UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

JUN 18 1982

Mr. E. P. Rahe, Manager
Nuclear Safety Department
Water Reactor Division
Westinghouse Electric Corporation
Box 355
Pittsburgh, Pennsylvania 15230

Reference: Your letter, NS-EPR-2588, Dated April 29, 1982

Dear Mr. Rahe:

First I wish to thank you for your letter of April 29, 1982 which provided the Westinghouse position on testing of the shunt trip circuits of reactor trip breakers in Westinghouse plants. Based on my review of this information including discussion with members of the Instrumentation and Control Systems Branch, I find that we do not concur with the Westinghouse position. In order that you may have the benefit of the staff concerns in writing, enclosed is our evaluation of this issue. If following your review of this information your position remains unchanged, we would be available to discuss this matter at your convenience.

Faust Rosa

Faust Rosa, Chief
Instrumentation & Control Systems Branch
Division of Systems Integration

Enclosure:
As stated

INDEPENDENT VERIFICATION OF THE OPERABILITY OF REACTOR TRIP BREAKER SHUNT AND UNDER-VOLTAGE COILS

BACKGROUND:

I&E Circular 81-12, "Inadequate Periodic Test Procedure for PWR Reactor Protection System dated July 22, 1981 was issued to all nuclear power reactor facilities holding an operating license or a construction permit. The Circular recommended that the procedures for surveillance testing of reactor trip circuit breakers provide independent testing of shunt and undervoltage coils. Further the circular noted that if trip circuit breakers do not have provisions for independent testing of each trip function then appropriate modifications should be made to include such features.

In the review of operating license applications, the Instrumentation and Control Systems Branch staff has discussed with applicants the concern for independently verifying the operability of shunt and undervoltage coils of reactor trip breakers. The staff conclusion is that the diverse features of reactor trip breakers (shunt and undervoltage coils) provide an additional degree of reliability for assuring the ability to trip the reactor. Further, surveillance procedures should independently verify the operability of these diverse features. The staff concludes that it would be unacceptable if the operability of one of these diverse features was not confirmed during the normal 40 year life of a plant. Thus the staff position is:

> A function test of the undervoltage and shunt trips shall be conducted every 18 months and following adjustment or maintenance of the reactor trip breaker to independently verify the operability of the breaker to perform its safety function in response to a trip signal for each of these diverse trip features.

This requirement would be in addition to those surveillance requirements for reactor trip breakers covered in the plant technical specifications. In its review of operating license applications, the staff's Safety Evaluation Reports have indicated that requirements for independent testing of diverse features of reactor trip breakers would be required in the plant Technical Specifications prior to their issuance.

DISCUSSION:

During operating license reviews, Westinghouse has indicated its opposition to the regulatory staff's position on independent testing of the shunt trip circuit of the reactor trip breakers in Westinghouse plants. Westinghouse provided their position on this subject via letter E. P. Rahe, Manager, Nuclear Safety Department to Faust Rosa, Chief, ICSB dated April 29, 1982. The following provides the staff's comments related to the issues raised by Westinghouse:

First it should be noted that in the Westinghouse design of the reactor trip system, all automatic trip functions operate to de-energize the undervoltage coils of the reactor trip circuit breakers. The manual reactor trip switch utilizes contacts which directly remove power from the undervoltage coils as well as use contacts to apply power to the shunt coil of the reactor trip breaker. The shunt coil trip is only manually actuated, however all manual reactor trips simultaneously actuates these diverse features of the reactor trip breakers.

One of the major arguments against the staff position is that the design of manual and automatic reactor trip provided by the operation of the undervoltage coil of the reactor trip breaker meets all applicable criteria. Westinghouse notes that their decision to include the shunt coil in the manual initiation of reactor trip was based on the fact that the shunt trip coil is a standard feature of the circuit breaker and that it was an exercise of good engineering judgment and had no basis in functional requirements to meet safety criteria.

