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SUBJECT: Responds to NRC 870602 request for addl info re use of Boraflex in high density spent fuel storage racks. Existence of small horizontal gaps in Boraflex poison matl discussed.

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JAMES D. SHIFFER
VICE PRESIDENT
NUCLEAR POWER GENERATION

August 4, 1987

PGandE Letter No.: DCL-87-190

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington D.C. 20555

Re: Docket No. 50-275, OL-DPR-80
Docket No. 50-323, OL-DPR-82
Diablo Canyon Units 1 and 2
Use of Boraflex in Spent Fuel Storage Racks

Gentlemen:

In a letter dated June 2, 1987, the NRC Staff requested further information regarding the use of Boraflex in the high density spent fuel storage racks. PGandE's responses to the requests are enclosed.

Kindly acknowledge receipt of this material on the enclosed copy of this letter and return it in the enclosed addressed envelope.

Sincerely,

J. D. Shiffer

Enclosure

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ENCLOSURE

ENCLOSURE

PGandE RESPONSES TO NRC QUESTIONS ON THE USE OF BORAFLEX IN SPENT FUEL STORAGE RACKS

Recent examination of the Quad Cities spent fuel storage racks revealed the existence of a number of small horizontal gaps in the Boraflex poison material. In two instances, gaps as large as 3-1/2 to 4 inches were reported. The gaps were apparently random in size and in location (although all gaps were above the lower 40 inches of the Boraflex). In a preliminary report by Northeast Technology Corporation (NET-042-01, dated April 10, 1987), the cause of the gaps was attributed to radiation-induced shrinkage of the constrained Boraflex.

PGandE has reviewed the recently identified degradation of Boraflex and does not expect it to present a problem for the Diablo Canyon Power Plant (DCPP) since the design of the racks precludes the formation of large single gaps. Accordingly, PGandE has concluded that Boraflex is appropriate for use at DCPP.

PGandE plans to monitor the results of industry programs presently underway to evaluate the nature and consequences of Boraflex shrinkage. If the results of those investigations indicate a need for some remedial action at DCPP, PGandE will take the appropriate action.

Furthermore, as described below, PGandE plans to conduct its own comprehensive surveillance program to ensure that the Boraflex in use at DCPP continues to perform its intended function.

NRC Question No. 1

> Based on the recent experience pertaining to degradation of Boraflex in spent fuel pools at Quad Cities and Point Beach nuclear power plants, provide justification to demonstrate the continued acceptability of Boraflex for application in the Diablo Canyon spent fuel pool.

PGandE Response No. 1

At the Diablo Canyon Power Plant, there are only three spent fuel storage racks per unit that use Boraflex. The three racks using Boraflex contain a total of 290 storage locations, or less than 22 percent of the proposed capacity (1324 storage location) for each pool. No Boraflex is used in the remaining spent fuel storage racks.

Designs of the Quad Cities racks and the DCPP racks differ in several important aspects that may affect the behavior of the Boraflex in response to shrinkage. In the Quad Cities racks, the Boraflex is tightly clamped between two 0.075-inch-thick stainless steel plates, seam welded together to form the storage cell wall.

In contrast, the Boraflex sheets used at DCPP are not clamped tightly but are supported by stainless steel cover plates on the outside faces of the cell walls, as shown in Figures 1 and 2. More important, on all interior rack walls, spot welds (through cutouts in the Boraflex) at 12-inch intervals are used to hold the backing plate in place, as shown in Figure 2. By pinning the Boraflex in place, these spot welds effectively prevent formation of large gaps from the shrinkage of Boraflex. Small gaps might form, which would not lead to an increase in reactivity above the acceptable limit ($k_{eff} \leq 0.95$, as specified in NRC guidelines).

PGandE has estimated the consequences of Boraflex shrinkage for Diablo Canyon. The worst-case scenario evaluated still resulted in an estimated k_{eff} of less than 0.95, utilizing an assumption of a 2-1/2 percent shrinkage (roughly 4 inches) of the Boraflex. All shrinkage was assumed to be in the same axial plane, forming a single large gap across the Boraflex sheet. Further, no credit was taken for the soluble boron in the spent fuel pool water.

It should be noted that the design k_{eff} of the DCPP racks containing Boraflex is 0.920. Moreover, unlike Quad Cities, the DCPP pools are maintained with a soluble boron concentration of 2000 ppm, which provides an additional margin of safety.

From the information currently available, and taking into consideration the particular design of the DCPP racks, PGandE has concluded that the use of Boraflex at DCPP is acceptable.

Notwithstanding this conclusion, PGandE will conduct the following activities:

- Monitor industry investigations of Boraflex behavior under irradiation that are presently underway to more accurately determine the degree of Boraflex shrinkage (or any other degradation) that may be expected.

