

U.S. Nuclear Regulatory Commission Public Meeting Summary

May 29, 2026

Title: Public Meeting on Condition Monitoring

Meeting Identifier: 20260408

Date of Meeting: May 19, 2026, 1:00 PM – 4:30 PM

Location: Hybrid, One White Flint North, 01F23 and Microsoft Teams

Type of Meeting: Information Meeting with a Question and Answer Session.

Purpose of Meeting:

The purpose of this meeting was to gather and exchange information regarding industry advancements and plans for the use of digital condition monitoring and the use of centralized maintenance and diagnostic (M&D) centers. Information gathered from advanced reactor designers, vendors, and applicants will support future development of NRC research and guidance, as needed, to enable efficient regulatory review and oversight.

Summary of Presentations Portion of Meeting:

Meredith Neubauer (NRC) opened the meeting, introducing herself as the facilitator. She provided an overview of the meeting logistics, participation guidelines, and the category of the meeting. A notice of recording was given. She concluded by introducing AJ Scheuermann (NRC), a reactor engineer and meeting organizer.

AJ introduced Christian Araguas (NRC), division director and agency code & standards executive, to provide opening remarks. Mr. Araguas discussed the current level of interest in expanding the scope of condition monitoring. He noted the issuance of the latest AMSE Operations and Maintenance (OM-2) standard, “Component Testing Requirements at Nuclear Facilities” and the NRC’s active review and development of guidance. He emphasized that information shared today would inform the NRC’s approach to enabling condition monitoring technologies in the near-term. He concluded by introducing Tom Scarbrough (NRC), the moderator for the meeting and lead technical reviewer for inservice testing programs.

The meeting then proceeded with presentations from the NRC, Idaho National Laboratory, and industry representatives, all introduced by Tom Scarbrough.

1. Dr. Raj Iyengar, NRC

Dr. Iyengar briefly introduced NRC regulations on maintenance approach and inservice testing, as well as the definition of advanced condition monitoring. He described the ability of advanced condition monitoring to enable a performance-based real-time monitoring program for maintenance and inservice testing, highlighting some reports issued by NRC on the subject. He discussed the NRC’s work with digital twins and the major technical considerations for deployment: information, communication, integration, analysis, and control. Dr. Iyengar also highlighted a recent report on a risk-informed approach for reviewing condition monitoring. He briefly addressed the NRC’s current work on condition monitoring, and the new process being used to issue the NRC’s guidance for ASME OM-2.

2. Dr. Jacob Farber, Idaho National Laboratory

Dr. Farber is a research scientist at INL in the Light Water Reactor Sustainability Program, and his presentation was titled “AI-Driven Technologies for Condition Monitoring and Decision Support”, providing an overview of INL’s work on the topic. He presented INL’s scalable framework for condition monitoring, using varied data for detection and informed decision support, intended to increase plant capacity factor. The topics also include the ALARM method developed by INL to be a flexible, equipment-agnostic set of models for anomaly detection, and AI foundation models that can process multimodal plant data of multiple types. INL also developed an AI architecture for root cause analysis, and incorporated economic analysis into plant generation risk for risk-informed asset management decisions. The goal is proactive, predictive condition assessment to optimize capacity factors and strengthen grid reliability.

3. Scott Nedrow, Curtiss-Wright

Mr. Nedrow, a senior performance engineer, presented Curtiss-Wright’s pattern recognition software, which detects anomalies before tripping factory alarm limits to enhance preventative maintenance. He explained that Curtiss-Wright’s models have dynamic alarm thresholds, which alarm before traditional limits allowing for earlier decision making, working during planned outages, and avoiding control room alarms and catastrophic failures. Mr. Nedrow included a case study of a bearing oil pump that had tripped without alarm. He explained that the software excels at detecting bad or unreliable instruments, which constitute most of their alarms. He concluded with a demonstration of the tool and explained how Curtiss-Wright models are created and verified.

4. Giancarlo Lenci, Metroscope

Dr. Lenci, scientific director and senior operations manager, presented on centralized monitoring and actionable diagnostics for nuclear plant equipment health. He identified four pain points addressed by enhanced condition monitoring: troubleshooting uncertainty, sensor coverage, limited risk-based prioritization, and alarm noise, with an average of 5 Mwe lost to performance-related faults. He explained 3 tiers of digital twin functionality, and Metroscope’s ability to provide simultaneous holistic diagnostics for faults, including magnitude. Dr. Lenci described Metroscope’s contributions to an ARPA-E project to increase plant output through power uprates by improving operating data accuracy and reduce operating costs through enhanced reliability and maintenance in safety-related auxiliary systems. He envisions the next level of enhancement to be automated diagnostics with risk-informed decision support assisted by AI, ultimately to be included in standards and regulations when the effectiveness is proven.

