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PRIORITY ROUTING

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FILE

Donald C. Cook Nuclear Plant Unit No. 2
Docket No. 50-316
License No. DPR-74
PLANS FOR CALIBRATING NARROW RANGE RESISTIVE
TEMPERATURE DETECTORS PRIOR TO STARTUP

Mr. James G. Keppler, Regional Administrator
U.S. Nuclear Regulatory Commission
Region III
799 Roosevelt Road
Glen Ellyn, Illinois 60137

Dear Mr. Keppler:

This letter is in response to a request by your staff and the staff of the Office of Nuclear Reactor Regulation on September 24, 1985. We were asked to provide the following information:

1) A description of the calibration technique which AEP plans to use prior to starting up D. C. Cook Unit 2 on or about October 6, 1985.

2) A description of the level of care and thoroughness which will be employed with this calibration. The level should be comparable to that employed on an initial startup.

3) The basis for entering Mode 3 with RTDs uncalibrated.

4) A schedule for describing differences, if any, between the procedure to be used for the October, 1985 Unit 2 startup and subsequent recalibration and verification tests.

Response to Item 1:

The procedure which will be used is **2 THP 6030 IMP 176, "Incore Thermocouple and Reactor Coolant System RTD Cross Calibration Test Procedure." This procedure is similar to the analogous D. C. Cook Unit 1 procedure. The primary differences between the two procedures are related to differences resulting from different RTD manufacturers. Copies of current drafts of the Units 1 & 2 procedures are available to the NRC resident inspector at the site.

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Attachment 1 is a letter from Westinghouse Electric Corporation, our NSSS supplier. It summarizes the Westinghouse experience and recommendations on RTD cross calibrations. Consistent with Westinghouse's recommendations, our procedure consists of bringing the reactor coolant system to a stable isothermal condition at four temperatures. All sixteen narrow range RTD resistances will be read four times at each of the four temperatures. A corresponding temperature reading is obtained from the average resistance readings at each temperature for each RTD. At each temperature an average of the RTD temperature readings, excluding those that deviate significantly from the average, is used to characterize the reactor coolant temperature. Differences between the indicated temperature for an individual RTD and the reactor coolant temperature are used to define installation corrections. Westinghouse will use the cross calibration data in conjunction with the original laboratory calibration data to develop a composite calibration curve.

Response to Item 2:

Both the Unit 1 and Unit 2 procedures will have been written by a collaboration of personnel from the D. C. Cook Plant staff, AEPSC, and Westinghouse. The Unit 1 procedure was purchased as a part of our program to replace Rosemount RTDs with RdF RTDs. Prior to the August 30, 1985 Confirmatory Action Letter (CAL), the Unit 2 procedure was planned for implementation as part of a similar program at the beginning of Cycle 6, scheduled to occur early in 1986. As a result of the CAL, we are expediting the development of the Unit 2 procedure.

These procedures will conform to Westinghouse's recommendations for initial installation calibration of narrow range RTDs. In addition, Westinghouse personnel experienced with this type of procedure will participate in data collection for the procedure. Their participation will help train plant personnel and ensure high quality data are obtained. The data will also be reduced by Westinghouse to produce a composite calibration as described above.

Response to Item 3:

Attachment 2 is our 50.59 review for the use of the Unit 2 procedure.

Response to Item 4:

For Unit 2, Cycle 6 the RTD cross calibration procedural methodology will be modified in only nonsignificant ways. This will include such changes as acceptance criteria appropriate to the RTDs being calibrated and changes required to improve the flow of work. The procedure used for Unit 2, Cycle 6 startup will employ a level of care and thoroughness appropriate for an initial startup. This is being done because 14 new RdF RTDs will be installed in Unit 2 prior to Cycle 6. Significant changes to the procedure for use in subsequent refueling surveillances will be described to you prior to the next use of the procedure after the Unit 2 Cycle 6 startup.

This document has been prepared following Corporate procedures which incorporate a reasonable set of controls to insure its accuracy and completeness prior to signature by the undersigned.

Very truly yours,

M. P. Alexich
Vice President 10/4/85

cm
Enclosure
cc: John E. Dolan
W. G. Smith, Jr. - Bridgman
R. C. Callen
G. Bruchmann
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NRC Resident Inspector - Bridgman
H. R. Denton, NRC - Washington, D. C.

