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July 26, 2000

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555-0001

Braidwood Station, Units 1 and 2
Facility Operating License Nos. NPF-72 and NPF-77
NRC Docket Nos. STN 50-456 and STN 50-457

Byron Station, Units 1 and 2
Facility Operating License Nos. NPF-37 and NPF-66
NRC Docket Nos. STN 50-454 and STN 50-455

Subject: Response to Request for Additional Information Related to the Review of the Best Estimate Analyzer for Core Operations Nuclear Core Monitoring and Support System, Byron Station, Units 1 and 2, and Braidwood Station, Units 1 and 2

References:
(1) Letter from R. M. Krich (ComEd) to U. S. NRC Document Control Desk, "Request for Amendment to Technical Specifications for Byron and Braidwood Stations to Implement the Best Estimate Analyzer for Core Operations Nuclear Power Distribution Monitoring System," dated February 15, 2000.

(2) Letter from G. F. Dick (U. S. NRC) to O. D. Kingsley, "Request for Additional Information Related to the Review of the BEACON Core Monitoring and Support System, Byron Station, Units 1 and 2, and Braidwood Station, Units 1 and 2," dated July 3, 2000.

A license amendment request related to the Best Estimate Analyzer for Core Operations Nuclear (BEACON) for the Byron Station and the Braidwood Station was submitted to the NRC in Reference 1. The NRC subsequently issued a Request for Additional Information (RAI) letter in Reference 2. The RAI letter requested that additional information be provided within 30 days

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after receipt of the letter (i.e., by August 2, 2000). The requested additional information is provided in the Attachments to this letter.

Should you have any questions concerning this letter, please contact Ms. Kelly M. Root at (630) 663-7292.

Respectfully,

R. M. Krich
Vice President - Regulatory Services

Attachments:
Attachment 1: Response to Request for Additional Information Related to the Review of the BEACON Core Monitoring and Support System, Byron Station, Units 1 and 2, and Braidwood Station, Units 1 and 2
Attachment 2: Response to Request for Additional Information Question #5 - Example of "PDMS Inoperable Axial Flux Difference (AFD) Bands"

cc: Regional Administrator - NRC Region III
NRC Senior Resident Inspector - Braidwood Station
NRC Senior Resident Inspector - Byron Station
Office of Nuclear Facility Safety - Illinois Department of Nuclear Safety

## ATTACHMENT 1

**Response to Request for Additional Information**
**Related to the Review of the Best Estimate Analyzer for Core Operations Nuclear (BEACON) Core Monitoring and Support System**

**Byron Station, Units 1 and 2**
**Braidwood Station, Units 1 and 2**

References:

(1) Letter from R. M. Krich (ComEd) to U. S. NRC Document Control Desk, "Request for Amendment to Technical Specifications for Byron and Braidwood Stations to Implement the Best Estimate Analyzer for Core Operations Nuclear Power Distribution Monitoring System," dated February 15, 2000.

(2) Letter from G. F. Dick (U. S. NRC) to O. D. Kingsley, "Request for Additional Information Related to the Review of the BEACON Core Monitoring and Support System, Byron Station, Units 1 and 2, and Braidwood Station, Units 1 and 2," dated July 3, 2000.

**Question #1**

**On page A-11, the statement is made that "-margins far exceed the actual operational requirements." Please elaborate on this statement.**

In the current pressurized water reactor core monitoring methodology, there is no direct margin assessment on a continuous basis. Hence, conservative methodologies compensate for the lack of detailed knowledge of core margins by use of generic, overly conservative, uncertainties (e.g., Nuclear Enthalpy Rise Hot Channel Factor ($F^N_{\Delta H}$) synthesis approach and peaking factor surveillance).

Current fuel cycles contain design margins (i.e., approximately 8%) to assure safe core operation under steady state and transient conditions due to the operator's inability to directly monitor the core power distribution. Due to this conservatism, these margins, "far exceed the actual operational requirements," and thus negatively impact the fuel cycle costs.

The BEACON Power Distribution methodology is capable of directly monitoring core power distribution and providing an accurate assessment of operating margins. BEACON would allow for changes in the core design methods and provide for more optimized core loading patterns.

**Question #2**

**On page A-12, the last sentence of the second paragraph and the first sentence of the third paragraph seem to contradict each other. Please provide clarification. Demonstrate how the conditions in the SER for BEACON are met.**

The conditions in the Safety Evaluation for the BEACON Technical Specifications (TS) are satisfied by the proposed TS, with the exception of the following differences.