5. Steven Unikewicz, TerraPower

Mr. Unikewicz is the chief engineer of plant engineering for TerraPower’s Sodium plant in Kemmerer, Wyoming, and did not have a visual presentation. He described how the Sodium molten salt small modular reactor is risk-informed and performance-based design using NEI 18-04 Rev. 1 and NRC Regulatory Guide 1.233 and aims to be online in 2030. The design uses passive safety features, with primary safety-related components being air-operated valves. TerraPower intends to include ASME codes QME-1, AG-1, and OM-2 in the Kemmerer FSAR, using continuous condition monitoring to meet the requirements of the latter two codes. He explains that all valves in the plant could be continuously monitored on site or remotely for degradation, and maintenance engineers would determine appropriate maintenance timeframes

from that data. TerraPower hopes to eventually have 9 units monitored remotely from a centralized location.

Some key points expressed during the presentations were: (1) There is significant interest in advanced condition monitoring as a way to determine maintenance needs before equipment failure, and schedule maintenance for planned outages to increase overall equipment uptime (2) There is significant interest in AI as a tool to analyze sensor data and diagnose the cause of alarms. NRC must be prepared to assess and approve these applications in a risk-informed manner.

Summary of Discussion Portion of Meeting:

Thomas Scarbrough moderated the discussion session during the meeting. The following topics were discussed:

1. An inquiry as to the INL data sources for its algorithm testing. INL worked with Utility Service Alliance to obtain real plant data to test its algorithms, and has worked with other utilities to obtain over 1000 sensor hours of data for practical testing.
2. A request to consider existing standards on digital twins from the International Organization for Standardization/International Electrotechnical Commission, ISO/IEC standards 30172 and 30173. Other standards mentioned for consideration are International Society for Automation (ISA) standard S18 and IEC 62682 on alarm management.
3. A discussion on NRC regulatory hook, and scope of oversight for condition monitoring on non-safety related systems. NRC is working to be prepared for any application using advanced condition monitoring to satisfy a host of regulatory requirements, with particular attention to inservice testing requirements.
4. An inquiry about ideal sensor parameters for development of new sensors
5. A comment on incorporating experience with condition monitoring and failure mode models, using a strong technical basis. Different failure modes require different sensors, and must be understood for diagnostics and proper risk evaluation.
6. An inquiry about how to approach development of a new type of sensor. Testing and data collection to verify functionality and prove it can detect what it is supposed to are key factors.

Juan Peralta (NRC) delivered closing remarks, thanking all participants for engaging in the public meeting. He expressed the NRC's goal to be flexible and provide a framework for licensees to use. He also mentioned the NRC may look at cybersecurity when considering condition monitoring.

Meredith Neubeuer (NRC) adjourned the meeting, noting that members of the public can also ask questions outside of the meeting, by contacting the appropriate NRC contact, and by using the NRC Public Meeting Feedback form at "feedback.nrc.gov" and meeting code 20260408.

Related Documents

[ML26134A081](#) – 05/19/2026 Public Meeting on Digital Condition Monitoring for Nuclear Facilities

Attendees:

Full Name	Affiliation
Ahmad Y. Al Rashdan	INL
Sari Alkhatib	ANL
Alexis Aponte	NRC
Christian Araguas	NRC
Odunayo Ayegbusi	NRC
Sarah Ayers	NRC
Stewart Bailey	NRC
Sam Bina	NRC
Thomas Braudt	Aalo
Brandon Brice	Emerson
Nicholas Camilli	EPRI
Alan Campbell	NEI
Brad Carlberg	
Ellery Coffman	NRC
Cynthia Costello	NY St Gov
Matthew Dennis	NRC
Michael Empey	Jensen Hughes
Jacob Fakory	NJ St Gov
Jacob Farber	INL
Ismael Garcia	NRC
Veena Gubbi	NJ St Gov
Mauricio Gutierrez	NRC
Nicholas Hansing	NRC
Matthew Hinman	EPRI
Nathan Hottle	Framatome
John Hughey	NRC
Barry Ives	UMD
Raj Iyengar	NRC
Larry Jones	NRC
Joshua Kaizer	NRC
David King	EPRI
Kenneth Kolaczyk	NRC
Taylor Lamb	NRC
John Lane	NRC
Matt Laney	
Erwin Laureno	NuScale
Giancarlo Lenci	Metroscope

