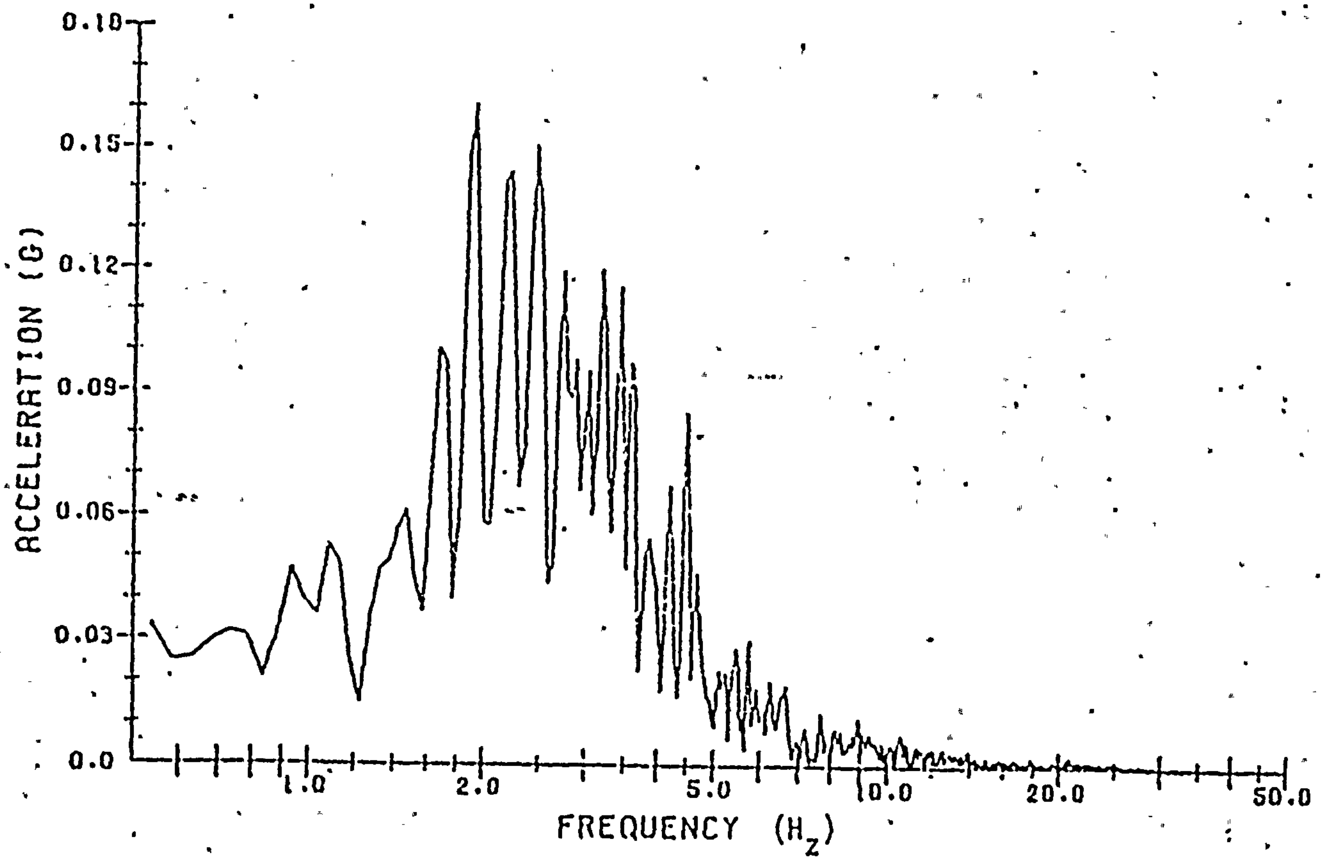


Figure 3.6.11 - Fourier Amplitude Spectrum for D. C. Cook Artificial Acceleration Time History

