VISITING COMMITTEE ON ADVANCED TECHNOLOGY (VCAT or Committee)
MINUTES OF THE TUESDAY, OCTOBER 26, 2021
WEBINAR MEETING

ATTENDANCE:

Visiting Committee Members Attending
Adler, Allen
Cerf, Vinton
Fischer, George
Ishak, Waguih
Jackson, Keoki
Johnson, Anthony M.
Kaler, Eric
Khan, Mehmood
Ku, Katharine
Vasko, David (Dave)
Wasserman, Gail

Designated Federal Officer
Shaw, Stephanie

NIST Leadership Board
Bahar, Mojdeh
Boehm, Jason
Brockett, Del
Brown, Essex
Chin, Joannie
Dimeo, Robert (Rob)
Dowell, Marla
Fangmeyer, Robert
Hooker, Stephanie
Ivester, Rob
Jenkins, George E.
St. Pierre, James (Jim)
Kushmerick, James
Lin, Eric
Mackey, Elizabeth (Liz)
Molnar, Mike
Moon, Sesha
Olthoff, James K.
Romine, Charles (Chuck)
Sastry, Chandan
Vaughn, Robert (Skip)
Wixon, Henry

NIST Staff
Acierto, Linda
Alderman, David
Andrews, Anne
Averill, Jason
Barrett, Claire
Beers, Kathryn
Boeckl, Kaitlin (Katie)
Chang, Walter
Chu, Pamela
Chukran, Melinda
Davis, Rick
Deblasi, Ann
Dohne, Kirk
Elwany, Alaa
Evans, Heather
Fasolka, Mike
Fato, Hope
Fetsko, Melissa
Folk, Alex
Forster, Amanda
Fraser, Gerald
Gayle, Frank
Gendron, Cheryl
Gillerman, Gordon
Glenn, Rachel
Hanna, Nancy
Hardis, Jonathan
Healy, William (Bill)
Hickernell, Robert (Bob)
Hildebrand, Jacqueline
Hoehler, Matthew
Huergo, Jennifer
Ivy, Nahla
Jahanmir, Said
Jeanette, Benjamin (Ben)
Jones, Christina
Kauffman, Leah
Kelsey, Richard
Keys, Mirta
Materese, Robin
Mattson, Bruce
Meritis, Dimitrios
Mitrani-Reiser, Judith
Nastus, Joe
Neumann, Dan
Orji, Ndubuisi (George)
Pascoe, Cherilyn
Petersen, Rodney
Pollack, Charles
Porch, Susanne
Ray, Howard (Clifton)
Reidy, Kari
Rudnitsky, Robert
Santos, Danielle
Saundry, Claire
Sberegaeva, Anna
Schiel, John
Schlatter, Katie M.
Schufreider, Jim
Seiler, David (Dave)
Shyam-Sunder, Sivaraj
Soles, Christopher
Stine, Kevin
Strouse, Gregory
Sullivan, Suzanne
Szakal, Christopher
Szuchyt, April
Tabassi, Elham
Teske, Michael
Ufford, Donald
Valdez, Zachary
Vouras, Peter
Wavering, Al
Whetstone, James
Yao, Jue
Yashar, David

Others
Belt, Justin - MITRE Corporation
Hormann, Linda - MITRE Corporation
Locascio, Laurie – University of Maryland College Park
Pilatowicz, Konrad - U-Haul International, Inc.
Ryen, Tind Shepper - Science, Technology Assessment, and Analytics Government Accountability Office
Sabuda, Mary - American Chemical Society
Suloway, Theresa – MITRE Corporation
Taub, Steve - U-Haul International, Inc.

Call to Order - *Dr. Alan Adler, VCAT Chair*

Dr. Adler called the meeting to order at 10:00 a.m., reviewed the meeting logistics and took roll call. Dr. Adler welcomed a new member to the VCAT, Dr. Anthony M. Johnson, and thanked Dr. Waguih Ishak for his contributions to NIST. Dr. Alder also stated that this would be his last meeting as well.

Administrative Update – *Ms. Stephanie Shaw, Administrative Specialist, Program Coordination Office, and Designated Federal Officer, VCAT*

Ms. Shaw welcomed Dr. Johnson to the VCAT and thanked Dr. Allen and Dr. Ishak for their time, expertise, and service. She then provided the VCAT members with an update on the new process of filing their annual financial disclosure forms for the upcoming year.

SESSION I: NIST UPDATE

NIST Update and Agenda Review – *Dr. James K. Olthoff, Performing Non-exclusive Duties of the Under Secretary of Commerce for Standards and Technology and NIST Director*

Dr. Olthoff began by welcoming the newest VCAT member, Anthony M. Johnson, and he acknowledged and thanked outgoing VCAT members, Waguih Ishak and Allen Adler, for their contributions, time, and experience. He continued with a brief overview of some future events at NIST and program highlights.

With respect to leadership changes, Dr. Olthoff said Dr. Laurie Locascio has been officially nominated to be the Under Secretary of Commerce for Standards and Technology and NIST Director and is awaiting confirmation from the Senate. Dr. Locascio served previously as Director of the Material Measurement Laboratory (MML) and is currently Vice President for Research at the University of Maryland. Ms. Jennifer Huergo will be the new Director of the Public Affairs Office (PAO), and Dr. Jeffrey DiVietro is serving as acting Director of the Technology Partnerships Office (TPO). Ms. Pravina Raghavan is going to be the new Director of the Hollings Manufacturing Extension Partnership (MEP).

Artificial Intelligence (AI) continues to be a priority. NIST has been tasked to develop the AI Risk Management Framework. The first virtual public workshop was held in October. NIST is also responsible for setting up the National AI Advisory Committee (NAIAC). A list of nominees will be submitted to the Department of Commerce (DOC) for approval. NIST is also continuing research programs on hardware based upon neuromorphic computing technologies.

Quantum Information Sciences continues to be a high priority both at NIST and across the United States. Several workshops have been scheduled to advance the new technologies, and recent publications that describe advances in creating qubits using quantum-enhanced detection. NIST is working with the White House to develop consortia.

Dr. Olthoff said NIST co-led a team in the Telomere-to-Telomere (T2T) Consortium, which completed the last 7 percent of the human genome, which has garnered significant media coverage.

