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United States Nuclear Regulatory Commission
Attention: Document Control Desk
Mail Station P1-137
Washington, D. C. 20555

Subject: JAMES A. FITZPATRICK NUCLEAR POWER PLANT
DOCKET NO. 50-333
LEADING EDGE FLOW MONITOR (LEFM)
START-UP TESTING REPORT

Gentlemen:

Please find attached the Leading Edge Flow Monitor (LEFM) Start-up Testing Report for the James A. Fitzpatrick Nuclear Power Plant, which is submitted consistent with the reporting requirements of Section 6.9.a.1 of the Plant Technical Specifications.

Questions concerning this insert may be addressed to John R. Hoddy at (315) 349-6538.

Very truly yours,

Michael J. Colomb

MJC/GJT/JRH

CC: U.S. Nuclear Regulatory Commission Region 1
NRC Resident Inspector
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Background

Feedwater flow at the Fitzpatrick Plant is calculated using flow nozzles inside the feedwater pipes, which produce a differential pressure (ΔP) across the flow nozzle that is proportional to feedwater flow. A ΔP transmitter converts inches of water column to a proportional 10-50 milli-amp analog signal, which is sent to the Data Acquisition System (DAS). From DAS the signal is then transferred to the Emergency and Plant Information Computer (EPIC) which has analog-to-digital converters that translate analog signals to engineering units of flow. The EPIC computer then calculates and temperature compensates flow in pounds mass per hour. The feedwater flow for loops A & B is then transferred to 3D-Monicore for the calorimetric calculation of reactor power.

This type of measurement is susceptible to many potential errors such as: incorrect scaling of ΔP transmitters, nozzle calibration coefficient errors, calibration drifts of transmitters/process racks/A-D conversions, mechanical degradation of nozzles (by erosion/corrosion, dissimilar metals stress cracking, bypass flow, throat tap edge rounding, upstream tap protrusion), RTD temperature errors in mass flow conversions, and primarily, feedwater flow nozzle fouling. Feedwater nozzle fouling is very prominent and is characterized by a build-up of material on the nozzle wall. The material can consist of many elements such as magnetite, hematite, copper, crud, scale and various other corrosion products. The fouling can manifest itself as a permanent bias, a dynamic variable change with time and power history, or a combination of both types. It only takes approximately 10 mils of build-up to make an error in feedwater flow of nearly 1%. This type of bias is always conservative in that actual feedwater flow is less than indicated flow. As a result of this bias, the reactor plant cannot reach 100% full power. The plant calorimetric power determination will be in error the same amount as feedwater flow error, since there is a one-for-one correspondence in error.

On July 28, 1999, Plant Modification M1-96-061 accepted as permanent plant equipment (designated component number 06FM-100) and returned to service a Caldon Leading Edge Flowmeter previously installed by temporary modification. The Leading Edge Flowmeter (LEFM) consists of two ultrasonic flowmeter assemblies, each mounted externally on feedwater piping upstream of existing feedwater nozzles, and an electronics cabinet which receives and processes signals from LEFM transducers. The LEFM provides an independent and absolute measurement of feedwater flow, utilizing ultrasonic transient time methodology. The flowmeter is a continuous real time measurement that measures the dynamic flow conditions of the plant. The feedwater flow measurements as indicated by the LEFM are not subject to feedwater flow element fouling as described above and exhibit extremely good measurement repeatability.

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The LEFM is an ultrasonic flow measurement system that measures feedwater flow on loops A & B at FitzPatrick. The LEFM ultrasonic feedwater flow measurement system measures flow independently of the existing feedwater ΔP measurement system for both loops. The LEFM is not subject to the bias (fouling) experienced by ΔP flow meter systems. Since this is so, ΔP flow measurement values compensated by the LEFM derived flow values in the form of a correction factor (CF) result in a more accurate value of feedwater flow for input into 3D-Monicore and subsequent calorimetric calculation. The LEFM based correction factors are multiplied by the ΔP flow values in the EPIC plant computer, prior to input to 3D-Monicore.

