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SUBJECT: Forwards response to remaining TER open item on design qualifications for plant electrical isolation devices.

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U. S. Nuclear Regulatory Commission
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Gentlemen:

Docket 50-305
Operating License DPR-43
Kewaunee Nuclear Power Plant
Regulatory Guide 1.97 (Accident Monitoring Instrumentation)

References: 1) Letter from C. R. Steinhardt (WPSC) to Document Control Desk (NRC) dated October 24, 1988.

2) Letter from J. G. Giitter (NRC) to C. R. Steinhardt (WPSC) dated June 26, 1989.

3) Letter from K. H. Evers (WPSC) to Document Control Desk (NRC) dated September 5, 1989.

Reference 1 provided the Nuclear Regulatory Commission (NRC) with a list of Regulatory Guide (RG) 1.97 variables and a summary of their current level of qualification. This information was provided at the request of the staff during a meeting between Wisconsin Public Service Corporation (WPSC) and NRC representatives on August 24, 1988. Reference 2 provided WPSC with an interim Technical Evaluation Report (TER) based on a review of the information provided in Reference 1. The TER identified 20 items which were found to be either unacceptable or for which additional information was required. Reference 3 provided the NRC with our response to 19 of the 20 open items. The attachment to this submittal provides our response to the remaining TER open item on the design qualifications of electrical isolation devices used at the Kewaunee Nuclear Power Plant (KNPP).

In a continuing effort to resolve the issues pertaining to RG 1.97, WPSC and NRC personnel participated in telephone conferences on September 5, September 21 and November 15, 1989. The first two discussions dealt primarily with WPSC's request for staff guidance to understand the intent of the RG recommendation

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for qualification of isolation devices, and the NRC's request that WPSC prescribe to a revision of the RG. The third telephone conference dealt principally with the qualification of accumulator tank level and pressure instruments and steam generator (SG) wide range level instrumentation.

In response to the NRC's request, WPSC will use the variable list and recommended level of qualification from revision 3 of the RG as a basis for future discussions on accident monitoring instrumentation. However, it remains axiomatic that the Emergency Operating Procedures and their background documents can be used to justify deviations from the RG. We also maintain that our current design basis for seismic qualification, redundancy, separation, and WPSC's approved environmental qualification program as described in previous submittals are sufficient to ensure equipment operability post-accident.

Based on the November 15, 1989, telephone conference, WPSC understands that the categorization of the accumulator tank level and pressure variables will be handled on a generic basis and additional staff review is necessary. Therefore, WPSC will take no action with regard to these instruments until further advised by the staff on the outcome of this generic review.

With regard to the level of qualification recommended for the SG wide-range level instrumentation, WPSC understands that the present justification, as discussed in Reference 3, is not adequate to address all of the staff's concerns. Therefore, an additional evaluation will be submitted to the staff by March 15, 1990. The submittal will provide further justification for deviating from the RG recommendation for Category 1 qualified wide-range SG level instrumentation. Our position will be based on the fact that other Category 1 qualified variables will provide reliable information to the operators allowing them to make decisions concerning the adequacy of the heat sink.

In a subsequent discussion with our NRC project manager, Mr. Anthony Gody, Jr., we were informed it would be acceptable to the staff to submit a further evaluation on heat sink variables. However, a final Safety Evaluation Report (SER) will be issued closing out the staff review of all the information submitted thus far. Therefore, the level of qualification for SG wide-range level instrumentation will be left as an open item pending further staff review.

As always, WPSC will continue to work with the staff to arrive at a mutually agreeable resolution to this issue. If you have any questions or need additional information, please contact Ms. S. L. Bernhoft of my staff.

Sincerely,

K. H. Evers
Manager - Nuclear Power

SLB/jms
Attach.
cc - Mr. Patrick Castleman, US NRC
US NRC, Region III

ATTACHMENT TO LETTER FROM K. H. EVERS (WPSC)

TO

DOCUMENT CONTROL DESK (NRC)

DATED

DECEMBER 5, 1989

TER Open Item 19

Interfaces -- The licensee should address the design qualifications of the isolation devices provided for Category 1 and Category 2 variables. (Section 4.3-1)

WPSC Response to Item 19

The Regulatory Guide 1.97, Revision 3 (RG), recommendation for the qualification of interfaces is specified on Table 1, "Design and Qualification Criteria for Instrumentation", as item 9. The recommendation for Category 1 and 2 variables states:

> "The transmission of signals for other use should be through isolation devices that are designated as part of the monitoring instrumentation and that meet the provisions of this document."

On September 5, and again on September 21, 1989, WPSC contacted the NRC for additional guidance on how to satisfy the intent of the above stated recommendation given that the design of the Kewaunee Nuclear Power Plant (KNPP) predates the IEEE Standards referenced by the RG. Based on these telephone discussions, WPSC understands that the staff recommends electrical isolation between Category 1 instrumentation and any equipment that does not meet the same design criteria. In the case of Category 2 instrumentation, the staff stated that electrical isolation between the safety related, e.g., reactor protection, and nonsafety related portions of the circuits such as that provided as a part of KNPP's design basis is acceptable.

