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DENTON,H.R. Office of Nuclear Reactor Regulation, Director

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SUBJECT: Forwards final response to Question F.15 of NRC 800325 ltr. Const of all portions of plant justified & CP should not be modified,suspended or revoked.

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TENNESSEE VALLEY AUTHORITY
CHATTANOOGA, TENNESSEE 37401
500A Chestnut Street Tower II

September 4, 1980

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Mr. Denton:

In the Matter of the Application of	)	Docket Nos. 50-438
Tennessee Valley Authority	)	50-439

In L. M. Mills' May 30, 1980, letter responding to Olan Parr's March 25, 1980, letter to H. G. Parris, TVA transmitted our response to the supplemental request for additional information regarding the changes and studies proposed in Enclosure F of our December 3, 1979, response to the initial 10 CFR 50.54 letter. As part of the May 30, 1980, response, TVA stated that the response to Question F.15 would be supplied by September 1, 1980. Enclosed is our final response to Question F.15.

Based upon our continuing investigations, continued construction of all portions of the Bellefonte Nuclear Plant is justified, and the construction permits for Bellefonte units 1 and 2 should not be modified, suspended, or revoked. If our additional assessments indicate otherwise, we will notify you immediately.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

J L Cross

J. L. Cross
Executive Assistant to the
Manager of Power

Sworn to and subscribed before me
this 4th day of Sept. 1980

Bryant M. Lowery
Notary Public

My Commission Expires 4/4/82

Enclosures
cc: See page 2

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8009090522

Mr. Harold R. Denton, Director September 4, 1980

cc: Mr. James McFarland (Enclosure)
Senior Project Manager
Babcock & Wilcox Company
P.O. Box 1260
Lynchburg, Virginia 24505

ENCLOSURE

FINAL RESPONSE TO QUESTION F.15

F.15 Question

Operating events at several plants with B&W NSSS designs (including Rancho Seco in March 1978; Oconee Power Station, Unit 3 on November 10, 1979; and the Crystal River Station on February 26, 1980) have occurred which resulted in loss of power to the ICS and/or NNI system. The loss of power resulted in control system malfunctions, feedwater perturbations, and significant loss of or confused information to the Operator. NUREG-0600 also discusses LER 78-021-03L on Three Mile Island, Unit 2 whereby the RCS depressurized and safety injection occurred on loss of a vital bus due to inverter failure. Discuss the extent to which these events would have been mitigated or precluded by the changes incorporated into the BLNP design. Include a response to action items 1 to 3 required of near-term licensees in IE Bulletin 79-27 and items 2, 4, 5 and 6 of letter dated March 6, 1980 to all operating B&W Reactor Licensees pertaining to the Crystal River event.

F.15 Response

The extent to which the events described in the question above would be mitigated or precluded by the BLNP design is presented below. The format of this discussion is in response to items 2, 4, 5 and 6 of the NRC March 6, 1980, letter, and action items 1, 2, and 3 of IE Bulletin 79-27.

Regarding items 2, 4, 5, and 6 of the NRC March 6, 1980, letter:

2. Specifically review the Crystal River event, and address your plant's susceptibility to it in general.

   The Crystal River event was caused by the loss of the ± 24V DC "X" bus which affected important shutdown indicators. The BLNP design is susceptible to the same kind of failure in the NNI; however, BLNP has an Essential Control and Instrumentation (ECI) System completely independent of the NNI. The ECI System consists of two duplicate cabinet assemblies (ECI - "X" and ECI - "Y") having redundant indications and control capable of maintaining the plant in a safe shutdown condition. The two ECI cabinet assemblies are powered from separate vital sources entirely separate from the NNI.