Bruce Lin	NRC
Curtis Lurvey	NRC
Michael Magyar	NRC
Matthew Marquez	
Todd Matthews	Framatome
Charles McFeaters	NRC
Jill Monahan	PSU
Dominik Muszynski	
Jared Nadel	NRC
Scott Nedrow	Curtiss-Wright
Curt Nehr Korn	DOE
Christopher Nellis	NRC
Meredith Neubauer	NRC
Caty Nolan	NRC
Ingrid Nordby	Amentum
Juan Peralta	NRC
Lundy Pressley	NRC
Eric Rasmussen	
Ben Robinson	Metroscope
Kendall Ruiz Acevedo	Emerson
Thomas Scarbrough	NRC
Andrew Scheuermann	NRC
Farshid Shahrokhi	Framatome
Amy Sharp	NRC
Robert Sharpe	Framatome
Kristine Ung	UMD
Steven Unikewicz	TerraPower
Kelli Voelsing	NEI
Mary Walker	Neal Gross & Co.
Collin Weigert	
Jing Xing	NRC
Chen Yang	UMD
Stew Yuen	NRC

Appendix A: Full Speaker Biographies

Christian Araguas – Division Director, US NRC

Christian J. Araguas serves as the Director of the Division of Engineering (DE) in the Office of Nuclear Regulatory Research (RES). Mr. Araguas joined the U.S. Nuclear Regulatory Commission (NRC) in 2001 as a co-op and then permanently in 2003 in the Office of Nuclear Reactor Regulation (NRR) as part of the Nuclear Safety Professional Development Program working as a Project Manager for operating reactors. Since then, he has served in various capacities, including as a Project Manager in the Office of New Reactors (NRO); Technical Assistant for Division of Advanced Reactors and Rulemaking in NRO; Chief of both the Containment, Structural, and Thermal Branch and the Inspection and Operations Branch in the Division of Spent Fuel Management in the Office of Nuclear Material Safety and Safeguards (NMSS); Deputy Director in the Division of Fuel Management in NMSS; Executive Technical Assistant to the NRC's Executive Director for Operations focusing on both technical and corporate offices; Deputy Director for the Division of Risk Analysis in RES. He also completed temporary assignments as the Acting Deputy Director for the Division of Systems Analysis in RES; Acting Deputy Director in the Division of Reactor Oversight in NRR; and Acting Deputy Director in the Division of Reactor Projects in Region II. Mr. Araguas also served in the Senior Executive Service (SES) position of Director in the Division of Risk Analysis in RES .

Mr. Araguas received a bachelor's degree in electrical engineering from the Pennsylvania State University and is a graduate of both the NRC's Leadership Potential Program and the NRC's SES Candidate Development Program.

Thomas G. Scarbrough – Senior Mechanical Engineer, US NRC

Thomas Scarbrough is a Senior Mechanical Engineer in the Mechanical Engineering and Inservice Testing Branch in the Division of Engineering and External Hazards of the NRC Office of Nuclear Reactor Regulation. Mr. Scarbrough's career with the NRC extends over 45 years and encompasses a wide range of assignments. He currently serves as the NRR lead technical reviewer for inservice testing programs at nuclear power plants licensed by the NRC.

Raj Iyengar – Branch Chief, US NRC

Dr. Iyengar leads the Reactor Engineering Branch in the Division of Engineering in the office of Nuclear Regulatory Research. He has over 30 years of professional experience in corporate and technical leadership positions. He oversees the regulatory research activities in the areas of reactor component performance, operations and maintenance of reactor mechanical systems, physical security, digital twins, and advanced fuel management. He received the NRC Meritorious Service award recently. Raj has authored or coauthored over 70 publications in digital twin applications, modeling and simulation of mechanical systems, and reactor component integrity, materials degradation, development of steels, structural optimization, and computational mechanics. Raj holds a PhD in solid mechanics and a MS in applied mathematics from Brown University, and an MS in mechanics and material sciences from Rutgers University, and an MS in metallurgy from the Indian Institute of Science.

Jacob Farber, Ph.D. – Research Scientist, Idaho National Laboratory

Jacob Farber, Ph.D., is a research scientist at Idaho National Laboratory in the Plant Optimization Department. Dr. Farber earned his B.S. from the University of Rochester and his Ph.D. from the University of Pittsburgh, both in Mechanical Engineering, and was a U.S.

