Online Monitoring (OLM) with AMS at Duke Energy






Agenda

- Introduction
- Background
- License Amendment Request (LAR) Overview
- Technical Specification Changes
- Precedent
- Schedule Milestones
- Closing Remarks

Introduction

- The purpose of this meeting is to discuss a proposed license amendment request (LAR) for the following sites:
  - Brunswick Steam Electric Plant (BRU), Units 1 and 2
  - Catawba Nuclear Station (CAT), Units 1 and 2
  - McGuire Nuclear Station (MCG), Unit 1 and 2
  - H.B. Robinson Steam Electric Plant (HBR), Unit 2
- Duke Energy proposes to use an online monitoring (OLM) methodology as the technical basis to switch from a time-based surveillance frequency for channel calibrations to a condition-based calibration frequency based on OLM results
- The proposed license amendment revises BRU, CAT, MCG, and HBR Technical Specification (TS) 1.1, “Use and Application Definitions” and adds a new TS “Online Monitoring Program” (BRU TS 5.5.16, CAT TS 5.5.18, MCG TS 5.5.19, and HBR TS 5.5.19)

Background

- OLM has been developed and validated for condition monitoring applications in a variety of process and power industries and used to optimize maintenance of transmitters used as sensor input to control and protection systems
- OLM consists of collecting transmitter data throughout an operating cycle (including startup, shutdown, or other process cycles), analysis of data to detect transmitter drift or degradation in dynamic performance, and identification of transmitters that warrant a calibration check
- OLM methodology has been used for more than twenty years at the Sizewell B nuclear power plant

Background (cont.)

OLM is a proven methodology based on:

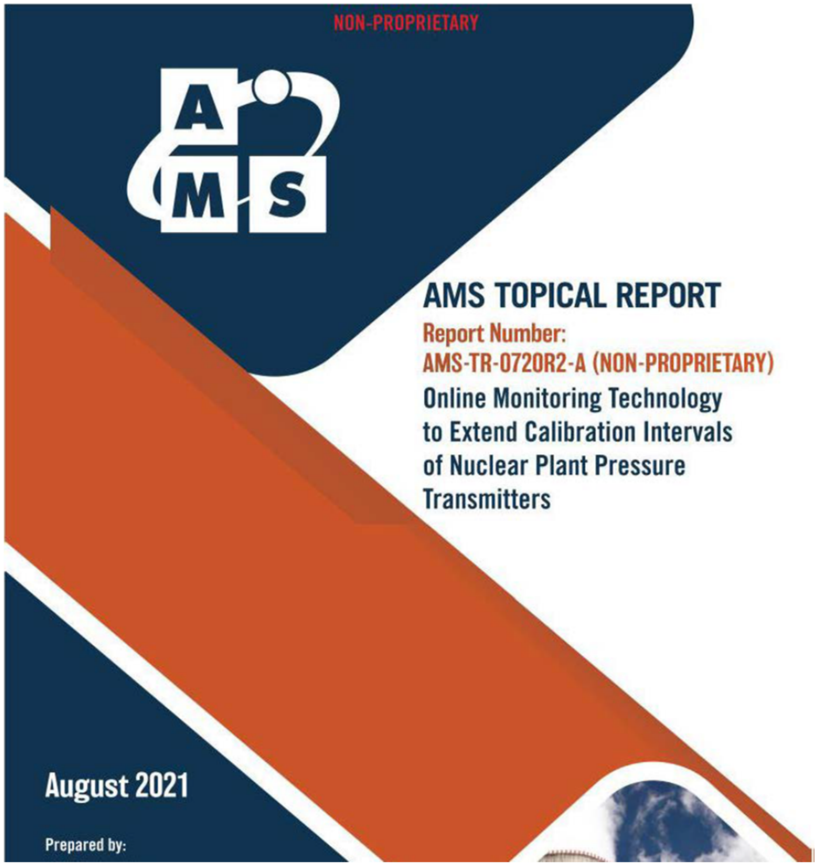
- Experience with OLM implementation in nuclear facilities
- Comparison between OLM results and manual calibrations
- Assessment of transmitter failure modes that can be detected by OLM
- Alignment with industry standards and guidelines

Background (cont.)