The staff concern centers on independent testing of existing diverse features of the manual reactor trip which are not rendered moot by arguments that the automatic and manual reactor trip using the undervoltage coils of the circuit breakers satisfies all regulatory requirements. With regard to the shunt coil and safety criteria we note that diversity is addressed in General Design Criterion 22 wherein it states: "Design techniques, such as functional diversity or diversity in component design shall be used to the extent practical to prevent the loss of the protection function." Clearly, the use of the shunt coil in the manual reactor trip meets the test of providing diversity to the extent practical. The fact that the shunt coil is not used in automatic reactor trips does not preclude consideration of GDC-22. In that diverse features have been provided and are encouraged to be used where practical by the regulations, it follows that testing should be conducted to verify the operability of these diverse features.

There is no question in the staff's view that the diversity provided by the use of the shunt coil in the manual reactor trip is a feature which is important to safety. The generic concerns for potential common mode failures in reactor trip systems have existed for a long time and are being pursued under the Unresolved Safety Issue A-9, "Anticipated Transient Without Scram." The diversity provided by the manual shunt coil trip does in fact provide a margin of safety when viewed from the aspects of those generic concerns. Therefore the staff concludes that testing to independently verify the operability of shunt and undervoltage coils of reactor trip circuit breakers is necessary in order to provide reasonable assurance of the operability of these diverse features. That,this requirement should be specified in plant technical specifications is consistent with the degree of specificity included in the testing of the reactor trip systems.

It was with full recognition of the redundancy, surveillance frequency and independence of the protection system automatic reactor trip function that a test frequency of 18 months was set forth in the staff's position for verifying the operability of the shunt coil trip. Further this is consistent with the surveillance interval for manual reactor trip. Thus the staff concludes that testing at this frequency would not place an unreasonable burden on the utility nor would it be without safety benefit as is the Westinghouse position.

Finally it is Westinghouse's position that the tests would require redesign of the system or the use of jury-rigging procedures, either of which has the potential to degrade a system of proven reliability. The staff notes that the aspect of proven reliability cannot be directly applied to the shunt coil trip when testing does not independently verify its operability. With regards to the means available to effect independent testing of undervoltage and shunt coil trips, there is an apparent misunderstanding on Westinghouse's part of what the staff said would be acceptable when this was discussed with near term operating license applicants. Based on these discussions TVA provided the following response to the staff's concern:

> "TVA will install a test switch to test the shunt trip coil on the RPS breaker separately from the undervoltage coil. An indicating light will be installed in parallel with the shunt coil to test the contact of the RPS manual trip switch and the shunt trip coil."

