SAFETY EVALUATION REPORT

FARLEY NUCLEAR STATION UNITS 1 AND 2
REACTOR TRIP BREAKER AUTOMATIC SHUNT TRIP

INTRODUCTION AND SUMMARY

Generic Letter 83-28 was issued by NRC on July 8, 1983 indicating actions to be taken by licensees based on the generic implication of the Salem ATWS events. Item 4.3 of the generic letter requires that modifications be made to improve the reliability of the Reactor Trip System by implementation of an automatic actuation of the shunt attachment on the reactor trip breakers. By letter dated June 14, 1983 the Westinghouse Owners Group (WOG) proposed a generic design modification to implement the automatic shunt trip. By letter dated June 30, 1983, the licensee, Alabama Power Company (APC), submitted their design for this modification which is based on the WOG generic design proposal. By letter dated August 25, 1983, APC provided responses to information required as identified in the staff's evaluation of the generic design submitted by the WOG. Additional clarification and commitments were provided by letter dated September 13, 1983. The staff has reviewed the licensee's proposed design for the automatic actuation of the reactor trip breaker shunt trip attachments and finds it acceptable.

The licensee intends to implement this modification during the September 1983 refueling outage for Unit 2 and during a subsequent outage of Unit 1 of sufficient duration to permit this change.

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EVALUATION

The following required plant specific information items were identified based on the staff's review of the WOG proposed generic design for this modification:

1. Provide the electrical schematic/elementary diagrams for the reactor trip and bypass breakers showing the undervoltage and shunt coil actuation circuits as well as the breaker control (e.g., closing) circuits, and circuits providing breaker status information/alarms to the control room.

The design of the electrical circuits for the shunt trip modification have been reviewed and found to be consistent with the WOG generic proposed design which was previously reviewed and approved by the staff. However, the APC design includes test jacks to facilitate the capability to perform response time tests during plant operation. This addition to the WOG generic design consists of test jacks wired directly to an auxiliary switch "a" contact (closed when the breaker is closed) and test jacks wired in series with 1 Kohm (2.5 watt) resistors across the undervoltage coil. Thus test connections for an undervoltage trip signal and breaker tripped condition are available to perform the response time test. The resistors in series with the test connections to the undervoltage coil provide protection against potential accidental shorts or grounds during response time testing to assure that such events would not result in an inadvertent breaker trip or overload on the protection system power source for the undervoltage trip attachment. Based on our review of these plant specific aspects of the APC design, we conclude that they do not introduce a safety significant consideration, will facilitate on line response time testing, and are, therefore, acceptable.

2. Identify the power sources for the shunt trip coils. Verify that they are Class 1E and that all components providing power to the shunt trip circuitry are Class 1E and that any faults within non-class 1E circuitry will not degrade the shunt trip function. Describe the annunciation/indication provided in the control room upon loss of power to the shunt trip circuits. Also describe the overvoltage protection and/or alarms provided to prevent or alert the operator(s) to an overvoltage condition that could affect both the UV coil and the parallel shunt trip actuation relay.

Redundant Class 1E power sources are used for the automatic shunt trip actuation of the reactor trip breakers and for the manual shunt trip of the bypass breakers. If the shunt trip circuit power is lost the breaker position status lights will go out alerting the operator. Also, normally open contacts of an auxiliary relay which is energized when the breaker is closed provide breaker status information to the plant computer. These contacts would change state if power for the automatic shunt trip circuit is lost.

Overvoltage conditions in the shunt trip circuits are only a significant consideration when the shunt trip coil is energized. Since the current through the shunt trip coils is interrupted when the breaker trips, energization of the shunt trip coil is only momentary. The maximum available voltage occurs during a battery equalizing charge at a maximum voltage of 115% of the normal 125V battery supply voltage. Due to the short duty cycle of the shunt trip coil, it can operate at this overvoltage condition without deleterious effects.

The added relay in parallel with the undervoltage coil used to actuate the shunt trip is powered from the regulated 48V DC power supply in the solid state protection system. This power supply has built in overvoltage protection set at 115% of nominal voltage. The shunt trip relay was selected based on its ability to operate under these conditions.

Based on our review, we conclude that appropriate consideration has been given to the aspects of the design described above and the design is, therefore, acceptable.

3. Verify that the relays added for the automatic shunt trip function are within the capacity of their associated power supplies and that the relay contacts are adequately sized to accomplish the shunt trip function. If the added relays are other than the Potter & Brumfield MDR series relays (P/N 2383A38 or P/N 955655) recommended by Westinghouse, provide a description of the relays and their design specifications.