Department of Energy Nuclear Energy University Program Graduate Fellow. His research merges control theory with machine learning to enhance the operation of nuclear power plants, aiming to improve performance and economics while strengthening safety and reliability. This has included extensive work on anomaly detection, online monitoring, and autonomous operations for advanced reactors. His efforts have led to the development of two software tools — ALARM (Automated Latent Anomaly Recognition Method), available for licensing through INL, and COMMAND (Control and Optimization Modular Modeling Application for Nuclear Deployment), which is open source.

Scott Nedrow – Senior Performance Engineer, Curtiss-Wright

Scott Nedrow currently serves as a Senior Performance Engineer for Curtiss Wright's Plant Optimization Division. He has 19 years of experience in the thermal performance improvement of power plants. His responsibilities include thermal performance modeling and consulting services to electric generating utilities. Scott has also been involved with creating complex automated reports and performing thermal performance software training. He has a bachelor's degree in Mechanical Engineering from the University of Idaho.

Giancarlo Lenci – Scientific Director and Senior Operations Manager, Metroscope

Giancarlo Lenci is Scientific Director and Senior Operations Manager at Metroscope, based in Alexandria, VA, USA. His responsibilities include scientific leadership, serving as principal investigator on customer-funded research projects, and overseeing operations related to the deployment of Metroscope digital twins at power plants across North America.

During his 3.5 years at Metroscope, he has led the delivery of software products at ten power plants, supporting the full business cycle. He has also conceptualized and led the development of several advanced technologies, including fault-informed capacity forecasting (EPRI report 3002033101), diagnostics-driven sensor optimization (Conexus report COG-24-4056), fault-tolerant data validation and reconciliation (DVR), automated diagnostics of auxiliary systems, and diagnostics-informed quantitative risk assessment.

His work has been recognized through selection as a performer in the 2024 EPRI Incubatenergy Labs Challenge and as a finalist for the 2026 challenge (with award decisions pending at the time of writing). Giancarlo has served as principal investigator on approximately ten projects sponsored by the U.S. Department of Energy, EPRI, and Canadian Nuclear Laboratories, and has conceptualized and led research resulting in two ARPA-E plus-up awards. Prior to joining Metroscope, Giancarlo was a Senior Engineer at Dominion Engineering, Inc. (DEI), a leading U.S. provider of specialized nuclear engineering services, for six years. His clients included power utilities, EPRI, and the U.S. Department of Energy.

Between his roles at DEI and Metroscope, he authored 17 EPRI reports. He has also published numerous journal articles, conference proceedings, and holds a patent. Giancarlo is a member of the ASME PTC DVR Standards Committee and is regularly invited to present at EPRI technical meetings, including those focused on Balance of Plant, Fleetwide Monitoring, and Program 223 (heat rate and flexibility).

He earned his Ph.D. in Nuclear Science and Engineering from MIT in 2016. During his Ph.D. at MIT (2016), he developed a novel CFD hybrid turbulence modeling methodology that has been adopted and validated by multiple research groups worldwide.

Steven Unikewicz – Chief Engineer, Plant Engineering, TerraPower Kemmerer

Mr. Unikewicz is the Chief Engineer – Plant Engineering for TerraPower's Sodium Plant in Kemmerer Wyoming. He has 44 years of commercial nuclear experience at Connecticut Yankee, Millstone, the USNRC, NuScale and various other companies including TerraPower. An ASME Fellow, he is a member of ASME's Board on Nuclear Codes and Standards, OM and QME.

Juan Peralta – Deputy Division Director, US NRC

Mr. Peralta has over 30 years of nuclear power plant-related design, engineering, licensing, inspection, and enforcement experience, including quality assurance, initial test programs, supplier oversight, and security and safeguards programs. Since joining the NRC in 1993 as an Operations Engineer, he has held positions of increasing responsibility including Acting Chief, Security Oversight Section, Division of Nuclear Security, Office of Nuclear Security and Incident Response, and Chief, Quality and Vendor Inspection Branch, Division of Inspection and Operational Programs, Office of New Reactors.

In January 2012, he left the NRC for a position in the private sector as Director, Quality Programs and Assessments, at a multi-national nuclear power plant design and engineering company. He returned to the NRC in 2014 and is currently the Acting Deputy Director, Division of Physical and Cyber Security Policy, Office of Nuclear Security and Incident Response.

Mr. Peralta received a bachelor's degree in Electrical Engineering from the Florida Institute of Technology, and a master's degree in Systems Engineering from Johns Hopkins University. Before joining the NRC, Mr. Peralta worked in the private sector for an architect/engineering firm at several nuclear reactor sites.