GPU Nuclear

GPU Nuclear Corporation
Post Office Box 480
Route 441 South
Middletown, Pennsylvania 17057-0191
717 944-7621
TELEX 84-2386
Writer's Direct Dial Number:

February 22, 1985
5211-85-2027

Office of Nuclear Reactor Regulation
Attn: J. F. Stolz, Chief
Operating Reactor Branch No. 4
Division of Licensing
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 September 28, 1984, NRC requested additional information with respect to the Saturation Margin Monitor Loop Error Analysis for TMI-1. Subsequently, GPU Nuclear Corporation (GPUN) and the NRC staff met on October 30, 1984 to clarify the NRC concerns. By letter 5211-84-2291 dated November 30, 1984 (Reference 1), GPUN responded to seven of eleven NRC questions. By letter 5211-84-2001 dated January 16, 1985 (Reference 2), GPUN addressed the remaining four concerns.

The purpose of this letter is twofold. First, we would like to summarize the conditions under which the Saturation Margin Monitor is intended for use, and the calculated maximum loop error associated with those uses. As part of this discussion, we would like to address both the assumptions presented in our loop error analysis (Reference 2), and the assumptions presented by Mr. F. Burrows of your staff in telephone conversations of January 29, 1985 and February 5, 1985, and February 14, 1985.

Secondly, we would like to reiterate the conditions under which the margin to saturation is determined based on the use of incore thermocouples and RCS pressure indication, in conjunction with steam tables. We will address the maximum instrument error associated with this method, based on the assumptions as presented in Reference 2, as well as based on Mr. Burrows' set of assumptions.

A001
1/1

The following discussions, summarized in the attached Table 1, demonstrate that under all postulated scenarios, the calculated error associated with determining margin to saturation remains under 23.4F° which was found acceptable, in conjunction with use of the 25F° indicated subcooling criterion for throttling HPI, by the Staff in SECY-84-237, dated June 14, 1984.

Subcooling Margin Determination Based on Saturation Margin Monitor

The Saturation Margin Monitor is used to determine subcooling margin when the reactor coolant pumps are operating. RCP's are not operated below 200 psig, since the RCP seals require this pressure to keep them staged. Therefore, the Saturation Margin Monitor is not used below 200 psig.

The GPUN loop error analysis (Reference 2, Response to Question 2 and Attachment 2), assumes that the worst case combination temperature, pressure and radiation errors would be bounded by containment conditions of 0 psig, 212°F and an integrated radiation dose of 4×10^6 rads. We evaluated each type of error involved in the analysis, and concluded that the only systematic errors are the negative systematic error in the characterizer and the negative systematic error due to containment pressure (combined algebraically.). All other errors are considered independent random errors which can be combined by taking the square root of the sum of the squares. Based on these considerations, the maximum calculated error associated with the Saturation Margin Monitor is +14.95 F°, occurring in the reactor coolant system pressure range of 200 to 400 psig. To this error is added 1.3F° to account for the instrument tap locations below the top of the hot leg U-bends. This results in a total error of 16.25F°.

In telephone conversations with Mr. Burrows of your staff, he informed us that he considers errors associated with containment temperature and radiation as dependent parameters that should be combined algebraically. Also, he thought that the effect of containment pressure, which results in a negative error contribution, should be ignored for added conservatism. GPUN maintains that our methodology, as presented in References 1 and 2, represents a conservative but more realistic set of assumptions. Nevertheless, we have performed an additional evaluation, algebraically combining the worst case errors associated with containment temperature and radiation. However based on the location of the pressure transmitters, (i.e. in open containment areas which are remote from all potential SBLOCAs and thus not subject to impingement or high localized temperature), the transmitters could not experience containment temperature conditions without experiencing containment pressure. The error calculated based on this revised set of assumptions (i.e. algebraic combination of temperature and radiation, and accounting for the containment pressure) is 18.57F°. This includes the physical configuration factor.

As further suggested by Mr. Burrows, we analyzed the thermal time lag of the pressure transmitters and determined that it would not be more than 10F° for a small break LOCA while the containment cools down. The negative bias due to containment pressure is sufficient to compensate for the error due to the containment temperature above 212°F plus a transmitter temperature twenty degrees above containment temperature; thus, no further consideration is required.

Subcooling Margin Determination Based on Use of Incore Thermocouples

The operator does not use the Saturation Margin Monitor to determine subcooling margin if the RCPs are not running. 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 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 under harsh containment environmental conditions of 17.76F° 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 RC pressure. An error in reading steam tables of no more than 0.5F° is added to these values along with a physical configuration factor of 1.3F°, for a maximum error of 19.56F°.

Assuming the same conservatisms presented by Mr. Burrows for the Saturation Margin Monitor loop error analysis, we performed an additional analysis under harsh containment environmental conditions, combining temperature and radiation induced errors algebraically. With these considerations, and including an error of 0.5F° for use of the steam tables and the 1.3F° physical configuration factor, the worst case combined error is 22.7F°.

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/SK/dls-1026f

0174A

cc: J. Van Vliet
P. Kadambi

Table 1 SUMMARY

Reactor Coolant[1] Pumps Status	Reactor Coolant System Pressure	Method to Determine Margin to Saturation	Worst Case Calculated Error[2] Case 1[3]	Case 2[4]
On	>200 psig	Saturation Margin Monitor	16.25F°	18.57F°
Off	>200 psig	Average of 5 highest Incore Thermocouples/ RCS Wide Range Pressure Indication/ ASME Steam Tables	17.74F°	20.54F°
Off	175 - 200 psig[5]	Average of 5 highest Incore Thermocouples/ RCS Wide Range Pressure Indication/ ASME Steam Tables	19.56F°	22.70F°

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.
3. Case 1 error is determined by combining temperature and radiation induced errors by the Square Root of the sum of the Squares Method. Errors include 1.3F° contribution based on physical configuration. Errors associated with Natural Circulation also include the 0.5F° maximum contribution due to use of the ASME Steam Tables.
4. Case 2 error is determined by combining temperature and radiation induced errors algebraically. Errors include 1.3F° contribution based on physical configuration. Errors associated with Natural Circulation also include the 0.5F° maximum contribution due to use of the ASME Steam Tables.
5. HPI throttling is a consideration only above 175 psig in the RCS.