Recommendations and Findings of the NIST Safety Commission
April 7, 2023

The following recommendations and findings represent the opinions of the NIST Safety Commission based upon presentations and discussions with NIST leadership, review of detailed written information provided by NIST, and frank live interviews with numerous NIST employees. The Commission will provide a report that places these recommendations and findings in context, but wishes to share this information with NIST at this time as these recommendations can be immediately actionable by NIST as it begins the process of reinventing its safety posture.

1. Organization and Leadership

a. **RECOMMENDATION 1**: Office of Safety, Health, and Environment (OSHE) and all related EH&S functions should report directly to the NIST Director. Further, the Chief Safety Officer (CSO) should be a voting member of the Enterprise Risk Management (ERM) Council. Moreover, the NIST Director should make any other organizational changes needed to ensure the success of these specific recommendations.

i. **FINDING:** Placement of OSHE under the Management Resources directorate does not adequately prioritize research safety or inform the NIST Director of safety risks.

ii. **FINDING**: It is not clear that NIST leadership has demanded the highest level of professional and technical expertise from all personnel involved in safety.

iii. **FINDING:** Research safety is not adequately considered or prioritized in the ERM Risk Inventory by the ERM Council despite significant risks to human life or institutional mission as demonstrated by known incidents involving injuries, physical damages, and a fatality.

iv. **FINDING:** The Occupational and Environmental Medicine (OEM) physician and medical team of competent and qualified/licensed professionals are underutilized or missing resources in the risk management process, discounting their value as an existing quality assurance asset. The current placement of the OEM physician does not adequately prioritize occupational health and safety within NIST nor inform the NIST Director of operational program status or employee health and safety concerns.

v. **FINDING:** While issues resulting from the COVID pandemic presented NIST with additional safety challenges, they are not thought to be material to the foundational safety vulnerabilities this Commission identified and described in detail below along with many documented in the 2008 and 2010 Blue Ribbon Commission reports.

2. Safety Management Systems and Safety Processes

a. **RECOMMENDATION 2**: Establish and implement a safety audit system into the Safety Management System (SMS) that proactively identifies hazards and their associated risks, provides quality assurance-based feedback on performance of corrective actions and activities, and is compatible and consistent with the intention of a high quality SMS as exemplified by the standards set by ISO 45001 or ANSI Z10.

i. **FINDING:** The lack of an audit process in NIST's Safety Management System (SMS) has not been appropriately prioritized, causing a material weakness and elevated risk to the organization's safety posture.

1. FINDING: This recommendation was made by the 2008 NIST Blue Ribbon Commission: "*Currently NIST has no independent, systematic, and comprehensive internal audit procedures to ensure compliance with safety standards and regulations*."

2. FINDING: This recommendation was also made by the 2010 NIST Blue Ribbon Commission: "*NIST's safety program will indicate metrics that would be appropriate to monitor safety requirements that are applicable throughout NIST. Once these requirements have been established, safety performance will be monitored, measured, assessed, and audited.*"

b. **RECOMMENDATION 3**: Improve the Hazard Review and Approval System (HR) and Risk Hazard Index process (RHI), to include quantifiable definitions, validation/verification of user proficiency, and requirement for a reviewing role by OSHE.

i. **FINDING:** The Hazard Review and Approval System (HR) is a capable tool for hazard identification, but requires improvements for quality hazard management.

ii. **FINDING**: Risk Hazard Index (RHI) assessments are somewhat arbitrary, contributing to a false sense of safety risk acceptance.

iii. **FINDING**: The current risk matrix used by OSHE is deficient and lacks defined time references to determine likelihood.

iv. **FINDING:** ANSI Z10 is being incorrectly interpreted and used as a risk assessment aid.

v. **FINDING:** The Emergency Response Plans that are part of the hazard review package in the Hazard Review and Approval System are not well understood and practiced and thus not consistently/reliably actionable by staff.

c. **RECOMMENDATION 4**: Develop more relevant safety training and more effective methods of delivery, addressing specific safety concerns of researchers and staff that is generated to provide targeted and actionable information.

i. **FINDING**: Some safety information is treated as if it were "spam", due to irrelevance, or too generic and basic, feeling more like a "check the box" exercise focused on compliance, which results in missed opportunities for safety education and reinforcement.

