October 20, 2003

Mr. John L. Skolds, President
Exelon Nuclear
Exelon Generation Company, LLC
4300 Winfield Road
Warrenville, IL 60555

SUBJECT: PUBLIC MEETING TO DISCUSS OPERATION ABOVE THE LICENSED THERMAL POWER LIMITS AT THE BYRON STATION

Dear Mr. Skolds:

This refers to the public meeting held on September 18, 2003, in Lisle, Illinois, to discuss the operation of Byron Station above the licensed thermal power limits as a result of events related to Byron's ultrasonic feedwater flow measurement correction factor errors. This meeting served to provide a brief overview of Exelon's activities to date and proposed future actions to address this issue. Mr. Chip Pardee and other Exelon managers presented information concerning the investigations performed, root cause and immediate corrective actions associated with the technical issues, and plans to review the appropriateness of decisions made in handling this issue.

As discussed at the meeting, we are concerned with decisions and direction taken by the Byron Station management and that NRC involvement was necessary for timely resolution of the issue. We look forward to discussing your evaluation of the decision-making process and any lessons learned and corrective actions in the near future.

The handouts provided at the meeting by the Exelon staff and a listing of principal NRC and Exelon Nuclear attendees are attached as Enclosures 1 and 2 to this letter.

In accordance with 10 CFR 2.790 of the NRC's "Rule of Practice," a copy of this letter and its enclosures will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records System (PARS) component of NRC's document system (ADAMS). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html (the Public Electronic Reading Room).

If you have any questions regarding this meeting, please contact me at (630) 829-9733.

Sincerely,

/RA/

David Hills, Chief
Mechanical Engineering Branch
Division of Reactor Safety

Docket Nos. 50-454; 50-455
License Nos. NPF-37; NPF-66

Enclosures: 1. List of Principal Attendees
2. Exelon Handout

See Attached Distribution

cc w/encl: Site Vice President - Byron
Byron Station Plant Manager
Regulatory Assurance Manager - Byron
Chief Operating Officer
Senior Vice President - Nuclear Services
Vice President - Mid-West Operations Support
Vice President - Licensing and Regulatory Affairs
Director Licensing
Manager Licensing - Braidwood and Byron
Senior Counsel, Nuclear
Document Control Desk - Licensing
M. Aguilar, Assistant Attorney General
Illinois Department of Nuclear Safety
State Liaison Officer
State Liaison Officer, State of Wisconsin
Chairman, Illinois Commerce Commission

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cc w/encl: Site Vice President - Byron
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Chief Operating Officer
Senior Vice President - Nuclear Services
Vice President - Mid-West Operations Support
Vice President - Licensing and Regulatory Affairs
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Senior Counsel, Nuclear
Document Control Desk - Licensing
M. Aguilar, Assistant Attorney General
Illinois Department of Nuclear Safety
State Liaison Officer
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Chairman, Illinois Commerce Commission

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Byron Thermal Power Measurement Public Meeting

September 18, 2003

List of Principal Attendees

Nuclear Regulatory Commission
J. Caldwell, Regional Administrator
G. Grant, Deputy Regional Administrator
S. Reynolds, Acting Division Director, Division of Reactor Projects
C. Pederson, Director, Division of Reactor Safety
A. Stone, Chief, Reactor Projects Branch 3
V. Mitlyng, Public Affairs Officer
K. Lambert, Enforcement Coordinator
M. Parker, Sr. Reactor Analyst,
D. Hills. Chief, Mechanical Engineering Branch
T. Bilik, Reactor Inspector

Licensee
K. Jury, Director, Licensing and Regulatory Affairs
J. Benjamin, Vice President, Licensing and Regulatory Affairs
C. Pardee, Senior Vice President, Nuclear Services
J. Meister, Vice President, Engineering
B. Kouba, Exelon Engineering Director
B. Adams, Byron Site Engineering Director
S. Kuczynski, Byron Site Vice President
D. Hoots, Byron Plant Manager
C. Dunn, Braidwood Site Engineering Director
K. Ainger, Byron/Braidwood Licensing Manager
J. Drowley, Mechanical Engineering Manager
B. Grundmann, Byron Regulatory Assurance Manager
K. Root, Braidwood Regulatory Assurance Manager
D. Drawbaugh, Byron Regulatory Assurance