Advanced Communications continues to be an area of great significance with respect to competitiveness. NIST continues to provide research on the supply chain for 5G, partnering with the National Science Foundation (NSF) and the Department of Defense (DOD) and other large industry partners in the Resilient and Intelligent NextG Systems (RINGS) program.

There is concern that China is attempting to leverage the standards development system globally to advance their own competitive posture. They are sending large numbers of people to international standards development meetings. NIST and DOC efforts will ensure that the U.S. and its allies have a sustainable foundation for continued leadership in standards development activities for critical and emerging technologies. NIST has helped support the U.S. Government with respect to the Quadrilateral Security Dialogue and is collaborating with the European Union (EU) on a Standards Alert System and AI.

Work is ongoing for the eventual renovation of the aging infrastructure that exists across NIST campuses, which is highly dependent upon funding from Congress. Plans for renovation of buildings include moving people from one building to the next while renovation is in progress.

NIST has been tasked with producing studies for eight technological areas and has contracted the Science and Technology Policy Institute (STPI) and Quantum Economic Development Consortium (QED-C) for this effort. A Request for Information (RFI) is under review, and the final report is due to Congress by December 31, 2022.

NIST is working with DOC to respond to several Executive Orders on Diversity, Equity, Inclusivity, and Accessibility (DEIA) in the Federal workforce. Progress in this area at NIST has been excellent.

MEP has played a significant role with respect to work related to COVID and other things. There is a potential for large increases in funding, which will provide an opportunity to change and expand MEP.

Dr. Olthoff said the DOC Strategic Plan Update has five key themes:

1. Innovation and global competitiveness,
2. Economic development,
3. Climate,
4. Equity (ethical and responsible data practices, making data more accessible), and
5. Customer service.

Dr. Olthoff added that NIST's primary role is related to manufacturing, development of emerging technologies and improving the nation's cybersecurity for protecting federal government networks.

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

Discussion. The group discussed the following topics:

- NIST interest in the origami aspects of folded proteins generated by human cells; and
- Monthly periodical *Standards Alert* that provides awareness of standards-making activities and information.

Innovation and Industry Services Update – *Ms. Mojdeh Bahar, Associate Director for Innovation and Industry Services*

Ms. Bahar said there are four components of Innovation and Industry Services:

1. Baldrige Performance Excellent Program,
2. Manufacturing USA,
3. Manufacturing Extension Partnership, and
4. Technology Partnership Office.

What unites the four groups is the formation of public-private partnerships that build communities around technological innovation, manufacturing, and performance excellence.

The Baldrige Performance Excellence Program continues to demonstrate exceptional agility and resilience while operating in a challenging environment. This program's survival depends on volunteers and currently has over 300 volunteers that produce products and services, with very limited federal funding. Baldrige converted key processes, products, and services to virtual platforms. The Quest for Excellence Conference is an example, which highlighted best practices of 11 award-winning recipient organizations over a 4-day period. The Baldrige Fellows Program moved to a hybrid approach in 2021.

The program continues to push forward on several key strategic initiatives. One important one is the Job Quality Framework Initiative. The Baldrige Program was asked by the Secretary's office to lead an interagency effort to develop a framework that will encourage and enable businesses to enhance their efforts to create and sustain high-quality jobs. Baldrige continues to maintain high levels of customer satisfaction and engagement.

This year, the Office of Advanced Manufacturing (OAM) conducted four competitions and made two of the largest awards in NIST history. OAM received $150 million through the American Recovery Plan. The National Institute for Innovative Manufacturing and Biopharmaceuticals (NIIMBL) was renewed for another 5 years and received $70 million earlier this year.

The Build Back Better initiative has proposed additional NIST Manufacturing USA Institute and Manufacturing USA education and workforce development programs. Some of the activities include developing a 2022-2026 National Strategic Plan for Advanced Manufacturing. The Return on Investment (ROI) Legislative Package for modernizing the Stevenson-Wydler Act was released to Congress for consideration. There were some substantive changes to Bayh-Dole, and the Notice of Proposed Rulemaking received 81,000 comments, and review of the comments is ongoing. The fast-track SBIR solicitation specific to COVID-19 response is a first-ever contract for NIST, which is where Phase I and Phase II are combined. This is commonplace in some federal agencies but new for NIST.

Accomplishments in 2021 include 51 CARES Act awards by the September 3, 2021 deadline, and a MEP National Network update meeting held in August, which ensured strong alignment between manufacturers' needs and MEP services.

Priorities for 2022 include publishing the 5-year strategic plan for the MEP National network, onboarding of at least 10 new MEP team members, an increase in MEP Center Base Aware Cooperative Agreements by at least $40 million, and an award of at least $40 million in new Competitive Awards to MEP Centers.

For more information, see Ms. Bahar's presentation.

NCNR Situation Update – *Dr. Robert Dimeo, Director, NIST Center for Neutron Research (NCNR)*

Dr. Dimeo said efforts will be able to start no earlier than April 2022 to restore the reactor to operational readiness. Also, implementing an extensive number of corrective actions and obtaining authorization from the U.S. Nuclear Regulatory Commission (NRC) to restart the reactor must happen.

The confinement building, which contains the reactor, control room, and infrastructure had significant contamination in February that included fission products released from a damaged fuel element. Progress has been made for cleaning the primary system. Root causes were identified, and corrective actions have been implemented. A request to restart the reactor has been submitted to NRC. The "No Earlier Than Date" to restart will be in April 2022.

The Reactor Oversight Committee was charged with convening a subcommittee to review the NCNR Root Cause Analysis, corrective actions, and determining the efficacy of those. They came up with two additional root causes and validated the corrective actions described along with suggested program improvements. The Reactor Operations and Engineering team developed a detailed implementation plan and corrective actions are in process of being implemented.

The final milestone of submitting safety documentation, Root Cause Analysis reports, and a corrective action implementation plan with safety information was submitted to the NRC. In response, the NRC is asking for more clarification, which is a good indicator that they are in the process of developing a roadmap for a path towards restarting the reactor.

On August 4, 2021 a damaged fuel element that was still in the reactor core was removed. There were no unforeseen circumstances, and the process went smoothly.