   For the BLNP design, a loss of power to the pilot operated relief valve (PORV) control circuitry could cause the valve to fail depending on where the power failure occurred. If the failure is in the Solid State Control System (SSCS) cabinet that controls the PORV, the valve will fail closed and remain closed. If the failure is in the NNI, the PORV will fail "as is" (i.e., if open, it remains open; if closed it remains closed). The pressurizer spray valve would fail as is on loss of control power (SSCS or NNI). For the NNI failure the valves could be manually closed and opened from the Main Control Room (MCR).

4. Address information available to the operator following various NNI/ICS power upset events, including a discussion of:

   - how the operator determines which information is reliable

- what information is needed to bring the plant to cold shutdown

The BLNP instrumentation and control design is different from CR-3 in that the ICS and NNI at BLNP are separate and nonredundant.

On failure of either the AC or DC buses in the ICS or NNI the operator should consider all information invalid and rely upon the ECI System for reliable indication.

BLNP has sufficient annunciation to alarm a total or partial loss of power to the NNI and ICS. BLNP operators will be trained to bring the plant to a safe condition using the ECI System upon receipt of an alarm of loss of power to NNI.

Information needed to bring BLNP to cold shutdown is discussed in FSAR Section 7.4.

5. Address the feasibility of performing a test to verify reliable information that remains following various NNI/ICS power upsets.

   The ICS, NNI, and ECI System are separated such that a test of the various input power systems is feasible to determine if the remaining parameter information is adequate for plant shutdown.

   Such a test would be expected to confirm the results of the present analysis by showing that a loss of NNI or ICS power supply does not affect the information available from the ECI System, and that a loss of power supply to either ECI-X or ECI-Y does not affect information available from the other redundant set of instrumentation indications and controls. This test will be performed before the first startup of BLNP.

   As stated in our response to item 2, above, a single train of the ECI System is capable of achieving and maintaining BLNP in a safe shutdown condition.

6. Address each CR-3 proposed corrective action in terms of applicability to your plant.

   As discussed in more detail, below, the proposed corrective actions at CR-3 are generally not applicable to BLNP because the instrumentation and controls are designed and arranged differently. BLNP has an ECI System with two redundant safety-related cabinets (ECI-X and ECI-Y) in addition to the ICS and NNI. CR-3 has an X and Y channel included in the NNI.

   Applicability of each planned corrective action at CR-3 to BLNP is as follows:

   (a) Thorough testing of NNI to determine cause of failure.

   It is our understanding that the CR-3 event was initiated by an improperly installed voltage buffer card. NNI at BLNP would also have failed from an improperly installed voltage buffer card. However, at BLNP, the ECI System is separate from NNI, and one train of the ECI System is capable of achieving and maintaining the plant in a safe shutdown condition. Procedures at BLNP will reflect the latest instructions from the vendor regarding proper installation of voltage buffer cards.

(b) Modify PORV so that NNI failure closes valve.

The BLNP circuit design is such that the PORV will fail as is on loss of power because of either an NNI internal power supply failure, or, in general, to a complete loss of power to the NNI.

(c) Modify pressurizer spray valve so that valve does not open on NNI failure.

BLNP circuit design is such that the pressurizer spray valve will not open automatically on loss of power because of either an NNI internal power supply failure or in general, a complete loss of power to the NNI.

(d) Provide positive indication of all three relief or safety valves.

Positive PORV and safety valve safety-grade position indication for BLNP will be provided in response to NUREG-0578.

(e) Establish procedural control of NNI selector switches.

Procedures will be developed for BLNP to control the operation of NNI selector switches.

(f) Train all operators in response to NNI failures.

All licensed operators and licensed operator candidates shall receive training for loss of power to the NNI or ICS. The training will be targeted toward identifying and controlling overcooling transients and overpressure transients which could result from the loss of power to the instrument circuits.

(g) Move 120V ICS "X" power to vital bus.

The ICS and NNI are powered from an uninterruptible bus (120V AC distribution panel) that is supplied by a non-Class IE inverter. However, TVA will provide redundant AC power to peripheral equipment associated with ICS. BLNP has an ECI System with two redundant safety-related cabinets (ECI-X and ECI-Y) powered from vital buses.