Westinghouse
S. Hauser, Westinghouse, Exelon Project Manager
R. Doney, Westinghouse, Manager, Plant Systems
R. Hunter, Westinghouse, Vice President, Exelon Customer Relations

IEMA - DNS
C. Thompson, Resident Inspector
C. Settles, Head - Resident Inspector Section

AMAG
A. Lopez, President

Caldon
Ernest Hauser, President - Nuclear

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Byron Station
Thermal Power Measurement

September 18, 2003

Enclosure 2

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Agenda and Opening Remarks

Jim Meister
Vice President - Engineering

Enclosure 2

Agenda

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- Opening remarks
- Background on ultrasonic feedwater (FW) flow measurement
- Chronology of ultrasonic flow meter (UFM) implementation
- UFM test plan and results
- Root cause and corrective actions
- Safety implications
- Future plans/actions
- Closing remarks

Opening Remarks

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- Several in-depth investigations performed, from 1999 to 2002, to determine reason for megawatt (MW) differences between Byron and Braidwood
- Test plan identified problem with UFM measurement of FW flow in August 2003
- Preliminary root cause determined to be UFM correction factor error caused by pressure pulses in FW piping which were caused by resonance
- Prior to 2003 test plan, multiple rigorous reviews conducted to evaluate all causes considered plausible
- Amount of reactor overpower initially determined acceptable with respect to safety analyses criteria
- Broad review of UFM decision making initiated

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Background on Ultrasonic FW Flow Measurement

Bill Kouba
Exelon Engineering Director

Enclosure 2

Background on Ultrasonic FW Flow Measurement

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- Purpose of UFMs
  - More accurately measure FW flow
  - Potentially recover MW lost due to FW venturi flow inaccuracies
- Installation was not part of a measurement uncertainty recapture (i.e., Appendix K) uprate
  - No intent to raise power beyond existing licensed limit
  - Five percent power uprate moved plants from Appendix K to Best Estimate loss of coolant accident (LOCA) basis

Background on Ultrasonic FW Flow Measurement (cont.)

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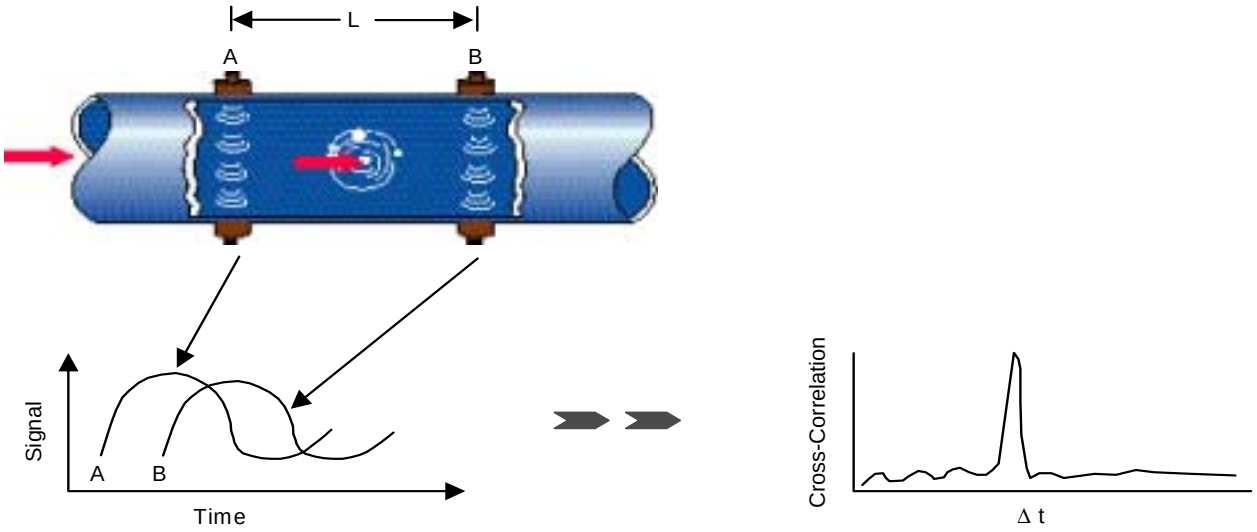
- UFM captures the signature at A and B and calculates the travel time