Funding requirements are needed to restore the reactor to operational readiness. NRC will carry out an inspection to ensure the corrective actions have taken place, but the NRC may have additional enforcement

actions. All previously approved experiments that have not been executed are going to receive the highest priority.

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

Discussion. The group discussed the following topics:

- Modernization possibilities for reactor readiness funded by the Build Back Better legislation,
- Sharing NRC documentation provided to NIST on root causes and extensive set of corrective actions,
- High priority for NIST with respect to NCNR to get reactor operational,
- NIST neutron experts seeking careers elsewhere, and
- Cross-agency collaboration on spallation neutron source between Commerce and Energy Departments.

Surfside Investigation Update - *Dr. Judith Mitrani-Reiser—Associate Chief of the Materials and Structural Systems Division, Engineering Laboratory (EL)*

Dr. Mitrani-Reiser said actual disasters and failure events provide important opportunities for study by NIST scientists and engineers to improve the safety of buildings, occupants, and emergency responders.

NIST has studied and investigated more than 50 earthquakes, hurricanes, building and construction failures, tornadoes, and fires since 1969. A slide was shown that highlighted National Construction Safety Team (NCST) investigations. The goal for NIST is to undertake post-event assessments and make recommendations to improve building codes, standards, and practices to make U.S. buildings more resilient and safer overall.

The NCST Act was signed into law in 2002 after the World Trade Center Towers collapsed which provides NIST the authority to make recommendations after investigations are completed on improvements to code standards and practices.

NIST is currently involved in two active investigations: Hurricane Maria in Puerto Rico and Champlain Towers South in Surfside, Florida. In Puerto Rico, NIST seeks to understand the wind environment and conditions that led to injuries and death as well as damage to critical buildings and designated safe areas. NIST is also examining emergency communications with public responders. The National Windstorm Impact Reduction Authority plays a key role in this effort.

A team is investigating the technical cause of building failure in the Champlain Towers South collapse and will make recommendations as necessary for specific improvements to building standards, codes, and practices. The building collapsed on June 24, 2021. NIST staff quickly started pulling together information on the same day of the collapse. Mission-essential travel approvals commenced. Within 48 hours, team members were on the ground in Surfside. The priority was to work closely with local authorities to ensure that potential evidence was identified and preserved without interfering in search and rescue operations. Artifacts were collected to provide clues to understand how the building was designed, constructed, modified, and maintained. The preliminary reconnaissance team found the collapse met all necessary criteria to invoke the NCST Act. NIST was supported by experts from FEMA, Florida University, Miami-Dade Fire Rescue, National Science Foundation (NSF), U.S. Army Corps of Engineers, and the U.S. Geological Survey.

On July 8, 2021 NIST briefed the Board of County Commissioners of Miami-Dade County and encouraged the public to submit any information on the collapse, including photos, videos, and other documentation to support the investigation. More than 3 weeks after the collapse was the first opportunity for NIST to inspect the foundation slab and to look at the debris that remained on-site. Army Corps taskforce structure specialists ensured that NIST staff members were safe.

On August 25, 2021, Dr. Olthoff, the ADLP, performing the non-exclusive functions and duties of NIST Director, and Ms. Huergo, the Director of Public Affairs, announced that NIST assembled a team of forensic engineers, academic researchers, and federal investigators to provide guidance on standards in building design and construction. The technical investigation is organized around six projects:

1. Building and Code History Project,
2. Evidence Preservation Project,
3. Remote Sensing and Visualization Project,
4. Materials Science Project,
5. Geotechnical Engineering Project, and
6. Structural Engineering Project.

The NCST investigation will include recommendations for improvements to codes, standards, and practice, and NIST is deeply committed to conducting a thorough and complete investigation of the collapse.

For more information, see Dr. Mitrani-Reiser's presentation.

Discussion. The group discussed the following topics:

- Length of investigation to determine root causes of collapse,
- Implementation of NIST recommendations, and
- Aging infrastructure of the nation and structural surveillance or monitoring technologies needed.

Safety Update – Keeping NIST Staff Safe During COVID - *Dr. Elizabeth Mackey, Chief Safety Officer and Director of Office of Safety, Health, and Environment*

Dr. Mackey said for COVID safety and health, the FY21 focus has been on keeping current. The NIST leadership continues to meet biweekly to review the status of COVID-19 in the community and to monitor conditions at NIST. Safety COVID team members monitor latest CDC guidance. New information and policy changes are communicated to staff regularly through NIST town hall meetings, all-staff email, webpages, training, and published directives, as well as guidance documents.

Current phased operations are tied to the CDC community transmission levels, and NIST is in Phase I, which means that community transmissions are substantially higher. According to DOC limits, NIST is limited to 25 percent occupancy and 200 square feet per person is feasible as well as maximized use of single-occupancy spaces. Conference rooms remained closed for in-person meetings and cafeterias remain closed, except for janitorial staff. All protocols remain in effect. When there is a need to have more than one person per 200 square feet, waivers are possible only after certified industrial hygienists evaluate the room for ventilation and other conditions required for work safety.

Through creative scheduling and work shifts, the Gaithersburg campus has been able to stay within the 25 percent occupancy cap. Since much of the Boulder campus staff is laboratory-based, OMB granted a waiver in September based on the NIST safety analysis to not have their mission impacted and to allow people to get into their laboratory spaces. Boulder remains in Phase I. Laboratories have inherently better ventilation than that in offices.

All staff must implement COVID protocols during the waiver which would require mask wearing and social distancing. Of the number of people who reported to have COVID or were symptomatic, there were 425 COVID cases as of October 17th. Protocol measures were immediately implemented to ensure disinfection and quarantine. The number of people who tested positive of the 425 were about 200, and 28 were physically present on the Gaithersburg campus. Of the 28 cases, there were 39 close contacts, 23 in Gaithersburg, 6 in Boulder, and 10 at the Surfside remote worksite. All staff in the trailer were fully vaccinated, and it is the only place where workplace transmission was seen among staff working in close quarters in the trailer. To date, there have been no cases of transmission at local campuses. Protocols have been modified for the remote worksites.

On incident data, there were a couple of incidents involving unsafe conditions around large outdoor tanks. A team from the Laboratory Program and Management Resources came together to look at the safety of the large tanks. Recommendations will be forthcoming in the next year. Crane inspections and repairs are underway, which is a collaboration with the facilities staff.