ii. **FINDING:** Many NIST researchers take their safety responsibilities seriously, but all personnel require/desire access to better tools, training, and expertise, to fulfill their safety responsibilities.

d. **RECOMMENDATION 5**: Revise the Workplace Inspection Program such that inspection teams include both subject matter experts and OSHE staff, inspection teams have authority to mandate changes, inspections look beyond compliance issues to work practices and research hazards, and inspection findings are corrected and verified in a timely manner.

i. **FINDING:** Laboratory inspections do not always include OSHE staff and sometimes were led by people lacking sufficient expertise or who were not unbiased, for example by inspecting a laboratory under their authority.
ii. **FINDING**: The laboratory inspection checklist was detailed with appropriate topic areas to be examined; however, it focused on compliance rather than on actual work practices or research hazards and risks specific to that laboratory.
iii. **FINDING**: Inspection findings are not prioritized consistently for correction, have no timeframe mandated for completion, and are not verified to have been completed or been effective in achieving their goals to mitigate identified vulnerabilities and eliminate or control risk at an acceptable level.
iv. **FINDING**: OSHE staff reported that while they are periodically invited by OUs to visit certain specific research spaces, they also reported that their requests to access research spaces were sometimes denied.

e. **RECOMMENDATION 6**: Improve the Incident Reporting and Investigation Program to enable effective **incident reporting** functionality, usage, prioritization, response, and communication. Improve the Incident Reporting and Investigation Program to enable effective **incident Investigations** with regard to explicit risk-based prioritization of what is investigated, who leads the investigation, how incidents are investigated, identification of true root causes (not just identification of superficial proximate causes), formulation of recommendations and actions that clearly address root causes (not just proximate causes), and contributing factors to mitigate risks, timeliness of investigations, and follow through on completion and effectiveness of recommended corrective actions.
    i. **FINDING**: Significant number of researchers interviewed did not know how to submit IRIS reports, were not authorized to submit IRIS reports, found the reporting system too cumbersome, were not encouraged to report close calls, and did not know how reports were utilized in improving their work environment.
    ii. **FINDING:** Placing responsibility and authority for initiating investigations, determining actions, and following-up on actions at each Organizational Unit level creates an actual or perceived conflict of interest, limits generalized learning, and may result in unrecognized and increased organizational risk.
    iii. **FINDING**: The tools for determining hazard induced risk use definitions of likelihood that have no specified period of time over which the likelihood is defined. This leads to inconsistent prioritization, inefficient allocation of resources, and detracts from the establishment and maintenance of a robust and sustainable culture of safety.
    iv. **FINDING**: The investigation process is not sufficiently standardized and the metrics for quality and success of the investigations are not adequate, for example, by not correctly identifying root causes.
    v. **FINDING**: Investigation reports performed by OUs or OSHE seldom properly identified and determined contributing factors and root causes.
    vi. **FINDING**: Investigations and their subsequent actions are not accomplished in a timely manner.
    vii. **FINDING**: No systematic method exists to audit what is accomplished and to provide independent Quality Assurance for the investigation process or the success of interventions.

viii. **FINDING**: Incident reporting information is being emailed to employees without categorization or prioritization as to individual relevance resulting in staff stating they view it as spam and thus has a detrimental impact on safety.

f. **RECOMMENDATION 7**: Conduct a comprehensive review and audit of all safety related information technology (IT) systems, and based upon that review, make the necessary changes/fixes to ensure seamless integration and interoperability of safety information across all safety system IT tools. In addition, establish an advisory panel of safety stakeholders to periodically review effectiveness of these systems and empowered to make recommendations for continual improvement.
   i. **FINDING:** NIST created a number of IT safety systems, but they do not work together nor share data that is common.
   ii. **FINDING**: Explicit usability testing was not employed for the tools, such as IRIS, and this resulted in less than desired use, efficiency, and benefit from their employment.

