VISITING COMMITTEE ON ADVANCED TECHNOLOGY (VCAT or Committee)
MINUTES OF THE TUESDAY, JUNE 11, 2024, HYBRID MEETING

*virtual attendance

ATTENDANCE:

Visiting Committee Members Attending
Fox, Glenn*
Ghosh, Monisha
Johnson, Anthony M.
Kaler, Eric
Khan, Mehmood
Matusow, Jason
Murray, Cherry
Parker, Michelle
Pierpoint, Mark

Designated Federal Officer
Shaw, Stephanie

NIST Leadership Board
Adams, James
Bahar, Mojdeh
Boehm, Jason
Brockett, Del
Chin, Joannie*
Fangmeyer, Robert (Bob)*
Folk, Alex*
Jenkins, George E.*
Johnson, Janelle*
Kushmerick, James
Locascio, Laurie
Mackey, Elizabeth (Liz)
Midzor, Melissa
Molnar, Michael (Mike)*
Olthoff, James (Jim)
Rao, G. Nagesh*
Romine, Charles (Chuck)*
Sastry, Chandan*
Stine, Kevin
Szakal, Christopher
Vaughn, Robert (Skip)
Wixon, Henry*

NIST Staff
Allocca, Clare
Arissian, Ladan*
Averill, Jason*
Ayala, Melissa*
Barbosa, Nicholas
Boeckl, Kaitlin (Katie)
Boggs-Russell, Ashley*
Britt-Crane, Michael*
Brown, Hannah*
Bruce, Sally*
Brunner, Zahraha (Zara)*
Buchanan, Kerrianne*
Cancino, Jannet*
Chang, Walter*
Cheng, Adrienne*
Chu, Pamela (Pam)*
Chukran, Melinda*
Conrad, Brad*
Coolbroth, Dana*
Corwin, Kristan*
David, Lindra*
Devereaux, Doug*
Dohne, Kirk*
Donley, Elizabeth
Fasolka, Michael
Feldman, Ari*
Fellows, Holly*
Fraser, Gerald (Jerry)*
Fronczek, Lisa*
Garcia, Bonnie*
Goldstein, Barbara*
Gonzalez, Carlos*
Hardis, Jonathan*
Hildebrand, Jacqueline*
Hooker, Stephanie*
Huergo, Jennifer*
Ipri-Brown, Susan*
Ivy, Nahla*
Jahanmir, Said*
Jones, Christina*
Kagan Guthrie, Benjamin*
Kauffman, Leah*
Kelly, Elizabeth*
Kim, Yekyung*
Knight, Christina*
Lamboy, Jorge*
Lawson, Jeremy*
Leonard, Cheryl*
Madsen, Mark*
Mani, Mahesh*
Martin, Natalia*
Materese, Robin*
Meritis, Dimitrios*
Morrow, Jayne*
Moylan, Shawn*
Nadal, Maria*
Newton, Thomas*
Perkins, John*
Phillips, Brandyi*
Pollack, Charles*
Pollard, Shelly*
Polyakov, Sergey
Popkin, Gabriel*
Press, Rich*
Rapp, Kathleen (Katie)*
Reidy, Kari*
Roberts, Kathleen (Kamie)*
Rogers, Kelley*
Rosa, Jennifer*
Rudnitsky, Robert*
Rushing, Erin*
Sberegaeva, Anna
Schlatter, Katie M.*
Sharpless, Kathy*
Shepard, Scott
Snow, Heather*
Shyam-Sunder, Sivaraj*
Snowden, Hope*
Sofka, Holly
St. Pierre, James (Jim)*
Stambaugh, Corey*
Sullivan, Suzanne*
Szuchyt, April*
Tabassi, Elham*
Tarlov, Michael (Mike)*
Thompson, Alan Keith*
Tran, Kimmai*
Vanek, Anita*
VanLandingham, Mark*
Wasil, Charles*
Whetstone, James*
Widdup, Joseph*
Yao, Jue*
Yashar, David*

Others
Harder, Josh – Lewis-Burke Associates LLC
Luckett, Mia - Lewis-Burke Associates LLC
McKenzie, Lindsay – AIP Science Policy News
Monyei, Yvonne – OIG/DOC
Mulberry, Karen – IEEE Standards Association
Steinberg, Brett – OIG/DOC
Webber, Naomi – Lewis-Burke Associates LLC

Tuesday, June 11, 2024

SESSION I: NIST PROGRAMMATIC UPDATES

Call to Order – *Mr. Jason Matusow, VCAT Chair*

Mr. Matusow called the meeting to order at 9:00 a.m. He thanked the outgoing VCAT chair, Dr. Mehmood Khan and vice chair, Dr. Keoki Jackson, for their service. He welcomed two new VCAT members, Dr. Cherry Murray and Dr. Glenn Fox. He then reviewed the meeting logistics and took roll call before turning the meeting over to Dr. Laurie Locascio.

Welcome Remarks & VCAT Meeting Pre-read – ***Dr. Laurie Locascio, Under Secretary of Commerce for Standards and Technology and NIST Director***

Dr. Locascio thanked the VCAT members for making the trip to the Boulder campus. She echoed Mr. Matusow's welcoming of the two new VCAT members, Dr. Murray and Dr. Fox. She also shared a NIST leadership change, with Dr. Kathryn Beers being confirmed as the new Director of the Material Measurement Laboratory (MML).

Dr. Locascio testified in May before the House Committee on Science, Space, and Technology to discuss the fiscal year (FY) 2026 budget request and the future of NIST. For FY 2025, Dr. Locascio requested increases above the FY 2024 enacted level for Artificial Intelligence (AI), both NIST internal laboratory research and the buildout of the U.S. AI Safety Institute, and for quantum information science. NIST also requested additional funding for facilities improvements. She said the Congressional members voiced their support by acknowledging the importance and necessity of the work NIST does. However, NIST did receive a reduction in the FY 2024 budget for both laboratory programs and facilities.

The Rapid Drug Analysis and Research (RaDAR) program provides near real-time identification of illicit street drugs and has expanded into more than 10 states. It has a publicly available monthly newsletter reporting on trends in detected drugs and never-before-seen substances. The RaDAR program work was called out in the Testing, Rapid Analysis, and Narcotic Quality (TRANQ) Research Act and has been a great partnership across the U.S. with public health and forensics entities.

