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

September 20, 1990

Mr. George J. Beck, Chairman
BWR Owners' Group
Philadelphia Electric Company
955-65 Chesterbrook Blvd., M/C 63B-5
Wayne, PA 19087-5691

Dear Mr. Beck:

I am writing in response to Mr. Stephen D. Floyd's letter of August 11, 1989, which appealed the staff's position on required diversity of trip units in the alternate rod injection system (ARI) from trip units in the reactor trip system (RTS) under 10 CFR 50.62 (ATWS rule). I have decided in favor of the staff's position and the BWR Owners' Group's appeal is denied.

As you know, the ATWS rule requires an ARI which is diverse from the RTS from the sensor output to the final actuation device. In 1988 the Brunswick ARI was installed using analog trip units which were similar to the trip units in the RTS. The licensee cited diverse energization states (energize to trip) and other factors in favor of acceptability. However, the NRC staff did not accept the design, concluding that the ARI trip units should be unlike those in the RTS. The issue was appealed to the Director of the Office of Nuclear Reactor Regulation (NRR) and the appeal was denied on two previous occasions.

After receipt of the latest appeal (Mr. Floyd's letter of August 11, 1989) the NRR staff performed additional studies and concluded its position was the proper one. The matter was then reviewed by the Committee to Review Generic Requirements (CRGR) which recommended in favor of the staff position. After considering the issues I have concluded that the staff's position is the proper implementation of the ATWS rule in this case and, thus, it should be followed. Trip units in the ARI should be diverse from trip units in the RTS. The degree of diversity that you proposed (including different energization states and other factors) is not sufficient. By separate correspondence, affected licensees will be requested to propose a schedule for achieving compliance.

It should be recognized that this is a generic position and there could be reason for making exceptions in specific cases; however, no requests for relief are currently under review.

One question, raised during discussions of this matter, concerned whether adherence to the staff position might reduce overall scram system reliability. Our conclusion is that the staff position should enhance overall reliability. It is expected that the reliable trip units currently in the ARI will be replaced with units that have comparable reliability but which are of different manufacture. Thus, no significant reduction in reliability of the system is expected. Concerns that the new trip units may be inherently much less reliable or may cause difficulties due to procedure mixups do not appear

warranted. Furthermore, it is generally thought that a substantial part of the RTS unavailability (due to a multiple failure of trip units) will be dictated by common mode failure probabilities. In these circumstances, use of different trip units in the ARI would enhance overall scram system reliability.

One of the main arguments in your appeal is that the trip units in the ARI should be considered as part of the sensors, and thus should be exempt from the diversity requirements of the ATWS rule. The pressure/level switches employed to perform the trip function in some systems are located inside the sensor casings and are considered part of the sensors. However, the analog trip units under discussion here do not resemble switches that are part of the sensors. They are located in separate racks remote from the sensors and are similar to analog trip units in many other systems which are not considered to be part of the sensors. Thus, we do not consider this type of trip unit to be part of the sensor.

Another argument was that, based on the statement of considerations which accompanied the ATWS rule, replacement of the trip units in the RPS should not be required unless considered reasonable and practical. For almost all of the plants involved, replacement units are readily available and can be fit into existing racks without wiring or other hardware changes. The cost would be about $170,000 per plant for these plants. Regarding the cost-benefit relationship, uncertainties in quantitative estimates of risk reduction are substantial enough to preclude definitive conclusions; however, our estimate indicates that the benefits exceed the cost. Based on these factors we consider replacing the trip units reasonable and practical.

I am enclosing relevant portions of the NRR staff's submittal to CRGR, which documents the staff's evaluation of this appeal, and relevant portions of the Minutes of CRGR Meeting No. 189, which document the CRGR recommendations to me. This material, which will be placed in the Public Document Room, provides additional detail regarding our consideration of the issues involved. (Note that one relevant contractor report, which was part of the staff's submittal to the CRGR, is not included because it contains proprietary information. The staff will obtain a non-proprietary version in the near future and forward it to you.)

Sincerely,

Original Signed By:
James M. Taylor
James M. Taylor
Executive Director
for Operations

Enclosure: As stated

cc: Mr. Stephen D. Floyd

Distribution: See next page

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

May 30, 1990

MEMORANDUM FOR: Edward L. Jordan, Chairman
Committee to Review Generic Requirements

FROM: Frank Miraglia, Deputy Director
Office of Nuclear Reactor Regulation

SUBJECT: REQUEST FOR CRGR REVIEW OF THE BWROG APPEAL OF THE STAFF POSITION REGARDING DIVERSITY OF ROSEMOUNT TRIP UNITS

REFERENCE: BWROG "Appeal from Staff Position Requiring Total Equipment Diversity Under ATWS Rule (10 CFR 50.62)"

A briefing of the CRGR regarding the BWROG appeal on ATWS diversity requirements is requested at your earliest possible convenience. As you are aware, this appeal was submitted to James Taylor, Executive Director for Operations (EDO), on August 11, 1989, and the EDO subsequently assigned CRGR to take the lead to review this issue. The NRR staff was directed by the EDO to perform a thorough review of this appeal and provide to the CRGR its recommendation with any and all background information that may be required to complete the CRGR review.

