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USE OF A BEST ESTIMATE POWER MONITORING TOOL TO MAXIMIZE POWER PLANT GENERATION

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ABSTRACT

The Best Estimate Power Monitor (BEPM) is a tool that was developed to maximize nuclear power plant generation, while ensuring regulatory compliance in the face of venturi fouling, industry ultra-sonic flowmeter issues and other technical challenges. The BEPM uses ASME approved “best estimate” methodology described in PTC 19.1-1985, “Measurement Uncertainty”, Section 3.8, “Weighting Method.” The BEPM method utilizes many different and independent indicators of core thermal power and independently computes the core thermal power (CTP) from each parameter. The uncertainty of each measurement is used to weight the results of the best estimate computation of CTP such that those with lower uncertainties are weighted more heavily in the computed result. The independence of these measurements is used to minimize the uncertainty of the aggregate result, and the overall uncerainty can be much lower than the uncertainties of any of the individual measured parameters.

Examples of the Balance of Plant parameters used in the BEPM are turbine first stage pressure, venturi feedwater flow, condensate flow, main steam flow, high pressure turbine exhaust pressure, low pressure turbine inlet pressure, the two highest pressure feedwater heater extraction pressures, and final feedwater temperature. The BEPM typically makes use of installed plant instrumentation that provide data to the plant computer. Therefore, little or no plant modification is required.

In order to compute core thermal power from the independent indicators, a set of baseline data is used for comparison. These baseline conditions are taken from a day when confidence in the value of core thermal power is high (i.e., immediately post outage when venturi fouling is not an issue or from a formal tracer test). This provides the reference point on which to base the core thermal power calculations for each of the independent parameters. The BEPM is effective only at the upper end of the power range, where the independent parameters generally vary in a highly predictable way with changes in core thermal power.

This paper will present a detailed description of the BEPM methodology, examples of the BEPM output, and examples of field application. Industry applications of the BEPM include monitoring venturi fouling, verification of an ultrasonic flow meter when used as in input to the secondary calorimetric, and monitoring the performance of other plant equipment that can affect core thermal power. When used routinely as part of a thermal performance monitoring program, the BEPM can be extremely effective in generation maximization, identification of equipment degradation or failure, and identification of potential overpower conditions.