In the CHIPS for America program, the Department of Commerce (DOC) has signed a preliminary memorandum of terms (PMT) for manufacturing incentives with seven companies since the last VCAT meeting in February. CHIPS R&D released three notices of funding opportunities:

- $300 million in advanced packaging focused on substrates and materials,
- $287 million for a new digital twin Manufacturing USA institute for semiconductor manufacturing, and
- $54 million for Small Business Innovation Research (SBIR) grants for new metrology instruments and processing.

NIST also plans to announce an open competition for a new Manufacturing USA institute focused on using AI to improve the resilience of U.S. manufacturing. NIST has also launched the U.S. AI Safety Institute and has a partnership agreement in place with the United Kingdom (UK) AI Safety Institute, and announced the formation of a global network of safety institutes during an event in Singapore.

The implementation roadmap for the U.S. Government National Standards Strategy for Critical and Emerging Technology (USG NSSCET) has been drafted, with an intended release from the White House in July.

For more information, see Dr. Locascio's presentation and pre-read material.

Safety Update - *Dr. Elizabeth Mackey, Chief Safety Officer and Director of Office of Safety, Health, and Environment (OSHE)*

Dr. Mackey provided an overview of the four high-level safety goals and actions taken to date in Fiscal Year (FY) 2024:

1. Complete a Fully Functional Safety Management System (SMS). The SMS has been underway since 2010. A linchpin of the current SMS that has been missing is the addition and implementation of an audit program while NIST develops and issues remaining SMS directives. A long-term effort was to have the operating units (OUs) re-review the existing hazard reviews, observe work in these areas, and make necessary changes.

2. Improve NIST Safety Culture. The National Safety Council (NSC) was brought in to host the safety barometer survey. Their recommendation was to have NIST staff develop action plans, which was completed. The goal for this year is to continue implementing the corrective actions and communicating the progress. The Executive Safety Committee (ESC) monitors the progress of the actions, and the updates are included in regular communications.

3. Strengthen OSHE Roles and Responsibilities. The Safety Commission recommended that the Chief Safety Officer should play a stronger role in safety at NIST, resulting in changes being made to the position. Dr. Mackey was named the Special Assistant for Safety to the NIST Director, a position that is codified in directive space and was also made a voting member of the Enterprise Risk Management Council. OSHE staff will now be required to lead workplace inspections in partnership with laboratory staff. Five new safety inspectors and three embeds have been hired, and hiring a fall protection specialist is in progress. The implementation to increasing services and staffing will be a phased approach.

4. Performance Metrics. Feedback obtained from VCAT was to establish goals to improve leading metrics, like near-miss reporting, timeliness of corrective actions, and training completion. The ESC established the goals, and a complete build of a safety dashboard has been rolled out.

On the International Organization for Standardization (ISO) Pre-Certification Assessment gaps, NIST has been building to this standard but is not fully there yet. An assessment done by external assessor found 15 positives where NIST conformed or exceeded the standard and found 24 opportunities for improvement. 13 gaps in the assessment would count as non-conforming if an audit was performed. In collaboration with the Enterprise Risk Management Council (ERMC), a process for elevating safety-related risks is being developed. A procedure that explains the appropriate codes needs to be established NIST is required to include training on ISO 45001 for NIST staff and leadership. Three main areas area of focus are to develop and implement a change management program, an internal audits and assessments program, and a corrective and preventative actions program to address non-compliance. A comprehensive process to evaluate performance, including audit inputs, which needs to be cited in management reviews is also needed.

The 35 items in the Safety 2.0 Action Plan were recommendations made by the Safety Commission after the fatality in the Engineering Laboratory (EL). The project plan started October 3, 2022, with the planned end date in 2026. They are divided into six basic categories:

- Leadership, vision, communication, resource allocation (96 percent complete);
- Safety culture (77 percent complete);
- OSHE roles and authorities (44 percent complete);
- Capital improvements (33 percent complete);
- Achieving and sustaining safety excellence (85 percent complete); and
- SMS improvements (39 percent complete).

On a timeline basis, the Safety 2.0 Action Plan is about 47 percent complete and on an action item basis, it is about 65 percent complete.

On 41 items being tracked for the NIST Fatality Investigation Corrective Action Plan, there is overlap between what the ESC recommended and the Safety 2.0 Action Plan. For this Action Plan, NIST is also currently about 47 percent complete, and on an action item basis, about 65 percent complete.

The Safety Dashboard, which provides access to metrics, is now live, and 96 percent of the Safety Advisory Committee gave positive feedback. The current dashboard is focused on actions needed by staff and managers and workplace inspection data will be added. Dr. Mackey also gave an example of how to use the training module on the Safety Dashboard and how it can look at organizations across NIST by operating unit (OU).

A recommendation of the VCAT was to set targets in a mix of performance indicators, with a focus on leading indicators verses lagging indicators. For example, on completing training, the goal in FY 2024 is 100 percent. Tracking how many new hazard reviews were initiated, renewed, and updated is a leading indicator. The database used by laboratory staff resides in one OU, but it is going to be migrated under the umbrella of OSHE applications in FY 2025. Soon a communication effort will be released to increase the near miss reporting across NIST. As a best practice, NIST has switched to looking at where potentially serious injuries or fatalities may be, not by risk or probability, but by severity. For workplace inspections, there are 9,339 spaces in the NIST database for facilities, and 3,700 were inspected last year, necessitating more coverage. It is a regulatory requirement for federal laboratories to provide 100 percent workplace inspections. An aggressive goal for closing out serious deficiencies is set at 100 percent and closing imminent danger deficiencies should be addressed immediately. Observations conducted by managers is a very strong leading indicator, tracked by the OUs. Additionally, safety communications have gone up over the past couple of years, which is attributed to the content being more engaging.

Dr. Mackey said they are on track in FY 2024 to have the same number of total events reported, between 150 and 175. Injuries are lower than they had been in the past. One thing that is being investigated is an unusual number of hearing loss cases.