In essence, the dispute involves use of the same type of Rosemount trip units in both the Alternate Rod Injection (ARI) system and the Reactor Trip System (RTS). The guidance published with the ATWS Rule states: "Equipment diversity to the extent reasonable and practicable to minimize the potential for common cause failures is required from the sensors to and including the components used to interrupt control rod power or vent the scram air headers." The ATWS Rule itself, 10 CFR 50.62, states that each BWR must have an ARI system that is diverse (from the RTS) from sensor output to the final actuation device. The NRR staff does not agree with the Owners Group contention that the subject trip unit is part of the sensor and, therefore, the diversity requirement set forth in the ATWS Rule does not apply because the Rule allows the use of the same sensor for output to both the ARI and the RTS. Other disagreements between the staff and the BWROG center on the degree of diversity as it relates to the subject trip unit application. The BWROG maintains that pursuing ARI/RTS diversity is both unreasonable and impracticable and little if any risk reduction is achieved by using trip units in the ARI that are diverse from the trip units being used in the RTS. In contrast to these BWROG positions, the staff continues to believe that an increase in scram reliability can be achieved by using diverse trip units in the ARI systems at BWR power plants. Since there are different trip units that can be used in the ARI system which are available at a reasonable cost, the BWROG's assertion that the staff's position on this issue is both, "unreasonable and impracticable" is without support. After reviewing all information submitted relating to this appeal, it is still the staff's position that the health and safety of the public will be enhanced by employing diverse trip units in the ARI system as stated above.

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CONTACT:
V. Thomas, (SICB:D3T)

The staff has completed its review of all pertinent facts mentioned in this latest BWROG appeal, has determined that its initial position on the issues is unchanged, and recommends that the appeal be denied.

The three enclosures that relate to the this diversity issue. Enclosure 1 is a draft letter from the EDO to the BWROG containing the decision on the appeal. Enclosure 2 contains the staff review findings of the BWROG appeal. Enclosure 3 is the NRR Contractor's Study Report on the BWROG appeal.

This information is submitted per discussion with the CRGR staff (D. Allison). We are prepared to discuss our recommendation on this appeal with the CRGR at the earliest opportunity.

Original signed by
Frank Miraglia, Deputy Director
Office of Nuclear Reactor Regulation

Enclosures:
1. Letter to BWROG
2. Staff Review Findings
3. A Review of Diversity in Trip Units, Feb. 1990

cc: D. Allison

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ENCLOSURE 1

Mr. Stephen Floyd, Chairman
BWR Owners' Group
Carolina Power and Light Company
411 Fayetteville Street
Raleigh, North Carolina 27602

Dear Mr. Floyd:

This correspondence is the followup response to my previous letter dated August 31, 1989. At that time, I committed to notify the BWROG of my decision on the latest appeal of a staff position regarding the use of Rosemount trip units. The BWROG appeal addresses the issue of the degree of diversity required when implementing hardware on a boiling water reactor (BWR) to comply with the requirements of the ATWS Rule (10 CFR 50.62).

Following an intensive review of all the pertinent facts mentioned in the appeal by a panel of selected staff members [i.e., Committee to Review Generic Requirements (CRGR)] and my review of its findings and recommendation, I have concluded that the information submitted in support of the BWROG appeal does not present a sufficient basis to support your position that the present ARI design meets the diversity requirements as set forth in the ATWS Rule. Further, I do not agree with your assertion that the staff is requiring equipment diversity only for the sake of diversity, in spite of the lack of safety benefit. The primary conclusion I reach in review of this appeal is that the staff position is a proper interpretation of the Rule and that it is in the interest of improving the reliability of the scram function. Therefore, the subject appeal of the Owners' Group is hereby denied. I expect that each licensee will propose a schedule to the NRC for modifying its plant.

If you wish to discuss this decision or any issue you believe to be germane, please contact Scott Newberry, Chief of the Instrumentation and Control Systems Branch, at (301) 492-0782.

Sincerely,

James M. Taylor
Executive Director
for Operations

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

ENCLOSURE 2

LISTING OF MAIN APPEAL POINTS AND STAFF RESPONSES

Appeal Position Number 1

Page 6, Section III, Item A:

Item A: "The ATWS RULE Does not apply to The Rosemount Transmitter/trip Units."

The BWR owners argue: "The ATWS Rule clearly acknowledges that devices upstream of the sensor output are excluded from the reach of the Rule. The subject circuit boards in the Rosemount/trip units are upstream of the sensor output and, accordingly, the staff's decision to require equipment diversity (or for that matter, any diversity) is inconsistent with the rule."

Staff Response to Appeal Position Number 1

The staff agrees with the first part of the appeal statement above regarding devices upstream of the sensor output; but disagrees with the second part regarding the subject circuit boards.

The ATWS Rule clearly states that those devices which are located upstream of the sensor output are beyond the scope of the diversity requirement. It has been and continues to be the staff's position that the phrase "upstream of the sensor output" includes only the sensor and its associated process sensing lines and valves which make up the front-end of a typical measuring system. The staff does not consider, and has never considered to our knowledge, such devices as signal conditioning equipment, analog trip units, or indicating/recorders which are part of the receiving or back end of a typical measuring system to be "upstream" of the sensor output. Process measuring systems do not always employ an analog trip unit with the sensor; such is the case of certain monitors installed pursuant to the guidance in Regulatory Guide 1.97 "Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant and Environs Conditions During and Following an Accident." In those applications, the sensor outputs can be fed directly to an indicator/recorder or data logger without the need for a trip unit.