A safety startup guide for resuming work with tips for both office and laboratory environments was disseminated. Preliminary workplace inspection data revealed five deficiency categories for FY2021:

1. Chemical labeling,
2. Nonfunctioning lighting,
3. Slip, trip, and fall hazards,
4. Housekeeping, and
5. Chemical inventory.

Most of the findings for lighting outages and slip, trip, and fall hazards related to spaces not being well kept during times of low occupancy.

An on-site review of the DOC Boulder site's stormwater permits by EPA Region 8 and the Colorado Department of Environment was conducted. The inspection went well, and a final report will be forthcoming. On radiation safety, the majority of work went into Building 245 to enhance the capability for mission delivery of medical isotopes, dosimetry, and all aspects of radiation work. Regulators have resumed their routine inspections. The NRC resumed its routine inspection of our SNM-362 license and the Exempt Quantity Distribution license tied to that SNM-362 license.

The completion of a new database to manage radioactive materials approvals and inventory tracking has replaced a very old technology that was difficult to update. The Radiation Safety staff assisted NCNR as needed. Focus in the NCNR is on the TR-5 license and radiation safety. The NCNR provides occupational safety and health support in this endeavor. The Safety Evaluation Committee associated with the TR-5 license was charged with providing that independent review. Two additional root causes were revealed, inadequate change in management processes and improvements in safety culture.

The NCNR is creating the Safety Culture Assessment Program, and a draft proposal has been issued. Focus areas for FY2022 include development of a COVID testing program, fostering a stronger safety culture, a Safety Management System, and formalizing the use of safety metrics for risk assessments.

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

Discussion. The group discussed the following topics:

- Looking to NRC NUREG-series publications on industry standards to improve the NIST Safety Culture Assessment Program, and
- Lessons learned from ventilation in Florida trailers and adherence to health screening form requirements.

SESSION II: BUDGET UPDATE

Budget Overview - *Dr. Jason Boehm, Director, NIST Program Coordination Office*

Dr. Boehm said NIST is dealing with multiple budget issues. NIST is on a Continuing Resolution until December 3, 2021. NIST did get an increase of $22 million for the NCST investigation and is waiting on a congressional resolution for the FY2022 budget.

Congressional attention is ongoing concerning the reconciliation bill and the President's infrastructure bill. The reconciliation bill could affect NIST's financial support, but the process is uncertain at this time. Potential funding for the CHIPS Act is also on the horizon.

As part of the Build Back Better initiative, NIST is recognized for their important role in emerging technologies, which was highlighted by the President's Executive Order early in the administration focusing on the importance on investment in advanced manufacturing in the U.S. NIST's advanced manufacturing is aligned with the administration's priorities.

The President's FY2022 budget request for NIST was positive, a total of $462.8 million increase over FY2021. This would be a 44.7 percent increase from total funding. This funding would provide significant growth for both Manufacturing USA and MEP ($125 million for MEP and $150 million for Manufacturing USA), and a significant increase for the NIST laboratory programs, which is a top priority for NIST. This funding would also allow investments in workforce, supply chain, increased technology, diffusion efforts, and strengthening the core network. For Manufacturing USA, it would allow NIST to create two new institutes and to expand the network.

Earmarks are back in play for Congress now. In the House overall, a $334 million increase is projected, which is slightly less than what the President requested. The Senate mark is also slightly different, with a much lower funding level than the President's request for MEP and Manufacturing USA. One point to keep in mind is that both bills would have to go to conference before any legislation is finalized, so there remains uncertainty in what the FY2022 financial situation will look like.

The CHIPS Act authorizes several programs for the Department of Commerce. The United States Innovation and Competition Act (USICA) passed the U.S. Innovation Preparedness Act which was a massive authorization of new science programs at NSF and elsewhere. It included $52 billion in appropriations for funding the CHIPS Act, which was passed as part of the National Defense Authorization Act, and these are a series of programs to substantially increase the U.S. domestic manufacturing capacity in advanced semiconductors and microelectronics as well as to strengthen the research and innovation ecosystem in that space. It was thought that there would be quick action on that bill in the House, but the reconciliation bill and other issues have taken priority. Passage of the bill is anticipated by the end of the 2021 calendar year.

High-level goals for the CHIPS Act are to protect and extend the U.S. semiconductor technology leadership, to ensure a secure supply of chips for critical sectors and to promote the long-term economic viability of U.S. industry in R&D manufacturing and other elements of the semiconductor value chain.

Goals for the Incentive Programs are to increase the U.S. share of the world's leading-edge chip production, ensure transparent and reliable chip supply for critical sectors, protect and extend U.S. semiconductor technology leadership, support legacy fabs for critical sectors with strong demand, and stabilize U.S. memory chip supply with maintaining

viability. Where the U.S. has a challenge is in the semiconductor and microelectronics arena, which is where the CHIPS Act R&D programs are going to help.

The NSTC is intended to cover advanced packaging work, manufacturing improvements, and workforce issues. The goal it to integrate these efforts and ensure there are no gaps and no redundancy between them.

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

Discussion. The group discussed the following topics:

- Incentives Program will ensure a strong ecosystem in transformational technologies,
- Persuade Congress to increase funding to fix inadequate infrastructure and plant facilities,
- USG funding to leverage implementation of a fabrication facility in the U.S. for chip designers,
- Awareness of increased heterogeneity associated with cybersecurity,
- Does NIST have a plan to deal with rare earths shortage,
- Building a research neighborhood design must be flexible with movable walls and distributed utilities,
- NIST must be strategic with Reconciliation Act monies when available,
- NIST remains shovel-ready to respond to whatever reconciliation funding is received,
- Contract awarded to National Academies of Sciences, Engineering, and Medicine (NASEM) to convene a committee for assessment of NIST capital facility needs,
- A follow-up email will be sent to VCAT members interested in participating in the NASEM committee, and
- Ensure the NCNR restart stays on track to receive additional funding.

SESSION III: NIST CLIMATE PORTFOLIO OVERVIEW

Climate Overview – *Dr. Anna Sberegaeva, Program Analyst, NIST Program Coordination Office*

Dr. Sberegaeva provided a brief overview of the NIST climate-related programs. The mission of these programs has aligned with the Biden administration's climate priorities.