- In their Safety Evaluation (ML20231A208) the Nuclear Regulatory Commission (NRC) determined that the Analysis and Measurement Services Corporation (AMS) OLM methodology outlined can be used to provide reasonable assurance that required TS instrument calibration requirements for transmitters will be maintained because it:
  - Is effective at identifying instrument calibration drift during plant operation
  - Provides an acceptable means of identifying when manual transmitter calibration using traditional calibration methods are needed
  - Will maintain an acceptable level of performance that is traceable to calibration prime standards

License Amendment Request (LAR) Overview

- NRC approved AMS Topical Report AMS-TR- 0720R2-A, "Online Monitoring Technology to Extend Calibration Intervals of Nuclear Plant Pressure Transmitters" in August 2021:
- This TR was approved for use by licensees to support plant-specific technical specification changes to:
  - ➢ Switch from time-based calibration frequency of pressure, level, and flow transmitters to a condition-based calibration frequency based on OLM results; and
  - ➢ Assess dynamic failure modes of pressure sensing systems using the noise analysis technique



LAR Overview (cont.)

- Duke Energy is developing the OLM implementation process in accordance with OLM implementation methodology described in AMS-TR-0720R2-A for:
  - BRU Units 1 and 2
  - CAT Units 1 and 2
  - MCG Units 1 and 2
  - HBR Unit 2

LAR Overview – OLM Technical Evaluations

OLM Implementation Process Development

- Implementation of the OLM program for BRU, CAT, MCG, and HBR follows the steps identified in AMS-TR-0720R2-A Section 11.1.1.
- Steps 1-6 identify transmitters in the OLM program and determine how to obtain OLM data.
  - AMS Report BRU2501R0, “Amenable Transmitters Report for AMS Report Brunswick Units 1 and 2”
  - AMS Report CAT2501R, "OLM Amenable Transmitters Report for Catawba Units 1 and 2”
  - AMS Report MCG2405R0, "OLM Amenable Transmitters Report for McGuire Units 1 and 2”
  - AMS Report HBR2501R0, "OLM Amenable Transmitters Report for H.B. Robinson Unit 2”

LAR Overview – OLM Technical Evaluations (cont.)

OLM Implementation Process Development (cont.)

- Steps 7-8 address calculation of OLM limits and establish methods of OLM data analysis.
  - AMS Report BRU2502R0, "OLM Analysis Methods and Limits Report for Brunswick Units 1 and 2"
  - AMS Report CAT2502R0, "OLM Analysis Methods and Limits Report for Catawba Units 1 and 2"
  - AMS Report MCG2406R0, "OLM Analysis Methods and Limits Report for McGuire Units 1 and 2"
  - AMS Report HBR2504R0, "OLM Analysis Methods and Limits Report for H.B. Robinson Unit 2"

LAR Overview – OLM Technical Evaluations (cont.)

OLM Program Implementation

- Implementation of the OLM program for Duke Energy follows AMS-TR-0720R2-A Section 11.1.2.
  - A mapping AMS-TR-0720R2-A Section 11.1.2 and LAR sections where items are addressed is provided
  - Implementation of these steps is performed using AMS software programs
  - AMS Report BRU2503R0, "OLM Drift Monitoring Program Report for Brunswick Units 1 and 2"
  - AMS Report CAT2503R0, "OLM Drift Monitoring Program Report for Catawba Units 1 and 2"
  - AMS Report MCG2407R0, "OLM Drift Monitoring Program Report for McGuire Units 1 and 2"
  - AMS Report HBR2503R0, "OLM Drift Monitoring Program Report for H.B. Robinson Unit 2"

LAR Overview – OLM Technical Evaluations (cont.)

OLM Noise Analysis Implementation

- Implementation of the OLM program for Duke Energy follows AMS-TR-0720R2-A Section 11.3.3.
  - A mapping AMS-TR-0720R2-A Section 11.3.3 and LAR sections where items are addressed is provided
  - Implementation of these steps is performed using the qualified noise data acquisition equipment and software programs developed by AMS
  - AMS Report BRU2504R0, “OLM Noise Analysis Program Report for Brunswick Units 1 and 2”
  - AMS Report CAT2504R0, “OLM Noise Analysis Program Report for Catawba Units 1 and 2”
  - AMS Report MCG2408R0, “OLM Noise Analysis Program Report for McGuire Units 1 and 2”
  - AMS Report HBR2504R0, “OLM Noise Analysis Program Report for H.B. Robinson Unit 2”

LAR Overview – OLM Technical Evaluations (cont.)