The staff position regarding what constitutes a sensor is supported by the General Electric (GE) Report, NEDC-31336, "Instrument Setpoint Methodology," dated October 1986; the Rosemount Controls Inc. Product Data Sheet No. 2302; and several industry standards.

GE treats the sensor and analog trip unit as two separate components when they are used as part of an instrument channel (Page I-4, Items 9 and 10, in NEDC-31336). General Electric defines a sensor as: "The portion of the instrument channel which converts the process parameter value to an electrical signal." The trip unit is defined as: "The portion of the instrument channel which compares the converted process value of the sensor to the trip [desired] value, and provides the output "trip" signal when the trip value is reached." Another example of GE's approach to considering these components as separate components

is shown on Pages I-12 and I-13 of the same report. On page I-12, the sensor transmitter and analog trip unit are treated as separate components in GE's discussion of the methodology for establishing instrument channel accuracy. The sensor transmitter component is represented as one term, A_T (A_T is equal to transmitter accuracy) and the trip unit is represented by a different term A_{TU} (A_{TU} is equal to trip unit accuracy). On Page I-13, in discussing instrument channel drift, GE assigns separate values of drift for the transmitter and the trip unit (i.e., D_T and D_{TU} respectively).

Another example of this approach by industry regarding the separate nature of the sensors and the trip units is demonstrated by Rosemount in their Product Data Sheet #2302. The electrical block diagram in this example shows the sensor as only one portion of the sensor/transmitter assembly. The sensor portion includes the capacitive element (plates) which sense a change in the sensing capsule oil pressure which in turn is affected by the changes in the process parameter value; the changes in the electrical characteristics of the plates are then converted to a proportional electrical signal. The remaining portion of the sensor transmitter is referred to as the transmitter section and includes the demodulator, current detector, oscillator, current control amplifier, and voltage regulator. The block diagram does not show the analog trip unit but does clearly show the converted process parameter output signal. As stated above, this output signal is sent "downstream" to indicators, trip units and data loggers as desired.

Additionally, all industry standards that have been reviewed by the staff define and treat the sensor and analog trip unit (sometimes referred to as a bistable or an alarm unit) as separate devices. These standards or guidelines include:

- IEEE Standard 603-1980: "IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations"
- ANSI/ISA S 51.1-1979 "Process Instrumentation Terminology"
- SAMA Standard PMC 20.1-1973 "Process Measurement and Control Terminology"
- ISA-RP67.04 Part II-1989-Draft "Methodologies for the Determination of Setpoints for Nuclear Safety-Related Instrumentation"

Early vintage BWR type power plants such as Oyster Creek, Dresden, Millstone, and the like originally used a local indicating pressure or differential pressure switches manufactured by Barton to initiate the scram function or actuate the engineered safety features system(s) when abnormal plant conditions were reached. However, after issuance of IE Bulletin 79-01B,

"Environmental Qualification of Class 1E Electrical Equipment," many of these licensees opted to replace the local indicating type switch with an analog type measuring system consisting of the sensor/transmitter (described above) and an analog trip unit to perform the same functions. The sensors of each system sense the plant process in the same manner. The indicating switch, which is located in the body of the sensor, operates from physical movement of the sensor's sensing element (e.g., bourdon tube, diaphragm, bellows, etc.) whereas its counterpart, the trip unit, needs an electrical conversion (after the sensing element movement) and then transmission (signal conditioning) of the resultant signal to the trip unit to provide the same scram trip or actuation functions as the indicating switch. Replacing the switches in the RTS or ARI, which are outside the scope of the ATWS Rule, with the analog transmitter and trip unit adds a component (the trip unit) which the staff views not to be part of the sensor and within the diversity requirements of the Rule. The BWROG disagrees.

On page 6 of the Appeal, the BWROG presents an excerpt taken from SECY 83-293 as support for its contention that the sensor/trip unit should be treated as one device. This excerpt is taken from an appendix to the ATWS Task Force recommendations regarding an ATWS Rule. The excerpt from SECY 83-293 reads:

> "The trip portion of the sensor system consists of bistables that signal an out-of-tolerance condition. This portion of the system is vulnerable to bistable calibration errors and like component common cause failures. However, continuous monitoring of the sensor output, and the frequent testing of the trip values provide a good chance of discovery of such common cause problems.... Though differences exist in the level of redundancy and logic structure, these only influence the independent failure contribution which does not contribute significantly to the overall RPS unavailability. Therefore, for the purposes of this analysis, the sensor portion of the RTS will be ignored."

This discussion can be interpreted in a manner that reflects the view of the BWROG or interpreted in another manner to support the staff's position on this issue. Review of all of the Task Force Report, however, contradicts the BWROG interpretation of the above excerpt. The following excerpt taken from the same report states that the transmitters, amplifiers, logic matrices and relays are part of the measuring systems logic subsystem. In this statement even the transmitters are said to lack diversity, and the sensor is the only device that is not considered to be part of the logic subsystem. The excerpt reads:

> "The transmitters, amplifiers, logic matrices, and relays that make up the logic subsystems do have redundancy to some degree, but generally lack diversity. The PRA's conducted to date generally have not quantified the contribution to unavailability caused by the possible common cause influences on the logic subsystems. The failure rates for these components are low and multiple failures are rare, although multiple failures caused by such influences as temperature degradation for certain logic components have been reported. Failures in these components are generally not announced at once and must await surveillance testing. In addition, comparator adjustments and calibrations can introduce human error."

