

# **Peach Bottom Atomic Power Station Units 2 and 3**

**License Amendment Request for  
Expanded Actions for LEFM Flow Meter Conditions**

**NRC Pre-Submittal Meeting  
May 31, 2018**



**Exelon Generation**<sup>®</sup>

# **Introductions Purpose and Agenda**

**Steve Minnick**



**Exelon** Generation<sup>®</sup>

# Attendees

---

<b>Steve Minnick – MUR Senior Project Manager</b>	<b>Exelon</b>
<b>Chris Weichler – Senior Manager, Operations</b>	<b>Exelon</b>
<b>Michael Lewis – LEFM System Engineer</b>	<b>Exelon</b>
<b>David Neff – Principal Regulatory Engineer</b>	<b>Exelon</b>
<b>Kelly Hamm – Senior Engineer</b>	<b>Exelon</b>

# Purpose

---

**Brief the NRC on a proposed PBAPS License Amendment Request to expand the number of Intermediate Power Levels from 1 to 4 when the LEFMs are not in CheckPlus (NORMAL) Mode**

# Agenda

---

- **PBAPS Station Overview (Chris Weichler)**
- **PBAPS LEFM System Overview (Mike Lewis)**
- **LEFM License Amendment Request (Dave Neff)**
- **Proposed Compensatory Measures (Chris Weichler)**
- **Uncertainty Calculation Approach (Kelly Hamm)**
- **Summary (Chris Weichler)**

# Station Overview

---

- **General Electric BWR-4, Mark I Containment**
- **Containment design pressure 56 psig**
- **Began commercial operation in 1974, OLTP 3293 MWt**
- **Extended Power Uprate in 2015 to 3951 MWt**
- **24-month operating cycle**
- **GNF2 full core**
- **Licensed for Increased Core Flow (ICF) (110%) and MELLA+**
- **Caldon (Cameron) CheckPlus<sup>®</sup> Leading Edge Flow Meter (LEFM) currently installed on Units 2 and 3 – Three FW lines**
- **Current Licensed Thermal Power 4016 MWt w/MUR Uprate & Intermediate Power Level for LEFM Check Mode condition**

# PBAPS LEFM System

---

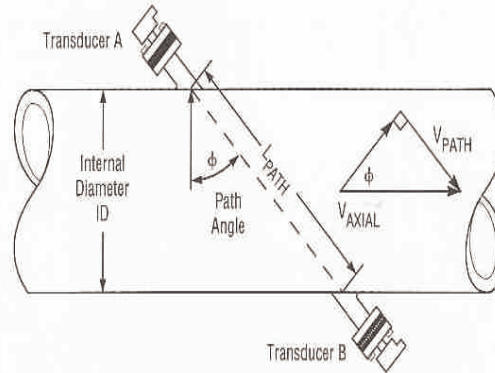
## ➤ Background

- **Original MUR uprate (1.62%) approved by NRC in 2002 based on installation of LEFM CheckPlus system**
- **The LEFM CheckPlus system has been operational at PBAPS since 2002**
- **EPU in 2015 did not incorporate MUR based on LEFM for simplicity of the LAR and NRC review. LEFMs continued to be primary means for FW flow measurement**
- **MUR Uprate (1.66%) NRC approved in 2017 included one intermediate power level with one or more LEFM(s) in Check Mode**

