James A. FitzPatrick
Nuclear Power Plant
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NewYorkPower Authority

Michael J. Colomb
Plant Manager

November 8, 1996
JAFP-96-0450

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Mail Station P1-137
Washington, D.C. 20555

SUBJECT: James A. FitzPatrick Nuclear Power Plant
Docket No. 50-333
Response to Request for Additional Information Regarding Porous Concrete Sub-Foundation

Reference: USNRC Letter, Karen R. Cotton to W.J. Cahill, Jr. dated October 22, 1996

Dear Sir:

This letter transmits the Authority's response to a recent request for additional information pertaining to the potential for erosion of cement from under the containment foundation basemat at the James A. FitzPatrick Nuclear Power Plant.

Attachment 1 provides: (A) a brief general overview of the containment foundation basemat construction at FitzPatrick; (B) responses to the five questions contained in your letter; and (C) the Authority's conclusions to the issues as they pertain to the FitzPatrick Plant.

If you have any questions, please contact Mr. Richard Plasse at (315) 349-6793.

Very truly yours,

Michael J. Colomb

MJC:GB
Attachment: As stated

cc: Next Page

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cc: Regional Administrator
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Attachment 1 to JAFP-96-0450
Response to Request for Additional Information Regarding Porous Concrete Sub-Foundation

A. INTRODUCTION

The basemat for the FitzPatrick Reactor Building is founded directly upon sandstone bedrock overlain by a porous or pop-corn concrete leveling slab of varying depth (6" min.). The porous concrete slab is surrounded by engineered structural backfill, on top of which is laid the continuous porous concrete drain pipe (12 in. dia.) leading to a sump. The invert elevation of the drain pipe is approximately 4 feet above the top of the porous concrete sub-foundation mat. Any ground water seeping down along the periphery of the reactor building collects in the sump and is eventually pumped to the drainage system.

B. NRC QUESTIONS

Question 1

Have you found slurry in the drainage from this layer?

Response 1

No.
Porous or pop-corn concrete is formed by bonding coarse aggregates with a cement paste at their points of contact only, without the presence of fine aggregates to fill-in the voids. The presence of the voids makes this form of concrete potentially susceptible to physical erosion in presence of liquids like ground water. If high amounts of tricalcium aluminates (C3A) are present in the cement used to make this concrete, it becomes susceptible to chemical attacks by sulfates present in the soil and ground water. Thus the cement in porous concrete may chemically disrupt and form a whitish looking slurry.

There has been no visual evidence of any cementitious slurry in the water samples regularly collected from the drainage sump at FitzPatrick. The results of analysis of water samples taken from the sump also provide supportive evidence of the absence of slurry in the water.

Additionally, the performance data of the sump pumps used to divert this water into the drainage system show that these pumps have not malfunctioned as a result of cement intrusion, further indicating the absence of solid particulates in the water.

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Question 2

Has there been any settlement of the containment basemat?

Response 2

No.
Any evidence of settlement of the basemat would be shown by cracks along the junction of the mat and the wall. NYPA engineers recently conducted a walkdown of the containment structure at FitzPatrick, including the basemat, per the requirements of 10 CFR 50.65,"Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants" (Maintenance Rule). There were no cracks found other than minor non-structural hairline cracks.

Also, no settlement of the basemat is theoretically feasible considering the strength of the porous concrete and its confinement. The strength of the porous concrete was documented during plant construction by the concrete test program (950 psi at 7 days and 1150 psi long term, i.e.; beyond 28 days). This provides a bearing capacity equivalent to or greater than that of underlain sandstone. The porous concrete is tightly confined between the engineered structural backfill and the surrounding natural rock; thus, even with the loss of the cement, the coarse aggregates will be contained in generally the same location and will provide the bearing capacity required at the bottom of the basemat.

Question 3

Have you noticed any unusual conditions which may be related to porous concrete sub-foundation layer ?

Response 3

No.
As stated earlier, no evidence of cracking was found. Also, no evidence of any unusual conditions like cementitious slurry in the sump water samples, clogging or irregularities of operations of the pumps due to cement intrusion, have been noted.

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Question 4

Are you monitoring anything related to the drainage from the porous concrete sub-foundation layer(s) below the containment basemat?

Response 4

YES.
Water samples from the sump are collected on a regular basis. Because the porcus concrete pipes collecting and draining into the sump are 4 feet higher than the top of porous concrete, solid particulates with specific gravity higher than water are not to be expected in the undisturbed samples.

FitzPatrick will continue to collect and monitor sump water samples. Because the test results compiled to date have been negative, additional actions are not necessary at this time.

Question 5

Is calcium aluminate (high alumina) cement used as a constituent in the porous concrete mix ?

Response 5

YES.
Sulfates (SO4) of sodium, magnesium, etc. may be present in the water or soil in contact with the foundation basemat. The sulfates react with hydrated lime and calcium aluminate which result in considerable expansion and disruption of concrete. Therefore, the key to non-disruptive concrete in such cases would be to use cement low in tricalcium aluminate (C3A) content. This may be achieved by adding suitable pozzolan in Type I (normal portland) cements or Type II (modified portland) cements.

All cements used for concrete construction at FitzPatrick, including the porous concrete sub-basemat, complied with ASTM Specification C 150-68 Type II and Federal Specification No. SS-C-192 Type II. Evaluations of the Mill Test Report of the cement used at FitzPatrick, indicate that the modified portland cement had amounts of C3A in accordance with ASTM specifications. Thus the possibility of expansion and disruption of the porous concrete layer due to chemical reactions is low.

C. CONCLUSIONS

It is the Authority's position that the cementitious materials forming the porous concrete layer under the basemat of the Reactor Building at FitzPatrick have not chemically disintegrated or physically eroded due to the presence of ground water seeping along the periphery of the foundation walls. This is based on: (1) results of visual inspections of the containment basemat; (2) the calcium aluminate content in the cement used for the sub-basemat construction; and (3) the analysis results of the water samples taken from the drainage sump.