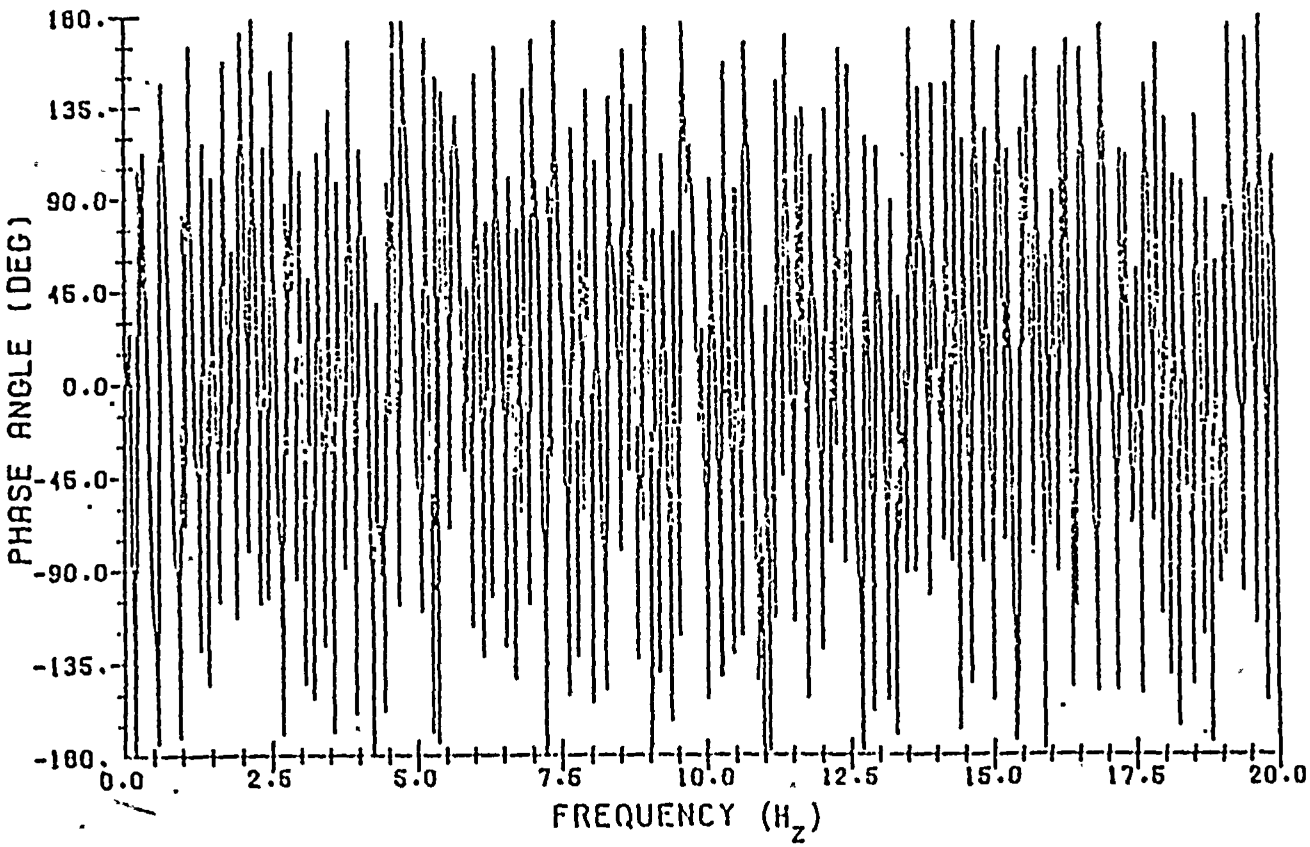


Figure 3.6.12 -Phase Angles of Fourier Components for D. C. Cook Artificial Acceleration Time History

QUESTION NO. 5

Discuss the provisions employed to limit the maximum height of a fuel assembly passing over a rack assembly to 15 inches.

RESPONSE

The new and spent fuel handling crane is equipped with two upper limiting devices. The first is a mechanical device which prevents the block assembly from jamming into the drum. The second is an adjustable limit switch which will be set in order to insure that fuel passing over the new spent fuel racks will be below the maximum height of 15 inches.

The limit switch will also be equipped with a positive action by-pass switch to allow the crane to perform other fuel related work such as movement of new fuel.

Operability of the limit switch will be demonstrated within seven days prior to the movement of fuel over the spent fuel rack and once every seven days of fuel movement.

QUESTION NO. 6

Describe the provisions employed to prevent movement of heavy objects over spent fuel assemblies. Include a description of all items which may be moved over the spent fuel assemblies.

RESPONSE

A system of interlocks prevents the auxiliary building over head crane hook from traveling over the pool at all times except when it is necessary to handle a spent fuel cask. Heavy objects are therefore prevented from being carried over stored spent fuel assemblies. A normally locked limit switch by-pass operated by a special key, now kept in the Shift Operating Engineer's Office, provides movement of the cask over the pool in only one corner away from stored fuel assemblies. FSAR Section 14.2.1 pages 2 and 5 and FSAR Amendment No. 70 Question 14.15 page 2 provide the response to movement of heavy loads over the pool.

