

From: Paul Rebstock
To: Mahesh Chawla
Date: 1/8/03 3:11PM
Subject: ByronTP: Bases for Concern Regarding Byron Thermal Power Operating Point

Re: Allegation RIII-02-A-0-192, regarding possible operation of Byron Unit 1 above Rated Thermal Power

Ref: Byron Unit 1 Condition Report 91771, "Unexplained Differences Between Byron and Braidwood," and associated Apparent Cause Analysis and other supporting information

Keith: I am sending this to you for information in your capacity of Acting I&C Section Chief this Wednesday and Thursday. If you have any concerns or comments, please let me know.

Jose: This is the matter that we discussed this morning, your copy as requested. Our discussion was mostly regarding the "side issue" described below.

Matt:

One related side issue: On July 5, 2000, the licensee for Byron and Braidwood (Commonwealth Edison at that time) requested a power uprate for each unit at each plant. The uprates were granted May 4, 2001. The concerns over the Feedwater flow measurements appear to have been known to, or at least suspected by, the licensee at that time, but were apparently not mentioned in the submittal. In any case, they do not seem to have been addressed in the granting of the uprate. Since uncertainty in feedwater flow is the principal contributor to core power uncertainty, potential problems with that measurement should have contributed negatively in the evaluation of the uprate request. I do not know whether the potential FW flow measurement problem was concealed or simply overlooked by the licensee or overlooked by the NRC, but I suggest that that power uprate request and the associated correspondence and documentation be reviewed in the light of these concerns. This review would be to establish whether the uprate should be rescinded and/or whether other actions should be taken.

If the uprate was based upon the use of the venturi flowmeters without consideration of the ultrasonic devices, then there is no problem here and my concern is misplaced. In that case, however, the later introduction of the ultrasonic flowmeters would constitute a substantial change in the instrumentation and procedures used to confirm adherence to Technical Specification limits, and so that change should have been subjected to appropriate review.

Note also that the implementation of the ultrasonic flowmeters at Byron and Braidwood appears to be unusual in that they are not in continuous use but rather utilize portable devices. They are connected when a measurement is needed, and disconnected when it is not. It is not clear to me how this practice corresponds to the use of such devices for a MUR power uprate (which is generally justified almost entirely by the improved accuracy of an ultrasonic flowmeter, UFM), for which the uprate is automatically terminated if the UFM is unavailable for more than a limited time, typically 48 or 72 hours. Explicit justification from the licensee is required even for that limited Allowable Outage Time for an MUR power uprate. The use of portable instruments suggests a much longer AOT, and no justification appears to have been provided. Again, if the UFM's do not influence the power uprate, this concern is misplaced. But since the UFM's do appear to be used to adjust the calibration of the venturi flowmeters, it would seem difficult to claim such a lack of influence.

Here are the main bases for my concern that Byron might be operating above its rated thermal power limit.

- 1) The discrepancies between Byron and Braidwood appeared after the installation of the Ultrasonic FlowMeters (UFMs). This suggests that the UFMs may not be giving the correct readings.
- 2) Many parameters reportedly show the same "error" direction, consistent with operation at higher

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thermal power than expected. Although the magnitudes of the individual deviations may be within expected limits, the fact that they are all in the same direction suggests some underlying common impetus (such as higher than expected thermal power) rather than random fluctuation.

3) There appears to be some evidence of higher fuel burn rate at Byron than at Braidwood. Licensee's Nuclear Fuel Management department indicates that there is insufficient evidence to confirm the apparent increased burn rate, but their analysis also does not preclude it.

4) Byron is producing more electrical power at a reported 97.9% RTP than Braidwood is producing at 100% RTP. Normalized to 100% RTP, Byron would be generating 4% more electrical power than Braidwood even though the designs are nominally the same. It seems unlikely that the efficiencies of the two units would differ by that much.

5) Byron reportedly is not able to attain the power level allowed by the recent 5% power uprating, because of limitations in the high-pressure turbine and/or steam control valve capacities. Braidwood reportedly experiences no such limitation. Given similar designs, this suggests that the Byron may be trying to generate more power than Braidwood but that the power level is being under reported.

