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October 23, 1996

Re: Indian Point Unit No. 2
Docket No. 50-247

Document Control Desk
US Nuclear Regulatory Commission
Mail Station P1-137
Washington, D.C. 20555

SUBJECT: Response to the NRC Generic Letter 96-04: Boraflex Degradation in Spent Fuel Pool Storage Racks

As requested, the response to the subject generic letter is provided.

Con Edison believes that our response to the subject generic letter provides assurance that the onsite storage of spent fuel at Con Edison is in compliance with GDC62 for the prevention of criticality in fuel storage and handling and with the 5 percent subcriticality margin position of the NRC staff to assure compliance with GDC62.

Should you have any questions regarding this matter, please contact Mr. Charles W. Jackson, Manager of Nuclear Safety and Licensing.

Very truly yours,

Jack McAvoy
for Steve Quinn

Subscribed and sworn to before me this 23rd day of October, 1996

Karen L. Lancaster
Notary Public

KAREN L. LANCASTER
Notary Public, State of New York
No. 60-4643659
Qualified In Westchester County
Term Expires 9/30/97

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Response to the NRC Generic Letter 96-04:

Boraflex Degradation in Spent Fuel Pool Storage Racks

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
INDIAN POINT UNIT NO. 2
DOCKET NO. 50-247
October, 1996

In the NRC Generic Letter 96-04: Boraflex Degradation in Spent Fuel Pool Storage Racks, which was issued June 26, 1996, licensees that use Boraflex are requested to summit a written response to the information requested in the generic letter. Con Edison's response to this generic letter is as follows:

Request

1. An assessment of the physical condition of the Boraflex, including any deterioration, on the basis of current accumulated gamma exposure and possible water ingress to the Boraflex and state whether a subcritical margin of 5 percent can be maintained for the racks in unborated water. Monitoring programs or calculational models in effect or being developed, or an estimation of anticipated concerns based on the specific rack design, are considered an appropriate basis for this response.

Response to Request 1

The physical condition of the Boraflex in the Indian Point Unit 2 fuel storage racks is acceptable, i.e. no significant loss in boron carbide or the polymer matrix has been evidenced. Also, at Indian Point Unit 2, a subcritical margin of 5 percent is maintained for the fuel storage racks in unborated water. The bases for these statements are described below:

To detect the onset of Boraflex degradation of the spent fuel storage racks at Indian Point Unit 2, three measures have been in effect. They are (a) the inspection and testing of Boraflex surveillance coupons, (b) the monitoring of Indian Point Unit 2 spent fuel pool silica level, and (c) the tracking of the industry experience with Boraflex, which consists of (i) industry events review, (ii) silica level data comparison, and (iii) rack design comparison.

These measures are used at Indian Point Unit 2 as a first level of defense to address the concern of Boraflex degradation in the spent fuel storage racks.

(a) Testing of Boraflex Surveillance Coupons

A Boraflex coupon surveillance program was established at Indian Point Unit 2 when the higher density racks utilizing Boraflex were installed in the Indian Point Unit 2 spent fuel pool in 1990.

The Indian Point Unit 2 Boraflex coupon surveillance program uses a total of 40 test coupons each mounted in a stainless steel jacket. The 40 coupons are mounted in two trees, each containing 10 Region I coupons and 10 Region II coupons.

Indian Point Unit 2 Region I racks are designed to store unirradiated fuel up to 5.0 w/o U-235 initial enrichment, while Region II racks are designed to store fuel which meets certain enrichment and burnup criteria.

On April 10, 1995 during the refueling outage, four Boraflex surveillance coupons from the Indian Point Unit 2 spent fuel pool were shipped to the Breazeale Nuclear Reactor Facility at the Pennsylvania State University for inspection and testing.

Two of the coupons examined received an integrated gamma exposure of ~ $3x10^9$ rads. Between these two coupons, one was Boraflex from the Region I storage racks and the other was Boraflex from the Region II storage racks.

The other two coupons examined received an integrated gamma exposure of ~ $1x10^9$ rads. Again, between these two, one was Boraflex from the Region I storage racks and the other was Boraflex from the Region II storage racks.

The tests conducted on these coupons included:

- Visual Inspection
- Dimensional Measurements
- Shore A Hardness
- Dry Weight and Density
- Radioassay
- Neutron Attenuation
- Dynamic Shear Modulus

Based on the tests and inspections of these surveillance coupons, there was no evidence of advanced or accelerated dissolution and/or degradation of the polymer matrix in any of the coupons. The measured average Boron-10 areal density of the Region I and Region II coupons is respectively about 19 % and 10 % higher than the nominal Boron-10 areal density assumed for the Region I and Region II storage racks design analysis.