ATTACHMENT 1

Westinghouse Electric Corporation **Water Reactor Divisions**

Nuclear Technology Division

Box 355
Pittsburgh Pennsylvania 15230-0355

AEP-85-811
September 26, 1985
NS-OPLS-OPL-I-85-066

Mr. M. P. Alexich, Vice President
and Director Nuclear Operations
American Electric Power Service Corporation
One Riverside Plaza
Columbus, Ohio 43216

Attention: Mr. V. VanderBurg

AMERICAN ELECTRIC POWER SERVICE CORPORATION
D. C. COOK UNIT 2
WESTINGHOUSE EXPERIENCE AND RECOMMENDATIONS RTD
CROSS-CALIBRATION AND PERIODIC RE-CALIBRATION

Dear Mr. Alexich:

In response to your request, the attached position statement summarizes our recent telephone conversations regarding Westinghouse's experiences and recommendations concerning the RTD cross-calibration test and periodic RTD re-calibration.

Further, concerning your questions "if a recent factory-calibrated RTD were installed and all other RTDs calibrated to it, what would be the affect on RTD calibration uncertainty?", our response is as follows:

> Westinghouse recommends that the calibration of all newly-installed RTDs be verified by checking against those previously installed. The average of all RTDs (excluding those that differ significantly from the others) is the best measure of system temperature. If all RTDs are calibrated to one RTD, the RTD error allowance should be increased by the difference between that RTD and the average of all RTDs. (The most recently-installed RTD is almost as likely to have shifted as any of the rest.)

If you have any comments or questions, please call.

Very truly yours,

Carmen C. Swizz for

A. P. Suda, Manager
Great Lakes Area
Projects Department

LVT:lsv

cc: M. P. Alexich
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24 September 1985

WESTINGHOUSE EXPERIENCE AND RECOMMENDATIONS
RTD CROSS-CALIBRATION AND PERIODIC RE-CALIBRATION

In the late 1960s, startup tests on Westinghouse PWRs found that, following installation, the calibration of some RTDs differed from the factory calibration curves by more than the accuracy specification on the RTDs. The discrepancy was found by comparing RTDs to each other during plant shutdown under essentially isothermal conditions. The discrepancy was attributed to a combination of error in the factory calibration and shift in the calibration during shipping and installation. To resolve it, a plant startup test, RTD Cross-Calibration, was developed and implemented on all plants since that time. Some of the basic objectives of the RTD Cross-Calibration Test are to compare RTDs to each other under isothermal conditions; identify RTDs differing significantly from the average (such that they can be excluded from the average so as not to unduely influence it); and determine "installation corrections" for each RTD (difference between indicated temperature for an individual RTD and the average of all RTDs). The "installation corrections" are recorded with the RTD calibration records and used for calibrating downstream equipment.

The RTD Cross-Calibration Test has been an integral part of the plant startup test program for all Westinghouse PWRs for about the last 15 years. It was very helpful in resolving the recent issue concerning calibration errors in RdF RTDs.

(Please note that each RTD has been factory calibrated, traceable to the National Bureau of Standards. In the Cross-Calibration test, the average of all such RTDs -- excluding those that deviate significantly from the average -- is used as the reference to permit close alignment of all RTDs.)

Based on experience, Westinghouse does not recommend removing RTDs from the Reactor Coolant System for re-calibration. Westinghouse recommends instead that the RTD calibration be periodically checked by comparing RTDs against each other. The difference between two RTDs at the same temperature should be the same as when originally installed and checked. If not, one is assumed to have shifted. (Based on both our experience and the technical literature, a minority of RTDs do experience a significant shift in their characteristic. These shifts, when they occur at all, are considered to be of random direction and magnitude.)

Because of the inherent stability of RTDs, and the expected nature of any shifts that might have occurred before, during, or after installation, Westinghouse recommends Cross-Calibration as the preferred means of verifying RTD calibration (or aligning if needed). Westinghouse believes this procedure meets the requirement in plant Tecnical Specifications to calibrate temperature sensors with prescribed frequency. This recommendation is independent of the length of time since factory calibration.

ATTACHMENT 2

AMERICAN ELECTRIC POWER SERVICE CORPORATION

DATE: October 4, 1985

SUBJECT: D.C. Cook Unit 2 RTD Cross Calibration Technical Specification Involvement Concerning Narrow and Wide Range Temperature Channels

FROM: R.P. Leonard / V. Vanderburg

TO: J.M. Cleveland

References:

1) Westinghouse in-core thermocouples and resistance temperature detectors (RTD) cross calibration procedure, SU 5.11.3

2) D.C. Cook Nuclear Plant Unit 2 Technical Specifications

3) D.C. Cook Nuclear Plant Incore Thermocouple and Reactor Coolant System RTD Cross Calibration Test Procedure **2 THP 6030 IMP .176

This review addresses questions raised concerning the upcoming Unit 2 RTD cross calibration procedure. Specifically, are we allowed to take all four (4) channels of temperature protection and indication out of service simultaneously during the procedure without violating the Technical Specifications? It will be concluded below that this can be done consistently with existing Technical Specification (T/S) wording.