Background on Ultrasonic FW Flow Measurement (cont.)

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How the UFM Works

- Signal sent through each of the two sets of transducers is modified by eddies
- Eddy modification “fingerprints” signal
- Time delay for “fingerprint” movement is determined by a statistical technique called cross-correlation
- Plant UFM “correction factor” is calculated by dividing the UFM mass flow by that from the venturi

Background on Ultrasonic FW Flow Measurement (cont.)

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- Installation verified by UFM vendor
  - In accordance with vendor procedures
  - NRC subsequently approved UFM technology in March 2000 for use in Appendix K uprates
  - Vendor procedures consistent with NRC-approved topical report
- UFM installed on each FW branch line supplying steam generators
- UFMs installed in the same manner on the four Byron/Braidwood units
- Correction factors used in calorimetric calculation to correct FW flow
- Correction factors determined periodically, after a defined change in power (potential de-fouling event), or plant parameter trending

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Chronology of UFM Implementation

Bill Kouba

Enclosure 2

Chronology of UFM Implementation

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- UFMs implemented at Braidwood – June 1999
- UFMs implemented at Byron – May 2000
- Electrical output differences identified between Braidwood and Byron
  - Upon initial installation
  - Following five percent power uprate in 2001
- Multiple evaluations conducted from 1999 through 2002 to determine reason for differences in electrical output

Chronology of UFM Implementation
Summary of Evaluations

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- Evaluations performed June 1999 to May 2000
  - Dual instrument test with ultrasonic flow instruments, and UFM vendor review of Byron installation
  - Additional validation testing at Braidwood to verify data acquisition based on venturi cleaning methodologies
  - Internal Exelon design review
    - Secondary plant parameters, fuel utilization, heat rates, implementing procedures
- Evaluations concluded Byron UFM implementation was installed and operating within criteria established for UFM technology

Chronology of UFM Implementation
Summary of Evaluations (cont.)

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- Independent Exelon review performed in February 2002
  - Identifies fuel burn-up anomalies
  - Recommends additional detailed evaluation
- Byron removes UFM venturi correction factors pending evaluation of fuel burn-up concern
- Exelon Nuclear Fuels organization determines fuel burn-up is within predicted range
  - Byron reinstates UFM correction factors after determination

Chronology of UFM Implementation
Summary of Evaluations (cont.)

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- UFM vendor, Corporate Engineering, and site review UFM implementation – March 2002
  - Installation and operational criteria verified including piping, transducers, cables, software, and test procedures
  - Comparison testing conducted between common FW header and individual FW lines
  - Study concludes UFM measured flow per design and implemented properly
  - Continuous data subsequently recorded in response to a recommendation from this study

Chronology of UFM Implementation

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- NRC resident inspector issues unresolved item in inspection report
- NRC issues letter to Exelon concerning Byron Unit 1 thermal power level
- Exelon response concludes Byron Unit 1 UFMs installed consistent with NRC guidance, and that Unit 1 is operating within its licensed thermal power limit
- Exelon Engineering test plan initiated – March 2003

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UFM Test Plan and Results

Bill Kouba

Enclosure 2

UFM Test Plan and Results

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- Purpose of test plan – identify reasons for electrical output differences between Byron/Braidwood stations
- Investigate long-term trends of specific plant parameters
  - Monitor correction factor trends on Byron Unit 1 with continuous data link to UFM vendor
  - Observe performance during steady state, power changes, pre/post-refueling outage
- Use additional UFM on common FW header upstream of UFMs on individual FW lines
  - Check venturi flow sum and existing UFM flow sum
  - Determine if difference between common header UFM and sum of individual FW line UFMs at Byron Unit 1 is within statistical allowance