The following fuel handling equipment may be moved over the spent fuel assemblies stored in the pool:

DESCRIPTION	APPROXIMATE WEIGHT	BASIC DIMENSION
15x15 Spent Fuel Handling Tools		
New Fuel Assembly Fuel Handling Tool	72 lbs.	25 in.
Thimble Plug Handling Tool	285 lbs.	37 ft.
Spent Fuel Assembly Handling Tool	397 lbs.	35 ft.
Burnable Poison Rod Assembly Handling Tool	800 lbs.	38 ft.
17x17 Spent Fuel Handling Tools		
New Fuel Assembly Fuel Handling Tool	85 lbs.	25 in.
Thimble Plug Handling Tool	270 lbs.	36 ft.
Spent Fuel Assembly Handling Tool	412 lbs.	35 ft.
Burnable Poison Rod Assembly Handling Tool	634 lbs.	38 ft.

Question No. 6 (Cont'd.)

In addition to the above listed tools, various hand tools and miscellaneous equipment such as a TV camera, spring scale, etc. weighing less and having smaller basic dimensions than those listed above may be carried over the stored spent fuel assemblies.

QUESTION NO. 7

Provide the maximum crane uplift force used in the analysis and describe how it was determined.

RESPONSE

The crane uplift force used in the structural analysis is defined as the maximum crane hook load. For purposes of this analysis, it was taken to be the capacity of the fuel handling crane hook and is equal to 2000 pounds.

QUESTION NO. 8

Discuss the first mode from the SAP IV analysis and provide a sketch of the mode shape.

RESPONSE

The primary mode in each of the three coordinate directions is shown in Figures 3.6.3 through 3.6.5 of the submittal of 4/16/79. The primary lateral modes are characterized by the superposition of the distortion of four components of the rack: 1) lateral shear deflection of the base feet, 2) a lateral shear deflection of the diaphragms, 3) lateral bending of the upper grid structure, and 4) the bending of the fuel cells which are supported at the ends. The primary vertical mode is characterized by the out of plane deflections of the base plate and the upper grid structure in the four regions bounded by the inner and outer shear diaphragms.

QUESTION NO. 9

Provide details of the rack base and support feet.

RESPONSE

The attached Figure 3.6.3 provides details of the rack base and support feet.