For more information, see Dr. Mackey's presentation.

Discussion. The group discussed the following topics:

- Engaging with third-party experts to bring different perspectives to hazard reviews,
- NIST staff providing safety culture change recommendations they want to see,
- An investigation in uptick of NIST staff hearing loss in progress,
- Changes resulting from hazard review re-reviews,
- Importance of laboratory directors reporting engagement on risk assessments and safety,
- Department of Energy (DOE) and Department of Defense (DoD) laboratories as good resources for safety,
- OSHE staff leading incident investigations and workplace inspections to simplify paperwork,
- Job hazard analyses (JHAs) simplified with use of a short form,
- Safety cannot be an exercise in more paperwork, and
- Looking at incentive implications of the Safety Dashboard.

Measurement Services and the Core NIST Mission – *Dr. James Olthoff, Chief Metrologist*

Dr. Olthoff's presentation covered five areas: history, NIST as a National Measurement Institute (NMI), advancing measurement science, the expanding role of NIST, and some concerns as NIST's Chief Metrologist.

History. Three things are needed for a measurement system: consistency, accessibility, and universality. The French are attributed with the idea of the importance of a measurement system being equal, fair, and trustworthy. The kings of France manipulated the measurement system to their benefit and the detriment of the populace, which is part of the reason for the French Revolution. As a result, the idea that a system needs to be codified to make it trustworthy and consistent within a country and supported by the government. They then developed the first concept of the metric system and the idea that measurements would be based on something that doesn't change, like earth and water.

In the early 1800s, the U.S. government was funded by duties levied at ports, and concerns about the accuracy of weights and measures arose, which prompted Congress to ask an expert, Ferdinand Rudolph Hassler, to do a study, in which he found great discrepancies. As a result of Hassler's report, the U.S. government formed the Office of Weights and Measures in 1836, the predecessor to the National Bureau of Standards (NBS, now NIST),

which still exists within NIST and plays a role working with the states to ensure the uniformity of the measurement system across the Nation.

The Treaty of the Meter became codified by 17 nations in 1875, including the United States, which created the prototype kilogram and meter standards and established a new governance structure. The International Bureau of Weights and Measures in France was also established to maintain the standards of the world.

Countries began to note areas needing measurement expertise during the Industrial Revolution. Germany led the world in establishing the first NMI in 1887, followed by the UK in 1900. NBS (now NIST) was established in 1901, followed by France also in 1901, Japan in 1903, Canada in 1916, and the rest of the world soon followed. The NMIs were to be the keeper of measurement standards for the country to ensure the measurement system was effectively implemented within the country and support the populace.

In 1987, NBS became NIST to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance security and improve quality of life. NMIs are authorized by a country's government to maintain the primary standards and provide traceability. Being the NMI of the United States is the only unique role of NIST, though NIST does have many other important responsibilities given by Congress.

NIST as an NMI. An NMI, from NIST's perspective has five responsibilities and roles:

1. Maintain primary standards and provide traceability. In addition to maintaining the standards for the seven base units, NIST provides traceability by performing 14,000 calibrations a year, 30,000 sales of standard reference material (SRM) units, and standard reference data with over 25 million views.
2. Represent the country to support international system of units. NIST staff is engaged in nearly every international metrology effort and holds many leadership positions, which requires a significant effort and commitment.
3. Engage with industry, government, and academia to determine measurement needs. NIST leads many industry-centered consortia and engages with industry in almost every sort of service program.
4. Advance measurement science to support economic competitiveness. More details are found below.
5. Utilize measurement expertise to support development of documentary standards. Over 400 NIST technical staff work on almost 1,700 standards committees. NIST's technical expertise results in improved standards and U.S. competitiveness.

Advancing Measurement Science. Measurement science is the investigation of all aspects of measurements and the development of tools and technologies enabling implementation and application of a universal and trustworthy system of measurements. In 2018, there was a major redefinition of the International System of Units (SI) that over 60 countries agreed unanimously to redefine. The kilogram was redefined by utilizing the NIST Kibble Balance (KB), which requires the most advanced electrical, dimensional, temperature, frequency, and gravity measurements in the world. Using the KB, and after conversations with the U.S. Air Force, NIST produced a quantum-based torque standard on a bench, got a patent, published it, and now there is a cooperative research and development agreement (CRADA) with Snap-on tools. Dr. Olthoff said that these new capabilities happen over decades with a dedicated long-term commitment to measurement science.

The Expanding NIST Role. NIST's role as an NMI has expanded to include Manufacturing USA, quantum computing, cybersecurity, AI, CHIPS, and more because of NIST's expertise, reputation, and capabilities.

Some concerns. NIST's budget far exceeds budgets of other major NMIs in the world, but this comparison is deceiving. Of the entire budget, about $750 million resides in the laboratories, but only a small portion of that, is spent specifically on NIST's NMI role. For approximate staffing comparisons, Dr. Olthoff said that for the Sensor Science Division, which is responsible for calibration services, staffing trends reveal that 60 percent of calibration staff are eligible for retirement amid overall low staffing levels. Most measurement services staff have little bandwidth for innovation, to respond to new measurement needs, or have insufficient time for leadership opportunities in international organizations. Additionally, in the last five years, the turnaround time for NIST's calibration services have doubled. The number of staff working on standard reference materials (SRM) is also down by 30 percent, and over the last 10 years, the number of unavailable SRMs has doubled, illustrating some of the negative impacts of underfunded measurement service programs.

The expansion of NIST responsibilities is an extension of capabilities, expertise, and reputation as the NMI of the United States. The importance of NIST's NMI role is underappreciated and often unrecognized or unknown. NIST programs have expanded greatly to cover critical areas of technology because of NIST's excellence at being the NMI of the United States The success of these programs requires a strong core measurement program at NIST.

Dr. Olthoff's suggestions for VCAT to consider are as follows: How can NIST highlight broadly the importance of NMIs? How does NIST expand awareness of NIST's NMI role? Is it understood that NIST's core measurement programs must be successful for all NIST programs to be successful? As the VCAT considers various issues this year, how does NIST's NMI role play into that? Dr. Olthoff also recommended attendees listen to "The Romance of Precision Measurement," a video done by the NIST Public Affairs Office (PAO) about the beauty of metrology.