Doesn't expect to see that

6) The 3% Feedwater flow oscillation at Byron, not reported at Braidwood, suggests some problem in the FW controls. One potential source of such a problem could be increased loop gain at Byron due to operation at higher than expected thermal power. Regardless of the source of the oscillation, the oscillation itself could be associated with similar fluctuations in actual core power. If the oscillation period is long compared to the thermal time constants of the mechanical equipment and structures, then the core power will indeed oscillate with the feedwater flow. If the period is shorter, then the stored energy in the equipment and structures will come into play and the core output will be more steady about some average value. The period of oscillation is not mentioned, and no correlation with other measures of core power, such as neutron flux, is offered, so the implications are not clear. This unexplained phenomenon and the associated unknowns seem cause for concern.

Question: Don't worry about the flow

7) Given the fact that FW flow oscillates by about 3%, the timing of a FW flow measurement within the FW flow oscillation cycle is important: If the measurement is a snapshot, at what point is the snapshot taken (peak? minimum? random?)? If the measurement is an average, how is that average determined? If anything other than the peak value is used, how is it assured that the core power fluctuations that might be implied by the FW flow fluctuations do not carry the power above the allowable value? Even if the flow fluctuations are not reflected in core power fluctuations, it is not clear how the core power relates to whatever flow measurement statistic may have been selected for determination of core power.

8) The fact that the Byron UFM has been "re-tuned" twice since installation is troubling. The first re-tuning appears to have been simply an attempt to ensure proper calibration in the as-installed configuration, but no such re-tuning appears to have been required at Braidwood. Since no primary standard for confirmation of calibration would have been available on-site, it is not clear exactly what was done nor why. The second re-tuning is more problematical: This was reportedly to render the system better able to deal with the 3% FW flow fluctuations. But apart from minor adjustments to some averaging or peak-detection routines — which I would hardly call "re-tuning" — it is not clear to me what adjustments would have been required or could have been made. Surely the UFM is capable of following a 3% undulation unless the period is very short, but a period that short would suggest more serious control problems than those mentioned earlier in this list of concerns. There is also mention of noise and of data rejection related to the flow oscillation, but given my present (admittedly limited) understanding of the system and the process, this makes no sense to me at all.

They do not expect for flow oscillations

9) Short-term variability in the venturi flowmeter correction factor is not expected. Venturi characteristics should not change except due to thermal expansion, fouling or erosion. Thermal expansion is predictable and is addressed in the calibration. Erosion and fouling should be too slow to result in the kind of variability indicated. Even serious water chemistry problems would not be expected to result in such behavior without also impacting the steam generators, turbine, and condenser. Changes in the characteristics of the pressure transmitters and other electronic devices that measure and interpret the

differential pressure produced by the venturis could result in an apparent need for such adjustments, but then it is those electronics, not the venturi correction factor, that should be adjusted.

10) In all the investigation and analysis devoted to this issue by the licensee, there does not appear to be any consideration of the possibility that a calibration problem might exist at *Braidwood* and that the system at Byron is actually functioning correctly. There also does not seem to have been much effort to thoroughly investigate alternative correlations or power inferences within the station in question. In addition, it is not clear that the recommendations of the consultants, such as continuous monitoring and such as more extensive testing at Braidwood, have been adequately addressed.

11) Problems with these same flowmeters were addressed in an earlier LER from these plants. The occurrence of subsequent problems concerning the same instruments, even if unrelated, suggests the possibility of deeper issues that have not been investigated.

12) The fact that the installation and commissioning of the new UFM's at Braidwood went smoothly whereas that at Byron was difficult suggests some fundamental difference in the installations at the two plants. Since the plants themselves and the UFM's are nominally the same, this suggests the possibility of some error in the installation or commissioning at Byron. That same condition could lead to the observed differences.

Please let me know if you need any further information or clarifications.

— Paul Rebstock (x3295)

CC: Evangelos Marinos; Glenn Miller; Jose Calvo; W. Keith Mortensen

AMAG INSTRUMENTS. -> CROSS FLOW.