(b) Monitoring of Spent Fuel Pool Silica Level

At Indian Point Unit 2, the spent fuel pool reactive silica level has been routinely measured since November 1991. The chronological monthly data and the graph for Indian Point Unit 2 spent fuel pool reactive silica level are provided in the response to Request 3.

The reactive silica level is monitored for both magnitude and trends. As of October 1996, the reactive silica level at Indian Point Unit 2 spent fuel pool is 13.1 ppm. As for the rate of increase in the reactive silica level, it is about 2.5 ppm per year since November 1991. This level is not indicative of accelerated Boraflex dissolution.

(c) Tracking of Industry Experience with Boraflex

- Industry Events Review

  Industry events related to Boraflex degradation, provided via NRC Information Notice or INPO Nuclear Network Information, have been carefully reviewed by Con Edison.

- Silica Level Data Comparison

  Con Edison has been a member of the EPRI Boraflex Users Group since 1988. As part of this group, an industry-wide data base of spent fuel pool silica levels has been developed. The Indian Point 2 spent fuel pool silica level is in the mid-range of this database. The level is comparable to Vogtle 2's level. Vogtle 2 has the same rack manufacturer and a similar rack installation date.

- Rack Design Comparison

  As a member of EPRI Boraflex Users Group, Con Edison has access to an industry-wide data base regarding types and design features of spent fuel storage racks.

  This data base has been used at Indian Point Unit 2 as a means to identify specific racks types and design features which may be susceptible to Boraflex gap formation and/or Boraflex dissolution.

  The design of fuel storage racks should not physically restrain the Boraflex. Boraflex is subject to shrinkage on irradiation. Any physical restraint may cause tearing and gaps may be formed. The Indian Point 2 racks do not physically restrain the Boraflex. In addition, the Indian Point 2 Boraflex panels were designed 4 % longer than required, to accommodate Boraflex shrinkage.

  As for the susceptibility to water ingress, and as a result, Boraflex dissolution, the Indian Point Unit 2 Boraflex panels in the spent fuel storage racks have been evaluated, and been determined not to be excessively open to water flow. The reactive silica level in the Indian Point Unit 2 spent fuel pool will continue to be closely monitored to detect the onset of accelerated dissolution of Boraflex.

Based on the results of the above first level defense actions at Indian Point Unit 2, the physical condition of the Boraflex in the Indian Point Unit 2 fuel storage racks is acceptable, i.e. no significant loss in boron carbide or the polymer matrix has been evidenced.

In the June 20, 1989 submittal from Con Edison to the NRC for the installation of higher density fuel storage racks utilizing Boraflex, the criticality analyses of each of the two separate regions of the spent fuel storage racks were summarized in Table 4.1 of Attachment B, 'Indian Point Unit 2 Spent Fuel Pool Increased Storage Capacity Licensing Report'. This table is enclosed herein for reference purposes.

As shown in Table 4.1, the maximum reactivity, K_{oo}, for Region I and Region II racks in unborated water are 0.9401 and 0.9408 respectively. Shrinkage of Boraflex panels was included in the design basis criticality calculations.

The analyses of the reactivity effects of the fuel storage in Indian Point Unit 2 spent fuel storage racks were performed with several assumptions which tend to maximize the rack reactivity. These include:

(1) Unborated pool water at a temperature yielding the highest reactivity;

(2) The absorption effect of the fuel assembly spacer grids is neglected;

(3) Assumptions of infinite extent in lateral and axial directions except for certain peripheral and abnormal assessments;

(4) Reactivity of design basis fuel assembly is higher than Westinghouse HIPAR, LOPAR, OFA or VANTAGE + fuel.

The current conditions of the Boraflex in the Indian Point Unit 2 spent fuel storage racks do not affect the result of the criticality analysis. Therefore, it has been determined that at Indian Point Unit 2, a subcritical margin of 5 percent is maintained for the spent fuel storage racks in unborated water.