For more information, see Dr. Olthoff's presentation.

Discussion. The group discussed the following topics:

- Organizing NIST around an NMI core from a management and organization standpoint,
- NIST's foundation of trusted measurements needs to be strong to meet needs of emerging technologies,
- Recruitment for younger staff,
- Measurement science needs to be integrated rather than separated to attract new staff,
- A strong connection to universities through student and associate programs for talent,
- Growing new hires in their career arcs and then teaching them the right skills,
- Blending people immersed in services roles with others immersed in research roles at NIST,
- Use of rotational assignments,
- Providing incentives for a team of researchers and service people to work together,
- Utilization of student and postdoctoral programs as feeders for new staff,
- Early career scientists disseminated through stakeholder groups as industry employees being important,
- Cadres of people moving through the programs to build networks and relationships,
- Added NIST demands reflecting excellence and integrity, but also reducing flexibility,
- Discretionary funds specifically targeted to invest in future capabilities,
- Including in a draft of next year's VCAT report that the core mission of NIST is an NMI, and
- Recruiting and retention of diverse workforce critical for students and postdocs.

Climate and Energy Technologies Focus

Intro to NIST Climate Portfolio and Announcement of New Center of Excellence for Climate Measurements – *Dr. Anna Sberegaeva, Program Coordination Office (PCO)*

Dr. Sberegaeva said the White House has passed key legislation and issued a range of Executive Orders to address climate, such as increasing resilience, protecting air from pollution, supply chain issues, financial incentives, emission targets, and zero emission technologies. DOC followed the lead and incorporated climate as part of its strategic plan with two objectives: to develop and deploy clean technologies and to incorporate climate considerations into operations and decision-making. NIST established a climate working group consisting of people across the organization to better understand how their work fits into NIST's climate portfolio. As a result, three pillars emerged: climate monitoring and measurements, decarbonization of the economy, and adaptation and resilience. A white paper was written to summarize the work and NIST's external website was updated with links to NIST programs. Reliable measurements are needed to inform those addressing climate-related problems, and NIST can have a large impact in this area.

NIST is about to award approximately $2.7 million for a new NIST Center of Excellence in Climate Measurements. The goal of the center is to develop reliable tools for modeling, predicting, and forecasting impacts on specific communities across various sectors. The results of the Center are envisioned to enable development of effective and equitable climate adaptation plans.

This year, NIST had three workshops focused on sea-level rise and coastal storm surge, rainfall and inland urban flooding, and wildfire and urban planning. Four more guiding workshops are planned for next year to focus on climate projections, design guidance, effects on the built environment, and infrastructure adaption and resilience. Dr. Sberegaeva also gave one example of work from the decarbonization of the economy pillar for the

development of new refrigerants with low global warming potential. Options have been provided to the DoD for new refrigerants as well as onboard heating and cooling systems.

For more information, see Dr. Sberegaeva's presentation.

Frequency Combs for Greenhouse Gas Sensing and Methane Leak Monitoring – *Dr. Ian Coddington, Communications Technology Laboratory (CTL)*

Dr. Coddington said the frequency comb is a NIST-generated technology, created in 2005. The frequency comb, from a greenhouse gas spectroscopy standpoint, has a very broad emission composed of discrete individual comb teeth that behave roughly like a million continuous wave (CW) lasers. Because of the high resolution, frequency combs record a high-fidelity spectrum of greenhouse gases with high precision. Additionally, being broadband allows frequency combs to "see" many species simultaneously. By using tracer species that are co-emitted with greenhouse gases, the source sectors contributing to emissions can be separated out. The frequency comb is also a path-integrated measurement, which allows for a much smaller sensitivity to wind variation and reduces one of the major sources of errors found in field measurements.

Dual comb technology was used to look for infrastructure leaks of methane in oil and gas fields in an effort with the University of Colorado, funded by the Advanced Research Projects Agency–Energy (ARPA-E). The results of field tests allowed measurement within 2 grams per minute from a kilometer away. This project is related to a spin-off company, LongPath Technologies, which is now monitoring more than 350 facilities in multiple states using this technology.

The frequency combs also contribute to measurements of fugitive methane source from cattle, leveraging the high precision of the instruments. In partnership with Kansas State University, experiments are being conducted to mitigate emissions and look at alternative feed sources to reduce emissions, like sorghum.

Dr. Coddington said a study of the Northern Colorado Front Range is underway. Co-emitted plumes of ethane and methane are indicative of an oil and gas source, while co-emitted plumes of methane and ammonia are an agricultural source. A larger-scale study in partnership with Colorado State University (CSU) and Colorado Department of Public Health and Environment (CDPHE) is being discussed using this technology. Future applications for this technology is anticipated to be used for landfills and wastewater treatment.

For more information, see Dr. Coddington's presentation.

Radiometry for Climate Metrology – *Dr. Michelle Stephens, Physical Measurement Laboratory (PML)*

The World Meteorological Organization (WMO) identified seven key indicators to measure that are necessary to monitor the health and status of the Earth's climate The indicators fall into four domains: temperature and energy, atmospheric composition, ocean and water, and cryosphere, in which Dr. Stephens will focus on temperature and energy. NIST strives to provide reliable and timely climate information to people who need it, which aligns with the Department of Commerce Climate Action Plan for Adaption and Resilience.

The amount of energy that comes to the Earth from the sun as light, and the amount of energy that leaves the Earth as light should balance. If they are not in balance, which, according to measurements, they are not, the Earth is gaining energy, which can be released as heat. The energy coming from the sun is mostly visible, ultraviolet with a little bit of infrared light, but is a difficult measurement to do with complicated interactions with clouds, ocean, and land.

Three separate efforts are underway. In Boulder, microfabricated broadband radiometers are being used to make very precise measurements of light in small packages, which is great for satellites. This projected started with seed money for NIST-on-a-CHIP. Two detectors have been launched on two satellites. A collaboration with Laboratory of Atmospheres and Space Physics (LASP) at University of Colorado, funded by NASA, resulted in two CubeSats that looked at the sun. A mission called Libera will launch in 2027 to monitor the Earth radiance, with flight hardware delivered to LASP.