The research in the laboratory programs for measurement science, standards, and technology concern climate monitoring measurements, resilience, energy efficient infrastructure, and advanced technologies.

On climate monitoring and measurements, work is focused on measuring the concentrations and emissions of greenhouse gases in the atmosphere and their impact on the global temperature. NIST collaborates with NOAA to collect standards and measurements that underpin foundational global climate change benchmarks. NIST also performs calibrations of earth-observing sensors and satellites to ensure accuracy.

The Surfside investigation is part of the broader Disaster Resilience Programs. Investigations occur not only during failures but also during normal operations. Reliable communications are needed to have an effective response to extreme weather events and disasters, and the Public Safety Communications Research program is focused on access to reliable communications for first responders.

To minimize impact on climate, the U.S. will need to transition to energy-efficient infrastructure, which includes emerging technologies for sustainable buildings. NIST efforts have focused on modernizing the electric grid and on solid state lighting, advanced appliances, photovoltaics, batteries, hydrogen generation, storage, and initiatives related to energy efficiency and reducing carbon intensity. NIST efforts also include research for light-weight vehicles, materials, and advanced composites.

In FY2021, NIST funded two new areas focused on direct-air capture and sequestration as well as the circular economy.

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

Discussion. The group discussed the following topics:

- NIST should work with HHS and others to build better communications during a crisis, and
- Repairability should be a part of the circular economy effort by NIST.

Disaster-Resilient Buildings, Infrastructure, and Communities – *Mr. Jason Averill, Chief of the Materials and Structural Systems Division, Engineering Laboratory*

Mr. Averill said the goal of disaster-resilient buildings, infrastructure, and communities is to reduce the damage risk and enhance the resilience of buildings, infrastructure, and communities to natural and manmade hazards through advances in measurement science. Two key areas of the goal are traditional STRS measurement science research and fire engineering for communities for things like wildfires and fire department response.

Two interagency leadership programs, the National Windstorm Impact Reduction Program and National Earthquake Hazard Reduction Program coordinate federal efforts to reduce windstorm and earthquake losses.

Natural disasters are a substantial economic and life-loss problem for the United States, and from 1980 to 2020, there were $7.1 billion in losses on average in disaster events. So far this year, there have been $18 billion in losses, with an atmospheric river and a Nor'easter currently sitting off both coasts of the U.S. The underlying climate physics are changing as NIST is trying to address the problem.

A changing factor in communities is the relationship between climate change and hazard events. For years, the engineering community and community regulators focused on life safety as the primary objective of regulation in the build environment, but as events ranging from Superstorm Sandy and Hurricane Maria have shown, the population is becoming less tolerant of interruptions to education, hospitals and health care services, supply chain, and government services.

Congress in the 2018 reauthorization of the NEHRP program asked NIST and FEMA to develop a roadmap that would provide a path forward to determine the performance of the built environment. That was published in January of this year and is called the "Post-Earthquake Re-occupancy and Functional Recovery Time."

Wildfires create substantial quantities of both carbon dioxide and particulate matter, which are drivers of climate change. As well, the increased temperatures and increased duration of droughts is an area that needs to be addressed as it contributes to the overall climate change problem. The annual global wildfire emissions of carbon dioxide are 7.3 billion tons, 46 million tons of particulates, and 24 percent of total carbon emissions. This makes wildfire seasons on the West Coast between 1 and 3 months longer which is a significant problem, and especially challenging during a respiratory-based pandemic.

Selected current priorities are structure-to-structure fire exposure, source-term characterization, material weathering research, SERI physical infrastructure research, and functional recovery. The Disaster Resilience Goal is directly beginning to address some of these problems. In the wildland urban interface, an understanding of how fire propagates from structure to structure needs further examination.

Tornado maps have been incorporated into the American Society of Civil Engineers' Building Code 7 that will be published in 2022. This code will now require segments of the country subject to tornado hazards to have specific tornado-resistant design provisions for the first time in our country's history.

At the request of Congress, two groups began to initiate information exchange. One group is all the organizations relevant to building codes, including the American Society of Civil Engineers, ASHRAE, the local community, and the International Code Council. This group wants to convey to the climate science community what the end-user needs are from climate science that could inform building codes.

In summary, a question to be answered is whether the buildings and infrastructure of today will withstand the hazards of tomorrow. This will require understanding how to measure the hazard, quantifying structural risk, and designing for resilience.

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

Discussion. The group discussed the following topics:

- Attribution is low for fires compared to other natural hazards that standards/codes need to address,
- White rooftops that reduce energy load on buildings during fire hazards is a plan in discussion,
- Research and development of a warning system for building structure failures,
- NIST and FEMA coordination in pre- and post-disaster events, and
- Ongoing work with NOAA and NCAR on integrating models of meteorology with the built environment.

Circular Economy - *Dr. Kathryn Beers, Manager, Circular Economy Program, Material Measurement Laboratory*

Dr. Beers said the Ellen MacArthur Foundation has spent the last decade-plus advocating for the circular economy on a global scale. The working definition of a circular economy is an economy that transitions away from what is called a "throwaway economy" or the "linear economy"' that extracts, consumes, and disposes of goods to one where things are recirculated, and waste is eliminated. The definition in legislation in the Save Our Seas 2.0 bill, passed in 2020, closely mirrors the MacArthur Foundation definition and included some direction for NIST to perform an assessment of recirculation techniques for polymers and to work with EPA on certain strategies for waste recovery and recycling efforts and technologies. However, Dr. Beers said, "natural regeneration" is how the circular economy should be measured, and a better definition is "keeping atoms and molecules inside the economy, producing value, and out of unwanted sinks such as the environment." NIST has been participating and supporting the State Department in preparing for global negotiations for the upcoming UNEP 5.2 meeting in February on some of the draft language.

There are converging issues with plastic waste and the consequences to the supply chain. The growing impact of plastics in the environment, particularly the marine environment, and the consequences of nano and microplastics waste are increasing rapidly.

There are multiple ways for polymers and plastics to come back into the supply chain if they are properly collected, sorted, and fed back into the system. The most important is mechanical recycling. There is an aggressive research effort right now and some efforts in industry to feed plastic waste back into plants and to try to extract value from it by converting it in a controlled way back into small molecules or sometimes fuels, specialty waxes or other materials.