- The last sentence of the second paragraph on page A-12 refers to differences that are administrative in nature. These differences include formatting changes as a result of converting to the Improved Standard Technical Specifications (ISTS) format, movement of actions contained in the old Standard Technical Specifications Tables to the Required Actions of the ISTS, relocation of alarms to the Technical Requirements Manual (TRM) due to the plant-specific implementation of the ISTS, and elimination of old Standard Technical Specifications requirements that were deleted during the plant-specific implementation of the ISTS.

- The differences referred to in the first sentence of the third paragraph on page A-12 are technical in nature and, therefore, are discussed in detail and justified on pages A-12 through A-19.

**Question #3**

**On page A-23, the last sentence of the third paragraph states that "-or when significant changes occur." Please provide the meaning of the phrase "-or when significant changes occur."**

The "reference" power distribution used by the BEACON System is defined by (1) the results of the Advanced Nodal Code (ANC) nodal power distribution calculations, expanded to full-core and adjusted by the nodal calibration factors determined from incore power distribution measurements, and (2) the Core Exit Thermocouple (CETC) and excore neutron flux detector adjustments present at the time of the calculations. The accuracy of the reference power distribution is maintained by periodically updating the initializing conditions input to the ANC model and re-calculating the reference power distribution. The conditions which will cause the re-calculation of the reference power distribution are:

a) 15 minutes since the last initiation of the previous ANC nodal calculation, or
b) When significant changes to the core power distribution occur, which is defined as a change in reactor power of greater than 5%, or change in the Axial Flux Difference (AFD) of more than 2%.

This methodology is documented in WCAP-12472-P-A, "BEACON - Core Monitoring and Operations Support System," August 1994, in the Response to Question M-2, Section F, page 26, and in the NRC's Technical Evaluation Report, Section B, page 10.

Therefore, the meaning of the phrase "-or when significant changes occur," is defined as a change in reactor power of greater than 5% or change in the AFD of more than 2%.

**Question #4**

**On page A-24, the second paragraph from the bottom makes reference to comparing BEACON to actual cycle specific parameters. What constitutes acceptable criteria for the comparison between BEACON predictions and the actual cycle data?**

Actual cycle data is used to perform a BEACON pre-operational calibration of the CETCs against the Reactor Coolant System (RCS) loop temperature data, which is collected during the plant heat-up. Acceptance criteria for the correlation coefficient resulting from the fit of the individual CETC data is "> 0.90." After each refueling outage, and periodically throughout the cycle, the BEACON model is calibrated using the Movable Incore Detection System (MIDS). The BEACON methodology includes a set of calibration processes, which allows an alignment of BEACON predictions with the actual cycle data. The BEACON nodal model, CETCs, and the excore neutron flux detectors are calibrated to the MIDS trace measurement, which provides the most accurate information of the core power distribution with actual cycle specific parameters (e.g., core average burnup, measured boron concentration, RCS temperatures, etc). During the BEACON model calibration process, differences between the measured (i.e., actual) and predicted incore reaction rates shall be less than 10% for the high power assemblies, which constitutes the acceptable calibration criteria. Higher differences require investigation and evaluation before the calibration process can continue.

**Question #5**

**On page A-26, in the second to the last paragraph from the bottom, the subject of "inoperable AFD bands" is mentioned. Please provide examples of these bands.**

An example of the PDMS inoperable AFD bands is provided in Attachment 2 of this letter. This example was provided in the changes to the Core Operating Limits Report (COLR) that result from the proposed TS changes contained in Attachments B-9 and B-10 of the Reference 1 letter.

**Question #6**

**The Power Distribution Monitoring System (PDMS) is not considered to meet any of the 10 CFR 50.36(c)(2)(ii) selection criteria for inclusion into the Technical Specifications (TS). There is not a proposed PDMS TS or a PDMS Technical Requirements Manual (TRM) TLCO. The BEACON topical report (WCAP-12472-P-A) proposed TS changes present the BEACON system as included in the draft TS since they meet criterion 2 of 10 CFR 50.36(c)(2)(ii). How does the PDMS differ from the BEACON system presented in WCAP-12472-P-A; why is a related specification not in the TS?**

PDMS is the plant-specific nomenclature for the BEACON monitoring system presented in WCAP-12472-P-A. The function of PDMS is the same as the function of the BEACON monitoring system.