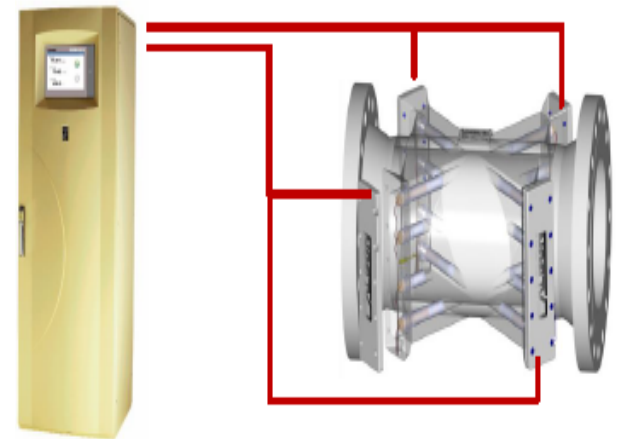
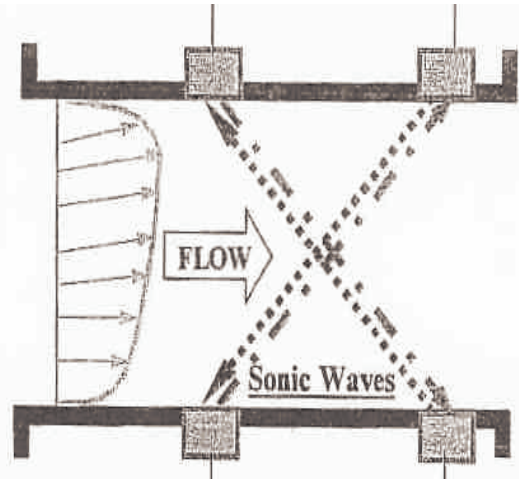
# PBAPS LEFM System

## PBAPS LEFM CheckPlus Schematic

Schematic  
Showing One  
Plane  
Check Mode



Schematic  
Showing Two  
Planes  
CheckPlus Mode





# PBAPS LEFM System – Modes

---

## ➤ Individual FW line LEFM Modes

### ❖ Operating Conditions

- **CheckPlus (NORMAL) – Both planes of the LEFM are fully functional**
- **Check (MAINTENANCE) – One plane of LEFM is not operable and flow measurement provided by operable plane**
- **FW flow measurement accuracy**

**CheckPlus (NORMAL) > Check (MAINTENANCE) > Venturi**

### ❖ Inoperable Condition

- **FAIL mode – Both planes of LEFM inoperable**
- **Flow measurement switched to Venturi (Venturi Mode)**

# Summary of License Amendment Request

---

- **PBAPS proposes to expand the number of Intermediate Power Levels from 1 to 4 when the LEFMs are not in CheckPlus Mode**
- **LEFM and Venturi uncertainties based on NRC-approved Cameron Topical Report and industry-standard method for statistical based uncertainty calculations**
- **LAR will address Simple Decision Making, Conservative Plant Operation, and Uncertainty Calculation Conservatism**
- **If approved, the changes will be incorporated into a revision to the Technical Requirements Manual (TRM)**
- **The Intermediate Power Level for each condition is based on the Total Power Uncertainty (TPU) for the LEFM conditions for each FW line**

# Proposed LEFM Expanded Actions

LEFM OPERATING CONDITIONS	Maximum Power Level (MWt)	
	Current	Proposed
All LEFMs in CheckPlus Mode	4016	4016
One LEFM in Check Mode and Two LEFMs in CheckPlus Mode	4010	4015
Two LEFMs in Check Mode and One in CheckPlus Mode		4013
Three LEFMs in Check Mode		4010
One LEFM in Venturi Mode and other LEFMs in CheckPlus or Check Mode	3951	3982
Two or three LEFM's in Venturi Mode		3951

# Reasons for Requested Change

---

- **Repair Requires Shutdown to Restore LEFM to CheckPlus Mode**
  - **LEFM spool pieces are located in High Radiation Area (3 R/hr dose rate field in steam tunnel) and acoustic transducers/cabling are inaccessible for repair**
  - **Power reduction of 65 MWt required until shutdown if one LEFM fails to Venturi Mode and cannot be restored in 72 hrs**
- **Optimization of Available Instrumentation Accuracy**
  - **Propose to take credit for greater accuracy of the other two LEFMs when one FW line is in Venturi Mode**
  - **Propose to take credit for greater accuracy of the LEFMs when one or two are in the CheckPlus Mode with none in Venturi Mode**
  - **Power reduction of 6 MWt required until shutdown if  $\geq 1$  LEFMs are in Check Mode and cannot be restored in 72 hrs**