The APC design includes the Potter & Brumfield MDR series relay as specified in the WOG generic design. Confirmation was provided that the relay contacts are adequately sized for the shunt trip function and that the additional load of the relay coil is within the capability of the protection system power supply. If the delivery of the Potter & Brumfield relay precludes their installation during the refueling outage for

Unit 2, APC has proposed to use a Struthers Dunn relay as a temporary substitute. The substitute relay is adequately sized for this service and would be replaced during the first outage that would permit their change out with the relays of the intended design. We find this aspect of the design is acceptable.

4. State whether the test procedure/sequence used to independently verify operability of the undervoltage and shunt trip devices in response to an automatic reactor trip signal is identical to the test procedure porposed by the Westinghouse Owners Group (WOG). Identify any differences between the WOG test procedure and the test procedure to be used and provide the rationale/justification for these differences.

The licensee has confirmed that the test complies with the provisions of the procedures developed by the WOG. Since no deviations were identified. We find this matter is considered acceptable.

5. Verify that the circuitry used to implement the automatic shunt trip function is Class 1E (safety related), and that the procurement, installation, operation, testing and maintenance of this circuitry will be in accordance with the quality assurance criteria set forth in Appendix B to 10 CFR Part 50.

The licensee confirmed that the circuitry is Class 1E and that procurement, installation, operation and maintenance of these circuits comply with the APC quality assurance criteria which satisfies Appendix B to 10 CFR Part 50. We find this is acceptable.

6. Verify that the shunt trip attachments and associated circuitry are/will be seismically qualified (i.e., be demonstrated to be operable during and after a seismic event) in accordance with the provisions of Regulatory Guide 1.100, Revision 1 which endorses IEEE Standard 344, and that all non-safety related circuitry/components in physical proximity to or associated with the automatic shunt trip function will not degrade this function during or after a seismic event.

The licensee has confirmed that seismic qualification is being completed through the efforts of the WOG. If this testing discloses seismic qualification problems with the as-installed design, APC has committed to replace all such components at the next outage subsequent to receipt of qualified replacement equipment. We find this commitment to be acceptable.

7. Verify that the components used to accomplish the automatic shunt trip function are designed for the environment where they are located.

The licensee has noted that shunt trip components have been selected to operate in the environmental conditions defined by the WOG generic design. However, APC did not confirm that the environmental conditions defined therein are applicable to the Farley Nuclear Plant. The staff will require that the licensee confirm that the WOG design conditions are appropriate to this plant specific application.

8. Describe the physical separation provided between the circuits used to manually initiate the shunt trip attachments of the redundant reactor trip breakers. If physical separation is not maintained between these circuits, demonstrate that faults within these circuits can not degrade both redundant trains.

The licensee has confirmed that the circuits and components are physically separated in accordance to the requirements of Regulatory Guide 1.75 as described in Farley FSAR Appendix 3A. Therefore, we find this aspect of the design is acceptable.

9. Verify that the operability of the control room manual reactor trip switch contacts and wiring will be adequately tested prior to startup after each refueling outage. Verify that the test procedure used will not involve installing jumpers, lifting leads, or pulling fuses and identify any deviations from the WOG procedure. Permanently installed test connections (i.e., to allow connection of a voltmeter) are acceptable.

At this time APC is working with the WOG to develop a generic procedure for operability testing of the manual reactor trip function. Since this matter is undefined at this time the staff will require that the plant specific test procedures be provided for staff review when they are available. However, this matter need not delay implementation of the proposed modification and will be subject to subsequent staff review.

10. Verify that each bypass breaker will be tested to demonstrate its operability prior to placing it into service for reactor trip breaker testing.

The licensee has indicated that the bypass breakers would be tested following testing of the reactor trip breakers. The staff's intent is that the bypass breakers be tested to determine that the undervoltage trip is operable before a bypass breaker is used to test the reactor trip breakers. During testing the bypass breaker would only be automatically tripped via the undervoltage trip attachment on an automatic reactor trip. It is clear through discussions with the licensee that his intent was to confirm the operability of the bypass breaker only via the manual shunt trip in the normal process of tripping the bypass breaker following a test of a reactor trip breaker. Further, due to the fact that the undervoltage coils of the bypass breaker are wired in parallel with the opposite train reactor trip breaker, it is clear that there is no inherent capability to test the undervoltage trip of the bypass breakers during power operation. Also since the automatic shunt trip modification is not being implemented on the bypass breakers, the staff concludes that there is a further benefit to being able to confirm the operability of the bypass breakers during plant operation.