- Institute a surveillance program to monitor for potential long-term degradation of Boraflex to ensure any such degradation may be accommodated without exceeding a k_{eff} of 0.95.

- Perform a baseline neutron blackness test for the spent fuel racks to confirm the presence of Boraflex and to provide data for future reference should the surveillance program identify an unacceptable degree of Boraflex degradation.

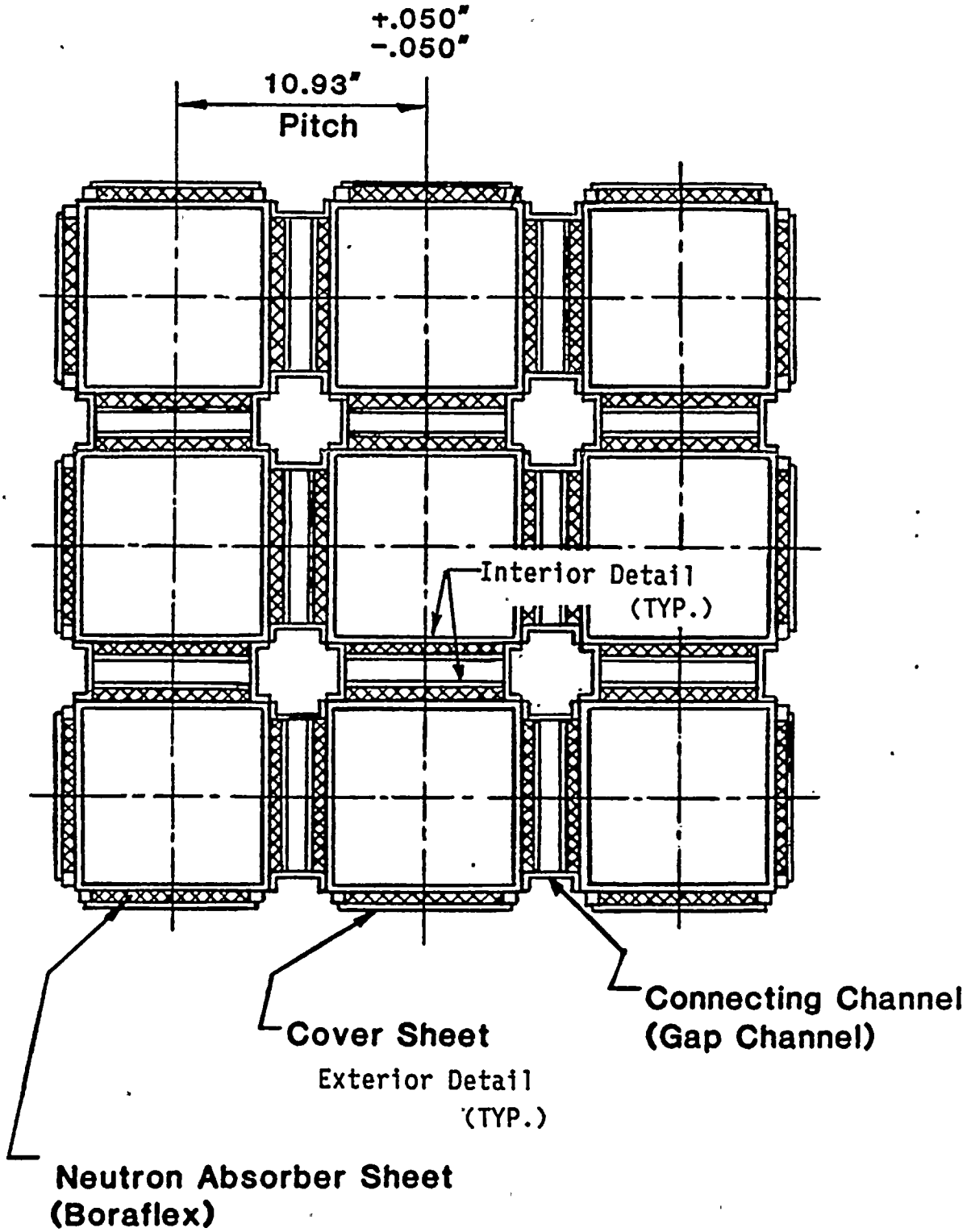

FIGURE 1 3 x 3 Typical Array (Poisoned Cells)