A few years ago, LASP took data from TSIS-1, a satellite on the International Space Station, and some data from CubeSat Compact SIM (CSIM), which had one of the NIST detectors in it and developed a hybrid solar reference spectrum. This spectrum was named an international standard for climate research, being used by all climate modelers when needing to model the energy coming in from the sun.

NIST's Sensor Science Division provides the calibration for all of these satellites. Additionally, the far infrared virtually imaged radiometer (FIRVIR) for climate metrology combines detector technologies, SI traceability capabilities, and spectroscopy to build a very high resolution far infrared tool to provide more accurate calibrations for climate metrologists.

For more information, see Dr. Stephens' presentation.

Discussion. The group discussed the following topics:

- A collaboration with Google Earth to use frequency combs for international monitoring of emissions,
- NIST working with the WMO on fiber comb technology for global monitoring of greenhouse gases,
- Ability of frequency combs to distinguish between isotopes, e.g., carbon-13 (^{13}C) and carbon-14 (^{14}C),
- Having frequency combs on the ground with receivers on satellites over the earth's poles,
- Pasture data useful for the Intergovernmental Panel on Climate Change (IPCC) to revies numbers,
- NIST instrument design data being given to solar and climate scientists,
- The ability to predict weather traces back to how well noise can be measured,
- The NMI of UK program on fundamental optical measurements being five times the size of NIST's,
- To understand root causes of emissions, buy-in from folks whose emissions are measured is critical,
- Center of Excellence for Climate Measurements focus on aggregating already existing data and ensuring it can be applied to specific communities,
- Engineering Laboratory (EL) climate impact studies for incorporation into building design and construction,
- Physical Measurement Laboratory (PML) responsibility for realization and dissemination of the SI,
- NIST's powerful role being to advance measurement science, but not as a regulatory agency,
- Dedication to frugality and creativity having resulted in complex hierarchy of agreements and partnerships; and
- Expansion of the standard reference data program considering the value of data today.

SESSION II: NIST FACILITIES

NIST Facilities Focus – *Mr. Robert "Skip" Vaughn, Director, Office of Facilities & Property Management*

Mr. Vaughn stated NIST facilities cover 1,300 acres across five sites: Gaithersburg, Maryland; Boulder, Colorado; Kauai, Hawaii; Fort Collins, Colorado; and Erie, Colorado. The Gaithersburg campus is about four times larger than the Boulder campus, by square footage. Two small radio stations are in Kauai and Fort Collins, and the new property in Erie is currently not developed. The overall condition of buildings on the NIST Gaithersburg campus reached critical status in 2018. NIST has approximately $1.1 billion in deferred maintenance and has about $95 million of enterprise IT infrastructure upgrades required.

To get the facilities where they need to be, the recommendation from the National Academies of Sciences, Engineering, and Medicine (NASEM) was to take a dual-pronged approach, looking at both deferred maintenance and new construction or major renovations together. The funding recommendation is $300 - $400 million each year for construction and major innovations and $120 - $150 million each year for Safety, Capacity, Maintenance, and Major Repairs (SCMMR), over a period of 12 years. A coordinated recovery plan was drafted to illustrate how the funding will be spent, with updates to be made annually, beginning after the FY 2025 budget is approved.

The NASEM report gained attention by DOC's Inspector General's office, which included prioritizing complex construction and maintenance projects and ensuring prudent financial management and oversight of funds for NIST as one of the "Top Management and Performance Challenges Facing the Department of Commerce in Fiscal Year 2024" report.

Mr. Vaughn presented a summary of problems on a campus-by-campus basis. As of the beginning of FY 2024, nearly 78 percent of the Gaithersburg campus facilities and nearly 75 percent of research facilities are in poor to critical condition by square foot area. Approximately 50 percent of Building 245 has been renovated, and there is a new addition that is all brand-new construction. There is no current funding to complete the rest of the Building 245 project at this time.

The Boulder campus is older by a decade, with original buildings being built in 1952, but there has been more work on the Boulder campus. Wings 3, 5, and 6 of Building 1 have been renovated. Buildings 2 and 24 are in poor condition, with it being more cost effective to level Building 24 and rebuild it rather than fixing all the different components. On the Boulder campus, 55.6 percent of the facilities and 35 percent of the research facilities are in poor to critical condition, by square foot area.

The Office of Science and Technical Policy (OSTP) report on U.S. Federal Research and Development Infrastructure, released in May 2024, aligns with the NASEM report on NIST facilities. The aging and inadequate research infrastructure, across federal research agencies, is causing a cascading impact of work being done because of substandard facilities. This widens the gap in global science and technology outcomes for the United States while competing against other governments. Four recommended actions agencies could take now are strategic planning, identification of gaps, benchmarking international research and development infrastructure (RDI), and sharing RDI strategies. Mr. Vaughn mentioned that NIST did not receive funding for facilities from the Infrastructure Investments and Jobs Act nor the Inflation Reduction Act.

Total Construction of Research Facilities appropriation levels for FY 2024 were decreased by approximately one third compared to FY 2023 for SCMMR projects. This resulted in several projects having to be cut. Because of the underground utility infrastructure funding during the Recovery Act for the Boulder campus, it is in good shape compared to the Gaithersburg campus. Overall, NIST facilities are well beyond the end-of-life renewal for most facilities.

In August of 2020 at the Gaithersburg campus, there was a catastrophic failure of a four-inch steam strainer in the Central Utility Plant (CUP). Forensic investigation of the piping indicated eight to ten years of life remaining in the entire stream distribution system. Awarding phase one of this project is planned for late 2025. Some of the other issues on the Gaithersburg campus is the structural failure of the underground electrical distribution system. Mr. Vaughn stated that between the CUP and the underground utility infrastructure, NIST will have mechanisms in place to award significant amounts of money to prevent future carryover issues if Congress provides a huge increase in funding. A large collaboration across NIST with over 700 staff developed program requirements for future projects to be shovel ready.

Mr. Vaughn and Dr. Romine are the executive sponsors leading the effort led by the NIST Business Operations Office to conduct laboratory conditions and mission impact analysis surveys, which will enable NIST to instantly provide data on NIST core missions and Critical and Emerging Technologies. The OSTP and NASEM have requested a copy of the data once it is complete.