- BRU2501R0, CAT2501R0, MCG2405R0, and HBR2501R0 address steps 1-6, from AMS-TR-0720R2-A Section 11.1.1 to establish amenable transmitters and data collection
- Step 1. Determine if Transmitters are Amenable to OLM
  - AMS-TR-0720R2-A Chapter 12 includes Table 12.4 that lists the nuclear grade transmitter models that are amenable to OLM. Any transmitter model that is not listed in this table should only be added to the OLM program if it can be shown by similarity analysis that its failure modes are the same as the listed transmitter models or otherwise detectable by OLM.

LAR Overview – OLM Technical Evaluations (cont.)

- Step 2. List Transmitters in Each Redundant Group
  - This step establishes how to group the transmitters and evaluates the redundancy of each group.
- Step 3. Determine if OLM Data Covers Applicable Setpoints
  - This step evaluates the OLM data for each group to determine if it covers applicable setpoints as described in AMS-TR-0720R2-A Chapter 14.
- Step 4. Calculate Backstops
  - A backstop, as described in AMS-TR-0720R2-A Chapter 13, must be established for each group of redundant transmitters amenable to OLM as a defense against common mode drift. The backstop identifies the maximum period between calibrations without calibrating at least one transmitter in a redundant group.

LAR Overview – OLM Technical Evaluations (cont.)

- Step 5. Establish Method of Data Acquisition
  - OLM data is normally available in the plant computer or an associated data historian. If data is not available from the plant computer or historian, a custom data acquisition system including hardware and software must be employed to acquire the data.
- Step 6. Specify Data Collection Duration and Sampling Rate
  - OLM data must be collected during startup, normal operation, and shutdown periods at the highest sampling rate by which the plant computer takes data. AMS-TR-0720R2-A Chapter 15 describes a process to determine the minimum sampling rate for OLM data acquisition to monitor for transmitter drift.

    AMS-TR-0720R2-A Chapter 8 describes a process to help determine the optimal sampling rate and minimum duration of OLM data collection.

LAR Overview – OLM Technical Evaluations (cont.)

The information on these Slides are considered Proprietary and are withheld from this presentation

a,b,f

- Examples of OLM Amenable Transmitters for Duke Energy (Using BRU 1 and 2 Data)
- Examples of OLM Amenable Transmitters for Duke Energy (Using CAT 1 and 2 Data)
- Examples of OLM Amenable Transmitters for Duke Energy (Using MCG 1 and 2 Data)
- Examples of OLM Amenable Transmitters for Duke Energy (Using HBR 2 Data)

LAR Overview – OLM Technical Evaluations (cont.)

Application Specific Action Items from AMS OLM TR

- ASAI 1 – Evaluation and Proposed Mark-up of Existing Plant Technical Specifications
  - TS changes provided in LAR are an adaptation from illustrative changes presented in AMS-TR-0720R2-A
  - Simplify the required plant-specific changes with no required changes to Channel Calibration and Response Time Surveillance Requirements
  - Online Monitoring Program description reorganized to better align with OLM implementation activities
  - Consistent with approved precedents

LAR Overview – OLM Technical Evaluations (cont.)

- ASAI 2 – Identification of Calibration Error Source
  - Calibration error for OLM signal path evaluated as part of the calculation of OLM limits as described in AMS-TR-0720R2-A
- ASAI 3 – Response Time Test Elimination Basis
  - OLM noise analysis methods adopted as basis for Response Time Test Elimination as prescribed in AMS-TR-0720R2-A
- ASAI 4 – Use of Calibration Surveillance Interval Backstop
  - Calibration surveillance interval backstop methods adopted as described in AMS-TR-0720R2-A

LAR Overview – OLM Technical Evaluations (cont.)

- ASAI 5 – Use of Criteria other than in AMS OLM TR for Establishing Transmitter Drift Flagging Limit
  - Criteria for Establishing Transmitter Drift Flagging Limits adopted as described in AMS-TR-0720R2-A ASAI 3 – Response Time Test Elimination Basis

LAR Table of Contents

LAR Table of Contents (cont.)

