SAFETY EVALUATION REPORT

Report Titles: 1. Attachment to Letter to John F. Stolz from Lowell E. Roe, Serial No. 439, BAW-1489, "Attachment 1 to Application to Amend Operating License for Removal of Burnable Poison Rod and Orifice Rod Assemblies", Rev. 1. 5/26/78

2. Attachment 1 to Toledo Edison Company letter dated May 26, 1978, Serial No. 436, "Determination of Total RC Flow Rate and its Accuracy for Davis-Besse 1"

Originating Organization: Toledo Edison Company
Reviewed by: Analysis Branch

Summary of Core Thermal-Hydraulics and Flow Rate Accuracy Determination

The licensee has proposed that all burnable poison rod assemblies (BPRAs) and all but two orifice rod assemblies (ORAs) be removed from the Davis Besse Unit 1 reactor core. This results in a calculated increase of 4.7% in the maximum core bypass flow (from 6.04% to 10.75%). A previous letter (Reference 1) requested that the minimum allowable reactor coolant flow be increased by 5% over the FSAR design flow to compensate for potential effects of fuel rod bowing. Therefore, modified operating conditions have been proposed to compensate for both the increased bypass flow and the potential effects of rod bow on the core thermal safety margin. An analysis has been performed based on a minimum allowable flow rate of 110% of design flow and a slightly adjusted trip limit curve (Technical Specification Figure 2.1-1) for reactor coolant core outlet pressure and outlet temperature. The analysis results indicate that operation at the proposed limits with BPRAs and ORAs removed would not result in violation of acceptable fuel design limits. Reactor coolant system flow measurements have indicated an actual system flow rate of at least 113% of the previous limit (measurement errors not included).

In a B&W designed nuclear power plant, Gentile flowmeters are used to measure loop 1 and loop 2 reactor coolant flow rates (B&W plants have two loops with two pumps each). These primary loop flowmeters are not calibrated prior to installation. Loop 1 and 2 feedwater flow rates are measured with calibrated flowmeters and a plant heat balance is used to calibrate the Gentile flowmeters.

The total reactor coolant flow rate for Davis-Besse, Unit 1, as determined from a plant heat balance, is 113.2% of the design flow rate. Based on the accuracies of primary and secondary side measurements reported in Table 1, the licensee calculated the reactor coolant flow rate accuracy to be $\pm$ 2.2%.

Technical Specification changes which are proposed to reflect the modified operating limits, including measurement uncertainties, are described in Section 7 of BAW-1489.

Summary of Staff Evaluation

Staff calculations of bypass flow through the guide tubes with the BPRAs and ORAs removed give approximate agreement with the value reported by B&W. Therefore, an increase in the reactor vessel flow of about 5% is sufficient to compensate the increased bypass flow. Also, as reported in a separate evaluation (Reference 2) an additional 5% in design flow provides sufficient margin to compensate for the potential effects of fuel rod bow on DNBR. The above considerations tend to confirm the analysis results for the modified operating limits.

Measurement accuracies for primary and secondary side measurements used for calculation of reactor coolant flow rate are shown in Table 1. Except for the pressure uncertainty and flow ΔP uncertainty, these values are reasonable and consistent with industry practice. The most significant terms in calculating accurate values of reactor flow rate are reactor coolant temperatures and feedwater flowmeter differential pressures.

The measurement accuracy reported for reactor coolant pressure is $\pm$ 0.77%; staff experience indicates that $\pm$ 1% is more reasonable. The change to $\pm$ 1% pressure measurement accuracy does not affect the final reactor coolant flow accuracy as given to three significant digits.

The measurement accuracy reported for reactor coolant flow rate ΔP ($\pm$ 1.046%) is for the ΔP transmitter only. It is the staff's opinion that a drift allowance for the flow element (Gentile tube) is also needed. Therefore, the staff has re-evaluated the reactor coolant flow measurement accuracy using a value of $\pm$ 2% for the reactor coolant flow rate ΔP measurement. The effect of this change is to increase the total flow rate measurement accuracy from $\pm$ 2.2% to $\pm$ 2.5%.

An important element in the error analysis is the assumed independence of the uncertainties in measurement of feedwater flow for the two loops. The major potential source of dependency for the feedwater flow measurement uncertainties is crud buildup in the flow elements. Although crud buildup has been observed in the feedwater venturi's for at least one reactor vendor, the once-through steam generator feedwater chemistry control minimizes the increase of contaminants into the system and the buildup of crud on the flow elements for

Davis Besse. Therefore, it is reasonable to assume that the feedwater flow measurement accuracies are independent.

Flow requirements given in Table 3.2-1 of the proposed Technical Specification revision (attachment to letter No. 439, 5/26/78) include a measurement uncertainty of ± 2.2% factored into the 110% design flow required for potential rod bow effects and increased bypass flow. Because the staff has assessed the measurement accuracy at ± 2.5%, a revised Table 3.2-1 is included with this evaluation.

Staff Position

Based on the analyses presented in the report BAW-1489 and previously documented analyses, Davis-Besse can be operated safely during Cycle 1 without BPRAs and ORAs at the rated core power level of 2772 MWt. Revised Technical Specification limits necessary for the safe operation at that power level are included in that report. The minimum flow required to assure a design flow of 110% original design flow, considering measurement uncertainties, is included in the revised Table 3.2-1 of this evaluation.

TABLE 3.2-1

DNB MARGIN

Parameter	LIMITS		
	Four Reactor Coolant Pumps Operating	Three Reactor Coolant Pumps Operating	One Reactor Coolant Pump Operating in Each Loop
Reactor Coolant Hot Leg Temperature T_H °F	≤ 611.1	≤ 611.1[1]	≤ 611.1
Reactor Coolant Pressure, psig.[2]	≥ 2062.7	≥ 2058.7[1]	≥ 2091.4
Reactor Coolant Flow Rate, gpm (3)	≥ 396,880	≥ 297,340	≥ 195,760

(1) Applicable to the loop with 2 Reactor Coolant Pumps Operating

(2) Limit not applicable during either a THERMAL POWER ramp increase in excess of 5% of RATED THERMAL POWER per minute or a THERMAL POWER step increase of greater than 10% of RATED THERMAL POWER.

(3) These flows include a flow rate uncertainty of 2.5%.

References

1. Letter and Attachment, Serial No. 426, Lowell E. Roe to Roger S. Boyd, April 10, 1978

2. "Safety Evaluation of Proposed Change to the 'DNBR Margin' Technical Specification for Davis-Besse, Unit 1", Memorandum from D. F. Ross to D. B. Vassallo.