The BEACON parameter TS in WCAP-12472-P-A for peak linear heat rate (i.e., $F_Q(Z)$), $F^N_{\Delta H}$, and Departure from Nucleate Boiling Ratio (DNBR), is included in the proposed Byron Station and the Braidwood Station TS, i.e., TS 3.2.1, "Heat Flux Hot Channel Factor ($F_Q(Z)$), TS 3.2.2, "Nuclear Enthalpy Rise Hot Channel Factor ($F^N_{\Delta H}$), and TS 3.2.5, "Departure from Nucleate Boiling Ratio (DNBR)", respectively. These TS have been modified to reflect the necessary changes to implement BEACON and adequately address the parameters and requirements in the WCAP-12472-P-A BEACON TS, i.e., TS 3/4.2.6, "BEACON Specification."

The PDMS instrumentation requirements are to be included in the Byron Station and Braidwood Station TRMs and the proposed TRM Specification was included in the BEACON TS Amendment Request for the Byron and Braidwood Stations (Ref. 1). As documented in Reference 1, on page A-19 of Attachment A, we applied the criteria in 10 CFR 50.36, "Technical specifications," paragraph (c)(2)(ii) to the proposed PDMS instrumentation requirements and none of these criteria were satisfied. In addition, the ISTS, in general, do not include indication only equipment, alarm only equipment, or equipment used only to perform surveillances or verify parameters are within limits. Control of the availability of, and the necessary compensatory activities if not available, for indication and monitoring equipment are addressed by plant operational procedures and policies. Furthermore, the proposed BEACON TS will require PDMS to be operable in order to take advantage of the relaxations afforded by BEACON. With PDMS inoperable, the TS requirements will be equivalent to the current TS without BEACON. Therefore, sufficient controls are available in the TS to ensure that PDMS is maintained operable.

**Question #7**

**The proposed PDMS Instrumentation Functions do not include a pressurizer pressure requirement. However, the proposed BEACON Instrumentation Functions do include a pressurizer pressure requirement. Please explain the difference.**

PDMS uses the pressurizer pressure input, among other inputs, to calculate the DNBR. When PDMS is operable the actual DNBR value shall be maintained greater than or equal to the Axial Power Shape Limiting DNBR ($DNBR_{APSL}$) value specified in the Core Operating Limits Report (COLR). $DNBR_{APSL}$ is the DNBR value determined to be the most sensitive to the core axial power distribution at the initial conditions of the limiting accident during the cycle-specific core reload design accident analysis process.

The PDMS power shape limit and associated Departure from Nucleate Boiling (DNB) margin are set by methods that incorporate the statistical uncertainty of pressure. Our current Constant Axial Offset Control methods are also based on power shape with statistical pressure uncertainties. In addition, DNB protection is afforded by the Overtemperature Delta Temperature Reactor Trip function, which is pressure sensitive.

During normal power operations the pressure is typically between 2230 and 2270 psia.
If the pressure status is "bad" or out of range, PDMS will use a value of 2250 psia. This type of pressure variation is accounted for in the uncertainties applied in the Revised Thermal Design Procedure (RTDP) analysis for operating limits, i.e., a pressure uncertainty of $\pm$ 43 psia is applied in the RTDP analysis. This uncertainty provides good coverage for any variations in the pressure from normal operational conditions. Therefore, BEACON operability is not dependent on the status of the pressurizer pressure input.

In a letter from L. M. Padovan (U.S. NRC) to G. J. Taylor (Virgil C. Summer Nuclear Station), "Issuance of Amendment No. 142 to Facility Operating License No. NPF-12 Regarding Best Estimate Analyzer for Core Operations-Nuclear (BEACON), Virgil C. Summer Nuclear Station, Unit No. 1," dated April 9, 1999, the requirements for PDMS instrumentation do not include a pressurizer pressure input.

**Question #8**

**TS 3.1.4, Required Action B.4 and B.5 have been combined into one action which states that the hot channel factors are to be determined, rather than the specific surveillance requirements to be performed. The current TS method of presentation is preferred, and is also consistent with the new generic standard technical specifications (STS). The staff recognizes that there will be surveillance options for when PDMS is operable or inoperable, and that conveying the options in the Required Actions statements would get involved. Reverting to a description of the SR to be performed rather than specifying the exact SR number to be performed is acceptable as long as the Bases are updated to explain the SR options explicitly by number, so there is no confusion over what is required.**

Prior to implementation of the BEACON TS Amendments, we will evaluate revising the proposed Bases to explain the TS Surveillance Requirement (SR) options explicitly by SR number.