For more information, see Mr. Vaughn's presentation.

Discussion. The group discussed the following topics:

- A space optimization algorithm to assess assigned space for researchers and projects,
- Capacity and availability of electrical power on Gaithersburg campus,
- Voltage transients or power bumps by local electrical providers causing impacts to equipment,
- Which laboratories score worst in facility needs will be in a lab impact analysis by relaying impact stories,
- Retention problems due to facilities no longer state-of-the-art when compared to other countries or industry,
- Restrictions of Gaithersburg campus infrastructure projects due to it being declared a historic district,
- Temperature and humidity being key issues in labs needing renovation,
- Renovating spaces for environmental conditions being needed for research,
- Feasibility of third-party funding to supplement cuts to the NIST budget,
- The need for research space and office space cannot be replaced by teleworking,
- Costs of delays that result from historic preservation issues, and
- Facilities needing help being the number one enterprise risk management item every year since 2017.

SESSION III: NIST AND VCAT PLANNING

NIST Response to VCAT Annual Report Recommendations – *Dr. Laurie Locascio, Under Secretary of Commerce for Standards and Technology and NIST Director*

Dr. Locascio stated that in response to the first set of recommendations from the VCAT Annual Report regarding NIST's role in future Critical and Emerging Technology (CET) priorities relating NIST's mission and research strengths to develop new priority areas, NIST plans to expand core CET strengths into new priority areas, including CET convergence, and leveraging core mission in standards, measurements services, and metrology. It is important for NIST to be prepared when industry emerges with something new in the market. Intersectionality of CETs is also a growth area, specifically in AI and biotechnology and AI and cybersecurity, which are being used as case studies.

Dr. Charles Romine said new development areas to revolutionize the economy in the future is an area needing further examination. He mentioned bioengineering and advanced manufacturing as well as the intersection of cybersecurity and bioinformatics as areas of interest. Conversations among the Laboratory Directors include identifying what areas may be strong investments for the future. Measurement science of these emerging technologies can be NIST's focal point.

Dr. Locascio said building a storytelling infrastructure and reorganization of websites is in progress. NIST has recently hired a senior advisor focusing on CET communications and a new communications strategist for AI and CHIPS. She continued by stating NIST is committed to avoiding duplication of efforts and continues to establish strong interagency communication channels and collaboration. The National Semiconductor Technology Center Steering Committee was established to help coordinate activities with representation from DOC, DoD, DOE, and NSF.

On ensuring U.S. leadership in international standards, it was recommended to increase communication about ways to engage on the U.S. Government's National Standard Strategy for Critical and Emerging Technology (USG NSSCET) strategy implementation. Over the last few months, NIST has been purposeful in working across the interagency and in close coordination with the American National Standards Institute (ANSI) to develop the implementation roadmap. NIST will release the implementation plan, in tandem with the White House, and use Standards.gov as a resource to enhance information and coordination. NIST is working with the White House and the National Security Council to understand interagency resource needs that can facilitate the implementation and development of a strategy around pre-standardization research.

There is a continual push for increased funding to support construction of NIST facilities. NIST has a multifaceted strategy to express the criticality of research facilities investments, including maintenance and new construction priority lists, multiple Congressional visits, and facilities tours for sharing the needs with DOC, the White House, and Congressional stakeholders, along with the annual budget request process. Shove-ready plans for construction are in place for any allocations outside of the normal budget process. NIST will continue to develop comprehensive budget requests to ensure both near-term deliverable and sustained progress in priority areas with DOC and OMB guidance, including authorized but unappropriated areas.

NIST has received flexible hiring authorities and is beginning to implement them for attracting and retaining top talent in CETs and other major initiatives. NIST has requested Congress to expand these flexible hiring authorities in the NIST authorization.

NIST onboarding safety training is transitioning back to in-person starting in July, and NIST is also beginning to offer in-person scenario-based training for laboratory staff. NIST will be evaluating the feasibility of increasing the number of trained responders on-site for faster intervention. NIST will also continue to address the prioritized maintenance backlog pending appropriate level of capabilities provided.

NIST has integrated a "508 Standards Checklist" into the Service/Acquisitions portal, which must be completed for all acquisitions. New staff have been hired to focus on ensuring the NIST required software follows accessibility principles beyond compliance. Communication about the successful implementation of the diversity, equity, inclusion, and accessibility (DEIA) strategic plan has been shared with NIST's various working groups. NIST is developing dashboards so people can see where there may be disproportionate representation.

The CHIPS Program Office is committed to increasing participation of and outreach to economically disadvantages individuals, minority-owned businesses, veteran-owned businesses, and women-owned businesses. The CHIPS team has briefed approximately 200 organizations about the CHIPS Act and continues to seek out stakeholder engagement. Since the hiring of the new Diversity, Equity, and Inclusivity Office(DEIO) Director, there has been a lot more strategy around how to approach various organizations around NIST's DEIA efforts.

NIST's DEIO Director, Ms. Janelle Johnson, said a major focus is on ensuring accessibility, especially for people with disabilities. She said it is important to have a culture at NIST that is inclusive to retain a talented workforce. Three areas that her office is focusing on are multigenerational diversity, ensuring a culture of belonging by mitigating microaggressions in the workplace, and understanding unconscious bias.

For more information, see Dr. Locascio's presentation.

Discussion. The group discussed the following topics:

- Collaboration and/or input of the intelligence community on science and technology,
- NIST's role in how digital twins fit into AI and cybersecurity,
- The funding available for the Strategic and Emerging Research Initiatives (SERI) program,
- Digital twins being an important solution to technology, innovation, and supply chain,
- CETs now being intersectional across multiple areas, both in industry and at NIST, and
- VCAT providing recommendations on how to articulate the core mission of NIST better.