By letter dated September 13, 1983, the licensee responded to the staff's concerns related to the operability of the bypass breakers. The licensee has provided a commitment to pursue a design change to allow provisions for at-power testing of the undervoltage trip attachment of the bypass breakers. If this feature is not implemented during the upcoming refueling outage, it will be installed at the next outage of sufficient duration following receipt of the required materials. Further, in the interim the licensee will confirm the operability of the shunt trip attachment on a bypass breaker immediately prior to placing it into use for testing a reactor trip breaker. This will, at least, confirm the operability of the shunt trip attachment which is actuated by the manual reactor trip. At the time when the test capability of the undervoltage trip attachment is installed, the staff will require that the technical specifications include appropriate surveillance requirements for the bypass breakers. In the interim the licensee has committed to perform complete functional testing of the bypass breakers via the undervoltage trip attachment, response time testing, dimensional and preventive maintenance during the upcoming refueling outage. The staff finds the commitment to these actions acceptable.

Finally, it has become apparent from this review that at the present time there does not exist a built-in means to readily confirm the operability of the undervoltage trip attachment on the bypass breakers for some Westinghouse plants, including the Farley Units. Of the three typical trip circuit configurations provided by the WOG generic design proposal, it is noted that one included the capability to manually trip each bypass breaker individually by actuation of the undervoltage trip attachment. With regard to Farley Unit 1, for which the automatic shunt trip modification will not be implemented until some future time, the licensee has committed to test the shunt trip attachment on the bypass breakers prior to their being used to conduct any subsequent reactor trip breaker testing. The basis for this commitment is that the shunt trip of the bypass breakers provides an additional means to assure that the manual reactor trip feature of the bypass breakers is operable when a reactor trip breaker is in test. In view of the questionable reliability of undervoltage trip attachments, the staff concludes that this action is warranted and, therefore, acceptable.

With regard to tests to confirm the operability of the undervoltage trip of the bypass breakers the staff is considering if any further action is warranted for all Westinghouse plants including Farley Unit 1. If further action is deemed appropriate, it will be taken on a generic basis for all Westinghouse plants.

11. Verify that the test procedure used to determine reactor trip breaker operability will also demonstrate proper operation of the associated control room indication/ annunciation.

The licensee has noted that the test procedures being developed will verify proper operation of the control room indicators. As noted in item 9 above, test procedures will be subsequently reviewed and are not a prerequisite to implementation of this modification.

12. Verify that the response time of the automatic shunt trip feature will be tested periodically and shown to be less than or equal to that assumed in the FSAR analyses or that specified in the technical specifications.

Until such time as revised technical specifications are proposed, the licensee has indicated that quarterly response time tests of the reactor trip breakers will be performed. The staff evaluation of this matter is included in item 13 below.

13. Propose technical specification changes to require periodic testing of the undervoltage and shunt trip functions and the manual reactor trip switch contacts and wiring.

The licensee is working with the WOG to develop proposed Technical Specification changes to address testing of the manual reactor trip switch contacts. However, as a result of the prior failures of the undervoltage trip attachments experienced at the Farley Units, the licensee had implemented additional testing beyond the Technical Specification requirements to provide further assurance of the operability of the undervoltage trip attachments. In view of the modifications to incorporate the automatic shunt trip feature on Farley Unit 2 during the forthcoming refueling outage, the licensee has proposed to modify this prior commitment for interim testing due to the increase in system reliability as a result of this change.

For Farley Unit 2, the licensee has committed to conduct monthly functional testing of the reactor trip breakers to confirm the operability of the shunt and undervoltage trip attachments and quarterly response time testing as noted under item 12 above. In addition, pre-startup testing of the reactor trip breakers will be performed, if not conducted in the previous 7 days, to functionally test the reactor trip breakers via the main control board switches and to independently functionally test the shunt trip attachments.

With regard to the licensee's commitment to extend the additional monthly functional tests of the shunt and undervoltage trip attachments and the quarterly response time tests, the staff concludes that with the increased reliability of reactor trip breakers provided by the automatic shunt trip, the best interest of plant safety is not served by the continuation of the interim testing. The basis for this conclusion is that during the testing a bypass breaker is closed and a valid reactor trip would only be effected by the opposite train protection system logic and operation of either the other reactor trip breaker or the closed bypass breaker. In this situation which is a basic one-out-of-one logic configuration the probability of an ATWS event is increased due to the fact that protection is only provided by a single train of the protection system. In that the vast majority of surveillance tests do not reveal system or component failures, the more frequent testing has a greater impact on overall system reliability since it reduces the one-out-of-two trip protection to one-out-of-one during testing of the reactor trip breakers. Further, less frequent testing should have an additional safety benefit by reducing the potential for inadvertent reactor trips due to testing and attendent challenges to the plant safety and shutdown systems. Therefore, the licensee's commitment to testing the Unit 2 reactor trip breakers more frequently than required by the plant Technical Specification surveillance requirements is waived and the staff recommends that the test frequency specified therein (every 62 days) be used for reactor trip breaker testing.