**Question #9**

**In TS 3.2.1, Required Actions A.4 and B.4, requiring the performance of surveillances prior to exceeding a power level, have been deleted. Both the STS and the Byron and Braidwood current TS have these requirements. The staff suggests retaining these Required Actions, with a note included stating, "Only required to be performed when PDMS is inoperable."**

The justification for deleting TS 3.2.1 Required Actions A.4 and B.4 is provided in paragraph "a" discussion of TS 3.2.1 on page A-14 in Attachment A of the Reference 1 letter. Paragraph "a" states, " Required Actions A.4 and B.4 for performing SR 3.2.1.1 and SR 3.2.1.2 are deleted. In the current TS these Required Actions are only explicitly stating the implicit requirement, i.e., $F_Q(Z)$ must be within limits before the Thermal Power limit imposed by Required Actions can be exceeded. $F_Q(Z)$ is only determined by the performance of SRs 3.2.1.1 and 3.2.1.2, and once verified to be within limit, the Condition is exited and the TS Required Action A.1 or B.1 limit is no longer in effect. With the changes being made to adopt PDMS, the system continuously monitors for compliance with the $F_Q(Z)$ limit. The same rules of usage apply, i.e., $F_Q(Z)$ must be within limits by performing flux mapping SRs as before or by utilizing an operable PDMS, which is reflected in new alternate SRs discussed below before the Thermal Power limit imposed by TS Required Action A.1 or B.1 can be exceeded. Explicitly stating this in TS Required Action A.4 and B.4 is unnecessary, and furthermore, would add increased unnecessary complexity to now have to also address the PDMS-based options (i.e., PDMS operable or PDMS inoperable)."

**Question #10**

**A note (2) has been proposed to be added to both SR 3.2.1.1 and SR 3.2.1.2 stating that the SR is, "Not required to be performed until 12 hours after declaring PDMS inoperable. Performance of SR 3.2.1.3/4 satisfies the initial performance of this SR after declaring PDMS inoperable." The second sentence of this note is unnecessary, and could lead to confusion over what is the initial performance of the SR. The staff recommends deleting the second sentence or rewording it to avoid potential confusion. A possible rewording might be: "Not required to be performed until 12 hours after declaring PDMS inoperable; if SR 3.2.1.3/4 had been performed within its required frequency prior to declaring PDMS inoperable."**

The justification for adding Note 2 to SR 3.2.1.1 and SR 3.2.1.2 is provided in the paragraph "b" discussion of TS 3.2.1 on page A-14 in Attachment A of the Reference 1 letter. Without the addition of Note 2, a violation of SR 3.0.4 would immediately occur upon discovery of an inoperable PDMS.

The wording for Note 2 that we proposed was chosen to allow the last performance of SR 3.2.1.3/4 (i.e., utilizing PDMS) prior to declaring PDMS inoperable to satisfy the initial performance of SR 3.2.1.1/2, which would otherwise require an incore flux map be obtained.

The next performance of SR 3.2.1.1/2 may not be required until 31 Effective Full Power Days (EFPDs) after the initial performance utilizing PDMS as currently specified in our TS. The NRC proposed wording, however, would always require the initial performance of SR 3.2.1.1/2 within 12 hours using an incore flux map after declaring PDMS inoperable.

**Question #11**

**TS 3.2.2, Required Actions A.2 and A.4 state that the Nuclear Enthalpy Rise Hot Channel Factor is to be determined, rather than refer to a specific surveillance requirement number to be performed. The current TS method of presentation is preferred; it is also consistent with the STS. The staff recognizes that there are now surveillance options for when PDMS is operable or inoperable, and that conveying the options in the Required Actions statements could get involved. Reverting to a description of the SR to be performed rather than specify the exact SR number to be performed is acceptable as long as the Bases are updated to explain the SR options explicitly by number, so there is no confusion over what is required.**

Prior to implementation of the BEACON TS Amendments, we will evaluate revising the proposed Bases to explain the TS SR options explicitly by SR number.