# Regulatory Screening

---

- **LEFM and TPU calculation methodology is consistent with the NRC-approved methodology in Cameron Topical Report ER-157P-A, Rev 8**
- **NRC-approved topical reports do not consider use of a FW venturi for the TPU calculations**
- **Proposed compensatory measures and Intermediate Power Levels are based on updated uncertainty analyses that are expansion to the 2017 MUR Amendment**
- **Our review concluded prior NRC approval is required per 10 CFR 50.59**

# Simple and Conservative Implementation

---

## ➤ The LAR will address

- **Expanded TRM Conditions, Compensatory Actions and Completion times**
- **Bases for Simple Decision Making and Conservative Plant Operation, and**
- **Bases for and Conservatisms in TPU Calculation Approach**

# Simple Decision Making

---

- **More than 15 years of procedure experience and training in responding to LEFM(s) in Check Mode, failures and restoration to CheckPlus Mode**
- **LEFMs have been in-service for Core Thermal Power calculation since 2002**
- **LEFM status is continuously monitored with alarms in the Main Control Room**
- **Sufficient time for operators to recognize and take necessary actions when LEFM(s) change from CheckPlus Mode**

# Conservative Plant Operation

---

- **FW venturi flow measurement instrument loop calibrated every refueling outage**
- **LEFM/Venturi flow comparisons are monitored daily and trended**
- **Procedures require that a venturi be calibrated to its associated LEFM using data from the 24 hours prior to the time the LEFM went into Check or Venturi Mode, or was removed from service**
- **If it is not possible to calibrate a venturi to its associated LEFM, Core Power is reduced to its Required Intermediate Power Level after a period of 2 hours, rather than after the Required Compensatory Measure Completion Time of 72 hours**



# MAIN CONTROL ROOM INDICATIONS

18-MAY-2018 17:09:00

## LEFM INTERFACE DISPLAY

	STRING A	STRING B	STRING C	TOTALS & AVERAGES	
<b>LEFM STRING STATUS</b>	NORMAL	NORMAL	NORMAL		
LEFM UNCERTAINTY	0.0950 %	0.1020 %	0.1410 %	0.0660 %	Total
LEFM FDWTR VOLUME FLOW	1.235E+04 GPM	1.284E+04 GPM	1.236E+04 GPM	3.752E+04 GPM	Total
LEFM FDWTR TEMP	384.3 DEGF	382.5 DEGF	383.5 DEGF	383.4 DEGF	Avg
LEFM FDWTR MASS FLOW	5.40 M#/HR	5.62 M#/HR	5.41 M#/HR	16.43 M#/HR	Total
VENTURI FDWTR MASS FLOW	5.40 M#/HR	5.62 M#/HR	5.40 M#/HR		
VENTURI FDWTR TEMP	384.0 DEGF	382.2 DEGF	383.7 DEGF		
LEFM / VENTURI RATIO	0.9997	0.9985	0.9977		
VENTURI CORRECTION	1.0000	1.0000	1.0000		
FDWTR OPERATING MODE	LEFM	LEFM	LEFM		
				SYSTEM HEALTH	
				LEFM SYS	NORMAL
				LEFM PROG	RUNNING
				COMM LINK	ACTIVE
CHANGE   DWTR PARAMETERS/MODE	CORE THERMAL POWER		4014 MW		
	MAX ALLOWABLE POWER		4016 MW		

# Uncertainty Calculation Approach

---

- **LEFM FW Flowrate uncertainties and Total Thermal Power uncertainties are calculated using the same methodology as for the MUR LAR and the Cameron Topical Report ER-157P-A, Rev 8**
- **Venturi Flowrate measurement error was determined using ASME PTC-6 Report. Venturi measurement loop uncertainties are calculated in accordance with the approved Exelon Setpoint Methodology**
- **Total thermal power uncertainty results for a given condition from the more conservative unit are applied generically to both units**
- **Calculations use conservative values and assumptions as compared to actual plant data**

# Summary

---

- **15 years of experience with LEFM system and TRM Requirements**
- **Conservative calculations consistent with NRC-approved topical report and industry standards**
- **Operators monitor LEFM and venturi flow measurements in live time**

# Questions?



**Exelon** Generation<sup>®</sup>