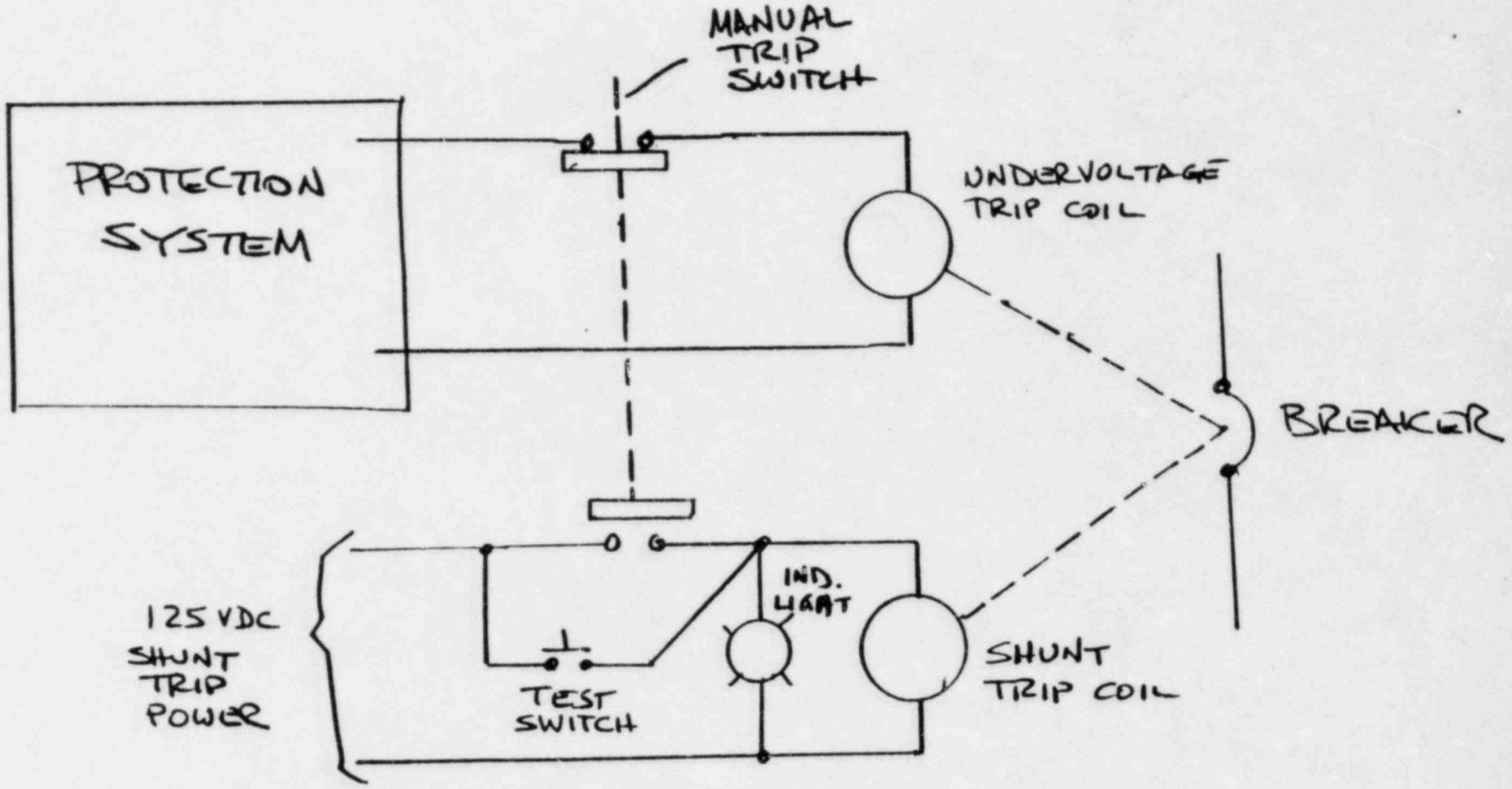
For discussion purposes, Fig. 1 provides our interpretation of this proposed modification. A typical procedure to independently verify the operability of the undervoltage and shunt trip features may be as follows:

	ACTION	PURPOSE
1.	Reset reactor trip breaker.	Permit breaker test.
2.	Remove Fuse for shunt coil power.	Permit independent verification of undervoltage coil operability.
3.	Actuate "Manual Trip".	Confirm manual trip by undervoltage coil.
4.	Replace Fuse for shunt coil power.	Permit shunt coil test.
5.	Repeat Step 1.	Same as 1 above.
6.	Actuate "Test Switch".	Confirm test trip by shunt coil. Confirms power restored to shunt coil circuit and operability of "Indicating Light".
7.	Actuate "Manual Trip Switch".	"Indicating Light" confirms power is applied to shunt coil by "Manual Trip Switch".

The staff concludes that the above test includes sufficient steps to conduct the testing to verify independently the operability of the shunt and undervoltage coils of the manual reactor trip. Further the order of the procedures assures that the removal of power, to independently verify operability, is conducted in a sequence to assure that power is restored. The method proposed by TVA is a straightforward modification which accomplishes the desired function. Other schemes could likewise be used and with the same end result. Some utilities may prefer to utilize key locked test switches for improved administrative control or may prefer to use multi-position test switches with sequenced operations that use contact to remove power, instead of other alternatives, or use contacts to remove the indicating light from the circuit when not in test. In any event, the staff concludes that such simple and straightforward modifications to provide a test capability would not degrade the system.