A broader effort in the circular economy for polymers has brought in new processes and materials, with one focus point centered on environmental impact. This initiative is built around manufacturing, but it is also addressing supply chain circularity. The partnerships needed both domestically and internationally must also be considered. The Engineering Laboratory is a primary partner in this effort, but there is also participation from PML. There are opportunities across all of NIST to participate in supporting the U.S. circular economy.
NIST, specifically MML, developed technology for Raman spectroscopy in rheometers, which revealed important insights about incompatible materials like polyethylene and polypropylene. PML is leading the work on nanoparticles and environmental assessment and is prototyping nanoparticle arrays using lithographic strategies.

NIST is creating a Resource Registry in collaboration of the Office of Data Informatics to track items relevant to the circular economy.

In FY2021, three workshops took place that explore other material classes, including what is known as "high-tech waste" which is a combination of eWaste, solar, and battery waste materials. Also being explored is whether NIST should have a role in textiles.

Relationship building across federal agencies and private sector is ongoing. The State Department has established three separate working groups on plastic waste, the circular economy, and support for upcoming UN negotiations. There has been strong collaboration with the International Trade Administration, NOAA, and EPA. EPA has a National Recycling Strategy that will be released soon after several postponements.

On the international front, NIST has coordinated workshops through a unique partnership with the EU's Joint Research Commission on Nano-plastics Research. Discussions are ongoing about how the two organizations can continue to collaborate.

Dr. Beers concluded that the circular economy effort is ambitious and has strong connections to a lot of other issues at NIST. It is related to carbon accounting and resilience. Infrastructure is also a major concern.

For more information, see Dr. Beers' presentation.

Discussion. The group discussed the following topics:

- Studies on biological response to microplastics,
- New designs in recyclable shipping packaging,
- Infrastructure to gather packaging back into recycling plants needs analysis, and
- Diverse supply chain affects food packaging.

Greenhouse Gas Monitoring and Measurements - *Dr. James Whetstone, Special Assistant to the Director for Greenhouse Gas Measurements Program, Special Programs Office*

Dr. Whetstone said the challenge with respect to greenhouse gas is to distinguish between adoption and mitigation. The purpose of NIST's Greenhouse Gas Measurements Program is to equip mitigation decision-makers and managers with quantitative information tools to support strategic decisions and to measure progress.

The program has focused on urban and regional greenhouse gas measurement tools, methods, and reference data. Urban areas are a focus because that is where most people live and most of the energy is used, and about 70 percent of global emissions occur from urban areas.

The Urban Greenhouse Gas Measurements Testbed System began in 2010. The cities involved were Indianapolis, Los Angeles, and the Baltimore-Washington area. Atmospheric measurements, often called top-down measurements, and emissions modeling, often called bottom-up measurements, are based on socioeconomic statistics and demographic data.

An illustration of an urban area was shown in a grid with a numerical weather prediction model. Models are typically one square kilometer in size. On four corners, communications towers are instrumented in order to measure concentration of greenhouse gases entering the domain and dispersing inside the city. This is known as an "observing network." Spectrometers are used in observing nodes and are manned on existing communication towers. They tend to have accuracies at a tenth to two-tenths of a part per million level for CO_2. Top-down measurements enforce mass conservation of greenhouse gases in a domain of the simulation, and the bottom-up method can give high spatial resolution and temporal resolution, although it does not have mass conservation properties. The bottom-up method is an elaboration of the EPA methods and the Task Force on National Inventory Method. A map called "Vulcan 3.0," shows emissions across the Continental U.S. at the 1- kilometer range. The Vulcan can be used as a reference point against radiocarbon measurements made by NOAA's global monitoring laboratory.

The first testbed city was Indianapolis, which harmonized the spatio-temporal observations and analytical results coming from a 12-tower observation network.

The most recent data was published in 2020 that combined all methods together in a single study. A Bayesian analysis of the results showed that only a small correction was necessary to the input data, which is a stellar result.

Near-term plans are to strengthen NIST emissions and biogenic modeling capabilities, to continue extending the Northeast Corridor testbed observing network from Washington to Boston, and to strengthen the measurements and analyses linking on-orbit GHG concentration observations and surface emissions estimates. NIST wants to initiate with the State of Maryland and EPA's R&D office a long-term landfill emissions testbed system to better quantify methane emissions in landfills.

There has been improvement in stack gas measurement capabilities based on velocity measurements in stacks that underpins EPA's stack gas measurement requirements. Gas concentrations are the foundation of all atmospheric measurements, and the need for field standards is going to increase by probably a factor of 100.

Work is ongoing in PML on differential absorption LIDAR. The goal is to obtain concentration measurements in the troposphere, which is a critical measurement for determining satellite instrument capabilities.

Biogenic processing is a new research area that seeks to understand how vegetation emits and absorbs carbon dioxide. The forest at the NIST Gaithersburg campus is being used for optical measurements in this investigation.

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

Discussion. The group discussed the following topics:

- NEON flux tower data to measure uptake and emissions from forested and agricultural areas,
- Tracking methane emission from gas wells,
- Measurements of trace gases using quantum cascade lasers,
- Global Atmospheric Watch at WMO coalesces global and urban greenhouse gas observing communities,

- Manufacturers looking for sustainability solutions and increased production, and
- Looking for ways to combine economic components with regulatory environments.

Emerging Technologies for Sustainable Buildings – *Dr. David Yashar, Deputy Chief of the Energy Environment Division, Engineering Laboratory*

Dr. Yashar said the goal for emerging technologies for sustainable buildings is to enable gains in energy and water efficiency while maintaining and improving the indoor environment and functionality of buildings. This will reduce greenhouse gas emissions and save money as well as improve the overall quality of life.

The United States has about 100 million homes and more than 5 million commercial institutional buildings, and buildings play a major role in climate change. Roughly a quarter of all CO_2 that is emitted into the air comes from the generation of electricity, and about three-quarters of all electricity is used in the building sector. In addition, heating, cooling, and refrigeration systems are inside the buildings and contain refrigerants that leak miniscule amounts over their lifetime but, are potent greenhouse gases. Ventilation systems play a role in health as transmission of airborne pathogens, such as COVID-19 and cleaning particulates, can occur through the air in buildings.

