VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

May 15, 1989

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United States Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D. C. 20555

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Gentlemen:

VIRGINIA ELECTRIC AND POWER COMPANY
SURRY POWER STATION UNITS 1 AND 2
MAIN STEAM FLOW TRANSMITTER ACCURACY

On December 15, 1988 and January 18, 1989 during telephone calls with your staff, additional information was requested in order for your staff to complete the review of main steam flow transmitter operability at low power levels. The attachment to this letter provides the response to those questions.

Should you have any further questions, please contact us.

Very truly yours,

W. L. Stewart
Senior Vice President - Power

Attachment

cc: U. S. Nuclear Regulatory Commission
Region II
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Mr. W. E. Holland
NRC Senior Resident Inspector
Surry Power Station

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ATTACHMENT 1
ADDITIONAL INFORMANTION
MAIN STEAM FLOW TRANSMITTERS

QUESTION 1:

What steam flow information does the operator need below 20% power.

RESPONSE:

For normal operation during a power escalation from low (ie., 2%) power level, steam flow indication is first utilized for the feed flow control transfer from hand to auto. For this transfer at 15% power, there is a reasonable probability of steam flow indication from at least one steam flow indicator per steam line. Figure 1 illustrates the Surry steam flow measurement with uncertainty as a function of steam flow. At 15% steam flow, an individual channel has a 70% to 95% probability of indicating at least 100,000 lb/hr at the channel meter. Since there are two channels per steam line and since the steam flow signal is available from other sources such as computer readouts, it is very likely that steam flow indication will be available to the operator at this time during the power escalation.

For conditions outside of normal operation during startup, current Surry Emergency Operating Procedures (EOP) contain no decision or branching points based on steam flow. Identification of secondary faults is based on observation of uncontrolled depressurization of one or more steam generators, and not steam flow. The status of steam generator heat removal capability is assessed through the indications of steam generator level, steam generator and main steam header pressures, and feedwater flow. Steam flow indication can be considered a secondary means of verifying sucessful completion of the main steam isolation function.

Other means of performing this verification include the main steam trip valve limit switches, steam generator and main steam header pressures, trends in steam generator levels, and the status of main steam relief and safety valves.

QUESTION 2:

Surry Technical Specification Table 3.7-3 item 2.a, "STEAM LINE ISOLATION, High Steam Flow in 2/3 lines and 2/3 Low Tavg or 2/3 Low Steam Pressure", does not contain any PERMISSIBLE BYPASS CONDITIONS. This differs from item 1.e of Table 3.7-2, "SAFETY INJECTION, High Steam Flow in 2/3 Steam Lines with Low Tavg or Low Steam Line Press", in which the PERMISSIBLE BYPASS CONDITIONS are with the Reactor Coolant average temperature less than 543°F (Nominal) during heatup and cooldown. Please explain.

RESPONSE:

The logic for the Steam Generator Trip Signals and the steam line isolation and safety injection functions of the High Steam Line Flow trip logic are different. The safety injection function has a manual block that can be actuated if the low Tavg signal is less than 543°F, while the steam line isolation function has no manual blocks. The safety injection manual block on low Tavg is similar to the safety injection manual block on low pressurizer pressure discussed in Surry UFSAR Sections 7.5.1.1 and 7.5.3.1. Both safety injection manual blocks are also listed within the Comments for item 10, "Safety injection signal (actuation)", of UFSAR Table 7.2-1.

As reported in Surry UFSAR Section 7.5.1.1, the purpose of the safety injection manual block on low pressurizer pressure "...is to prevent inadvertent safety injection actuation when the plant is being cooled down and depressurized". Other plant design information states that both the

low Tavg and low pressurizer pressure safety injection manual blocks are to be used only during normal procedures for plant cooldown and startup. This infers that the purpose of the low Tavg safety injection manual block is to prevent inadvertent safety injection actuation during a normal plant cooldown or startup. The low Tavg manual block is interlocked with the low Tavg signal in such a way that the blocking action is automatically removed as operating temperatures are approached (ie., above a Tavg value of 543°F). Since normal plant power operation above 2% power begins at approximately 547°F, the low Tavg safety injection manual block would be automatically removed during the plant startup.

The absence of a steam line isolation manual block during startup and shutdown conditions simply means that the protective functions of steam line isolation will be provided both for power operation and during shutdown conditions below 543°F.

QUESTION 3:

Surry Technical Specification Table 3.7-3 item 2.a, "STEAM LINE ISOLATION, High Steam Flow in 2/3 lines and 2/3 Low Tavg or 2/3 Low Steam Pressure", does not contain any PERMISSIBLE BYPASS CONDITIONS. This differs from item 1.e of Table 3.7-2, "SAFETY INJECTION, High Steam Flow in 2/3 Steam Lines with Low Tavg or Low Steam Line Press", in which the PERMISSIBLE BYPASS CONDITIONS are with the Reactor Coolant average temperature less than 543°F (Nominal) during heatup and cooldown. Please explain the 543°F setpoint and justify this difference between Tables 3.7-2 and 3.7-3.