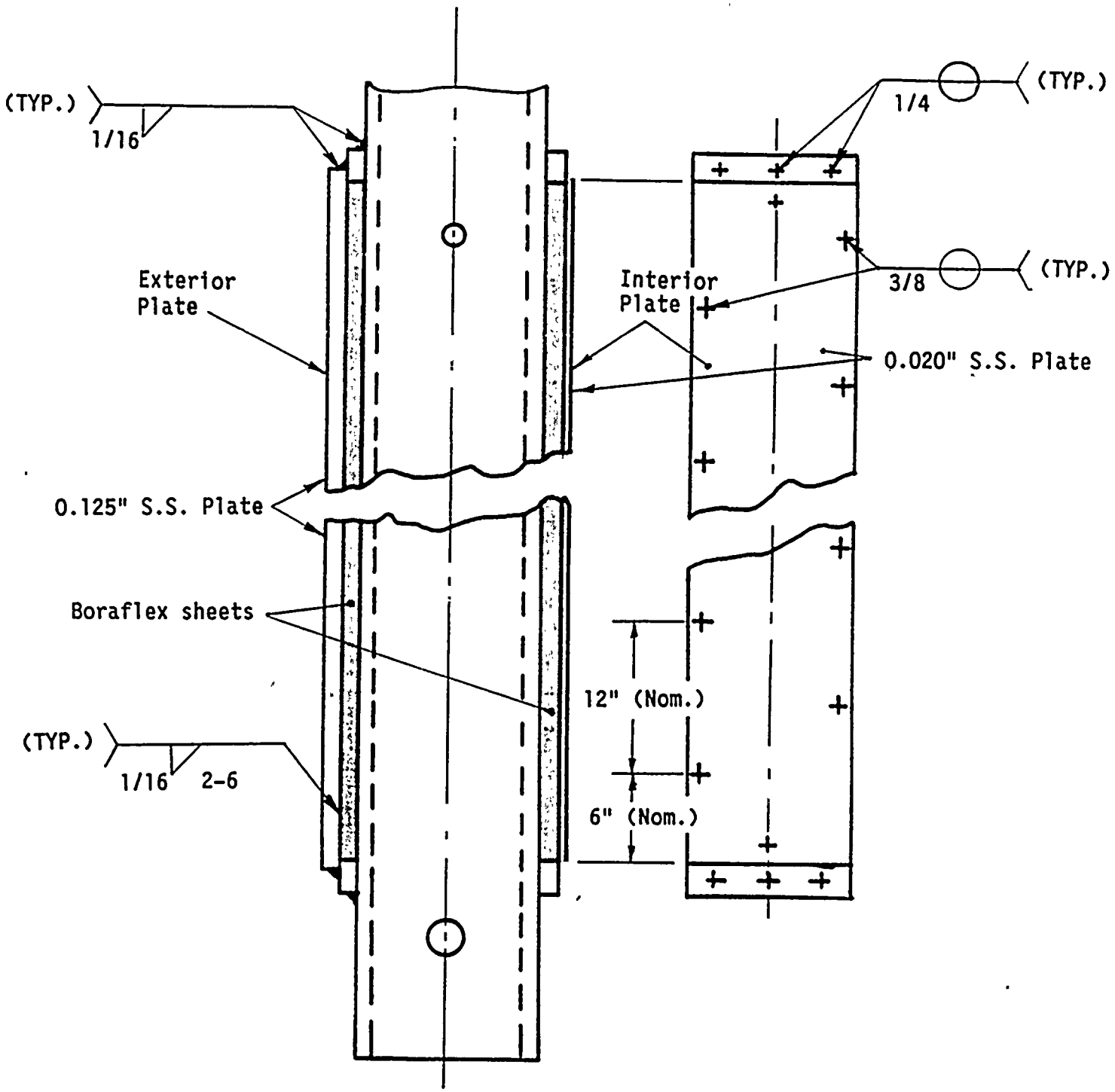

FIGURE 2

Boraflex and Backing Plate Details

NRC Question No. 2

> Based on the recent information, provide any changes to the inservice surveillance program for Boraflex neutron absorbing material and describe the frequency of examination and acceptance criteria for continued use. Provide the procedures for testing the Boraflex material and interpretation of test data.

PGandE Response No. 2

A procedure for inservice surveillance of Boraflex and interpretation of test data is currently under development. This procedure will be completed and implemented prior to storage of spent fuel in the high density spent fuel racks containing Boraflex. In this connection, PGandE has noted that surveillance samples from Point Beach showed considerably more degradation than the full-length Boraflex sheets installed in those racks, leading Wisconsin Electric Company to conclude:

> This degradation only occurs in the presence of gamma irradiation. It is possibly enhanced by differences in the method of encapsulation. Sample degradation may be enhanced due to the fact that the edge area/surface area ratio of the samples is larger than that of actual full sheets. This allows permeation of the SFP water throughout the sample relatively quickly. In contrast, permeation is only evident at the edges of the larger irradiated Boraflex insert. In either case, however, when SFP water permeation occurs the Boraflex material changes from a material of good integrity to one that is easily degraded. The onset of permeation and subsequent Boraflex degradation occurs roughly at 1×10^{10} rads gamma.