ATTACHMENTS

1. Technical Specification Mark-ups – BRU Unit 1
2. Technical Specification Mark-ups – BRU Unit 2
3. Technical Specification Mark-ups – CAT Units 1 and 2
4. Technical Specification Mark-ups – MCG Units 1 and 2
5. Technical Specification Mark-ups – HBR Unit 2
6. Technical Specification Bases Mark-ups – BRU Unit 1 (Information only)
7. Technical Specification Bases Mark-ups – BRU Unit 2 (Information only)
8. Technical Specification Bases Mark-ups – CAT Units 1 and 2 (Information only)
9. Technical Specification Bases Mark-ups – MCG Units 1 and 2 (Information only)
10. Technical Specification Bases Mark-ups – HBR Unit 2 (Information only)

Proposed TS Changes – TS Definitions

Proposed CHANNEL CALIBRATION – BRU 1 and 2

A CHANNEL CALIBRATION shall be the adjustment, as necessary, of the channel output such that it responds within the necessary range and accuracy to known values of the parameter that the channel monitors. The CHANNEL CALIBRATION shall encompass the entire channel, including the required sensor (excluding transmitters in the Online Monitoring Program), alarm, display, and trip functions, and shall include the CHANNEL FUNCTIONAL TEST. Calibration of instrument channels with resistance temperature detector (RTD) or thermocouple sensors may consist of an inplace qualitative assessment of sensor behavior and normal calibration of the remaining adjustable devices in the channel. The CHANNEL CALIBRATION may be performed by means of any series of sequential, overlapping, or total channel steps so that the entire channel is calibrated.

Proposed TS Changes – TS Definitions (cont.)

Proposed CHANNEL CALIBRATION – CAT 1 and 2, MCG 1 and 2, and HBR 2

A CHANNEL CALIBRATION shall be the adjustment, as necessary, of the channel so that it responds within the required range and accuracy to known input. The CHANNEL CALIBRATION shall encompass the entire channel, including the required sensor, alarm, interlock, display, and trip functions (excluding transmitters in the Online Monitoring Program). Calibration of instrument channels with resistance temperature detector (RTD) or thermocouple sensors may consist of an inplace qualitative assessment of sensor behavior and normal calibration of the remaining adjustable devices in the channel. Whenever a sensing element is replaced, the next required CHANNEL CALIBRATION shall include an inplace cross calibration that compares the other sensing elements with the recently installed sensing element. The CHANNEL CALIBRATION may be performed by means of any series of sequential, overlapping calibrations or total channel steps so that the entire channel is calibrated.

Proposed TS Changes – TS Definitions (cont.)

Proposed definition of ECCS RESPONSE TIME – BRU 1 and 2

The ECCS RESPONSE TIME shall be that time interval from when the monitored parameter exceeds its ECCS initiation setpoint at the channel sensor until the ECCS equipment is capable of performing its safety function (i.e., the valves travel to their required positions, pump discharge pressures reach their required values, etc.). Times shall include diesel generator starting and sequence loading delays, where applicable. The response time may be measured by means of any series of sequential, overlapping, or total steps so that the entire response time is measured. In lieu of measurement, response time may be verified for transmitters in the Online Monitoring Program provided that the methodology for verification has been previously reviewed and approved by the NRC.

Proposed TS Changes – TS Definitions (cont.)

Proposed definition of ISOLATION INSTRUMENTATION RESPONSE TIME – BRU 1 and 2

- The ISOLATION INSTRUMENTATION RESPONSE TIME shall be that time interval from when the monitored parameter exceeds its isolation initiation setpoint at the channel sensor until the isolation valves receive the isolation signal (e.g., de-energization of the MSIV solenoids). The response time may be measured by means of any series of sequential, overlapping, or total steps so that the entire response time is measured. In lieu of measurement, response time may be verified for transmitters in the Online Monitoring Program provided that the methodology for verification has been previously reviewed and approved by the NRC.

Proposed TS Changes – TS Definitions (cont.)

<u>Proposed definition of RPS RESPONSE TIME – BRU 1 and 2</u>

The RPS RESPONSE TIME shall be that time interval from SYSTEM (RPS) RESPONSE when the monitored parameter exceeds its RPS trip setpoint TIME at the channel sensor until de-energization of the scram pilot valve solenoids. The response time may be measured by means of any series of sequential, overlapping, or total steps so that the entire response time is measured. In lieu of measurement, response time may be verified for transmitters in the Online Monitoring Program provided that the methodology for verification has been previously reviewed and approved by the NRC.

Proposed TS Changes – TS Definitions (cont.)

Proposed definition of TURBINE BYPASS SYSTEM RESPONSE TIME – BRU 1 and 2

The TURBINE BYPASS SYSTEM RESPONSE TIME consists of two components:

a. The time from initial movement of the main turbine stop valve or control valve until 80% of the turbine bypass capacity is established; and

b. The time from initial movement of the main turbine stop valve or control valve until initial movement of the turbine bypass valve.