The staff has not examined the layout of terminal block and connections with the test circuit shown in the figure to determine how it would interface with the existing design. However if the points of interconnections are reasonably accessible one might consider whether it is necessary to add test features in order to accomplish the objective of independent verification of operability of shunt and undervoltage coils. Recognizing that the staff has advocated built-in test capabilities, it is willing to listen to requests for specific exceptions. Since the testing in question would only be performed during plant shutdown this is a factor which limits the potential adverse effects, as contrasted to normal power operation. In the test sequence outlined, a test meter could readily perform the function of the "Indicating Light". Under controlled conditions a momentary electrical connection could duplicate the action of the test switch. The staff does not view this in the same light as those measures which require the use of jumpers to bypass safety actions that if not removed could render systems inoperable. In this case even if a jumper were used to energize the shunt-coil, the scram breaker could not be reset if the jumper were not removed. Therefore while the staff does not advocate alternatives to built-in test capabilities, this particular case is not one in which it would take the position that such alternatives would not be considered.

FIGURE 1


MANUAL
TRIP
SWITCH
PROTECTION
SYSTEM
UNDERVOLTAGE
TRIP COIL
BREAKER
IND.
LIGHT
125 VDC
SHUNT
TRIP
POWER
TEST
SWITCH
SHUNT
TRIP COIL

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NS-EPR-2588
April 29, 1982

Mr. F. Rosa, Chief
Instrumentation and Control Systems Branch
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Rosa:

This letter is in response to your Branch request, made to George Butterworth of my Staff, that Westinghouse re-evaluate its opposition to the ICSB position requiring independent testing of the shunt trip circuits of the reactor trip breakers in Westinghouse plants. We have completed the re-evaluation and do not believe any change to our position is warranted because:

(1) Our analyses take no credit for these circuits to open the breaker to trip the reactor (2) the tests are an additional utility burden with no safety benefit (3) the tests would require redesign of the system or the use of jury-rigging procedures. Either has the potential to degrade a system of proven reliability.

I request that this issue be resolved generically. In the interim, pending resolution, Westinghouse has recommended that near term operating plants make no committment to the tests. Should you continue to disagree with the Westinghouse position on this issue, I strongly recommend a meeting be arranged with my staff to attempt to reach an agreement. Failing that, I recommend that you refer this issue to the Committee to Review Generic Requirements for its consideration.

Should you need any additional information my cognizant staff manager is George Butterworth, Manager, Instrumentation & Control Systems Licensing.

Yours truly,

for E. P. Rahe, Manager
Nuclear Safety Department

PDR
8205040524

cc: T. Speis
E. Rossi

GB/keg
Attachments

Attachment to NS-EPR-2588

Introduction:

The Instrumentation and Control Systems Branch (ICSB) has taken a position requiring additional Tech Specs to independently test the shunt trip circuits of the reactor trip breakers in Westinghouse plants. Westinghouse has been contesting this requirement.

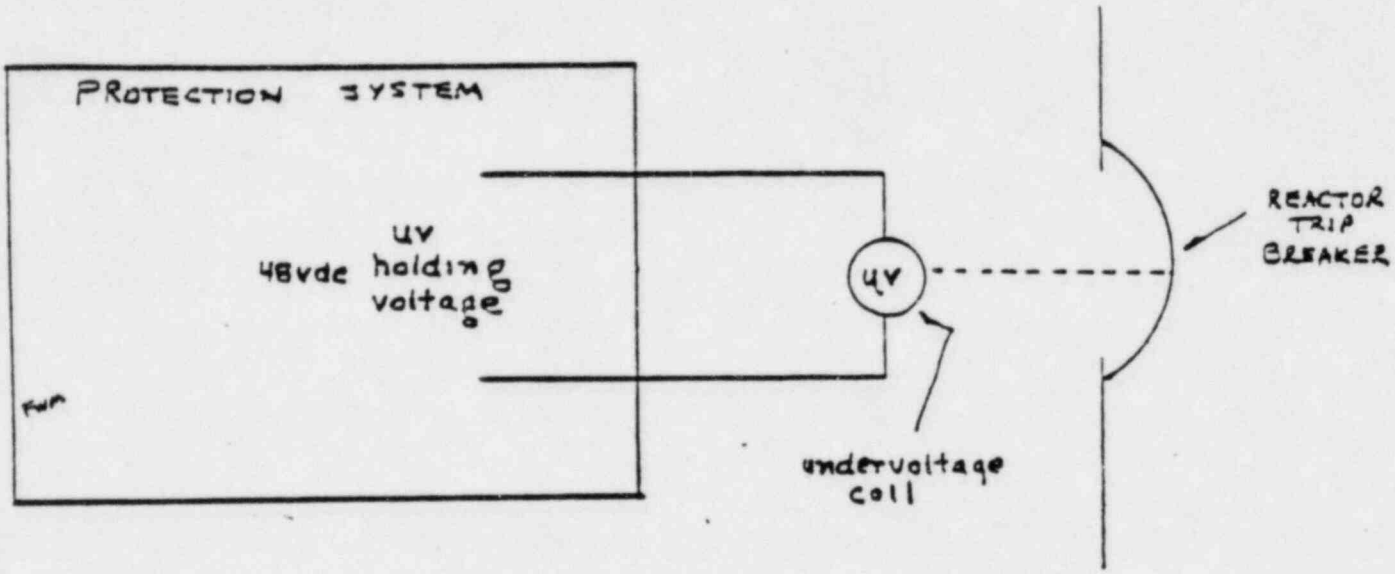
The basis for the ICSB position was a problem at the St. Lucie plant covered in IE Circular 81-12 dated July 22, 1981. The difference between the Westinghouse and Combustion Engineering designs is discussed in the following text.