On August 30 1985, AEPSC received a Confirmatiory Action Letter from the Nuclear Regulatory Commission, Region III, which addressed in part, concerns about sensor calibrations. The RTD cross calibration procedure, reference 3, was written and will be performed to verify the calibration of the narrow and wide range RTDs and will subsequently be performed to satisfy the eighteen month sensor calibration requirement for the RTDs. Data from this procedure will be used to verify the RTD calibration and, if necessary, provide calibration corrections to be incorporated into the circuit electronics. The procedure requires the reading of all the narrow and wide range RTD resistances at four (4) coolant temperatures - 250 °F, 350°F, 450°F, and approximately 527°F. In order to minimize the effects of coolant temperature drift, the RTD data must be obtained in the shortest possible time interval. The requirement to minimize the time plus the need to read actual RTD resistances can be best accomplished by disconnecting all of the RTD leads at their input to the protection racks and then providing a means, possibly using a switch box, to rapidly read their resistances. This method would result in removing from service all the narrow range temperature channels thus affecting protection, safeguards, and control functions. It also would affect wide range channel operability.

The narrow range RTDs provide the following control and indication, protection, and safeguards functions:

Control and Indication

1) Tavg Indication - used for DNB T/S 3.2.5 which is applicable in mode 1.
2) Tavg/Auct. Tavg Deviation Alarms
3) Tref/Auct. Tavg Deviation Alarm
4) Auct. Tavg to Rod Insertion Limit Alarms and Indication
5) High Auct. Tavg Alarm
6) Auct. Tavg Recorder
7) Steam Dump Control
8) Pressurizer Level Control (Reference Level)
9) Rod Control System
10) ΔT/Auct ΔT Deviation Alarms
11) ΔT to Rod Insertion Alarms and Recorder
12) OTΔT Setpoint, OPΔT Setpoint, and ΔT Signals to a Recorder
13) Various inputs to the computer

Engineered Safety Features (ESF)

1) Steam Line Isolation - High Steam Flow Coincident with Low-low Tavg (P-12).

2) Blocking Permissive for Low Steam Pressure Safety Injection and Steam Line Isolation--Low-Low Tavg (P-12)

3) Steam Dump Block - Low-low Tavg (P-12)

4) Feedwater Isolation - Low Tavg Coincident with Reactor Trip

Note: ESF items 1-3 are derived from the same Tavg bistable output, (P-12).

Protection Features

1) Overtemperature Delta T (OTΔT) Trip

2) Overpower Delta T (OPΔT) Trip

3) Rod Withdrawal Block and Turbine Runback from either OTΔT or OPΔT (Low Setpoint)

Technical Specifications

The RTD cross calibration procedure is performed during modes 3 and 4. The Technical Specifications do not require any of the narrow range RTD outputs noted above to be operable in mode 4 and only ESF item 1, Steamline Isolation, is required in mode 3. The High Steam Flow Steamline Isolation function is required in mode 3 but may be blocked when below P-12, Table 3.3-3, item 4d. Table 3.3-3, items 1f and 4f, also indicates that the Low Steam Pressure Safety Injection and Steamline Isolation ESF may be blocked

when below P-12. It is noted that although the Technical Specifications allow blocking the High Steam Flow Steamline Isolation when below P-12, the circuitry to do so does not exist. Steamline Isolation cannot be physically blocked using the P-12 signal as the Low Steam Pressure signals can.

ACTION statement 14 of specification 3/4.3.2, ESF Actuation System Instrumentation, addresses operations with fewer than the total number of channels.

ACTION 14 - With the number of OPERABLE Channels one less than the Total Number of Channels, operations may proceed until performance of the next required CHANNEL FUNCTIONAL TEST provided the inoperable channel is placed in the tripped condition within 1 hour.

ACTION statement 14 as applied to the narrow range ESF items is modified with a superscripted star. The star refers to a Table 3.3-3 notation which states, "The provisions of Specification 3.0.4 are not applicable."

Technical Specification 3.3.3.6, Post-Accident Instrumentation, requires two (2) operable channels of wide range Thot and two (2) channels of wide range Tcold indication in modes 1, 2, and 3 for post accident conditions. The ACTION statement associated with this specification is included in the body of the Specification.