UFM Test Plan and Results

Results of Testing

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- Braidwood Unit 1 comparison showed very close correlation between common header and individual line UFMs
- Comparison of common FW header UFM to sum of individual FW line UFMs on Byron Unit 1 was not within statistical allowance
- Signal noise observed on some individual FW line UFMs
- Common FW header UFMs had no signal noise
- Definite problem identified, decisions made to reduce power

UFM Test Plan and Results
Power Reductions

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- Byron Unit 1 reduced power 32 MWe
  - Based on correction factor differences between common FW header UFM and individual FW line UFMs
  - Correction factors reset to 1
- Signal noise anomalies, in conjunction with common header to individual line comparisons, were used to determine extent of condition for other units
- Byron Unit 2 reduced power 22 MWe
  - Based on noise observed in one of four individual FW line UFM signals
  - Correction factors conservatively reset to 1

UFM Test Plan and Results
Power Reductions (cont.)

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- Braidwood Unit 1 not affected because of very close correlation between common header UFM and sum of individual FW line UFMs
- Braidwood Unit 2 reduced power 11 MWe
  - Based on noise observed in two of four individual FW line UFM signals
- ENS notifications made in accordance with license condition

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Root Cause and Corrective Actions

Brad Adams
Site Engineering Director

Enclosure 2

Root Cause and Corrective Actions
Overview

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- Formed root cause analysis team to determine root cause of UFM inaccurate FW flow measurements
- Preliminary root cause
  - UFM correction factor error
  - Correction factor error caused by noise impact on time delay
  - Bias on calculated time delay (flow) varies at different power levels
  - Resulting bias varies as a function of noise structure and intensity

Root Cause and Corrective Actions
Overview

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- Preliminary root cause (cont.)
  - Presence of noise in individual loops' flow signal caused a non-linearity in calculated venturi correction factor as a function of power level
  - Noise caused by pressure pulses in FW piping
  - Pressure pulses in FW piping caused by resonance
  - Resonance in FW piping caused by a driver at the natural acoustic frequency of the piping

Root Cause and Corrective Actions

Corrective Actions

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- Removed correction factors to eliminate error
- Installation of common FW header UFM to provide for an alternate calculation of correction factor
- Revising appropriate site procedures to check UFM for noise
  - Acceptance criteria established for correction factor determination
- Independent technical review
- Evaluation performed on portion of decision making regarding use of UFMs, team has been chartered to comprehensively evaluate decision making on a broader level and over the life span of this issue

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Safety Implications

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Enclosure 2

Safety Implications

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- Byron Unit 1 overpower limited to 101.6%, Byron Unit 2 overpower limited to 100.4%
- Braidwood Unit 2 overpower limited to 100.3%
- Evaluations of LOCA, non-LOCA, containment, and dose analyses being performed
- Evaluations being performed with conservative assumptions that envelope historical power levels
- Preliminary results indicate applicable safety analyses acceptance criteria were met

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Future Plans/Actions

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Enclosure 2

Future Plans/Actions

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- Project plan in progress to install common FW header UFMs
  - Testing has determined common header UFMs are free of noise
- Scheduled completion for Byron/Braidwood units is September/October 2003
- Independent technical review
- Broad review of decision making initiated
  - Results will be shared with NRC

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Closing Remarks

Jim Meister

Enclosure 2

Closing Remarks

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- Root cause is UFM correction factor error caused by pressure pulses in FW piping
- Low safety significance of overpower condition
- UFM implementation at Byron Units 1 and 2, and Braidwood Unit 2 pending formal evaluation of root cause and corrective actions
- Actions were taken historically to investigate power level anomalies
- Previous evaluations were rigorous and resource intensive
- Overall review of decision making has been initiated