Table 4.1

SUMMARY OF CRITICALITY SAFETY ANALYSES

	Region I	Region II
Design Basis burnup at 5.0% initial enrichment	0	40,900 MWD/MTU
Temperature for analysis	20°C (68°F)	20°C (68°F)
Reference k_∞ (CASMO-2E) (Includes 2½% width shrinkage of the Boraflex)	0.9310	0.9100
Calculational bias, δk	0.0013	0.0013
Uncertainties		
Bias	± 0.0018	± 0.0018
B-10 concentration	± 0.0025	± 0.0038
Boraflex thickness	± 0.0034	± 0.0046
Boraflex width	± 0.0015	± 0.0012
Inner box dimension	± 0.0012	± 0.0012
Water gap thickness	± 0.0013	NA
SS thickness	± 0.0005	± 0.0001
Fuel enrichment	± 0.0016	± 0.0016(1)
Fuel density	± 0.0021	± 0.0021(1)
Eccentric position	± 0.0001	Negative
Statistical combination of uncertainties(2)	± 0.0058	± 0.0070
Allowance for Burnup Uncertainty	NA	+ 0.0205
Allowance for Module Interfaces	+0.0020	+ 0.0020
Total	0.9343 ± 0.0058	0.9338 ± 0.0070
Maximum Reactivity (k_∞)	0.9401	0.9408

(1) For fuel tolerances, uncertainties in Region II assumed to be the same as those for Region I.
(2) Square root of sum of squares.

Request

2. A description of any proposed actions to monitor or confirm that this five percent subcriticality margin can be maintained for the lifetime of the storage racks and describe what corrective actions could be taken in the event if it cannot be maintained.

Response to Request 2

We propose three levels of defense to address the concern of possible Boraflex degradation in the spent fuel storage racks to assure the five percent subcriticality margin can be maintained for the lifetime of the storage racks.

As described in the response to Request 1, there are three measures in effect at Indian Point Unit 2 to detect the onset of Boraflex degradation of the spent fuel storage racks. They are as follows:

(a) the inspection and testing of Boraflex surveillance coupons;

(b) the monitoring of Indian Point Unit 2 spent fuel pool silica level; and

(c) the tracking of the industry experience with Boraflex, which consists of (i) industry events review, (ii) silica level data comparison, and (iii) rack design comparison.

These measures will continue to be used at Indian Point Unit 2 as a first level of defense to monitor or confirm that 5 percent subcriticality margin can be maintained.

In the event that during the Boraflex in-service surveillance program, the percentage of the shrinkage, or the Boron-10 areal density of Boraflex coupon is found to exceed the value used in the design criticality safety analysis, and/or the reactive silica level becomes relatively high compared with industry averages, and/or there is an increasing trend with time in the rate of increase in the reactive silica level, actions for a second level of defense will be taken to assure safe storage of fuel in the spent fuel pool.

First, the degraded Boraflex would be evaluated to determine the effect on the criticality safety analysis. Based on the results of the evaluation, direct testing of the Boraflex panels in the storage racks would be considered. This testing would involve quantitative in-situ testing of the Boraflex in the racks and a determination of the Boron-10 areal density of the material. One such method, BADGER- Boron Areal Density Gauge for Evaluating Racks, has been developed by the Electric Power Research Institute (EPRI). BADGER provides panel average and local Boron-10 areal density measurements with a measurement uncertainty comparable to range of variation in the as-manufactured areal density of Boraflex.

In conjunction with the in-situ Boron-10 measurement, the RACKLIFE program would be used at Indian Point Unit 2 to determine the performance of the Boraflex panels, and to help determine which Boraflex panels would be selected to have in-situ Boron-10 measurement.

The RACKLIFE program was developed by Northeast Technology Corporation (NETCO) through EPRI sponsorship. This program tracks the behavior of each panel of Boraflex in the rack installation based on the irradiation history of each panel and changes in the bulk pool conditions supplied by the user. RACKLIFE provides the quantity of Boraflex (and Boron-10) lost as a function of service history.

The second level actions therefore are (a)the evaluation of degraded Boraflex, (b) the RACKLIFE program, and (c) the BADGER or other similar in-situ Boron-10 measurement.

If the results of the above evaluation or direct testing indicate that the storage racks could not assure a $K_{eff} \leq 0.95$, the following corrective actions would be considered as a third level of defense:

1. Cessation of further additions of fuel assemblies to affected cells until there is reasonable assurance that $K_{eff} \leq 0.95$ will be maintained.

2. Relocation of fuel assemblies from affected to non-affected cells.

3. Increasing the soluble boron concentration in the spent fuel pool.

4. Addition of poison material to affected cells such as control element assemblies in the stored fuel assemblies.

5. Using administrative controls to limit the enrichment and/or burnup of fuel assemblies to be placed in affected cells.

These corrective actions were also reported in the August 25, 1989 submittal from Con Edison to the NRC in response to the NRC July 28, 1989 letter requesting additional information to support Con Edison's license amendment request, dated June 20, 1989, to expand spent fuel storage capacity.