The LEFM has no direct dynamic input into 3D-Monicore. The flow rate measured by the LEFM system is sampled by the LEFM system, and the flow rate obtained from the ΔP measurements is sampled by the EPIC computer. The correction factor is calculated by comparing the averages of the sampled data and manually entered into the EPIC computer in accordance with plant procedures. Based on this manually entered correction factor, the flow rates obtained from ΔP measurements are corrected by the EPIC and passed to 3D-Monicore. Part of the 3D-Monicore program is a calorimetric calculation, which determines reactor power. The plant continues to be operated within the licensed thermal power limit stated in the FSAR and Technical Specifications, based on the reactor power calculation of 3D-Monicore, but at a higher actual power level, due to compensation for flow measurement errors, as provided by the LEFM derived correction factor.

As described, the LEFM provides neither control function nor direct input into any control function at FitzPatrick. It is only used to provide a manually input correction factor to existing feedwater flow measurements, lessening the error inherent in these measurements. This does not result in any change in core thermal limits or existing analyses, nor does it directly affect plant controls or control functions. However, by lessening the amount of error in feedwater flow measurement, a primary input into core thermal power calculations (calorimetric), use of the LEFM permits the plant to produce power closer to the licensed limit. This results in a higher true power output from the plant than has previously been attainable.

<u>Summary of Testing</u>

Although use of the LEFM does not affect existing limits or analyses and does not involve uncertainties associated with core alterations, use of the LEFM would result in higher true power than was previously produced at FitzPatrick. Accordingly, a start-up test program was prepared and executed for the LEFM modification. The purpose of this program was two-fold:

- To assure LEFM performance, stability, and reliability prior to the performance of subsequent testing or raising of core thermal power to new, increased (actual) levels

- To demonstrate that operation at the increased actual core thermal power permitted by use of the LEFM Feedwater Flow Correction Factor does not adversely affect plant performance and that Core Thermal Limits are not exceeded.

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Testing was controlled by POT-06B, "Test Program For 06FM-100 (LEFM) Feedwater Flow Ultrasonic Monitor". This test was primarily administrative in nature, coordinating the sequence and directing the performance of other Tests/Procedures which constituted the LEFM Test Program. The overall LEFM test program was similar in nature to that employed for Power Uprate, employing some of the same elements as this previous program.

The test program commenced October 6, 1999, and was concluded satisfactorily December 17, 1999. General program elements consisted of the following:

- Demonstration of satisfactory LEFM performance and proper LEFM/EPIC Interface
- Establishment of stable plant conditions with Core Thermal Power (CTP) at or near 100 percent rated.
- Determination and input of an LEFM Feedwater Flow Correction Factor (CF) into 3D Monicore. The resultant calculation reflected a decrease in CTP.
- Collection of an extensive set of plant parameter data corresponding to the decreased CTP resulting from use of the LEFM CF.
- Evaluation and extrapolation of the collected plant parameter data prior to raising CTP to the increased (actual) level corresponding to 100 percent rated.
- Data collection and testing at the new (actual) 100 percent rated CTP. Testing included the following:

Procedure No.	**Title**
RAP-7.3.5	Core Power Symmetry Analysis
RAP-7.3.7	Core Flow Evaluation And Indication Calibration
RAP-7.3.14	Traversing Incore Probe System
RAP-7.3.29	Determination of Rated Recirculation Flow
RAP-7.4.3	LPRM Calibration
RES-SO-22	RES Department Power Uprate Testing
RP-OPS-08.01	Routine Surveys and Inspections
RT-01.02	Feedwater And Condensate Sampling And Analysis
SP-01.02	Reactor Water Sampling Analysis
SP-01.06	Gaseous Effluent Sampling and Analysis
SP-03.05	Steam Jet Air Ejector And Recombiner Sampling And Analysis
ST-5D	APRM
ST-5E	Core Performance Surveillance
TST-55	Feedwater Level Control Transient Test

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Procedure No.	**Title**
TST-59	Power Uprate Testing And Plant Monitoring

As stated, testing was completed satisfactorily December 17, 1999. Test records and supporting data are available for inspection at the James A. FitzPatrick Power Plant.