Nuclear Safety Advisory Letter

Westinghouse Electric Company

This is a notification of a recently identified potential safety issue pertaining to basic components supplied by Westinghouse. This information is being provided so that you can conduct a review of this issue to determine if any action is required.
P.O. Box 355, Pittsburgh, PA 15230

Subject: **High Net Heat Input**	Number: **NSAL-03-6**
Basic Component: Reactor Coolant System	Date: 08/20/2003

Affected Plants: Almaraz 1 and 2, ASCO 1 and 2, Beaver Valley 1 and 2, Byron 1 and 2, Braidwood 1 and 2, Comanche Peak 1 and 2, Diablo Canyon 1 and 2, Indian Point 3, J. M. Farley Units 1 and 2, Prairie Island 1 and 2, Sizewell B, Watts Bar 1

Substantial Safety Hazard or Failure to Comply Pursuant to 10 CFR 21.21(a)	Yes ☐ No ☒
Transfer of Information Pursuant to 10 CFR 21.21(b)	Yes ☐
Advisory Information Pursuant to 10 CFR 21.21(d)(2)	Yes ☐

References: None

SUMMARY

Errors have been found in calculations that may result in use of a non-conservatively high net heat input value. The net heat input is the difference between the reactor core power and the NSSS power. It consists of energy provided by the reactor coolant pump to the reactor coolant, heat supplied by the pressurizer heaters, and other minor heat removal and additions such as the cooling provided by the reactor coolant pump seal injection. A non-conservatively high net heat input value used in calorimetric calculations could allow the plant to operate at a higher than licensed core power.

NSSS power is the sum of core power and net heat input. If net heat input is over-estimated, the actual core power will be higher than that calculated by the power calorimetric procedure. The impact of the net heat input over-estimation has been estimated based on generic values for seal injection and leak-off flow rates and temperatures, and reactor coolant pump test data for thermal barrier heat exchanger performance.

An evaluation determined that the increase is as much as 0.4 MWt net heat input over-estimation for the affected plants. Westinghouse includes a conservative uncertainty larger than the error in net heat input when determining the calorimetric power measurement uncertainty. A difference of 0.4 MWt in net heat input is a small fraction of the value of net heat input used. An over-estimate of 0.4 MWt in net heat input does not represent a substantial safety hazard and is therefore not reportable to the NRC pursuant to the requirements of 10 CFR Part 21.

Additional information, if required, may be obtained from the originator. Telephone: (412) 374-4865

Originator:(s)

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ISSUE DESCRIPTION

Errors have been found in calculations that may result in non-conservatively high calculated net heat input. The net heat input is the difference between the reactor core power and the NSSS power. It consists of energy provided by the reactor coolant pump to the reactor coolant, heat supplied by the pressurizer heaters and other minor heat removal and additions such as the cooling provided by the reactor coolant pump seal injection. A non-conservatively high value of net heat input used in calorimetric calculations could allow the plant to operate at a higher than licensed core power. Evaluated on a generic basis, the error results in a small, non-conservative over-estimation of the net heat input value, up to approximately 0.4 MWt. The value for specific affected plants may be less.

TECHNICAL EVALUATION

NSSS power is the sum of core power and net heat input. If net heat input is over-estimated, the actual core power will be higher than that calculated by the power calorimetric procedure. The error involves the modeling of the heat removed by the component cooling water flow to the reactor coolant pump thermal barrier heat exchanger and the seal leak-off flow. Originally, the component cooling water flow was expected to remove only the heat passed on to the seal injection flow by reactor coolant pump components on its way to the thermal barrier heat exchanger. The component cooling water also removes additional heat from other reactor coolant pump metal components. Heat removed via the seal leak-off flow, though small, was non-conservatively ignored.

Westinghouse includes a conservative uncertainty of ±20% of the net heat input value when determining the calorimetric power measurement uncertainty, whereas an analysis of the terms considered in the net heat input calculation indicates that the net heat input uncertainty is only ±10%. The difference between the calculated uncertainty of ±10% and the 20% allowance is greater than the over-estimate of 0.4 MWt stated above.

An actual increase in core power would result in an increase in the reactor coolant system calorimetric flow, so the current calorimetric flow measurement is slightly conservative.

An increase of approximately 2 MWt in core power has been evaluated for a Westinghouse designed plant. The increase has been shown to be within existing margins or accuracy of safety analyses of record, and therefore, has had no adverse effect on the safety analyses. Although available margins in safety analyses vary among plants it is anticipated that the over estimation of net heat input will not have an adverse impact on safety analyses.

Westinghouse has previously provided net heat input values for use in calorimetric procedures for determination of reactor power. Westinghouse requested specific plant operating data at the time of the analysis. Therefore, the calculated net heat input value represents a "snapshot" of plant operation, and is subject to some variation over the operating cycle. For example, steam generator tube plugging reduces reactor coolant system flow and therefore slightly increases reactor coolant pump heat input (i.e., reactor coolant pump horsepower increases with decreasing flow). Steam generator tube sleeving results in a similar, but smaller effect. Changes in chemical and volume control system letdown and charging flow can affect net heat input positively or negatively by a small amount.

The exact impact of the net heat input over-estimation has been estimated based on generic values for seal injection and leak-off flow rates and temperatures, and reactor coolant pump test data for thermal barrier heat exchanger performance. It is possible that the exact reduction of net heat input could be smaller than 0.4 MWt because of one or more of the following:

1. Plants may reduce the net heat input value provided by Westinghouse for margin.
2. Westinghouse may have reduced the calculated value to provide margin or rounded up the value of net heat input to a whole number of MWt.
3. Plant operating parameters may have changed since the calculation of record was created.
4. For a twin unit plant, the limiting parameters for the two units were used for both units.

The list of affected plants on Page 1 includes those plants for which Westinghouse calculated and provided a value of plant specific net heat input that included the error related to reactor coolant pump heat balance. Plants that did not have the plant specific net heat input calculated for them by Westinghouse are not on the affected plant list.

SAFETY SIGNIFICANCE

Westinghouse includes a conservative uncertainty of ±20% of the net heat input value when determining the calorimetric power measurement uncertainty. The uncertainty allowance is greater than the over-estimate of 0.4 MWt stated above. A difference of 0.4 MWt in net heat input is a small fraction of the value of net heat input used and a very small fraction (e.g., 0.013% for a 3000 MWt plant) of total NSSS power. As noted, the increase net heat input is not expected to have an adverse effect on the safety analyses. Based on these considerations, an over-estimate of 0.4 MWt in net heat input does not represent a substantial safety hazard and is therefore not reportable to the NRC pursuant to the requirements of 10 CFR Part 21.

NRC AWARENESS

The NRC has not been formally notified.

RECOMMENDED ACTIONS

Review the value of net heat input used along with changes in operating parameters since the value was calculated to assess whether the value used for net heat input should be updated.