(h) Initiate more extensive program for events recorder system.

TVA is investigating upgrading the BLNP events recording system.

(i) Provide operator with redundant indication of main plant parameters.

The ECI System provides this function independent of NNI and ICS at BLNP.

(j) Install indication lights on all panels to know if power on panel.

Please see our response to item 4, above.

(k) Quick access to fuses is being designed into cabinets.

The non-Class IE, inverter backed, 120V AC distribution panel which provides power to the NNI and ICS is designed with hinged door to facilitate quick access. No design change is proposed for BLNP.

(l) Modify EFW pump circuit to start pumps on any low steam generator level signal.

This feature is already included in the BLNP design by the ECI System as part of the safety-grade AFW control system. Please see FSAR Section 7.4 for details.

(m) Investigate upgrade of NNI capabilities - total loss of NNI.

As stated in our response to item 2, above, a cold shutdown condition can be achieved and maintained at BLNP using the safety-grade, redundant ECI System.

(n) Remote shutdown is being designed.

Already provided in the BLNP design by the ECI System. Please see FSAR Section 7.4 for details.

(o) Provide backup AC sources to inverters with automatic transfer.

The inverters which supply power to the BLNP NNI and ICS are already provided with a static transfer switch which automatically transfers to a backup voltage regulated power source on inverter failure.

Regarding Action Items 1 to 3 in IE Bulletin 79-27:

1. Review the Class IE and non-Class IE buses supplying power to safety and nonsafety-related instrumentation and control systems which could affect the ability to achieve a cold shutdown condition using existing procedures or procedures developed under item 2 below. For each bus:

   (a) Identify and review the alarm and/or indication provided in the control room to alert the operator to the loss of power to the bus.

   (b) Identify the instrument and control system loads connected to the bus and evaluate the effects of loss of power to these loads including the ability to achieve a cold shutdown condition.

   (c) Describe any proposed design modifications resulting from these reviews and evaluations, and your proposed schedule for implementing those modifications.

TVA has identified and reviewed all Class IE and non-Class IE buses which supply power to safety- and nonsafety-related instrumentation and control systems that are required to achieve cold shutdown.

Item 1a - As a part of this review, TVA examined in detail the alarm and/or indication provided in the Main Control Room (MCR) which alerts the operator of the loss of power to the bus. In all cases, loss of power to a bus was alarmed or indicated in the MCR.

Item 1b - TVA has performed an analysis of each bus identified in item 1a above, and have evaluated the effects of a sustained loss of power to the instrument and control system loads supplied by each bus required to achieve cold shutdown. The methods used in performing the bus failure analysis are described in detail in Appendix A. In every case a cold shutdown condition could be achieved. However, in some cases a loss of power could result in challenges to safety systems. TVA is evaluating design modifications which are intended to minimize the number of safety system challenges.

Item 1c - The analysis showed that a cold shutdown condition could be achieved following failure of any of the Class IE and non-Class IE boards evaluated. The analysis also showed, however, that transients of various types would be initiated, and various safety systems will be challenged.

Some of the transients identified are related to the OTSG sensitivity matter; and consideration of design modifications for these transients will be added to the TVA effort previously described in our responses of December 3, 1979, or May 30, 1980. Other transients resulted in economic loss; consideration of design modification for these transients will be handled separately from safety issues, but their integrated effects will be considered in the overall program.

2. Prepare emergency procedures or review existing ones that will be used by control room operators, including procedures required to achieve a cold shutdown condition, upon loss of power to each Class IE and non-Class IE bus supplying power to safety and nonsafety-related instrument and control systems. The emergency procedures should include:

   a. The diagnostics/alarms/indicators/symptom resulting from the review and evaluation conducted per item 1 above

   b. The use of alternate indication and/or control circuits which may be powered from other non-Class IE or Class IE instrumentation and control buses

   c. Methods for restoring power to the bus

   Describe any proposed design modification or administrative controls to be implemented resulting from these procedures, and your proposed schedule for implementing the changes.