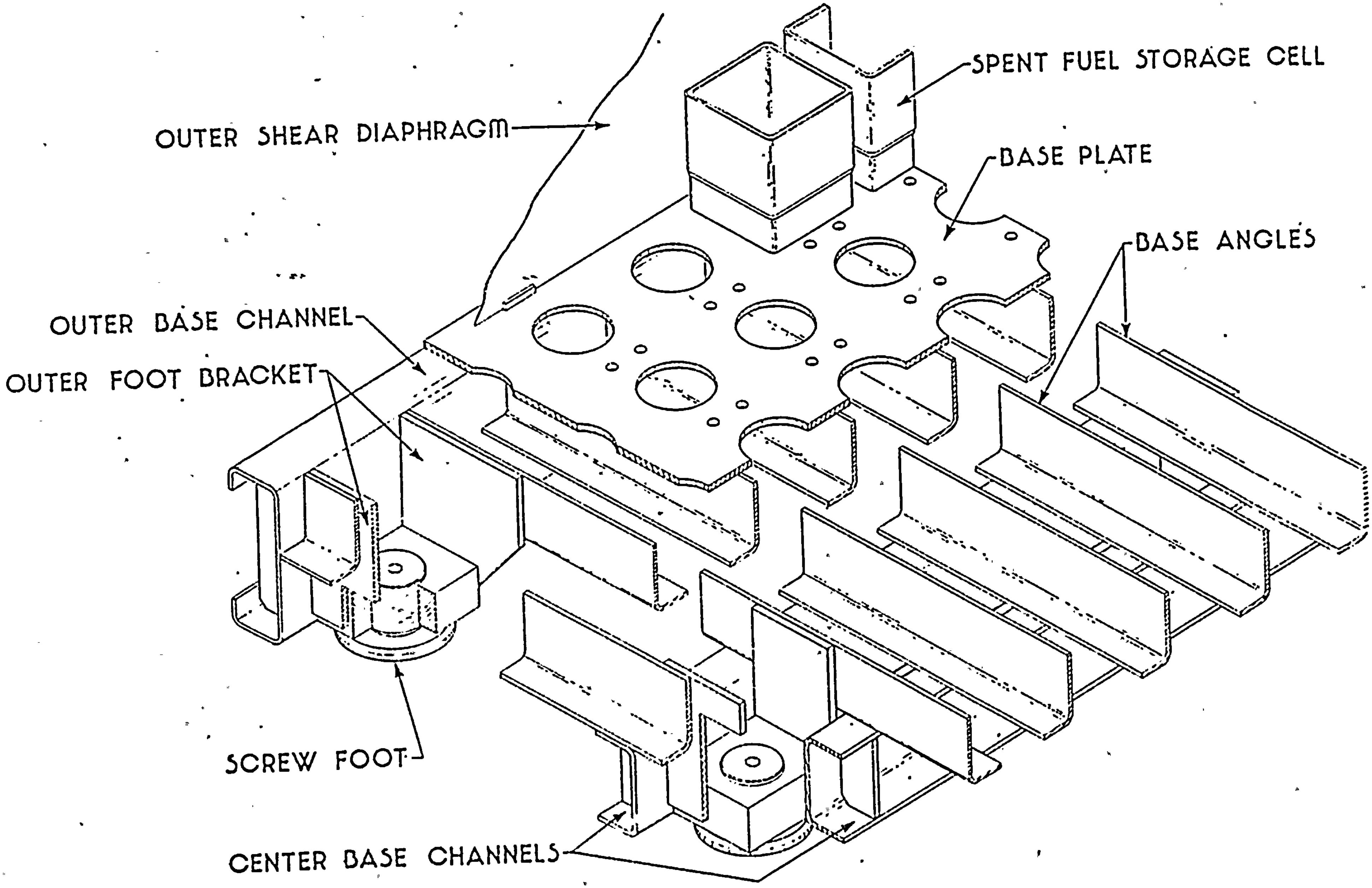


FIGURE 3.6.13

Rack Base And Support Feet
Isometric

QUESTION NO. 10

Provide details on how the hydrodynamic mass effects were included in the analysis. Discuss whether these effects were included in the elastic and non-linear analysis.

RESPONSE

The information requested is provided in our April 16, 1979 submittal. The description of the representation of the hydrodynamic mass effects is contained in Section 3.6.4.1 (second paragraph) for the elastic analysis and Section 3.6.4.2 (fourth paragraph) for the non-linear analysis. The effects of the hydrodynamic mass surrounding the module array are discussed in Section 3.6.7. The analytical treatment of the added mass and damping effects of submergence in the pool water are in accordance with the recommendations given in Report Number UCRL-52342, "Effective Mass and Damping of Submerged Structures", by R. G. Dong, Lawrence Livermore Laboratory, April, 1978.

QUESTION NO. 11

Discuss the effects of the increased loads due to the new rack structures on the fuel pool.

RESPONSE

Additional support will be placed under the spent fuel pool slab to permit the additional loading due to the use of high density fuel racks.

The maximum forces and moments in the spent fuel pool slab and the ultimate strength capacity of the slab are indicated in the following table. All loads and moments are computed in accordance with ACI 349-76, Article 9.3.1, "Nuclear Safety Related Concrete Structures".

LOADS	CURRENTLY ACTING	WITH ADDITIONAL LOADING AND ADDITIONAL SUPPORT	LIMIT CAPACITY OF SLAB
$+M_u$	298 Kft/ft	316 Kft/ft	415 Kft/ft
$-M_u$	163 Kft/ft	177 Kft/ft	272 Kft/ft
V_u	52 Kips/ft	53 Kips/ft	71 Kips/ft

Note:
a) Results are obtained on Strength Design Concept.

b) All values shown are per foot width of floor slab.

c) Limit capacity of floor slab has been derived from information on reinforcing drawings.

d) Table notation follows ACI 349-76.

QUESTION NO. 12

Discuss the effects of the seismic shear loads on the fuel pool liner in the context of the proposed modification.

RESPONSE

The liner of the spent fuel pool is sufficiently anchored to the concrete to resist the calculated shear loads and as such we do not anticipate any adverse effect on the pool liner caused by these loads.

QUESTION NO. 13

Discuss the effects of the fuel assembly drop on the pool floor and liner in the context of the proposed modification.

RESPONSE

To support the additional load imposed on the spent fuel pool by replacing the present spent fuel racks with ones capable of containing 2050 fuel assemblies, additional supports will be placed under the spent fuel pool bottom slab. The critical stress at the supports will be less than that as originally designed. Hence, the total effect of a fuel assembly drop on the pool floor and liner will be less than that for the original design.