This issue has been debated during ICSB technical reviews of SNUPPS, Watts Bar, Byron, and Catawba. During the Catawba review Duke Power was advised that failure to comply with the ICSB tests could result in denial of an operating license. In our judgement the ICSB requirement is without basis. During recent discussions with TVA on its committment to do the tests on Watts Bar, we were advised that they have reassessed the safety implications and will oppose the tests on the basis that design changes, or jury-rigging, have the potential to degrade a vital system.

It should be noted that, after their assessment of the P-4 contact safety problem reported by Westinghouse in 1979, ICSB took a position requiring means to avoid the potential for human errors associated with entering the reactor trip switchgear to conduct the safety tests. We concur with this position. On the shunt coil issue, however, we believe that the tests are not important to safety and, in fact, have the potential to adversely affect the performance of the reactor trip system by virtue of human or technical errors.

Discussion:

In the Westinghouse design, each reactor trip breaker is automatically opened when necessary by the protection system, which de-energizes the breaker's undervoltage (uv) coil. The coil's holding voltage is provided by and controlled by the protection system. The design meets all criteria applicable to automatic reactor trip. Nearly any failure in the system will interrupt the uv voltage and cause a reactor trip (fail safe). Any failure which could prevent voltage interruption is detectable by routine system tests, including those failures recently imposed accidentally in the protection system at the Brazilian Angra plant. Credit is taken in Westinghouse analyses for automatic de-energization of the uv coils, by the protection system, to trip the reactor. A simple sketch shows the automatic reactor trip design:



This design has been reviewed, accepted, and licensed many times. It should be noted that in the St. Lucie plant design, the protection system not only de-energizes a uv coil in the breaker but, at the same time, energizes a shunt coil in the breaker. The shunt coil causes the breaker to open in a manner identical to the undervoltage coil. Credit cannot be taken for shunt circuits since they require power to operate and violate GDC 23 which requires the system to fail safe on loss of power. Failure of shunt circuit power would prevent opening the breaker, not open it.

The breakers used by Westinghouse are reliable commercial units required to meet restrictive nuclear specs. The standard commercial design used only a shunt trip circuit to open the breaker. An undervoltage coil was an option. In implementing its design Westinghouse specified the undervoltage coil option in order to meet functional requirements for the nuclear application. However, in order to avoid breaker redesign and the potential to degrade the reliability of the commercial breaker, Westinghouse chose to retain the shunt trip circuits and simply add the uv coil.