**Question #12**

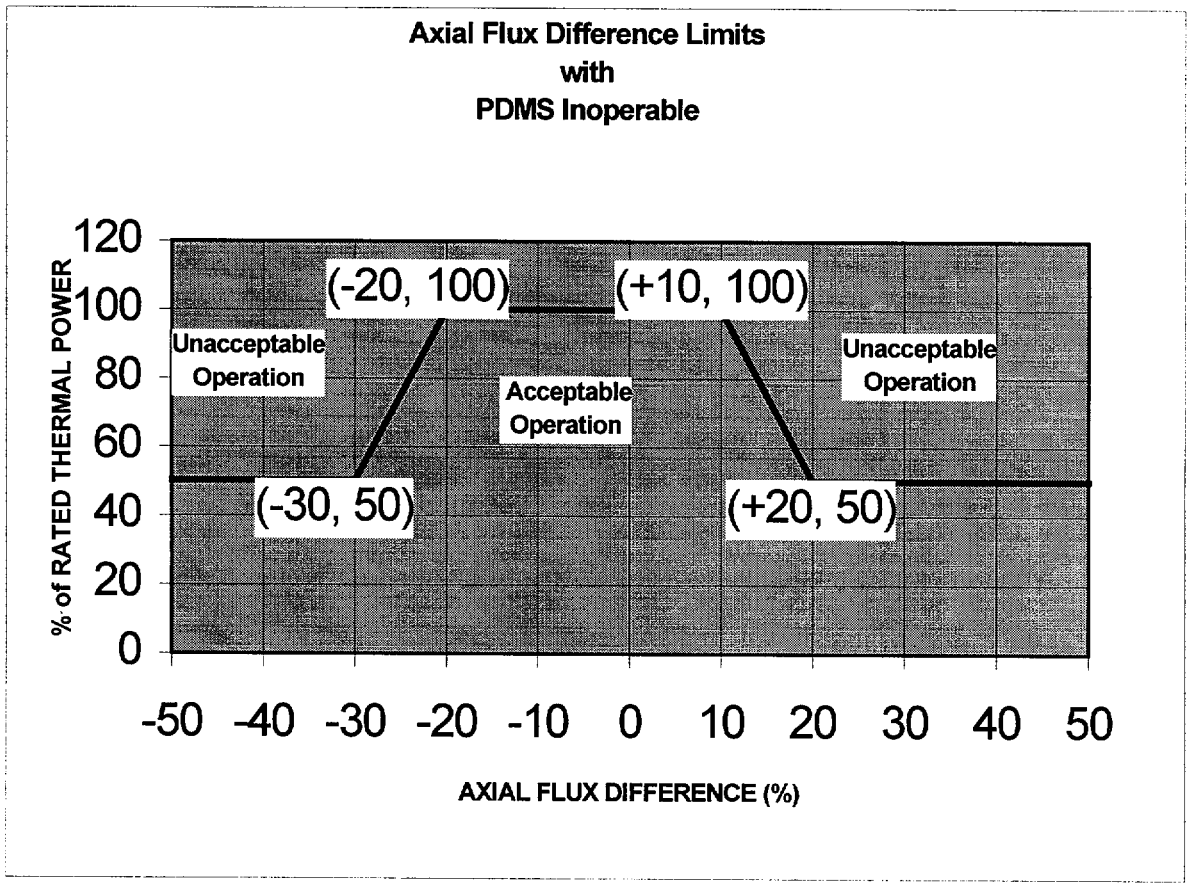
**A note has been proposed to be added to SR 3.2.2.1 stating that the SR is, "Not required to be performed until 12 hours after declaring PDMS inoperable. Performance of SR 3.2.2.2 satisfies the initial performance of this SR after declaring PDMS inoperable." The second sentence of this note is unnecessary, and could lead to confusion over what is the initial performance of the SR. The staff recommends either deleting the second sentence or rewording it to avoid potential confusion. A possible rewording might be: "Not required to be performed until 12 hours after declaring PDMS inoperable; if SR 3.2.1.3/4 had been performed within its required frequency prior to declaring PDMS inoperable."**

The justification for adding Note to SR 3.2.2.1 is provided in the paragraph "b" discussion of TS 3.2.2 on page A-15 in Attachment A of the Reference 1 letter. Without the addition of the Note, a violation of SR 3.0.4 would immediately occur upon discovery of an inoperable PDMS.

The wording for the Note that we proposed was chosen to allow the last performance of SR 3.2.2.2 (i.e., utilizing PDMS) prior to declaring PDMS inoperable to satisfy the initial performance of SR 3.2.2.1, which would otherwise require an incore flux map be obtained. The next performance of SR 3.2.2.1 may not be required until 31 EFPDs after the initial performance utilizing PDMS as currently specified in our TS. The NRC proposed wording, however, would always require the initial performance of SR 3.2.2.1 within 12 hours using an incore flux map after declaring PDMS inoperable.

# ATTACHMENT 2

**Response to Request for Additional Information Question #5**
**Example of "PDMS Inoperable Axial Flux Difference (AFD) Bands"**

**Byron Station, Units 1 and 2**
**Braidwood Station, Units 1 and 2**

**ATTACHMENT 2**