SESSION IV: NIST PROGRAMMATIC UPDATES II

AI Updates: NIST Labs Technical Portfolio and Launch of the U.S. AI Safety Institute (USAISI) – *Ms. Elham Tabassi, Chief AI Advisor, and Ms. Elizabeth Kelly, Director, USAISI*

Ms. Tabassi said since establishment in 1901, the mission of NIST has been to promote U.S. innovation and industrial competitiveness by advancing measurement science and standards that make technology more reliable, secure, private, interoperable, and trustworthy, which is what NIST is and has been doing in the AI space. NIST helps industry develop valid, scientifically rigorous methods, metrics, and standards while working with the whole community through multi-stakeholder, open, and transparent collaborations.

The NIST AI Risk Management Framework (AI RMF), directed by Congressional mandate, is a voluntary framework for managing the risk of AI in a flexible, structure, and measurable way for organizations designing, developing, deploying, or using AI systems to manage AI risks and promote trustworthy and responsible AI.

Since the release of the AI RMF, Ms. Tabassi provided some major milestones and accomplishments. In March 2023, the AI Resource Center was released as a one-stop shop for knowledge, data, tools, and documents about risk management while remaining a work in progress. In June 2023, a generative AI public working group convened, with more than 2,000 volunteers, to study and understand the risks of generative AI. The Executive Order (E.O.) on Safe, Secure, and Trustworthy AI supercharged the effort to cultivate trust in AI. The tasks included developing evaluations, red-teaming, safety and cybersecurity guidelines, facilitating the development of consensus-based standards, providing a test environment for evaluations of AI systems, and building community through international and global engagement. Shortly after the release of the E.O., Vice President Harris announced the establishment of the US AI Safety Institute (USAISI).

On February 8, 2024, the first round of AISI Consortium (AISIC) members was announced, with more than 280 members. Crosswalks to Singapore AI Verify and Japan's AI Governance have been developed, and the AI RMF has been translated to other languages. Most of NIST's due dates to the President under E.O. 14110 are July 26, 2024, but some will extend into January 2025. The AISIC working groups focus on five topics: risk management for generative AI, synthetic content, capability evaluations, red-teaming, and safety and security.

Assessing Risk and Impacts of AI (ARIA), was announced and will assess models and systems that are submitted by technology developers and will be sector- and task-agnostic. ARIA will support three levels of evaluations:

model testing, red teaming, and field testing. The program will produce guidelines, tools, methodologies, and will advance measurement science for evaluations of safety and trustworthiness of the systems.

NIST not only works across government agencies and with industry to identify critical standards, development activities, strategies, and gaps, but also works across agencies with both scientists and technical staff on developing technical building blocks and advancing the science and research for development of technically sound and scientifically valid standards.

Since the release of the AI RMF roadmap in January 2023, NIST has been focusing on working with the broader community, and colleagues both in the U.S. and globally, to develop tools, benchmarks, and testbeds. NIST has also made good progress on alignment with international standards, expanding test and evaluation programs, and developing the profiles.

The National Artificial Intelligence Advisory Committee (NAIAC) was established as part of the AI Act of 2020. It advises the President on the intersection of AI and innovation, competition, societal issues, the economy, law, international relations, and other critical areas. In May, NAIAC released their first report. E.O. 14110 included some of the NAIAC recommendations.

Ms. Kelly said the mission of the AISI is to advance the science of AI safety and, at the same time, advance the implementation and adoption of that science. She said AISI's belief is that safety breeds trust, trust breeds confidence and adoption, and adoption accelerates innovation.

Ms. Kelly noted that more powerful AI systems accelerate scientific discovery, technological innovation, and widespread economic growth, but while people are already interacting with AI systems more every day, there remain open questions about how define and evaluate risks. The AISI plans to ensure frontier AI models and systems are not deployed with dangerous capabilities. There will be direct testing of AI models systems and agents, and then AISI will build out a suite of evaluations to use as data on how AI models perform, what capabilities they exhibit, and what risks are posed by the capabilities. Feedback to model developers on where mitigations may be needed and will be shared prior to deployment. AISI wants third-party and in-house evaluators to use their guidance and to catalyze a robust ecosystem of independent research and evaluation. AISI also plans to issue guidance on how developers can plan for risk-reported safety and security mitigations and how to test the efficacy of these mitigations and release guidance on tools that can be used to help detect synthetic content, along with the NIST AI Innovation Lab. Ultimately, the efforts will feed into building an empirical understanding of AI, and securing its safe design and deployment, as models and systems continue to grow in capabilities.

Along with the AI Innovation Lab, AISI will leverage the AISIC. The working groups have already been invaluable providing feedback on several E.O. deliverables. The goal for this network is to engage agile information and resource sharing that will yield significant efficiencies in research. Ms. Kelly mentioned the work in Singapore on content authentication and the work in Canada on risk mitigation, and said it is important to build on and leverage those efforts rather than duplicating them across the globe. This network will facilitate alignment of safety policies across the participating countries. AISI has collaborations with the UK, Japan, Kenya, Canada, Singapore, and a dialogue with the EU's AI office as they work to implement safe and secure AI.

In terms of international coordination, AISI will be convening international AI safety institutes and other stakeholders in San Francisco this fall to launch this network and accelerate the advancement of AI safety science.

For more information, see Ms. Tabassi's and Ms. Kelly's presentation.

Discussion. The group discussed the following topics:

- Differentiation between domestic AI safety work focused on general AI safety and national security concerns,
- Focus on potential misuse of AI models and systems,
- Inclusion of Africa and Asia in international engagement on AI safety and innovation,
- Sharing information with close allies and partners as opposed to a broader swath of countries,
- Open-source software models and sensitivity of some data,
- Interactions with international committees in standards development,

- Not isolating countries being strategically important to avoid making regional standards,
- AISI's plans for the next twelve months, and
- The role of NIST around AI concerns with the upcoming election.

Boulder Research Highlights – *Dr. Ana Maria Rey, PML*

Dr. Rey gave a short overview and brief historical context of quantum science history. In 1954, the NIST Boulder Laboratories came to life and the National Bureau of Standards, now NIST, created the first atomic clock. A bit after 1962, JILA was founded as a joint institute of the University of Colorado (CU) Boulder and NIST and resides on the CU campus. JILA is the home of the NIST Quantum Physics Division (QPD).