We conclude that this report is ambiguous with respect to defining the scope of the Rule.

Finally, all PWR power plants are also required by the ATWS Rule to install new systems. They employ the analog type measuring systems similar to those measuring systems in use at many BWRs to actuate a diverse scram system and/or diverse auxiliary feedwater/turbine trip systems. To date, the staff is not aware of any utility interpretation of the Rule that led to non-diverse trip units or bistables. On the contrary, all plants, to our knowledge, have designed and are installing systems that use different bistables/trip units in the RTS and ATWS systems.

We conclude that the background information on sensor channels and logic subsystems in SECY 83-293 is ambiguous and does not support the BWROG. We conclude that the definition of sensor in the literature and in practice is clear and that the ATWS Rule does apply to the trip units.

Appeal Position Number 2

Page 9, Section III, Item B:

Item B: "Even if it is determined that the ATWS Rule applies to the Rosemount/trip units, these units meet the Rule."

The BWROG acknowledges the need for the Commission's diversity requirement "from sensor output to the final actuation device." However, they maintain that the Rule does not specify the type of diversity, but simply requires diversity. Because the alternate rod injection (ARI) system employs combinations of methods of diversity such as equipment, functional, and application state diversity, the BWROG reasons that the system complies with the ATWS Rule.

Staff Response to Appeal Position Number 2

The Statement of Considerations published with the ATWS Rule defines what is meant by the term "diversity" as required in the ATWS Rule. The Statement of Considerations states that "equipment diversity" is the primary objective of the general term "diversity" in the Rule. The staff has always interpreted equipment diversity to mean unlike or different equipment.

During staff reviews of various utility ATWS designs, equipment diversity has always played a significant role when assessing the acceptability of a given functionally diverse application, as in the case of the ARI system. For example, two instrument channels that are measuring different plant parameters such as level and flow and are part of the same logic matrix, are sufficiently diverse only if the components in each channel are different from sensor output up to and including the final actuation devices that vent the air header. In addition, past experiences and the studies conducted jointly by industry and the NRC that led to the ATWS Rule and the associated Statement of Considerations leave no doubt that the intent of "diversity" set forth in the Rule is to improve the reliability of the scram function by minimizing the potential for

common mode failures. The staff believes that this increase in reliability is achieved through equipment diversity so long as the potential drawbacks of diversity (such as unreliable equipment or additional failure modes) are adequately addressed.

The need for equipment diversity can be illustrated by reviewing events involving equipment used in the reactor trip systems to achieve a reactor scram. For example, the Salem event resulted largely from inadequate equipment diversity. Two identical undervoltage trip attachments, located one in each of two reactor trip circuit breakers, simultaneously failed to perform their intended functions following a demand to scram, thereby causing the ATWS event.

An example of a component failure that has a potential to lead to common mode failure recently occurred when a defective component 1/ was used in the Rosemount 710 Master and Slave trip unit circuitry. These are the trip units in question. The deficiency was caused by a change in the manufacturing process. Specifically, under certain environmental and operating conditions, the trip unit may fail to actuate as intended even when in different energized states. The vendor has notified end-users of the potential problem and has offered a replacement unit considered more suitable for the intended service. In addition, our recent search of the Nuclear Plants Reliability Data System (NPRDS) uncovered other failures involving the Rosemount trip units which bring into question the perception that they are highly reliable and not vulnerable to common mode failure. The following are "Failure Descriptive Narratives" submitted by just one licensee about faulty Rosemount trip units:

- Grand Gulf personnel while conducting an 18-month surveillance test noted that an analog trip unit indicated a trip condition, but no reactor protection system response occurred. Subsequent investigation of the cause for failure revealed that a defective Rosemount trip unit was determined to contain two faulty operational amplifiers, a faulty potentiometer, one faulty timer and one faulty diode.

- Grand Gulf personnel experienced another failure of a Rosemount trip unit and in the Cause of Failure Narrative they state in part that "... the input diode failure is considered a normal electrical failure." The diode was replaced, a retest was performed satisfactorily on the trip unit, and it was returned to service.

The examples cited above are intended to illustrate the purpose of the diverse equipment in the ARI system which is to improve scram reliability by minimizing the potential for common mode failures and to enhance the confidence level that <u>all</u> power reactor plants will automatically scram on demand.

1/ (Part 21 notifications on Rosemount model 710 Trip/Calibration units and 414 E/F resistance bridges, dated August 17 and October 10, 1989)

This is not to say that the staff has always required completely different equipment in all instances during licensees' proposals to provide a diverse or alternate trip system. In the past, the staff has exercised engineering judgement and will continue to do so as questions on equipment diversity and the degree of design difference arise. The staff's decisions on these diversity issues are based on the reasonableness and practicableness of the given application coupled with a judgement regarding fundamental design differences. These are the bases the staff has used in arriving at the present decision to require licensees to use trip units in the ARI system diverse from similar functional trip units being used in the reactor trip system.

The BWROG argues against the use of diverse trip units and maintains that diversity from the RTS is already achieved throughout the ARI by combinations of allowable methods of diversity. It states the ARI system employs equipment, functional, and application state (i.e., de-energized versus energized) diversity from the RTS and thus complies with the Rule.