ACTION: a. With the number of OPERABLE post-accident monitoring channels less than required by Table 3.3-10, either restore the inoperable channel to OPERABLE status within 30 days, or be in HOT SHUTDOWN within the next 12 hours.

b. The provisions of Specification 3.0.4 are not applicable.

Technical Specification 3/4.4.9 Pressure/Temperature Limits, requires temperature be limited in accordance with figures 3.4-2 and 3.4-3. Wide range RTDs are attendant instrumentation for this specification.

Specifications 3.0.4 and 4.0.4 are pertinent to the performance of the RTD cross calibration procedure.

3.0.4 Entry into an OPERATIONAL MODE or other specified applicability condition shall not be made unless the conditions of the Limiting Condition for Operation are met without reliance on provisions contained in the ACTION statements unless otherwise excepted. This provision shall not prevent passage through OPERATIONAL MODES to comply with ACTION statements.

4.0.4 Entry into an OPERATIONAL MODE or other specified applicability condition shall not be made unless the Surveillance Requirement(s) associated with the Limiting Condition for Operation have been performed within the stated surveillance interval or as otherwise specified.

The involvement of Specifications 3.0.4 and 4.0.4 is discussed in more detail in the Analysis section.

Analysis

Separation between the four channels of protection instrumentation will be maintained during the procedure by the use of various switch boxes. A switch box capable of selecting four RTDs and one dummy position will be used for each channel. A separate switch box will be used to select one of the four channels for monitoring. Administrative controls will be established to ensure that a minimum of three channel switch boxes are selecting the dummy position at all times. This procedure will be followed during the test and will ensure channel separation is maintained.

The wide range RTD involvement is relatively simple and easily resolved. It will be addressed first.

The Technical Specifications require a minimum of two channels of both Thot and Tcold indication to be operable. In order to be able to take data from the wide range instruments and still maintain the operability required, three of the Tcold RTD signals will be applied to a two position switch in each circuit. The switches will be maintained in a position so as to provide normal wide range temperature indication except during those times when data acquisition is required. At those times the switches will be placed in the test position long enough to read the RTD's resistance and will then be returned to normal. Conduction of the test in this manner will ensure that the minimum number of Tcold channels are always operable. We shall declare the Thot channels inoperable when they are removed from service and comply with the ACTION statement which requires the channels to be made operable within 30 days.

Specification 3.0.4 is not applicable to the Specification involving wide range temperature instrumentation. Therefore we can change modes relying on the ACTION statement if necessary.

The wide range temperature channels provide temperature indication with an accuracy of $\pm$ 23.1 $^{\circ}$F. This accuracy must be taken into account when relying on the wide range channels for indication. In particular the P-12 reset point for unblocking the High Steam Flow Safety Injection should be interpreted as 527 $^{\circ}$F wide range indication. This value is derived by first reducing the error of an individual wide range channel by a factor which accounts for the number of channels used to determine wide range Tavg. The minimum number of channels available will be two and thus the individual channel error allowance may be reduced by dividing by the square root of two, or 1.414. This yields an accuracy of $\pm$ 16.3 $^{\circ}$F which is then rounded up to $\pm$ 17.0 $^{\circ}$F for use in the analysis. The P-12 reset point is then taken as 544 $^{\circ}$F minus 17 $^{\circ}$F = 527 $^{\circ}$F.

Further conservatism is introduced by monitoring and controling to the indicated Tcold. The source of heat during the performance of this test will be the Reactor Coolant Pumps. Therefore the Tcold indications will be higher than the Thot indications. By maintaining plant control with the Tcold indication, we shall be conservative in our actions.

Specification 4.0.4 requires surveillance requirements be met before changing to a mode requiring the surveillance. The calibration of wide range RTDs will be verified at several temperatures during the plant heatup by using a method patterned after the cross calibration procedure identified in reference 3. The temperature points chosen for this verification will be selected to ensure that the wide range RTD's calibration is verified before entry into a different mode. Technical Specification 3.4.9.1 requires this be done prior to entry into mode 4. Technical Specifications 3.4.9.1 and 3.3.3.6 require this be done prior to entry into mode 3. The individual RTD resistances will be read and converted to the equivalent temperature and then the average temperature will be calculated. The individual temperatures must be within $\pm$ 8.4 °F of the average at each test point for the RTD to be considered calibrated. The 8.4 °F acceptance criteria is based upon an allowance of 1.2% of span which accounts for sensor accuracy and drift effects. The wide range span is 700 °F.