   TVA is in the early stages of preparing emergency procedures for BLNP. Those procedures required to achieve a cold shutdown condition, upon loss of power to each Class IE and non-Class IE bus supplying power to safety and nonsafety-related instrument and control systems, will include: the diagnostics/alarms/indicators/symptom resulting from the review and evaluation conducted per item 1 above, the use of alternate indication and/or control circuits which may be powered from other non-Class IE or Class IE instrumentation and control buses, and methods for restoring power to the bus.

   All procedures will be completed before fuel loading.

3. Re-review IE Circular No. 79-02, "Failure of 120 Volt Vital AC Power Supplies," dated Janaury 11, 1979, to include both Class IE and non-Class IE safety-related power supply inverters. Based on a review of operating experience and your re-review of IE Circular No. 79-02, describe any proposed design modifications or administrative controls to be implemented as a result of the re-review.

IE Circular 79-02 has been reviewed for BLNP to include the vital (Class IE) and preferred (non-Class IE) 120V AC power supplies. The following results were determined from this review:

1. There are no deliberate time delay circuits utilized in the vital and preferred power supplies.

2. Only the preferred power supply has the transformer tap design; however, proper transient suppression on the AC input prevents exceeding the DC input voltage rating of this equipment.

3. Only the preferred power supply utilizes the automatic static transfer switch; however, the setpoints for transfer to the alternate 120V AC supply have been optimized to prevent inadvertent transfer. Note that in this case, once the static switch transfers to the alternate source, it will automatically transfer back to preferred power supply when this source returns to normal.

4. Administrative controls employed by BLNP will ensure operability of safety systems after their subcomponents have been subjected to maintenance or testing.

Appendix A

Bus Failure Analysis Method

In response to Question F.15, TVA performed an evaluation of all Class IE and non-Class IE buses supplying power to the plant to determine the effect of any bus failure on the ability to achieve a cold shutdown condition. The procedure used in performing this evaluation is outlined below:

1. A diagram indicating the function required to be achieved in order to reach a cold shutdown condition was developed. The diagram includes both safety grade and nonsafety grade paths for accomplishing functions. The diagram was developed primarily from existing safe shutdown logic diagrams (see FSAR Section 9.5.1) and preliminary operating procedures.

2. In parallel with the development of the cold shutdown diagram, a diagram indicating the arrangement of all instrumentation and control buses was prepared. The diagram follows the power distribution system from offsite power down to the last piece of equipment containing a fuse or circuit breaker. The diagram was developed primarily from existing single-line drawings.

3. For each required function identified on the cold shutdown diagram, all systems, both safety grade and nonsafety grade, capable of performing the function were identified. For each system identified, supporting systems required for that system to function such as service water, control air, or environmental control, were also identified. Then, for each system and its supporting systems, the components (meter, strip chart recorder, valve, pump, valve position indicator, etc.) utilized to accomplish the shutdown function were listed. Finally, the buses supplying power to each component were listed.

4. For each component identified in step 3 above, its failure mode upon loss of power, both motive and instrumentation and control, was identified. The effect of the failure mode upon loss of power of each component on the ability of the system to perform the required shutdown function was then determined.

5. Each component identified in step 3 above along with its failure mode and system effect identified in step 4 was then grouped according to the bus supplying power. There then existed for each motive, instrumentation and control bus a list of all components utilized in achieving a cold shutdown condition, powered by that bus along with the components' failure mode and effect on system function on loss of power.

6. From the lists developed in step 5 above, an evaluation of the total impact on the ability to achieve a cold shutdown condition upon failure of each bus was made. The evaluation included identifying any transient, loss of instrumentation, or loss of system function resulting from the loss of the bus.