Pursuant to these discussions, WPSC personnel reviewed the plant's design basis information, drawings, and qualification test reports to determine conformance with the above stated recommendations.

The following discussion is provided in three sections. These are: the KNPP design basis pertaining to the application of electrical isolation devices, the qualification of the isolation amplifiers used for the nuclear instrumentation and reactor protection systems, and a summary section.

KNPP Design Basis Criteria for Isolation Devices

The design basis of the KNPP Instrument and Control system is described in the Updated Safety Analysis Report (USAR), Chapter 7. The KNPP was designed and constructed in the late 1960's, early 1970's time frame. The applicable standards in existance at that time were the Atomic Industrial Forum (AIF), "General Design Criteria for Nuclear Power Plants," dated December 22, 1969, and IEEE No. 279, "Proposed IEEE Criteria for Nuclear Power Plant Protection Systems," dated August, 1968. Chapter 7 of the USAR demonstrates that the intent of the AIF and proposed IEEE 279 design criteria were reasonably satisfied by the KNPP instrumentation and control systems.

The applicable General Design Criteria (GDC) 20 states:

Criterion: Redundancy and independence designed into protection systems shall be sufficient to assure that no single failure or removal from service of any component or channel of such a system will result in loss of the protection function. The redundancy provided shall include, as a minimum, two channels of protection for each protection function to be served.

In section 7.2 of the USAR, WPSC stated that this GDC is satisfied as follows:

> The Protection System consists of two discrete portions of circuitry: an analog portion consisting of two to four redundant channels which monitor various plant parameters in systems such as the Reactor Coolant System, Steam System, Containment System, etc.; and a digital portion consisting of two redundant logic channels (trains) which receive inputs from the analog protection channels and performs the needed logic to initiate reactor trips, engineered safety features, etc. Each digital channel is capable of actuating a separate and independent trip breaker in the case of the Reactor

> Protection System or the appropriate equipment required in the case of the engineered safety features. The intent is that "any single failure within the Protection System shall not prevent proper protection system operation when required."
>
> The channelized concept is applied to both the analog and logic portions of the system. Separation of redundant analog channels begins at the process sensors and is maintained in the field wiring, containment vessel penetrations and analog protection racks, terminating at the redundant groups of protection logic racks.
>
> In certain applications, it is considered advantageous to employ control signals derived from individual protection channels through isolation amplifiers contained in the protection channel. In these cases, analog signals derived from protection channels for nonprotective functions are obtained through isolation amplifiers located in the analog protection racks. (By definition, nonprotective functions include those signals used for control, remote process indication, computer monitoring, etc.) The isolation amplifiers are designed such that a short circuit, open circuit, or the application of 118 VAC or 140 VDC on the isolated output portion of the circuit (i.e., nonprotective side of the circuit) will not upset the input (protection) side of the circuit. One type of an isolation amplifier is discussed in (Reference 2); another type in (Reference 4). Since the signals obtained through isolation amplifiers are never returned to the protection racks, any postulated failure in the control system will not affect the protection channel.

Additionally, in USAR Section 7.2 there is a discussion which explains the principles of the original design as they relate to the proposed IEEE 279 standard. Under the subsection on electrical isolation the USAR states:

> The design criterion used to assure electrical isolation is that no analog signal which is required for initiation of reactor protection or engineered safety feature actuation is allowed to leave a set of protection channels. Where protection signal intelligence is required for other than protective functions, an isolation amplifier (part of the protection set) is used to transmit the intelligence. The isolation amplifier prevents the perturbation of the protection channel signal (input) due to any disturbance of the isolated signal (output) which normally could occur near any termination of the output wiring external to the protection racks. A description of the nuclear instrumentation isolation amplifiers that are used in this plant is given in Reference 2. A description of the process control system isolating device is available in Reference 4.

Qualification of Isolation Devices Used for Nuclear Instrumentation and Reactor Protection Systems

The USAR references 2 and 4, as referred to in the GDC discussion and the IEEE 279 description, are WCAP-7819 "Nuclear Instrumentation System Isolation Amplifier," and WCAP-7685 "Test Report on Isolation Amplifiers" respectively.

WCAP-7819, which is the nonproprietary version of WCAP-7506-L, provides a description of the isolation amplifier used in the nuclear instrumentation system and the results of in-circuit testing of the isolation capabilities of a prototype amplifier. This WCAP was reviewed and found acceptable by the staff as documented in a letter from D. B. Vassallo (AEC) to R. Salvatori (WEC) dated September 3, 1974.

WCAP-7685-A, which is the nonproprietary version of WCAP-7508-L, provides a description of Foxboro isolation amplifiers, model number 66GC-OW voltage-to-current converter and model number 66BC-O current repeater, which were installed in the reactor protection and control system instrumentation. The test results concluded that the isolation amplifiers provided an effective electrical barrier for the input (protection side) signal when the output (control side) signal was subjected to faulted conditions such as opens, shorts, and voltages commonly available in the control room. This WCAP was reviewed and found acceptable by the staff as documented in a letter from D. B. Vassallo (AEC) to R. Salvatori (WEC) dated June 6, 1973.