One of the NIST flagship facilities is the Net-Zero Energy Residential Test Facility, which is a modern single-family home that operates on less energy than it produces. It is used to look at equipment operating in a real-world setting, whole building performance issues and interactions between the different systems in the building. Datasets have been released characterizing the electrical output of photovoltaic arrays on campus coupled with relevant weather data.

Several software packages are widely used by experts in the building science community. CONTAM is one, which is a premier building airflow and contaminant transport model used to analyze airflow and contaminant dispersal in buildings. Some other online tools are the Building Industry Reporting and Design for Sustainability (BIRDS) and the Building for Environmental and Economic Sustainability (BEES). Staff members hold leadership positions in many standard development organizations and engage with many trade organizations.

Central to the effort to successfully develop and implement building systems is NIST leadership with the ASHARE and BACnet standard. BACnet is the data communication protocol for building automation and control networks. It enables the communication links between building systems. This work also relates to standards and research on the smart grid. NIST is helping industry adopt software tools to help automate the labor-intensive building process.

Heat loss and heat gains are also a big part of the overall energy performance of buildings. The way to minimize heating loads is through insulation and a strict adherence to construction guidelines. One area of improvement in HVAC&R equipment is the reduction of hydrofluorocarbons from refrigerants. They are being phased out through international agreement. This means a new design practice for this industry needs to be developed quickly.

Because of the mismatch between design approaches and modern plumbing features, water is another area of focus. If water spends a much longer time in the piping network than was intended, the consequences are more contaminants in the water, increased growth of opportunistic pathogens in premise plumbing systems (OPPPs), and a lot of wasted energy.

Future goals are to make significant impacts in standards for premise plumbing, develop technical information to enable transition of low-GWP fluids without compromising system efficiency in heating/cooling systems, develop energy-efficient ventilation systems, use AI and machine learning techniques to improve energy efficiency by optimizing the design and operation of buildings and equipment.

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

Discussion. The group discussed the following topics:
- Objectives for localized energy codes motivated by climate concerns and
- Development of standards for old buildings as well as new buildings.

Carbon Capture and Sequestration – *Dr. Pamela Chu, Group Leader, Chemical Process and Nuclear Measurements, Material Measurement Laboratory*

Dr. Chu said from the latest IPCC report that the driving force of climate change is the human-generated greenhouse gas emissions that have been accumulating since the Industrial Revolution. The level of greenhouse gases is at a

climate tipping point and necessitates the need to manage the carbon dioxide in the atmosphere. It will be difficult to replace liquid fuels in certain sectors such as air transport. Carbon removal technologies need to be included in the strategy to meet climate goals.

There are several negative emission technologies that remove carbon dioxide from ambient air and permanently store it elsewhere. For this to be economically viable, the cost of removing a ton of carbon dioxide needs to be less than $100. There are several negative emission technologies, both natural and engineered, that enhance natural processes. Currently, the focus is on direct air capture, which uses chemical processes. One advantage of DAC (direct air capture) over natural processes is that it is less vulnerable to reversal, but R&D is needed.

The Climeworks facility in Iceland went operational last month. It's projected to capture 4,000 tons of carbon dioxide per year using a process based on solid sorbents. It relies on geothermal power and captured CO_2 is then directly injected into underground basalt caverns for permanent sequestration. There is a demonstration project in Canada that is expected to capture a megaton of CO_2 per year. The Climeworks facility in Iceland and the Carbon Engineering facility in Canada and Texas use active systems where air is forced across a sorbent platform. The Klaus Lackner facility at Arizona State University is developing passive approaches to capture carbon dioxide with reduced energy requirements.

Substantial challenges for direct air capture to reach the 10 gigaton capacity is needed by midcentury. The fundamental chemistry driving these processes is poorly understood, and it is still early in the development cycle to know the best approach. Costs are high and need to decrease to make this economically viable. A rapid scale-up is needed.

NIST can play an important role by developing benchmark materials, new measurement capabilities, data and models, and standards to help accelerate innovation and to validate the performance of direct capture technology. Congress appropriated $3 million in FY2021 to NIST for this effort. A three-pronged approach has been taken: outreach to stakeholders, an expansion of measurement and modeling capabilities, and leveraging measurement expertise across NIST to characterize candidate reference materials and to develop documentary standards. The NIST Facility for Absorbent Characterization and Testing (FACT) is equipped with five state-of-the-art instruments for using different measurement principles to provide quality-assured data and reference materials. The entire measurement expertise across NIST is also leveraged by including NCNR, EL, and MML. NCNR uses neutron scattering to characterize the structure and dynamics of adsorbent materials. EL conducts research to predict the performance of conventional and innovative building materials and correlates the material performance with degradation mechanisms. MML has expertise in state-of-the-art measurements and models.

The focus has been on direct air capture and carbon mineralization in building materials, but ultimately carbon measurements and carbon accounting need further development.

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

Discussion. The group discussed the following topics:

- Possibility of catalytic reactions in the carbon capture process,
- Synergy between catalysis and adsorbent materials,
- Using inexpensive and abundant materials for catalysis processes, and
- Specialized systems to capture areas of higher carbon concentrations from waste piles.

SESSION IV: CYBERSECURITY OVERVIEW

Cultivating Trust Through NIST's Cybersecurity and Privacy Program – *Mr. Kevin Stine, Chief of the Applied Cybersecurity Division, Information Technology Laboratory*

Mr. Stine said the mission of the Information Technology laboratory is to cultivate trust. This can happen by working with the community to advance cybersecurity and privacy standards and guidelines, technology, and measurement science. This effort will help enable organizations to transition resources produced by NIST, which includes putting practical and actionable resources in the hands of practitioners for securing their missions and business objectives.

To achieve these goals, the core tenets are to work in an open, transparent, and collaborative way, enlist best expertise from around the world, share solutions, and to listen. The Cybersecurity Framework is an open and collaborative approach, and after 8 years, it continues to go strong. There has been great adoption domestically from sector to sector and even internationally. NIST has always been committed to sharing ideas but does not want to duplicate. It is important to produce things of value to the community. Listening is something that is unique to NIST as a part of an open and transparent collaborative approach. It is important to hear from others about their pain points as well as what their successes are and then to work with them to find out how NIST can provide value to address their challenges.