Conclusion:

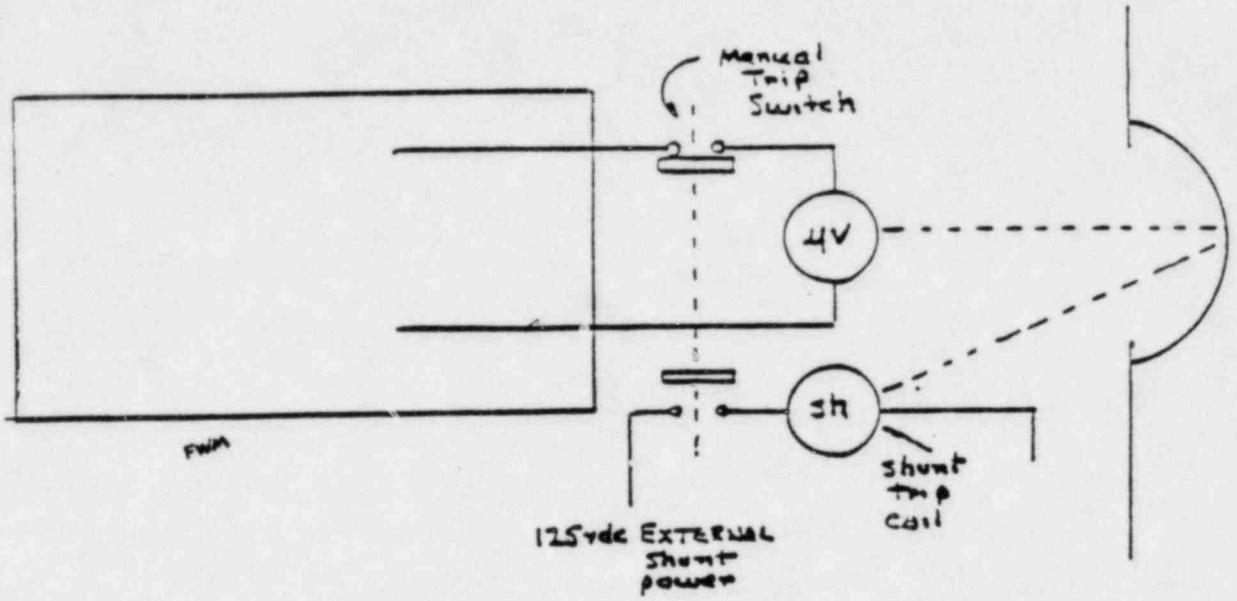
It is the Westinghouse belief that the additional tests are unnecessary and unjustified. Specifically:

(1) Our analyses take no credit for these circuits to open the breaker to trip the reactor.

(2) The tests are an additional utility burden with no safety benefit.

(3) The tests would require redesign of the system or the use of jury-rigging procedures, either of which has the potential to degrade a system of proven reliability.

In conforming to regulations on manual initiation of reactor trip, Westinghouse designers chose to not only interrupt the uv coil voltage by manual trip switch contacts, but to also energize the shunt trip coil from the switch. This was done because the shunt trip circuits and mechanism were already a part of the breaker. This decision was an exercise of good engineering judgement and had no basis in functional requirements needed to meet safety criteria. A simplified sketch of the Westinghouse manual reactor trip is as shown:



Westinghouse does not concur with independent testing of the shunt trip circuits on the ICSB basis that the shunt coil circuits are a diversity requirement of the regulations. Neither can we agree that safety interests are served by additional entrance to the switchgear to test the shunt circuits ability to open the breakers from the control room. This requirement is satisfied by redundant uv interruption contacts on redundant manual trip switches in the control room.

To meaningfully test the shunt trip, the breaker must be closed. This means that the uv coil must be energized from the protection system. It will then be necessary to defeat de-energizing the uv coil from the control board switch if the shunt trip is to be independently verified. Historically, the NRC has denied jury-rigging or jumpering in order to perform tests. The current ICSB position is requiring it. The mandate should have instead been to independently verify the uv trip from the manual switch.

During the Catawba review the NRC stated that TVA had committed to a "gismo" circuit to check the shunt trip circuits. The ICSB reviewer explained that the "gismo" consisted of a switch and a light which confirmed continuity of the shunt coil circuits. When reminded that such a test would not confirm the ability of the shunt coil circuits to open the breaker from the remote manual switch, ICSB accepted Duke Power's proposal to jumper the uv circuits. As mentioned earlier, TVA has since taken action to withdraw its commitment to any tests because of degradation risks.