We believe that taking one or more actions similar to these would be successful in assuring a $K_{eff} \leq$ 0.95 can be maintained.

The Indian Point Unit 2 Technical Specification 3.8.D.2 states that "At all times the spent fuel storage pit boron concentration shall be at least 1500 ppm." The required 1500 ppm adds additional assurance that a $K_{eff} \leq 0.95$ can be maintained.

Request

3. Describe the results from any previous post operational blackness tests and state whether blackness testing, or other in-situ tests or measurements, will be periodically performed. Chronological trends of pool reactive silica levels, along with the timing of significant events such as refuelings, pool silica cleanups, etc., should be provided. Implications of how these pool silica levels relate to Boraflex performance should be described.

Response to Request 3

At Indian Point Unit 2, no post operational blackness testing has been performed.

As described in the response to Request 2, in the event that during the Boraflex in-service surveillance program, the percentage of the shrinkage, or the Boron-10 areal density of Boraflex coupon is found to exceed the value used in the design criticality safety analysis, and/or the reactive silica level becomes relatively high compared with industry averages, and/or there is an increasing trend with time in the rate of increase in the reactive silica level, the second level of defense actions will be taken to assure safe storage of fuel in the spent fuel pool. The BADGER or other similar in-situ Boron-10 measurement is one of the second level defense actions.

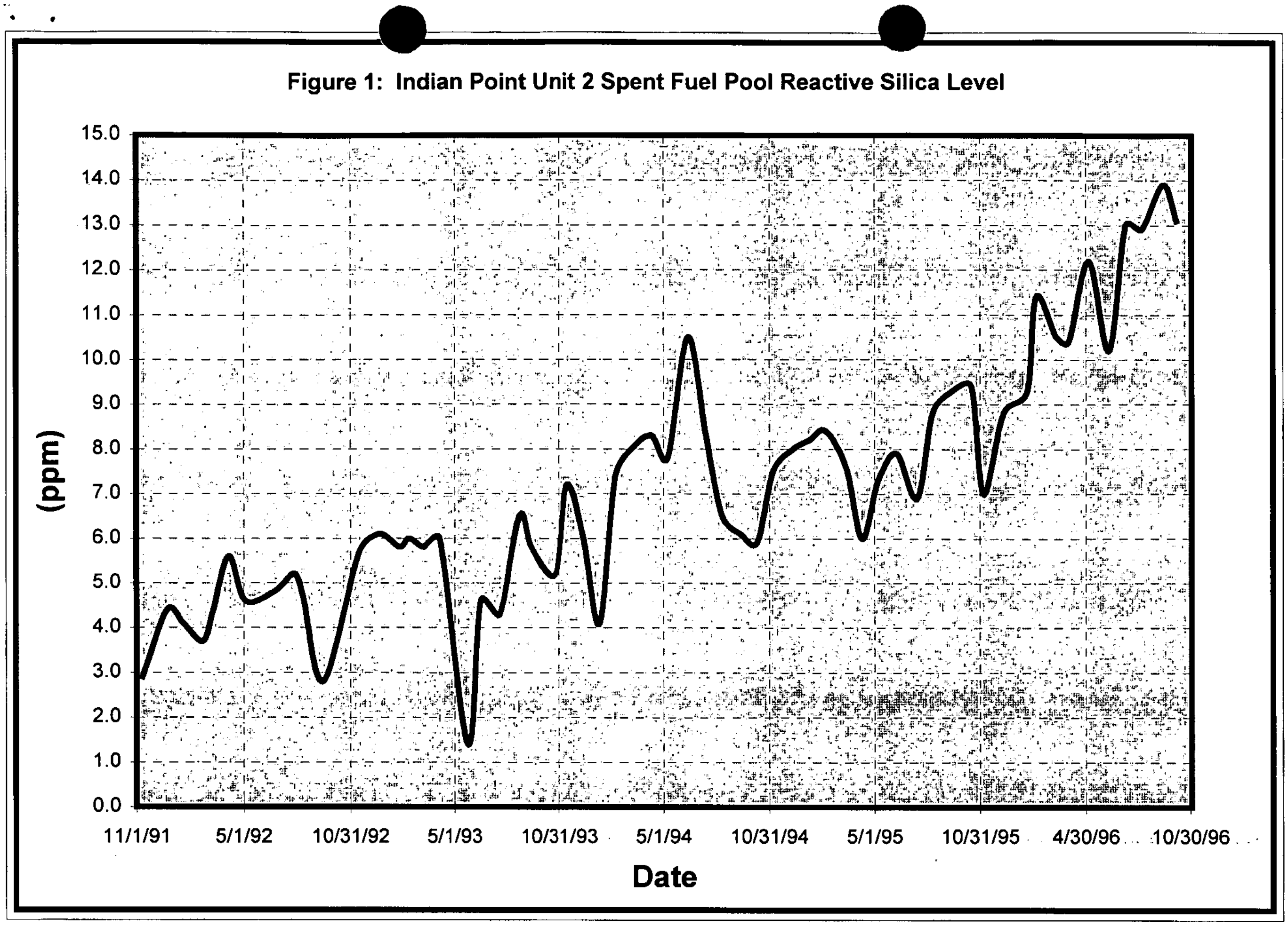
Chronological reactive silica level data at Indian Point Unit 2 spent fuel pool since November 1991 are listed in Table 1. The graph showing the trend of the reactive silica level is shown in Figure 1. The timing of significant events such as refuelings, resin changes, etc. is also shown in Figure 1. At Indian Point Unit 2, reverse osmosis cleanup has never been performed.