There is no shortage of opportunity in cybersecurity and privacy. Ransomware is an area that has received attention and resources across the nation and the world. Trustworthy networks and platforms can leverage foundational components like cryptography. The CHIPS Act illustrates the importance of hardware security and is going to inform a lot of the direction NIST takes in the coming months and years.

One of the most visible and engaging parts of the program at NIST is the laser-sharp focus of the National Cybersecurity Center of Excellence on the practical application of standards and technology. The center works with the community collaboratively and promotes the use of best practices in commercially available technologies. Today NIST has 52 formal partners that see the value of working with the NCCoE and NIST to address the challenges in cybersecurity.

Some current projects at the center include securing the industrial Internet of Things (IoT) and protecting genomics data and DNA sequencing techniques. Some other technology platforms being addressed are security for 5G and zero-trust architecture, and helping organizations prepare to migrate to post-quantum cryptographic algorithms. There are a lot of cross-NIST collaborations in key areas, including work with MML on genomics, IoT work with EL, CTL, and all things quantum with PML. The MEP and Baldrige reach manufacturers and others through their programs and capabilities. The NCCoE is a great resource for everyone at NIST.

The implementation of Executive Order 14028 on improving the nation's cybersecurity was issued in May 2021 and has a one-year timeline. The requirements are very ambitious, but achievable. NIST will play a significant role primarily on enhancing the software supply chain. NIST has longstanding programs in cybersecurity supply chain risk management and software quality and security. A key point is that this is not a one-year-and-done effort. This effort will lead to a much more sustained and enhanced security posture.

Stakeholder engagement and collaboration is key. Feedback is one of the most important driving forces behind what NIST does from a cybersecurity and privacy perspective. Feedback helps form decisions on which areas to invest in and on what are the best vehicles and formats to deliver results that can be useful to the community.

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

Discussion. The group discussed the following topics:

- How technology at the NCCoE is used to address challenges, e.g., solving power grid security,
- NIST stance on cybersecurity is focused on defensive measures and not offensive measures,
- A barrier to good cybersecurity is the inconvenience of protection measures,
- Attention is needed to fix bugs in open-source codes for libraries, and
- Possible development of a NIST platform for SMEs to help the public.

Strengthening the Nation's Cybersecurity Workforce – *Mr. Rodney Petersen, Director of the National Initiative for Cybersecurity (NICE)*

Mr. Petersen said the mission of NICE is to energize, promote, and coordinate a robust community working together to advance an integrated ecosystem of cybersecurity education, training, and workforce development. NICE is all about cybersecurity education, but it recognizes the importance of training. Workforce development is the end game, with a goal to make sure that organizations have qualified employees with the knowledge and skills needed.

The five strategic goals and NICE areas of focus are career discovery, learning process, talent management, NICE Framework, and research. The Cybersecurity Career Awareness Week was part of the first goal which reached out to young people and working adults to illustrate that cybersecurity is a viable and rewarding career opportunity. A webinar was held on cybersecurity apprenticeships for the Federal Government, which recognized ways to "learn as you earn" while employed in this field. Modernizing talent management is a big focus area for pay, recruitment, and retention.

A NICE special publication, "Workforce Framework for Cybersecurity," revised in 2020, addressed the cybersecurity risk to organizations. Specialty areas and ability statements were removed, and the appendices were moved outside the publication.

The core building blocks of NICE are tasks, knowledge, and skills. The task describes the work, and the skills and knowledge describe the learner. The NICE Framework has 62 work roles currently in place, which are used to augment position descriptions and to assess the federal cybersecurity workforce. It was important that the NICE Framework discussed competencies in a way that employers can use to help define or identify. The learners are the people that acquire, process, or develop the competencies. This work development is being done with the federal government, private sector, and academia through a variety of partnerships. There is no end to the amount of workforce frameworks to be developed, and each one should follow a similar playbook, which is what NICE is seeking to promote.

A series of success stories based on people using the framework is shared in a NICE quarterly newsletter called "Framework in Focus." It is necessary to engage with a variety of stakeholders. The NICE Interagency Coordinating Council meets monthly and works with various agencies and departments of the federal government. The NICE Community Coordination Council is a partnership with academic and industry. CyberSeek.org is a job map that shows a number of open cybersecurity positions across the U.S. It leverages the NICE Framework as a way to identify available jobs. The number of people employed in cybersecurity continues to rise. A quarterly newsletter puts a spotlight on events that are happening in the K through 12 and higher education arena, describes what companies are doing, and what is happening in the government at a state, federal, tribal, or territory level. NIST partners with the Office of Personal Management to do an annual Federal Cybersecurity Workforce Summit as well as holding quarterly webinars. There is also an annual NICE conference and expo that brings together the entire ecosystem. The Federal Information Security Educators (FISSEA) organization comes together regularly to share information and best practices as well as to be a place to engage with others and to ask questions.

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

Discussion. The group discussed the following topics:

- Diversity in workforce is a prime consideration for new entrants in the cybersecurity field,
- NICE Framework is preparing students within a legal context to think like an adversary,
- Programs to reach out to women and underrepresented minorities and to increase retention, and
- Accommodation to a more mobile workforce.

Meeting Wrap-up

Dr. Locascio said NIST has many opportunities to look forward to in emerging technologies, manufacturing, and semiconductors, but it will need strong and vibrant internal laboratory programs and robust extramural programs that are well executed, which will be her priority. Having been at NIST before, Dr. Locascio said she knows that the strength and influence of the VCAT Committee and its advisors is critical to the health of NIST.

Dr. Ishak congratulated Dr. Locascio for her nomination and expressed appreciation for being a VCAT member.

Dr. Olthoff said it is hard to predict the future and hopes the VCAT will meet in person soon. Dr. Adler thanked the NIST leadership and staff for the thought-provoking presentations and discussion of another virtual meeting. He also thanked Dr. Olthoff for his leadership, contributions, and service to the nation and congratulated Dr. Locascio on her nomination.

Adjournment

The meeting was adjourned at 5:30 PM.

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

Stephanie Shaw, Designated Federal Officer, NIST Visiting Committee on Advanced Technology

Dr. E. Allen Adler, Chair, NIST Visiting Committee on Advanced Technology