The staff agrees that combinations of methods such as energization states, the use of AC power versus DC power, functional diversity, components from different manufacturers, and different components from the same manufacturer are used when assessing the diversity issue. In addition to these methods, other factors that may influence the assessment include the history of successful operation and the ability to demonstrate reliability through periodic surveillance tests.

With respect to the BWROG contention that the present ARI system complies with the Rule, the staff has carefully reviewed the scenario presented on pages 9 and 10 of the appeal and disagrees with BWROG position for the following reasons:

- Functional diversity using different components is an acceptable means to meet the diversity requirement of the ATWS Rule. However, for the BWROG Loss of Feedwater event (LOF) mentioned above, there is no functionally diverse trip that uses diverse equipment to automatically initiate scram and mitigate the LOF event. For a LOF, the only RPS signal is low reactor water level. [This issue is discussed in detail in the attached contractor report dated February 1990, Enclosure 3.]

- Very little trip unit diversity is provided by different energization states. The bistable element (as stated on page 10 of the appeal) is not the only active component on the trip unit during normal operation. The staff maintains that active components are not just components that have a physical movement such as relays or switches. Active components that could fail due to common cause are also those components that change their electrical states such as logic networks, zener diodes, and

transistors. Examples of components that don't continually change electrical state are resistors, capacitors, terminal strips and potentiometers.

- The issue of reasonableness is not violated because there are trip units available that have diverse active components as defined above.
- The practicable aspect of this issue is not violated because the cost to replace or use diverse trip units is not prohibitive if the trip unit card manufactured by GE is used.
- Other trip units that are available for replacement have proven histories of successful operation in similar service applications at many nuclear power plants.
- The use of other available diverse trip units will improve reliability and will minimize the potential for common mode failures in the ARI systems at BWR type power plants.

The BWROG has argued that the drawbacks of diversity outweigh the safety benefits in this case. In an effort to assist us in the assessment of the safety benefit of replacing the trip units in the ARI with different trip units, we have, with the assistance of our contractor, reviewed in detail the quantitative reliability and risk assessments performed by the BWR Owners' Group and CP&L which were referenced in the BWROG appeal.

Current PRAs are not helpful in resolving this issue because common mode failures between the RPS and the ARI are not modeled at all or in very little detail. For example, prior to the ATWS Rule, the Utility Group on ATWS did not explicitly include common mode failures involving the RPS and ARI in its analysis. The values used in its analysis suggest that common mode failures are not considered at all. The Brunswick PRA referenced in the CP&L appeal also provides no models sufficiently detailed to aid in this evaluation. The simplified analysis provided by CP&L does provide a common mode failure analysis but also introduces considerable benefit from manual scram by the operator. The General Electric analysis includes common cause failures within each trip function but does not include any consideration of common cause failure of identical trip units that exist in all of these functions. Even the staff ATWS models which provided a basis for the recommended ATWS rule did not model components such as trip units separately. A more detailed review and description of these analyses is contained in Enclosure 3.

The improvement in overall system reliability provided by diversity is difficult to estimate quantitatively. However, also contained in Enclosure 3 is a quantitative estimate of this improvement using the same event trees used by the staff in recommending the ATWS Rule. While the uncertainties in such estimates are large, we believe that the estimates in Enclosure 3 are reasonable and that they provide an improved methodology for evaluating the safety benefit. In addition to concluding that replacing the ARI trip units would be cost beneficial, these models point out systematically that, contrary to our previous understanding that equipment outside the scope of the ATWS Rule (sensors) was diverse to a very large extent in the BWR design, identical trip units exist in

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

September 10, 1990

MEMORANDUM FOR: James M. Taylor
Executive Director
for Operations

FROM: Edward L. Jordan, Chairman
Committee to Review Generic Requirements

SUBJECT: FINAL (REVISED) MINUTES OF CRGR MEETING NUMBER 189

The Committee to Review Generic Requirements (CRGR) met on Wednesday, June 27, 1990 from 1:00-5:00 p.m. The following items were addressed at the meeting:

1. Deleted for Purposes of BWROG Appeal Response (Item 2. below)

2. A. Thadani, S. Newberry, G. Mauck, and V. Thomas of NRR presented for CRGR review information concerning an appeal by the BWR Owner's Group regarding the staff's position on diversity of the trip units in the alternate rode injection system from the trip units in the reactor protection system. The Committee recommended in favor of upholding the staff's position. This matter is discussed in Enclosure 3.

In accordance with the EDO's July 18, 1983 directive concerning "Feedback and Closure of CRGR Review," a written response is required from the cognizant office to report agreement or disagreement with the CRGR recommendations in these minutes. The response, which is required within five working days after receipt of these minutes, is to be forwarded to the CRGR Chairman and if there is disagreement with CRGR recommendations, to the EDO for decisionmaking.

It should be noted that the preliminary minutes of CRGR Meeting No. 177 were provided to CRGR members on August 15, 1990 for comment. No comments were received; however, Enclosure 3 has been revised to correct minor technical errors that were discovered during the comment period.

Questions concerning these meeting minutes should be referred to Dennis Allison (492-4148).

Edward L. Jordan, Chairman
Committee to Review Generic
Requirements

Enclosures:
As stated

cc: See next page.

all instrumentation channels that automatically trip the plant in response to a loss of feedwater event. We conclude that installation of reliable trip units that are different will improve safety.