The response time may be measured by means of any series of sequential, overlapping, or total steps so that the entire response time is measured. In lieu of measurement, response time may be verified for transmitters in the Online Monitoring Program provided that the methodology for verification has been previously reviewed and approved by the NRC.

Proposed TS Changes – TS Definitions (cont.)

Proposed definition of ESF RESPONSE TIME – CAT 1 and 2 and MCG 1 and 2

The ESF RESPONSE TIME shall be that time interval from when the monitored parameter exceeds its ESF actuation setpoint at the channel sensor until the ESF equipment is capable of performing its safety function (i.e., the valves travel to their required positions, pump discharge pressures reach their required values, etc.). Times shall include diesel generator starting and sequence loading delays, where applicable. The response time may be measured by means of any series of sequential, overlapping, or total steps so that the entire response time is measured. In lieu of measurement, response time may be verified for selected components provided that the components and the methodology for verification have been previously reviewed and approved by the NRC (including transmitters in the Online Monitoring Program), or the components have been evaluated in accordance with an NRC approved methodology.

Proposed TS Changes – TS Definitions (cont.)

Proposed definition of RTS RESPONSE TIME – CAT 1 and 2 and MCG 1 and 2

The RTS RESPONSE TIME shall be that time interval from when the monitored parameter exceeds its RTS trip setpoint at the channel sensor until loss of stationary gripper coil voltage. The response time may be measured by means of any series of sequential, overlapping, or total steps so that the entire response time is measured. In lieu of measurement, response time may be verified for selected components provided that the components and the methodology for verification have been previously reviewed and approved by the NRC (including transmitters in the Online Monitoring Program), or the components have been evaluated in accordance with an NRC approved methodology.

Proposed TS Changes – TS Definitions (cont.)

Proposed definition of RTS RESPONSE TIME – CAT 1 and 2 and MCG 1 and 2

The RTS RESPONSE TIME shall be that time interval from when the monitored parameter exceeds its RTS trip setpoint at the channel sensor until loss of stationary gripper coil voltage. The response time may be measured by means of any series of sequential, overlapping, or total steps so that the entire response time is measured. In lieu of measurement, response time may be verified for selected components provided that the components and the methodology for verification have been previously reviewed and approved by the NRC (including transmitters in the Online Monitoring Program), or the components have been evaluated in accordance with an NRC approved methodology.

Proposed TS Changes – Programs

Online Monitoring Program

- BRU 1 and 2 TS 5.5.16
- CAT 1 and 2 TS 5.5.18
- MCG 1 and 2 TS 5.5.19
- HBR 2 TS 5.5.19

Proposed TS Changes – Programs (cont.)

Online Monitoring Program

This program provides controls to determine the need for calibration of pressure, level, and flow transmitters using condition monitoring based on drift analysis. It also provides a means for in-situ dynamic response assessment using the noise analysis technique to detect failure modes that are not detectable by drift monitoring.

The Online Monitoring Program must be implemented in accordance with AMS-TR-0720R2-A, "Online Monitoring Technology to Extend Calibration Intervals of Nuclear Plant Pressure Transmitters" (proprietary version). The program shall include the following elements:

a. Implementation of online monitoring for transmitters that have been evaluated during the plant operating cycle in accordance with an NRC approved methodology.
   1) Analysis of online monitoring data to identify those transmitters that require a calibration check and those that do not require a calibration check.
   2) Performance of online monitoring using noise analysis to assess in-situ dynamic response of transmitters that can affect response time performance.
   3) Calibration checks of identified transmitters no later than during the next refueling outage.
   4) Documentation of the results of the online monitoring data analysis.

b. Performance of a calibration check for any transmitter where the online monitoring was not implemented during the plant operating cycle no later than during the next refueling outage.

c. Performance of calibration checks for transmitters at the specified backstop frequencies.

d. The provisions of Surveillance Requirement 3.0.3 are applicable to the required calibration checks specified in items a.3, b, and c above.

Precedents

- The Duke Energy license amendment request to extend calibration intervals of nuclear plant pressure transmitters using AMS-TR-0720R2 is similar to the NRC-approved license amendment request submitted by Southern Nuclear Operating Company for Vogtle Electric Generating Plant Units 1 and 2 (see ML22355A588 and ML23115A149) and Farley Nuclear Plant Units 1 and 2 and Hatch Nuclear Plant Units 1 and 2 (See ML24124A133 and ML24351A080)

Schedule Milestones

- Duke Energy to submit LAR to NRC by September 18, 2025.
- Request NRC approval within 1-year from submittal.
- 6-month day implementation following NRC approval.

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