With regard to response time testing, the staff notes that the licensee has included test features which facilitate response tests during operation and that such tests do not increase the time required to be in a condition where the bypass breakers are closed (single train of protection). Therefore, it is recommended but not required that the licensee include response time tests to the extent practical at the same frequency as the breaker operability testing. This would provide additional data related to the response time of undervoltage trip attachments which may be significant and permit further relaxation of interim testing commitments for Farley Unit 1. In any event, the licensee has not altered his prior commitment to maintenance of breakers on a six month interval and the tests included as a part of this action include response time tests of both the shunt and undervoltage trip attachments. It is concluded that with the increase in system reliability provided by the automatic shunt trip and in view of the staff's recommendation to perform reactor trip breaker tests at 62 day intervals, the licensee's commitment to quarterly response time testing is waived for the Unit 2 reactor trip breakers.

The existing surveillance requirements specified in table 4.3-1 requires that the operability of the reactor trip breakers be demonstrated operable prior to plant startup if not performed in the previous 7 days. With regard to the licensee's commitment on the pre-startup testing, the staff notes that the bases for the instrumentation surveillance requirements identified in the plant technical specification makes it clear that "the operability of these systems is required to provide the overall reliability, redundancy, and diversity assumed available in the facility design for the protection and mitigation of accident and transient conditions." With the addition of the automatic shunt trip feature, it is assumed that diverse features are available (i.e., operable undervoltage and shunt trip attachments) to ensure that the breaker will trip on a demand for reactor trip. The staff concludes that the proposed pre-startup tests do not include the independent testing of both the undervoltage and shunt trip attachments and that this is not consistent with the current plant Technical Specification requirements.

Therefore, the tests conducted to fulfill the surveillance requirements to demonstrate that the reactor trip breakers are operable must be conducted in a manner which independently demonstrates the operability of the shunt and undervoltage trip attachments for the reactor trip breakers. This is also applicable to technical specification surveillance requirements for the reactor trip breakers to be conducted every 62 days. Therefore, the staff will require that the licensee confirm that these tests will be conducted in the manner cited above in accordance with the Technical Specification requirements.

As a matter separate from those identified in the staff's evaluation of WOG generic design proposal, the staff examined the manner in which the control board indication of breaker position is configured. The green indicating light, indicating that the breaker is tripped, is operated by a breaker auxiliary switch contact that closes when the breaker is in the tripped position. The red indicating light, indicating that the breaker is closed, is energized by a breaker auxiliary switch contact that is closed when the breaker is closed; also, it is located in series with the breaker shunt trip coil. As a result the indicating light is also in parallel with the momentary manual reactor trip switch contacts and the added relay contact to effect the automatic shunt trip feature. The red light configuration, which is in series with the shunt trip coil, is a standard design approach which provides, in addition to breaker closed position indication, a means to monitor the continuity of the normally deenergized shunt trip coil and interconnecting circuit wiring.

In the review of this design, the staff notes that the relay contact which provides the automatic shunt trip actuation also effectively shorts out the red indicating light that is located in parallel with this contact. Under normal conditions this is not of any significance since the breaker auxiliary contact in series with the trip coil would open to deenergize both the trip coil and the red indicating light. However, if the breaker failed to trip on a trip command, the positive indication provided by the red indicating light that the breaker remained closed would be lost due to the action of the relay contact which shorts out the red light in order to energize the shunt trip coil. In this situation both position indication lights would be out. Thus, while the green indication would not be lit, providing positive indication that the breaker is tripped, a natural reaction on the part of some plant operators might be to conclude that the bulb for the green indicating light may have burned out. Since the red indicating light was previously lit and was extinguished following a reactor trip, it might be assumed that the breaker opened when in fact it may not have.

Thus the concern is whether the automatic shunt trip modification may lead to an erroneous conclusion due to an apparent lack of a more direct indication of a closed breaker position.

In evaluating this matter the staff notes that the ideal situation may be to have a red indicating light that is operated solely by a breaker closed position contact as well as a light confirming the continuity of the trip coil. However, this may deviate from the standard practice used elsewhere for electrically operated breakers. Further, it is expected that some plant designs may use red indicating lights operated only by breaker position contacts and trip coil continuity monitoring may not exist. It is the staff's conclusion that the positive indication, which is provided at least from the standpoint of the green indicating light, is acceptable and that operators should not make assumptions on breaker position without such indication. Further, should two breakers fail to open on a reactor trip command, it would be obvious from the standpoint of other control room indication that the control rods had not been tripped. The staff finds that this aspect of breaker position indication does not present a safety significant issue and is, therefore, acceptable.

CONCLUSION

Based on the review of the WOG generic design and the plant specific aspects of automatic shunt trip modifications proposed by the licensee, we find the design acceptable conditioned on the receipt of the confirmatory information and the completion of the action items identified herein. The staff will require the resolution of these matters prior to restart following the implementation of this design change.

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