PGandE expects the DCPP samples to conservatively represent the long-term degradation of Boraflex in the racks, since the DCPP samples exhibit similar edge area to surface area ratios, and the chemical and radiation environments in the Point Beach and DCPP pools are expected to be similar. At the present time, no changes to PGandE's proposed inservice surveillance program for the Boraflex neutron absorbing material appear necessary or desirable.

Changes in dimensional measurements on the Boraflex samples required under PGandE's surveillance program will provide indications of Boraflex shrinkage before unacceptable degradation can occur. In situ neutron blackness testing of the storage cells or other direct measurements of Boraflex integrity may be employed should the surveillance data suggest greater than expected degradation.

The surveillance program will include the following:

- A baseline neutron blackness test will be performed to verify integrity of the Boraflex in the racks.

- One sample tree is being provided for each spent fuel pool. Each sample tree will be located to ensure that the Boraflex samples are exposed to a realistic gamma dose representative of the worst-case exposure.

- A sample will be removed for examination after initial storage of spent fuel in racks containing Boraflex within 12 months after each of the following years: 1, 3, 5, 8, 15, and 25. This schedule will be subject to change for each unit based on the examination results, fuel cycle lengths, and expected spent fuel pool lifetime.

- The most recently discharged spent fuel assemblies will have resided in the pool at least two months prior to removal of samples for examination.

- Attenuation measurements of the samples will be performed. The boron-10 loading will be calculated from these measurements.

- The samples will be visually examined for signs of physical degradation due to the spent fuel pool environment.

- Sample lengths, widths, and thicknesses will be measured with a precision micrometer using a procedure similar to ASTM D1042 (a standard method for measuring changes in dimensions of plastics).

- The samples will be weighted.

- Sample hardness will be measured with a durometer.

If the results from the surveillance program indicate variances from established criteria, additional evaluations will be made and appropriate actions taken to ensure that any such variances will not result in a k_{eff} >0.95.

NRC Question No. 3

Describe the corrective actions to be taken if degraded Boraflex specimens or absorber is found in the spent fuel pool.

PGandE Response No. 3

PGandE will determine specific corrective actions needed when and if any degraded Boraflex is found. The nature of the corrective actions will depend on the extent and magnitude of any Boraflex degradation indicated by the surveillance program or industry investigations that are currently underway, and the reactivity effects associated with such degradation. Possible corrective actions may include:

- Augmentation or modification of the surveillance program, e.g., to increase the frequency of coupon examination.
- Initiation of additional in situ direct measurements (e.g., neutron blackness testing) of the Boraflex integrity.
- Development of an alternative spent fuel loading pattern, using, for example, a checkerboard array, that will provide a sufficient reduction in reactivity to maintain $k_{eff} \leq 0.95$.
- Performance of additional analyses to evaluate the reactivity effects of Boraflex degradation identified in the surveillance program.

Implementation of the appropriate corrective actions will ensure that k_{eff} remains ≤ 0.95.

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DOCKET NO(S). 50-275/323

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SUBJECT: PACIFIC GAS & ELECTRIC COMPANY - DIABLO CANYON NUCLEAR POWER PLANT, UNITS 1 & 2

The following documents concerning our review of the subject facility are transmitted for your information.

- ☐ Notice of Receipt of Application, dated _____.
- ☐ Draft/Final Environmental Statement, dated _____.
- ☐ Notice of Availability of Draft/Final Environmental Statement, dated _____.
- ☐ Safety Evaluation Report, or Supplement No._____ dated _____.
- ☐ Environmental Assessment and Finding of No Significant Impact, dated _____.
- ☐ Notice of Consideration of Issuance of Facility Operating License or Amendment to Facility Operating License, dated _____.
- ☒ Bi-Weekly Notice; Applications and Amendments to Operating Licenses Involving No Significant Hazards Considerations, dated 9/9/87 [*see page(s)*] 34025.
- ☐ Exemption, dated _____.
- ☐ Construction Permit No. CPPR-_____, Amendment No. _____ dated _____.
- ☐ Facility Operating License No. _____, Amendment No. _____ dated _____.
- ☐ Order Extending Construction Completion Date, dated _____.
- ☐ Monthly Operating Report for _____ transmitted by letter dated _____.
- ☐ Annual/Semi-Annual Report- _____ _____ transmitted by letter dated _____.

Office of Nuclear Reactor Regulation

Enclosures:
As stated

CC: See next page

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DATE	9/11/87						

NRC FORM 318 (10/80) NRCM 0240

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