The reactive silica level is monitored for both magnitude and trends. As of October 1996, the reactive silica level at Indian Point Unit 2 spent fuel pool is 13.1 ppm. As for the rate of increase in the reactive silica level, it is about 2.5 ppm per year since November 1991.

This silica level is not indicative of accelerated Boraflex dissolution.

Table 1: Indian Point Unit 2 Spent Fuel Pool Reactive Silica Level

Date	Reactive Silica ppm
11/11/91	2.9
12/23/91	4.4
1/20/92	4.1
2/22/92	3.7
3/11/92	4.4
4/6/92	5.6
5/4/92	4.6
6/22/92	4.8
7/27/92	5.2
8/10/92	4.7
9/14/92	2.8
11/16/92	5.7
12/21/92	6.1
1/25/93	5.8
2/11/93	6.0
3/8/93	5.8
4/5/93	6.0
5/24/93	1.4
6/16/93	4.6
7/19/93	4.3
8/23/93	6.5
9/13/93	5.8
10/25/93	5.2
11/15/93	7.2
12/13/93	6.0
1/10/94	4.1
2/7/94	7.4
3/7/94	8.0
4/11/94	8.3
5/9/94	7.8
6/13/94	10.5
7/14/94	8.3
8/11/94	6.5
9/12/94	6.1
10/10/94	5.9
11/7/94	7.5
12/12/94	8.0
1/9/95	8.2
2/6/95	8.4
3/13/95	7.6
4/10/95	6.0
5/8/95	7.3
6/9/95	7.9
7/14/95	6.9
8/10/95	8.8
9/13/95	9.3
10/16/95	9.4
11/6/95	7.0
12/11/95	8.8
1/21/96	9.3
2/5/96	11.4
3/11/96	10.5
4/1/96	10.4
5/6/96	12.2
6/10/96	10.2
7/9/96	13.0
8/6/96	12.9
9/13/96	13.9
10/6/96	13.1



Timing of Significant Events:

1. Feb. 93 to April 93	refueling outage
2. Feb. 16, 94	demineralizer bed changed
3. Feb. 95 to May 95	refueling outage
4. Jan. 5, 96	demineralizer bed changed

No reverse osmosis cleanup performed.

Request

4. All licensees are requested to submit the information to the NRC to ensure that the onsite storage of spent fuel is in compliance with GDC 62 for the prevention of criticality in fuel storage and handling and with the five percent subcriticality margin position of the NRC staff to assure compliance with GDC 62.

Response to Request 4

As described in the response to Request 1, the analyses of the reactivity effects of the fuel storage in Indian Point Unit 2 spent fuel storage Region I and Region II racks were performed with several assumptions which tend to maximize the rack reactivity. These include:

(1) Unborated pool water at a temperature yielding the highest reactivity;

(2) The absorption effect of the fuel assembly spacer grids is neglected;

(3) Assumptions of infinite extent in lateral and axial directions except for certain peripheral and abnormal assessments;

(4) Reactivity of design basis fuel assembly is higher than Westinghouse HIPAR, LOPAR, OFA or VANTAGE + fuel.

The maximum reactivity (K_{∞}) for Region I and Region II racks are 0.9401 and 0.9408 respectively. Shrinkage and edge deterioration of Boraflex panels was included in the design basis criticality calculations. The current conditions of the Boraflex in the Indian Point Unit 2 spent fuel storage racks do not affect the result of the criticality analysis. Therefore, it meets the requirements of General Design Criterion 62 for the prevention of criticality in fuel storage and handling and with the five percent subcriticality margin position of the NRC staff to assure compliance with GDC 62.