With respect to the "drawbacks-of-diversity" that the BWROG noted in its letter to J. Taylor, NRC, dated August 11, 1989, and in the subsequent meeting with the staff (same subject) on November 15, 1989, little new or substantive information was offered in response to the EDO's request for information. Enclosure 3, on pages 15 through 19, discusses in detail the events surrounding the three drawbacks of diversity highlighted by BWROG. We conclude that there are no significant drawbacks to installing different trip units.

Appeal Position Number 3

Page 11, Section III, Item C:

Item C: If the term "diversity" is more broadly construed to require "equipment diversity," such construction should be read as "equipment diversity, to the extent reasonable and practicable."

The BWROG maintains that, as stated in its Appeal Position Number 2, the Rule itself does not impose a limitation on diversity so as to require that all diversity be achieved through diversity of equipment. Rather, the staff's support for equipment diversity comes from guidance set forth in the Statement of Considerations.

Staff Response to Appeal Number 3

As noted in the staff responses to Appeal Position Number 2, the staff's position regarding functional and equipment diversity are influenced by the aspects of both reasonableness and practicableness, risk reduction/benefit gained, and engineering judgement. Additionally, these staff positions have been and continue to be strongly influenced by the guidance set forth in the Statement of Considerations as the Owners' Group indicated above.

Responses to the many concerns and assertions that the BWROG raised throughout this appeal position are addressed in the staff responses to Appeal Positions 1 and 2 herein and/or in Enclosure 3.

Conclusion

We conclude that the original NRR position is the proper one. The definition of a sensor in the literature and in practice is clear, and the diversity statement in the ATWS Rule applies to the analog trip units. The language found in an appendix to the ATWS Task Force Report attached to SECY 83-293 recommending a rule is ambiguous. We conclude that in the affected plants no diverse equipment to the RTS analog trip units exists for automatically scramming the reactor following a loss of feedwater. The BWROG provided insufficient information to support their assertions regarding the drawbacks of diversity. Our review indicates that these suggested drawbacks are non-existent or are not significant. Finally, we conclude that replacement of the Rosemount trip units will improve safety, is cost beneficial, and should proceed. It is our judgement that such action is reasonable and practicable and is consistent with the guidance issued with the ATWS Rule.

cc/w enclosures:
Commission (5)
SECY
J. Lieberman
P. Norry
D. Williams
Regional Administrators
CRGR

Enclosure 1

Attendence List for CRGR Meeting
Number 189

CRGR Members

E. Jordan
J. Moore
J. Murphy (for B. Sheron)
F. Miraglia
L. Reyes
G. Arlotto

NRC Staff

D. Ross
J. Conran
D. Allison
A. Thadani
R. Jones
L. Phillips
S. Newberry
G. Mauck
V. Thomas
N. Kadambi
H. Li
M. Lynch
M. Taylor

Enclosure 3 to the Minutes of CRGR Meeting No. 189

Appeal by the BWR Owners' Group Regarding Staff Position on Diversity of Trip Units in the Alternate Rod Injection System

June 27, 1990

TOPIC

A. Thadani, S. Newberry, G. Mauck and V. Thomas of NRR presented for CRGR review information concerning an appeal by the BWR Owners' Group regarding the staff's position on diversity of the trip units in the alternate rod injection system (ARI) from trip units in the reactor trip system (RTS).

The ATWS rule (10CFR50.62), which was issued in 1984, required an ARI that was diverse (from the RTS) from sensor output to final actuation device. It also required submittal of information to demonstrate the adequacy of the system.

In 1988 Carolina Power and Light Company installed the ARI at the Brunswick plants using Rosemount analog trip units. These ARI trips were provided by the same manufacturer as the analog trip units being used in the RTS and were similar to the RTS trip units. The licensee cited diverse energization states (enegerize to trip), physical separation, and functional diversity to indicate acceptability in the application at Brunswick.

The NRC staff did not accept the licensee's approach, indicating that the ARI trip units should be of different manufacture than those in the RPS. (This could be achieved by using dissimilar units from the same manufacturer or from a different manufacture). However, the staff allowed the licensee to operate the plant during the (then) forthcoming fuel cycle before replacing the trip units.

The licensee, joined by the BWR Owners' Group, appealed the staff position to the Director of NRR and the appeal was denied. The BWR Owners' group subsequently appealed again to the Director of NRR and the appeal was again denied. Then the BWR Owners' Group appealed to the Executive Director for Operations (EDO). The EDO referred the matter to the CRGR to review the appeal and provide recommendations to the EDO. The purpose of this meeting was to conduct the review and make recommendations.

In other formats, including review of a GE topical report and review of other plant submittals, the staff had generally taken the same position regarding diversity of the RTS trip units. However, in one case (Monticello) the staff had accepted a design where some (but not all) of the ARI trip units were from the same manufacturer as the RTS trip units. The BWR Owners' Group appeal did not argue that the Monticello approval would mean that the staff's actions on other plants would be backfits, nor did the staff consider that to be the case. However, the Owners' Group did argue that the Monticello precedent supported a judgment in favor of its appeal.

The primary arguments made in the appeal were:

(1) The ARI trip units should be considered part of the sensor and thus be excluded from the diversity requirements of the ATWS rule.

(2) If the ARI trip units were subject to diversity requirements they should be considered to meet the requirement based on diverse energization states and separation. In addition, there were diverse parameters, sensors and trips for transients other than the loss of feedwater transient. For the loss of feedwater transient there was time for operation action.