After consideration of the Technical Specifications and their relationship to the wide range temperature channels and the RTD cross calibration test, we conclude that performance of the RTD cross calibration test will not violate any provisions of the Technical Specifications.

The narrow range RTDs present a situation which is not as simple as the wide range RTDs. An understanding of the process involved in performing the procedure is necessary for a proper evaluation.

When a protection channel is removed from service, the bistable outputs to the Solid State Reactor Protection and Safeguards System (RPS) logic cabinets are placed in a tripped condition by means of the rack test switches on the bistable outputs. This action results in the RPS receiving a trip signal from the bistable circuit affected. The trip signal provides the associated logic input, e.g. low-low Tavg (P-12), for the particular channel tripped. During the RTD cross calibration procedure, all four temperature channels are to be removed from service. As a result of this all of the protective and safeguards signals associated with Tavg and ΔT will be present. Thus the OTΔT and OPΔT reactor trip signals will be present as well as the low-low Tavg (P-12) signal. The low-low Tavg signal provides one-half of the logic required for High Steam Flow Steamline Isolation. By placing all four narrow range temperature channels in test, we shall not be defeating the function of the protection temperature channels but rather we shall be establishing a more conservative condition by providing the reactor trip signal and the low-low Tavg signal. Therefore, even though the narrow range RTDs will not be providing inputs into the protection system, their design protection function is achieved in a most conservative manner.

As noted above, the Technical Specifications required ESF feature, High Steam Flow Steamline Isolation is allowed to be blocked when Tavg is below P-12. Since this feature is the only narrow range temperature signal required in mode 3, the implication is that the narrow range temperature channels are not required in mode 3 below P-12. This conclusion is supported by the fact that although mode 3 is defined in part by Tavg $\geq$ 350 °F, the ranges of the Tcold and Thot inputs and the derived Tavg signal are 510-630 °F, 530-650 °F, and 530 °F-630 °F respectively as indicated on drawing 2-98501-1. Below these ranges the temperature channels provide no usable signals. At the Cook plant Tcold is actually calibrated from 530 °F to 630 °F.

In consideration of the facts that the Tavg associated ESF functions may be blocked below P-12 and that the temperature channels do not provide meaningful signals below 530 ^{o}F, our conclusion is that these narrow range temperature channels are not needed or required below P-12 and may therefore be removed from service without violating the technical specifications.

As noted in the description of applicable Technical Specifications, the provisions of Specification 3.0.4 are not applicable and mode change may be made relying on ACTION statement 14. ACTION statement 14 allows operations to continue with three operable channels. Based upon arguments presented in the previous paragraphs, i.e. since the Technical Specifications allow blocking the narrow range ESF functions below P-12 and that no meaningful signals are generated below 530 ^{o}F, we conclude that we can enter mode 3 with the four narrow range channels inoperable. Operations in this mode will be limited to below 527 ^{o}F as described earlier to prevent temperatures rising to the P-12 reset point.

A similar argument is presented to address Specification 4.0.4. Since the narrow range temperature ESF function may be blocked when below P-12 and is therefore not needed, and since there are no meaningful signals below 530 ^{o}F, we conclude that we can enter into mode 3 and operate there below P-12, as corrected for indication error, without violating the Technical Specifications.

Based on the above considerations, it will be consistent with the current Technical Specifications to remove from service all narrow range RTDs below P-12 to obtain RTD cross calibration data.

We conclude that operation in mode 3 below P-12 with four channels of wide range Thot, two channels of wide range Tcold, and four channels of narrow range temperature all out of service simultaneously as described in this evaluation neither violates the Technical Specifications nor results in an unreviewed safety question as described in 10 CFR 50.59, paragraph (a)(2). We also conclude that the performance of this procedure will not result in a substantial hazard to the health and safety of the general public. No reactor trips are required in mode 3 but the bistables will be conservatively tripped. The associated ESF functions may be blocked as provided in the Technical Specifications, Table 3.3-3, but can be actuated manually. The Tavg inputs to ESF actuations will also be conservatively tripped. Temperature indication will be provided by the operable wide range Thot and Tcold channels with appropriate penality for the larger error.

Robert Leonard / Vince Vanderburg

R.P. Leonard / V. Vanderburg

cc: M.P. Alexich
J.G. Feinstein
V. Vanderburg
NMFM #85-0387

Checked by NS&L P.G. Barrett

Approved by J.M. Cleveland
J.M. Cleveland, Manager
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