ATTACHMENT 2

Insert the attached pages and Table 3.1-4 and delete the similarly numbered ones in Attachment 1 to our transmittal Number AEP:NRC:00105, dated November 22, 1978.

in Unit 2; see Tables 3.1-1 and 3.1-2) are very similar. Hence, differences in pool k_{eff} values for storage of different assembly design types are deemed insignificant.

The fuel assembly specifications and the lattice cell parameters for all three fuel types are given in Table 3.1-1. The bundle averaged cell parameters were calculated by including the zirconium associated with the control rods and instrument guide tube in the zirconium clad of each fuel rod. Water associated with each guide and instrument tube was included by increasing the unit cell dimensions (lattice pitch). Such assumptions permit a conservative estimation of the effect on reactivity of the extra zirconium and water within the fuel assembly.

The analysis discussed herein assumes the storage of W 17x17 fuel design at a maximum enrichment of 3.5 wt% ^{235}U for all UO_2 fuel rods.

3.1.4 Storage Array Description

The D. C. Cook Units 1 and 2 spent fuel storage pool will accommodate twenty specially designed storage rack modules. Each rack module contains a specific number of fuel assembly locations (e.g., 110 locations for a 10x11 module) and installation calls for a 15.3 inch nominal center-to-center fuel cell separation between adjacent modules. 1

Individual fuel assembly storage cells will be manufactured out of stainless steel clad BORAL™. Each cell guide will have a maximum outside square dimension of 9.453 inches and a nominal wall thickness of 0.196 inches as outlined below: 1

BORAL™ Storage Cell Wall Thickresses

Material	Dimensions, Inches Nominal	Minimum	Assumed*
304 Stainless Steel (inner shroud)	.075	.071	.071
1100 Aluminum	.010	.010	.021
B_4C-Al Matrix Core (35 w/o B_4C)	.071	.066	.066
1100 Aluminum	.010	.010	.021
304 Stainless Steel (outer shroud)	.030	.028	.028
TOTAL	.196	.185	.207

* Values used in the final worst case reactivity calculation given in Table 3.1-4.

The assumed storage cell wall material thicknesses used in the calculation maximize the pool reactivity by minimizing the amount of both poison and water present between adjacent fuel assemblies in the overmoderated array. Storage cells manufactured to the minimum specified dimensions assure a minimum ^{10}B loading between fuel assemblies of 0.040 g/cm^2, assuming a $^{10}B/B_{nat.}$ weight ratio of 0.180.

From a neutronics standpoint, the arrangement of modules in the storage pool results in an essentially infinite array of fuel assemblies in both the axial and radial directions. The nominal storage position assumes normal conditions where each unit within the effectively infinite storage array is concentric in its respective cell.

In addition to the nominally spaced array, the minimum spacing between fuel assemblies and the minimum water gap between adjacent storage cells has been considered. Specifically, the minimum center-to-center separation between adjacent storage cells will be "gauged" to assure a minimum water gap between cells of 0.953 inches, compared to a nominal water gap of 1.047 inches. (Based on the maximum outside cell size dimension). The fabrication tolerances will ensure that the worst credible spacing in the pool array occurs as a cluster of four adjacent assemblies with other storage cells being spaced the nominal center-to-center distance from that cluster. This arrangement also assumes that fuel assemblies in the cluster are in contact with the inside of each respective cell. 4

For the postulated accident condition of a fuel assembly lying horizontally across one or more of the storage modules, criticality safety is maintained through neutron isolation. A fuel assembly lying across the top of the modules would be isolated from other fissile material by greater than 20 inches of water. This separation between fuel assemblies essentially isolates, from a neutronics standpoint, the horizontal assembly from those in the module cells and, hence, there is no significant contribution to the overall reactivity of the array.

TABLE 3.1-4

Reactivity Calculation
D. C. Cook Units 1 and 2

Fuel Type: W 17 x 17 (3.5 w/o)

Storage Cell: Stainless Steel Clad BORAL™ - 0.207" total thickness
Outside Square Dimension: 9.453"
Center-to-Center Spacing: 10.50" (nominal)
^{10}B Loading: 0.020 g/cm^2 per cell plate

Case	Description	$k_{eff} \pm \sigma$ NITAWL-XSDRNPM-KENO IV (123 group)
1	Nominal	0.908 ± .004
2	Worst Case Geometry and Pool Temperature*	0.923 ± .004

* See description of assumed temperature conditions in Section 3.1.5.2.