RESPONSE:

The response to question 2 describes the low Tavg safety injection manual block and its interaction with the high steam line flow signal. The purpose of the low Tavg safety injection manual block is to prevent inadvertent safety injection actuation during a normal plant cooldown or startup. The low Tavg manual block is interlocked with the low Tavg signal in such a way that the blocking action is automatically removed as operating temperatures are approached (ie., above a Tavg value of 543°F). Since normal plant power operation above 2% power begins at approximately 547°F, the low Tavg safety injection manual block would be automatically removed during plant startup. The absence of a steam line isolation manual block during startup and shutdown conditions simply means that the protective functions of steam line isolation will be provided both for power operation and during shutdown conditions below 543°F.

Design documentation defines the low Tavg interlock as 2 out of 3 low Tavg signals ≤ 543°F. The low Tavg interlock is part of the coincident logic of the "High Steam Flow in 2/3 lines and 2/3 Low Tavg" protection logic for safety injection and steam line isolation (ie., the low Tavg interlock satisfies one half of the conditions of this protection logic, and must be accompanied by high steam flow in 2 out of 3 lines). The low Tavg interlock must also be satisfied to actuate the low Tavg safety injection manual block. If the low Tavg interlock is not satisfied (ie., if Tavg remains greater than 543°F for 2/3 signals), then the protection logic is not met and the low Tavg safety injection manual block cannot be enabled. If the low Tavg interlock is satisfied, then the low Tavg safety injection manual block can be enabled, but also, part of the safety injection and steam line isolation protection logic is met. Since the low Tavg interlock is a condition of the protection logic for safety injection and steam line isolation, the setpoint of the low Tavg interlock must support the timely actuation of this protection function during the steam line break accident. The 543°F setpoint does not correspond to a power level related to the low Tavg safety injection manual block, but rather, to needed actuation of the protection function during the steam line break accident. Nevertheless, during plant heatup to about 547°F, the reactor power level is limited to 2% power by station procedures (criticality below a temperature of 522°F is not permitted by Technical Specifications).

QUESTION 4:

The North Anna verification of steam flow indication is required at or before 5% power while the Surry verification is required at or before 23% power. Please explain this difference.

RESPONSE:

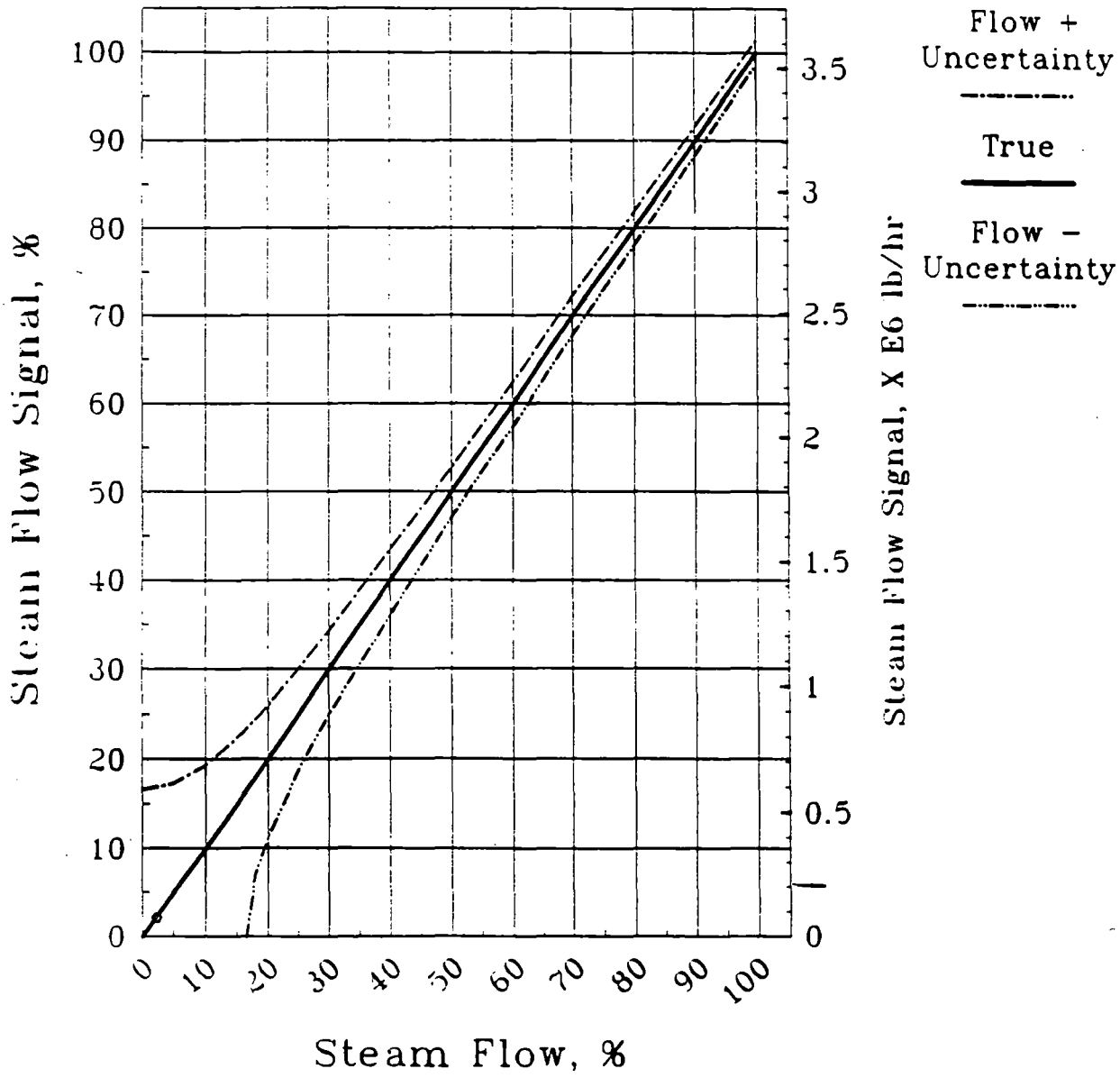
Both the North Anna and Surry verification criteria were derived from similar instrumentation uncertainties and from similar uncertainty combination methodologies. The variation in these verification criteria can be attributed to the magnitude of the difference between steam flow channels used for the qualitative assessment. The steam flow indication verification is basically a comparison of two steam flow channels. The magnitude of the steam flow measurement uncertainty is a function of steam flow, as shown in Figure 1. At low steam flow levels (and correspondingly, at low power levels) there is large variability in the steam flow signal, making the comparison test between steam flow channels less sensitive. Hence, at low steam flow levels, the difference criteria for comparing two channels must be set at a larger value to avoid an unacceptable frequency of incorrect inferences from the channel comparison. At higher steam flow levels, the difference criteria for this comparison can be set at smaller values to achieve the same low frequency of incorrect inferences.