In 1978, shortly after JILA was founded, the capability to cool atoms by laser became a possibility which was used to create the first Bose-Einstein Condensate (BEC), marking the beginning of new quantum science in 1995. In 1999, the production of frequency comes revolutionized the way to measure time and continues to play an important role in metrology. Also in 1999 was the realization of the cooling of fermions, opening the stage for a new part of quantum science where JILA has always been a key player. Dr. Rey gave examples of the discoveries made at JILA, including ultracold polar molecules, entangled interferometers, and the nuclear transition in thorium. By being in an academic institution, JILA is able to expand the mission nationally and internationally, and being able to get support from different centers allows NIST to push the research in a very collaborative way. Another advantage is the diversity of the workforce, which attracts an amazing group of undergraduates and postdocs.

The scientific vision of JILA is harnessing quantum complexity, with a goal of harnessing many-body quantum systems and using them for applications ranging from quantum simulation information to metrology. When advancement of metrology and control of quantum systems happens, it can allow for us to understand the behavior of the universe.

Dr. Rey gave an example of atoms with two outer electrons, which are useful because the atomic structure of atoms allows them to have two very long-lived electronic states, which correspond to an optical transition. By building a clock operating with many atoms, the signal-to-noise ratio was better than that with a single particle; however, atoms are not invisible and collide, changing the desired transition. Dr. Jun built a clock using fermionic atoms, but the clock was still so precise that the collisions in the clock were bad. To create better clocks, an understanding of many-body physics was necessary, which will also allow for the clock to become a better sensor. Eventually, by understanding collisions, a sensitivity as low as 10^{-21} was gained. This year, JILA is starting to look at the interplay between general relativity and many-body physics, which has not been done before.

Dr. Rey also said with the support from NIST, she is confident that JILA will keep pushing the frontiers of science, allowing JILA to invest in how to use quantum science to create better clocks, which can lead to progress on quantum computers and to advance fundamental science.

Dr. Locascio recognized Dr. Rey for being inducted into the National Academy of Sciences.

For more information, see Dr. Rey's presentation.

Discussion. The group discussed the following topics:
- Long-term funding concerns,
- JILA collaboration(s) with other agencies and industry outside of CU,
- JILA being really two institutions working in a collaborative and open environment,
- The condition of infrastructure and space limitations at JILA,
- Rydberg atom interactions for entangling atoms in clocks,
- Allocation of researchers' time on single projects or multiple projects,
- More collaboration between JILA and NIST campuses, and
- Buy-in, proximity, and mutual recognition being needed to make joint institutes successful.

SESSION V: NIST BUDGET UPDATES

NIST Budget Overview – *Dr. Christopher Szakal, Acting Director, Program Coordination Office*

Dr. Szakal said the NIST budget is one of the few budgets that has the authority to put pass-through money into it that is not used for programs but goes out to communities. The Scientific and Technical Research and Services (STRS) had a $33 million decrease in FY 2024, compared to FY 2023, and $10 million had to be reprogrammed for the USAISI. There was a big increase in the community projects from $62 million to $222 million, however these funds are not spent internally. NIST had a large decrease in funding for the Construction of Research Facilities (CRF) account from $130 million to $88 million. Funding was flat for the Manufacturing USA and Manufacturing Extension Partnership (MEP) programs. but flat means a decrease because of inflationary adjustments and not enough to meet the demand of salaries and benefits. On AI funding, there was a reprogramming of NIST base STRS funding to launch the USAISI. NIST will direct CRF funding to address SCMMR, but the underfunding on the facility side, a decrease of $42.2 million, has been made worse in those critical areas. Additionally, the reduction in funding for CRF strains flexibility, as $54.6 million of the $87.8 million appropriated will be used for recurring annual costs.

The FY 2025 Budget Request is an increase of $38.5 million over FY 2024 enacted levels to address critical facility's needs, grow funding for critical mission areas, and fully fund inflationary adjustments to current programs. This increase allows NIST to focus on three big areas: AI, advancing quantum information science, and modernization of Building 245. The FY 2025 President's Budget targets funding at core measurement science and fully funds inflationary adjustments. There was a plus-up allotted from Office of Management and Budget (OMB) of $41.7 million to Invest in the USAISI and expand upon E.O. 14110. An increase of $13.9 million for NIST will enhance quantum technology research in critical technologies to support the nascent U.S. quantum industry. There was an allotted significant increase in funding for CRF to $311.5 million. For Construction and Major Renovations (CMR), the $178.3 million increase allows NIST to resume full delivery of reliable radiation measurements to support security, health care, energy, and research by finishing the renovation of Building 245. The increase of $45.4 million for SCMMR will be used to initiate safety-related projects, repair and revitalize NIST facilities, modernize IT networking infrastructure, support infrastructure improvements, and ensure that NIST is able to support a leading-edge research and development program. ITS funding remains flat but allows NIST to operationalize initiatives that recently received plus-ups and maintain that funding level, like continuing to build out the Supply Chain Optimization and Intelligence Network (SCOIN).

The FY 2026 budget planning is in progress, starting with aligning requests with DOC priorities, and with an assumption of a flat funding level with respect to the FY 2025 budget request. After review, the request will go through an OMB process to align with the President's priorities, which NIST will be monitoring. Separate House and Senate markups will also take place from the President's 2025 Budget Request. Additionally, last year's Fiscal Responsibility Act puts constraints on available funding.

For more information, see Dr. Szakal's presentation.

Discussion. The group discussed the following topics:

- Differences between enacted and requested funding levels,
- Earmarks and starting new projects not allowed in Continuing Resolutions,
- Earmark funding and how it is disseminated,
- Compounding problems of projects not being completed to the end due to funding constraints, and
- Integrity problems when OUs are asked to oversee and provide project updates.

Day 1 Closing Session

There were no public comments. Mr. Matusow thanked the members for attending and staff for making the meeting successful at the Boulder campus.

Adjournment

The meeting was adjourned at 5:00 PM.

I hereby certify that to the best of my knowledge; the forgoing minutes are accurate and complete.

Ms. Stephanie Shaw, Designated Federal Officer, NIST Visiting Committee on Advanced Technology
Mr. Jason Matusow, Chair, NIST Visiting Committee on Advanced Technology