(3) As discussed in the statement of considerations for the ATWS rule, diversity should be required to the extent reasonable and practical. The Monticello design approval provided a precedent in support of a judgment that replacing the trip units should not be considered reasonable and practical. Comparing the costs against the safety benefits of changing the trip units indicated that the change should be considered unwarranted.

The NRR staff considered the current appeal and performed additional studies and concluded that (1) the trip units were not part of the sensors and thus not exempt from diversity requirements; (2) the energization state diversity and other factors did not provide sufficient diversity, particularly for feedwater transients where only one parameter and automatic trip function operate; and, (3) changing the trip units would be reasonable and practical.

Slides used by the staff in its presentation are provided as an attachment to this enclosure.

BACKGROUND

The Owners' Group appeal was transmitted to the CRGR by a memorandum dated September 18, 1989 from J. Taylor to E. Jordan, Subject: CRGR Review of Backfitting Appeals. The enclosures included:

(1) Letter dated August 11, 1989 from S. Floyd, BWR Owners' group, to J. Taylor, NRC, Subject: Appeal from Staff Decision Requiring Total Equipment Diversity Under ATWS Rule (10 CFR 50.62). The attachments included:

   (a) Appeal of Staff Decision Concerning the Diversity Requirement of the ATWS Rule (10 CFR 50.62).

   (b) Letter dated June 14, 1989 from F. Remick, ACRS, to L. Zech, NRC, Subject: Reliability and Diversity.

The staff's position on the appeal was transmitted by a memorandum dated May 30, 1990 from F. Miraglia to E. Jordan, Subject: Request for CRGR Review of the BWROG Appeal of the Staff Position Regarding Diversity of Rosemount Trip Units. The enclosures included:

(1) Draft letter to BWROG

(2) Listing of Main Appeal Points and Staff Responses

(3) A letter report dated February 9, 1990 from S. Hanauer, Technical Analysis Corporation to A. Nolan, EG&G Idaho, Inc., entitled "A Review of Diversity in Trip Units."

In addition, the following documents were provided to the members:

(1) Letter dated August 31, 1989 from J. Taylor, NRC to S. Floyd, BWROG requesting information.

(2) Memorandum dated April 25, 1990 from M. Lynch to J. Hannon documenting a meeting with the BWROG on November 15, 1990.

(3) Memorandum dated January 27, 1989 from S. Newberry to A. Thadani documenting a meeting with the BWROG on January 12, 1989.

CONCLUSIONS/RECOMMENDATIONS

The Committee recommended in favor of upholding the staff's position.

The following points were noted during the discussions:

1. It was noted that the Advisory Committee on Reactor Safeguards (ACRS) had previously raised questions about the effect of diversity on overall system reliability and indicated that, where diversity is to be required, effort should be made to ensure that it will contribute to increased reliability rather than making the system less reliable.

2. The CRGR considered the effects of the staff position on overall scram system reliability and agreed with the NRR staff that its position could be expected to enhance reliability. The following points were addressed during the discussion. The existing reliable trip units in the ARI would be replaced with units from a different manufacturer than those in the RTS but of comparable reliability. This should not decrease overall scram system reliability. There would be a question about this conclusion if the replacement units were much less reliable because of inherent unreliability or other factors such as maintenance difficulties. However, neither situation was expected to be the case. Furthermore, it was generally believed that a substantial part of the RTS unavailability (due to multiple trip unit failure) would be dictated by common mode failures. In these circumstances, use of a different trip unit in the ARI should enhance overall scram system reliability

3. With regard to whether the benefits were greater than the costs:

   (a) The Owners' Group, in its appeal, had performed a simplified calculation indicating that the benefits were less than the costs.

(b) The NRR staff's consultant had performed a more detailed calculation (which nevertheless was characterized as simplified) indicating that the benefits were more than the costs.

(c) The NRR staff had concluded in its review package that, while the uncertainties were large, its consultant's estimates were reasonable and provided an improved methodology for evaluating the safety benefit.

(d) CRGR comments indicated that the calculations could be performed differently, indicating that the benefits were less than the costs. This did not, however, mean that these results would be better than the staff's consultants' results. It meant that the answer was indeterminate as to whether the benefits were greater than the costs.

4. The CRGR did not consider the trip units to be part of the sensors (which are excluded from the diversity requirements of the ATWS rule).

5. The staff position was a generic position. It was recognized that, on a plant specific basis, there might be reasons to deviate from the generic position. For example, if it should turn out that Oyster Creek would experience extraordinary difficulty and great expense in implementing the position, there might be a basis for the licensee to request relief.

6. The staff's position was not considered to be a backfit (nor had the Owners' Group argued that it was). However, the staff had previously approved a system at Monticello that did not fully meet the generic position. It was recognized that the staff might consider rescinding the Monticello approval; if so, such an action would be considered a plant specific backfit.

7. CRGR comments indicated that the sensors at one end of the scram system and relays which were part of the final actuated device at the other end, which were exempt from diversity requirements, might represent more of a risk with regard to common mode failure than the trip units. However, there did not appear to be sufficient risk to warrant considering a change in the ATWS rule to require diversity in these areas.

8. The CRGR did not consider changes in the rule or the staff's guidance for the purpose of enhancing clarity to be necessary or warranted.

9. The CRGR considered it unfortunate that so many staff and licensee resources had been expended on repeated appeals regarding this issue which is of relatively minor significance at modest cost.

