July 28, 2000

Mr. Oliver D. Kingsley, President
Nuclear Generation Group
Commonwealth Edison Company
Executive Towers West III
1400 Opus Place, Suite 500
Downers Grove, IL 60515

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION RELATED TO GENERIC LETTER 96-06; BYRON STATION, UNITS 1 AND 2, AND BRAIDWOOD STATION, UNITS 1 AND 2 (TAC NOS. M96789, M96790, M96782, AND M96783)

Dear Mr. Kingsley:

Generic Letter (GL) 96-06, Assurance of Equipment Operability and Containment Integrity During Design-Bases Accident Conditions, dated September 30, 1996, included a request for licensees to evaluate cooling water systems that serve containment air coolers to assure that they are not vulnerable to waterhammer and two-phase flow conditions. Commonwealth Edison Company (ComEd) provided its response for Byron and Braidwood Stations in letters dated October 28, 1996, (30 day response), and January 28, 1997, and May 2, 1997 (120 day responses). Requests for additional information (RAIs) were issued by the NRC in its letters of April 13 and May 1, 1998. ComEd provided information to the April 13, 1998, RAI in its letters of June 30 and September 30, 1998. Responses to the RAI of May 1, 1998, were addressed in ComEd letters of August 27, 1998, February 26 and October 27, 1999.

In reviewing the information provided regarding the waterhammer and two-phase flow analyses to determine adequacy and conservatism of the analyses, the staff and its contractor, Scientech, Inc., have determined that supplementary information is needed, particularly with respect to the use of the RELAP5 computer code. The staff's observations and specific comments pertaining to ComEd's September 30, 1998, submittal along with requests for supporting information are enclosed. The enclosed information has been discussed with members of the ComEd staff. During a subsequent discussion with ComEd staff, it was agreed that 60 days after receipt of this letter was an appropriate time for a response.

Please contact me at 301-415-3019 if there are questions.

Sincerely,

/RA/

George F. Dick, Jr., Project Manager, Section 2
Project Directorate III
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket Nos. STN 50-454, STN 50-455, STN 50-456, and STN 50-456

Enclosure: As stated

cc w/encl: See next page

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1400 Opus Place, Suite 500
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July 28, 2000

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION RELATED TO GENERIC LETTER 96-06; BYRON STATION, UNITS 1 AND 2, AND BRAIDWOOD STATION, UNITS 1 AND 2 (TAC NOS. M96789, M96790, M96782, AND M96783)

Dear Mr. Kingsley:

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Sincerely,

/RA/
George F. Dick, Jr., Project Manager, Section 2
Project Directorate III
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket Nos. STN 50-454, STN 50-455, STN 50-456, and STN 50-456

Enclosure: As stated

cc w/encl: See next page

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Request for Additional Information

Regarding Generic Letter 96-06

Byron Station, Units 1 and 2

Braidwood Station, Units 1 and 2

Docket Nos. STN 50-454, STN 50-455, STN 50-456, and STN 50-457

The hydrodynamic loading for the waterhammer and two-phase flow analysis was evaluated by the licensee using the RELAP5/MOD3.1.1 computer code. Although the code input and modeling assumptions, such as the use of homogeneous equilibrium model choking at the coil exits, were deliberately chosen to achieve conservative results, in the absence of any specific benchmark calculations, the validity of the RELAP5 results is questionable and may not be conservative. Additionally, the applicability of the one dimensional integrated thermal hydraulic models in addressing some important phenomena of concern to the waterhammer issue (e.g. water/steam stratification in horizontal lines) is questionable. Following are the staff's comments and observations regarding ComEd's September 30, 1998, response to the staff's RAI of April 13, 1998.

A. The licensee's response to question 2.a states that there was no specific assessment or validation performed for this application of RELAP5. This brings into question the capability of the model to accurately model the water hammer and two phase flow for the containment air cooling water systems. RELAP5 relies heavily on empirical models that were developed for specific phenomena and accident conditions. The code must be assessed against data that are applicable and properly scaled to show that it adequately predicts the accident conditions. In this case both the details of the two-phase flow calculations and the load generation methodology need to be assessed against applicable test data. Please provide a discussion of the results obtained from the load generation methodology validation.

B. In the licensee's response to question 2.b, key features of the model are listed. While they are desirable features, their value is uncertain without code comparison to specific assessment data that are applicable to the problem. The justification for introducing a non-condensable gas into the system is not stated except as a means to compensate for perceived code deficiencies and to make the code run without failing. This is an indication that use of RELAP5 may not be appropriate for this calculation.

C. As a part of the response to question 2.c, the licensee is requested to provide justification for the use of pressure boundary conditions to simulate pump behavior. Further, the licensee's interpretation of the results is that the observed pressure spikes were water packing problems. The RELAP5 code can not distinguish between water packing and real

waterhammer events. Therefore, the pressure spike that is described as an artifice of the computational method could be a waterhammer. The peak pressure which exceeded the design pressure was apparently deleted during the filtering out of other "numerical" noise. Use of the water packing model for these calculations can distort the physical phenomenon of interest. This description of the simulation supports the staff's concern that use of RELAP5 may not be appropriate for this calculation.

D. The licensee's response to question 2.e, regarding "engineering judgment" should include the technical rational for the decisions made with respect to "filtering." Discuss the method used to distinguish numerical oscillations from real phenomena. Also, high frequency waterhammer loads can amplify modes of vibration other than bending modes; therefore a structural frequency cutoff significantly greatly than 33 hertz (typically used for seismic analysis) should be used in order to properly evaluate the structural response. Therefore, please provide assurance that the filtering methodology will not result in underestimating the structural response.

E. In the licensee's response to question 3, it is not possible to know if the analytical results are conservative without a detailed code assessment against applicable experiments. Also, the staff does not agree that the use of the HEM choking model will maximize the flow out of the coils. Please discuss the applicability of the HEM choking model.

F. The staff questions the conclusions stated by the licensee in response to question 4 because there was is no validation of the forcing functions generated by RELAP5 (as discussed previously), and because part of the loading was arbitrarily filtered out.

G. With regard to the two-phase flow assessment, quantitative analysis and justification are needed in support of the conclusion that flow stall due to increased two-phase pressure drop is highly unlikely. For example, the difference in system refill time due to the presence of steam was not quantified.