Seismic qualification testing is described in WCAP-7817, "Seismic Testing of Electrical and Control Equipment." The WCAP describes vibration tests which simulated the seismic conditions for low seismic plants, e.g., having a Design Basis Earthquake horizontal acceleration less than or equal to 0.2g. The equipment operation was monitored during the test to prove proper performance of functions. The test results showed that there were no electrical malfunctions. The equipment types tested are discussed in section 2 of the WCAP. Among the

equipment tested were Foxboro process equipment, safeguards actuation racks and nuclear instrumentation system cabinets. This WCAP was found acceptable by the staff as documented in an AEC memo from R. R. Maccery to R. C. DeYoung dated August 22, 1974.

Environmental qualification is not required because the isolation devices are located in the KNPP relay room which is a mild environment.

Summary

In order to verify the placement and types of electrical isolation devices used, WPSC personnel reviewed instrument block diagrams, wiring diagrams and integrated logics for all the KNPP Category 1 variables and for the Category 2 variables which provide a reactor protection function. The attached figure is a typical instrument block diagram for a protection system circuit. This shows the placement and type of devices that provide electrical isolation between the safety related and nonsafety related portions of the circuit. This illustration is intended to present a typical configuration to aid the staff in understanding the KNPP original design basis; exact circuit configurations will vary somewhat from the illustration. For example, signal converters, resistance to voltage converters, voltage to current converters and current repeaters, which are all capable of providing electrical isolation, are used in other locations as necessitated by the circuit design.

The Category 1 and Category 2 variables which provide a reactor protection function have, as a minimum, electrical isolation as illustrated on the attached figure. Therefore, KNPP's design basis for electrical isolation is satisfied. The intent of the original design basis was to ensure that a catastrophic electrical fault on the nonprotective side of the circuit would not upset the

protection side of the circuit. This philosophy was in keeping with the design standards which were in existence when the KNPP was designed and constructed. Category 1 and 2 variables which do not provide a reactor protection function are discussed later in this section.

One of the intents of the RG is to ensure that indication is available for the variables which are required by the control room operating personnel to monitor and respond to an accident. While the existing circuit configuration was not explicitly designed and installed to this criteria, it is implicit that preservation of control room indication can be reasonably assured.

Control room indication could be compromised by a catastrophic electrical fault on any part of the nonprotective portion of the circuit. However, this is a very low probability event. For the instruments which serve a protection function, the portion of the circuit from the Foxboro current repeater on is located in a mild environment. Therefore, the electronics are not exposed to a harsh temperature, pressure, humidity or radiation environment. In other words, there are no new or additional stresses placed on this equipment following a design-basis accident.

The two events which could affect the equipment located in a mild environment are a fire in the control room or relay room, or a seismic event. In the event of a fire in the relay room or control room, the post-accident monitoring instrumentation would not be required to follow the course of an additional accident event. This is consistent with actions taken previously to ensure compliance with 10CFR50, Appendix R requirements.

In the unlikely event of a design-basis earthquake, an electrical fault of the magnitude to cause a loss of indication would not be expected. The indicators and recorders in the control room are mounted in seismically-qualified control room panels, therefore, a catastrophic electrical fault is not probable. The signal to the plant process computer and technical support system (TSC) data logger are run in cable trays and conduits which are not safety related but have been mounted to the same requirements as the safety-related trays and conduits. In addition, the computer and data logger are suitably mounted and powered from a non-safeguard, highly reliable source. Therefore, there is reasonable assurance that the existing licensing basis for protection circuits is adequate to satisfy the intent of the RG, which is to ensure adequate indication and trending of the accident monitoring variables.

A similar argument can be made for the Category 1 and 2 variables which do not provide a reactor protection function. The portions of the circuit located outside of the control or relay room and which may be exposed to a harsh post-accident environment are qualified in accordance with the KNPP EQ Program. Therefore, this portion of the circuit will not cause a catastrophic electrical fault. The remainder of the circuit is located in a mild environment, and the same argument as discussed for the protection circuits applies.

In summary, a loss of indication due to an electrical fault for the variables which are required by the control room operating personnel to monitor and respond to an accident is improbable. For the instruments which provide a protection function, there is, at a minimum, an isolation device between the protection and nonprotection portions of the circuit. The portion of the circuit from the isolation device on is located in a mild environment and not

exposed to harsh parameters. The instruments which do not provide a protection function may or may not have an isolation device in the form of a signal converter, resistance to voltage converters, voltage to current converters, or current repeaters; however, the electrical equipment is qualified to withstand a harsh post-accident environment. There are two events which could affect equipment located in a mild environment. These are a fire in the control room or relay room, or an earthquake. The potential impact of these two events was discussed earlier in this section and considered unlikely to cause a catastrophic electrical fault.

Based on this review, the as-installed design basis configuration of electrical isolation is acceptable to satisfy the intent of the RG recommendation.

TYPICAL INSTRUMENT BLOCK DIAGRAM
FOR PROTECTION CIRCUIT