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April 10, 1985
5211-85-2054

Office of Nuclear Reactor Regulation
Attn: J. F. Stolz, Chief
Operating Reactor Branch No. 4
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Mr. Stolz:

Three Mile Island Nuclear Station Unit 1 (TMI-1)
Operating License No. DPR-50
Docket No. 50-289
Subcooling Margin Indication

By letter dated February 22, 1985 (Reference 1), GPU Nuclear Corporation presented a summary of the conditions under which the margin to saturation is determined by use of the Saturation Margin Monitor. We also presented a summary of the conditions under which the incore thermocouples and RCS pressure indication are used in conjunction with steam tables. The maximum calculated loop errors associated with both methods were discussed based on two sets of assumptions; those included in the GPUN loop error analysis submitted on January 16, 1985 (Reference 2), and those presented by your staff in a series of telephone conversations, as discussed in Reference 1.

Subsequently, we have refined our calculations and found that we had utilized a calculational method which results in an over-prediction of the error when using the Incore Thermocouples. We had converted the pressure instrumentation error from psi to F° by multiplying the pressure error by the slope of the saturation curve (dT/dP) at the actual RCS pressure. Our revised calculations convert from psi to F° by taking the difference between the saturation temperatures at the indicated RCS pressure and actual RCS pressure. (Indicated RCS pressure is equal to actual RCS pressure plus the error due to the pressure instrumentation string.) This is done in two steps to segregate the non-random and random portions of the pressure string error. The total Saturation Margin error is then determined by combining the random pressure and temperature string errors, and then adding the non-random pressure string error plus the 0.5 F° maximum contribution due to interpolation of the steam tables.

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The following discussions, summarized in the attached Table 1, demonstrate that under all postulated scenarios, the calculated instrumentation error associated with determining margin to saturation remains under 20 F°.

Subcooling Margin Determination Based On Saturation Margin Monitor

The Saturation Margin Monitor error analysis is unchanged from that presented in Reference 1. However, to distinguish between instrument error and physical configuration contribution, the latter (1.3 F°) has not been included in the values listed in Table 1.

Subcooling Margin Determination Based On Use Of Incore Thermocouples

When the RCPs are not running, the operator uses incore thermocouples to determine subcooling margin. Under those conditions, the margin to saturation is determined by manual calculation, based on reactor coolant temperature and pressure indications available in the control room, and the steam tables. Determination of subcooling margin when the RCPs are not running is discussed in Reference 2, Response to Question 5.

Using the same methodology for combining errors as in the Reference 2, GPUN Saturation Margin Monitor alarm loop error calculation, we calculated an error of 17.07 F° under harsh containment environmental conditions at reactor coolant system pressures down to 175 psig, which is the lowest RCS pressure at which HPI throttling is a consideration (See Reference 2, Response to Question 11). The error decreases for higher RCS pressure. An error in reading the steam tables of no more than 0.5 F° is included in this value. The physical configuration factor of 1.3 F° must also be added to this value. This calculation contains the following changes from the calculation discussed in Reference 1:

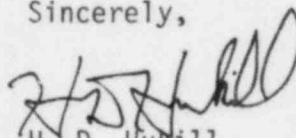
1. The error in psi was converted to F° as discussed above.
2. The calibration meter for the Incore Thermocouples is a DVM with a two-sigma error of $\pm 0.02\%$ of reading. This is equal to ± 0.08 F° at 400°F, which is the upper limit of the range of concern.
3. The multiplexer error for the thermocouples is calculated at 400°F.
4. It is assumed that one containment penetration RTD is used for all five thermocouples.
5. The calibration errors for the five thermocouples are assumed to be dependent.
6. An additional 8 F° surveillance tolerance was included for each thermocouple reading.

We performed an additional analysis under harsh containment environmental conditions based on the assumption suggested by Mr. F. Burrows of your staff that temperature and radiation induced errors be combined algebraically, as well as the changes listed above. This resulted in a calculated error of 19.53 F°. This includes an error of 0.5 F° for use of the steam tables but does not include the physical configuration factor.

Conclusion

Based on the above, we conclude that the capability provided at TMI-1 to assess margin to saturation is appropriate for all conditions for which this determination is required.

Sincerely,



H. D. Hukill
Director, TMI-1

HDH/MRK/spb

Attachment

cc: J. Thoma
R. Conte

References:

1. GPUN Letter 5211-85-2027, dated February 22, 1985
2. GPUN Letter 5211-85-2001, dated January 16, 1985

Table 1 SUMMARY

<u>Reactor Coolant(1) Pumps Status</u>	<u>Reactor Coolant System Pressure</u>	<u>Method to Determine Margin to Saturation</u>	<u>Worst Case Calculated Error(2)</u>	
			<u>Case 1(3)</u>	<u>Case 2(4)</u>
On	> 200 psig	Saturation Margin Monitor	14.95F°	17.27F°
Off	> 200 psig	Average of 5 highest Incore Thermocouples/ RCS Wide Range Pressure Indication/ ASME Steam Tables	15.90F°	18.19F°
Off	175 - 200 psig(5)	Average of 5 highest Incore Thermocouples/ RCS Wide Range Pressure Indication/ ASME Steam Tables	17.07F°	19.53F°

Notes:

1. Reactor coolant pumps do not operate at reactor coolant system pressure less than 200 psig.
2. In all cases, the worst case calculated error corresponds to harsh environmental conditions inside containment. Errors associated with Natural Circulation include the 0.5 F° maximum contribution due to interpolation of the Steam Tables. The 1.3 F° contribution based on physical configuration must be added to all values.
3. Case 1 error is determined by combining temperature and radiation induced errors by the Square Root of the sum of the Squares Method.
4. Case 2 error is determined by combining temperature and radiation induced errors algebraically.
5. HPI throttling is a consideration only above 175 psig in the RCS.