CRGR BRIEFING
ON
ATWS DIVERSITY
FOR
BOILING WATER REACTORS

BACKGROUND

- ATWS RULE (10CFR 50.62) WAS ISSUED IN JUNE 1984 AND BECAME EFFECTIVE IN JULY 1984

- SECTION 50.62 (C)(3) REQUIRES ALL BWRS TO HAVE AN ALTERNATE ROD INJECTION (ARI) SYSTEM THAT IS DIVERSE (FROM RTS) FROM SENSOR OUTPUT TO FINAL ACTUATION DEVICE

- ARI PROVIDES DIVERSE AND INDEPENDENT PATH FOR REACTOR SHUTDOWN
  - LOW REACTOR WATER LEVEL OR HIGH REACTOR PRESSURE ACTUATE REDUNDANT ARI SCRAM VALVES

OBJECTIVE OF ARI DIVERSITY

- RTS FAILURE IS DOMINATED BY CMF
- EQUIPMENT DIVERSITY IS A DEFENSE AGAINST CMF
- EQUIPMENT DIVERSITY IMPROVES RTS SYSTEM RELIABILITY
- ATWS RULE RECOGNIZES SIGNIFICANCE OF CMF AND REQUIRES DIVERSITY

ATWS IMPLEMENTATION SUMMARY

- ALL OPERATING BWRS HAVE INSTALLED & OPERABLE ATWS SYSTEMS (EXCEPT FOR BIG ROCK)

- ALL SYSTEM DESIGNS REVIEWED AND APPROVED BY NRR STAFF AND ARE BEING VERIFIED USING TI 2500/20

- PLANTS HATCH 1 & 2 HAVE ISSUES ON TESTABILITY WHICH WILL BE COMPLETED DURING NEXT REFUELING OUTAGES IN 12/90 AND 12/91 RESPECTIVELY

SUMMARY OF TRIP UNIT DIVERSITY ISSUE

- DISCOVERED DURING CP&L BRUNSWICK TECHNICAL SPECIFICATION REVIEW DATED MARCH 9, 1988

- IDENTICAL ROSEMOUNT ANALOG TRIP UNITS ARE USED IN BOTH ARI AND RT SYSTEM AT BWRS

- STAFF FINDS USE OF IDENTICAL TUs IN ARI AND RTS UNACCEPTABLE IMPLEMENTATION OF THAT PORTION OF RULE CITED ABOVE

- BWROG VIEWS DIVERSITY OF PARAMETER FUNCTIONS AND ENERGIZATION STATES SUFFICIENT TO MEET ATWS RULE
  - DIVERSE PARAMETER FUNCTIONS: LEVEL, VALVE POSITION, AND PRESSURE
  - DIVERSE ENERGIZATION STATES: ENERGIZED ATTU (RTS)-DEENERGIZED ATTU (ARI)

- STAFF POSITION ON ATWS DIVERSITY ISSUE WAS APPEALED
  - MAY 1988: CP&L TO NRC (MURLEY) APPEAL DENIED

- JUNE 1988: BWROG (GRACE) TO NRC (MURLEY) APPEAL DENIED

- APPEAL TO EDO AUGUST 1989

- RESPONSE TO BWROG FROM EDO AUGUST 31, 1989 EDO REQUESTED INFORMATION ON NEGATIVE IMPACT OF TU REPLACEMENT

- MEETING WITH BWROG NOVEMBER 1989 RESPONDING TO LETTER

STAFF CONCLUSIONS

- TRIP UNITS ARE NOT PART OF THE SENSOR AND THE ATWS RULE APPLIES

- LITTLE DIVERSITY IS PROVIDED BETWEEN TRIP UNITS IN THE ARI AND IDENTICAL TRIP UNITS IN THE RTS

- THERE IS NO FUNCTIONALLY DIVERSE REACTOR TRIP THAT USES DIVERSE EQUIPMENT FOR A LOSS OF FEEDWATER EVENT - ROSEMOUNT TRIP UNITS EXIST IN ALL RTS AND ARI INSTRUMENTATION CHANNELS

- THERE ARE NO SIGNIFICANT DRAWBACKS TO INSTALLING DIFFERENT TRIP UNITS

- OTHER RELIABLE TRIP UNITS ARE AVAILABLE WHICH HAVE PROVEN HISTORY. CP&L RECENTLY INSTALLED GE TUs AT BRUNSWICK UNIT 2, WILL DO SAME AT UNIT 1 IN SEPTEMBER

- REPLACEMENT WILL IMPROVE SAFETY, IS COST BENEFICIAL, AND SHOULD PROCEED PROMPTLY

BWROG APPEAL TO EDO

- CURRENT DESIGN MEETS THE RULE
  - TU PART OF SENSOR
  - SUFFICIENT DIVERSITY

- REPLACEMENT OF TUs INCREASES POTENTIAL FOR CMF, CALIBRATION & MAINTENANCE ERROR - REPLACEMENT TUs LACK PROVEN PERFORMANCE

- STAFF POSITION NOT COST BENEFICIAL, UNREASONABLE, IMPRACTICAL

- ISSUE IS RELIABILITY NOT EQUIPMENT DIVERSITY

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REMARKS

This previous Central File material can now be made publicly available.

LETTER DATED 9/20/90 FROM J. TAYLOR, NRC TO GEORGE J. BECK, BWR OWNERS' GROUP

CC (LIST ONLY) JEAN RATAJE, PDR L STREET

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