In 1988, the channel check criteria was revised at both stations to address the steam flow measurement variability that exists at low steam flow levels. Surry chose to maintain the prior lower steam flow

difference criteria of 275,000 lb/hr, while North Anna increased their difference criteria to 680,000 lb/hr for a new verification criteria to be used at the lower power level of 5%. The Surry difference criteria of 275,000 lb/hr is a much more sensitive comparison of the instrument signal, but the comparison at this flow difference must be done at higher power levels (ie., 25% power) in order to avoid an unacceptable frequency of incorrect inferences from the comparison.

The Surry steam flow indication verification at 23% power does not imply that the accuracy of steam flow indication is undesirable below 23% power. Figure 1 illustrates that a single channel has at least a 50% probability of indicating some steam flow (ie., 100,000 lb/hr or more) even at very low steam flow rates such as 100,000 lb/hr steam flow. At 16% steam flow, there is a much higher probability for indicating some steam flow, approaching 70% to 95% for a single channel. These steam flow uncertainties are combined for the comparison, yielding a difference criteria with the same 70% to 95% probability for a correct decision. If a higher rate of incorrect decisions or a lower sensitivity (ie., higher difference value) were chosen, the power level for the successful verification could be reduced.

Figure 1
Surry Steam Flow Measurement Uncertainty
Signal with Uncertainty as a Function of Flow



QUESTION 5:

Discuss the operator training for steam flow indication at low power levels.

RESPONSE:

Initial operator training provides basic instrumentation theory and operation. The System Training lesson plans include the operation, control and safety function of the instrumentation for each system. Surry Operations personnel training enhancements were performed, including a review of the North Anna 2 event (LER 339/87015-01) in the Licensed Operator Requalification Program (LORP) classroom segment and simulator exercises. Specific enhancements include:

- Training for Surry Operations personnel on the North Anna 2 event has been provided in the Licensed Operator Requalification Program (LORP) and included the studies and evaluations generated in response to that event on the reliability of steam flow indication at low power.

- A plant startup simulator exercise guide was prepared which included steam flow instrumentation that would not be normally indicating at very low power levels and was a component of the LORP session 3 simulator exercise guide. Increased emphasis will be provided on the use of alternative indication during simulator exercises.

- A Human Performance Evaluation System (HPES) evaluation has been performed of the North Anna 2 event to provide details concerning the untimely operator actions associated with declaring the affected

steam flow channels inoperable. Recommendations from this report were included in the review of this event that was provided to Operations personnel in LORP session 3.