g. **RECOMMENDATION 8**: Improve the Enterprise Risk Management program (ERM), and its current standard of processes and practices, to better address critical research safety matters such as by conducting enterprise-wide audits/scans of safety issues, and improving the timeliness and efficiency of addition of items to the Risk Inventory to inform strategic decisions by NIST leadership.
   i. **FINDING:** The ERM system is being used as a financially-oriented business tool and safety risks are not adequately considered.
   ii. **FINDING:** The ERM process and ERM Council do not adequately address and manage risks, thus appearing ineffective, addressing only high level safety risks. The ERM Council is failing to inform executive leadership's safety awareness for timely risk setting deliberations and prioritizations.
   iii. **FINDING:** The ERM process has technical shortcomings, for example the likelihood criteria of the Risk Scoring Matrix, objective uses of Risk Appetite and Risk Tolerance, and reporting of corrective action plans and their status as required by OMB Circular A-123 V.B. The Matrix does not employ likelihood definitions that have a grounding in an actual time reference without which reliable determination of risk is virtually impossible.
   iv. **FINDING**: ERM personnel do not personally brief upper management or are they present when senior management is briefed. This increases the likelihood that senior managers are deprived of an accurate picture of the systems level implications of the hazards and risks that exist.
   v. **FINDING**: ERM personnel do not proactively explore and identify organization risks that have enterprise implications. ERM personnel reported that they only take input from NIST organizational elements and do not systematically verify the veracity of the reports.
   vi. **FINDING**: Deficiencies in safety issues even being considered by the ERM Council were also noted by Thomas Mason (Director, Los Alamos National Laboratory) in his 2022 NIST NCNR Reactor Incident Review (https://www.nist.gov/system/files/documents/2022/08/02/T.%20Mason%20Report%20on%20NCNR_2022.pdf): "the NCNR had only been added to the NIST Risk Matrix shortly before the incident and only then in the context of an ageing reactor that might not meet beam delivery needs of the scientific community.

The fact it represents the highest hazard operation across all of NIST seems not to have been formally recognized."

3. Safety Culture

a. **RECOMMENDATION 9**: Make appropriate administrative, policy, and organizational changes to establish and promote an enterprise-wide sense of responsibility and ownership for safety, by 1) increasing the role of OSHE in Organizational Units (OU) safety operations, 2) holding all employees accountable for their safety roles, awareness, and performance, 3) eliminating differences between federal employees and Associates regarding their safety roles and responsibilities.

   i. **FINDING:** NIST's philosophy of OU ownership of safety has the (unintended) consequence of relegating OSHE to an advisory role with little to no authority and lessened safety impact. This siloed approach results in a failure to take advantage of learning from one OU and sharing across the NIST enterprise to proactively mitigate risks.

   ii. **FINDING:** Federal employees and Associates perform many similar research activities and thus have similar exposures to risks and propensity for being involved in safety incidents yet have distinctly different safety authority. This inequity results in exposure to unmitigated safety risks.

   iii. **FINDING**: There is a lack of consistent understanding of safety principles at their most fundamental level throughout the organization, which adversely affects a positive safety culture.

   iv. **FINDING**: NIST's approach to safety is primarily reactive and utilizes a compliance-based approach compared to a preferred proactive and sustained approach. The compliance approach results in a safety culture that is fragmented and inconsistent where the organization's value for safety is merely cosmetic.

b. **RECOMMENDATION 10**: NIST leadership should take visible and proactive measures to inculcate essential elements of a robust safety culture, by promoting an engaged and informed learning culture involving all NIST personnel.

   i. **FINDING:** Instantiations of a compliance mindset instead of a proactive safety attitude, particularly in training, field inspection, and policy have been observed and reported, which promotes minimal safety for standard procedures, and increases safety risk in unique, complex, or non-standard/non-routine procedures.

   ii. **FINDING:** Transparency, awareness, and follow-up of safety-related activities and actions are lacking, leading to mistrust and pessimism of some staff towards management's and leadership's safety commitment. Further, an absence of explicit risk-based prioritization and acceptance of residual risks in the determination of what safety actions are taken erodes staff confidence in the value of safety.

   iii. **FINDING:** The Management Observation Process (MOP) is not having its intended effect of visibility, engagement, and effectiveness promoting safety due to inconsistent participation by leadership and deficiencies in execution

(e.g., not conducted during active laboratory operations and focused on compliance issues rather than hazards and risks).

iv. **FINDING**: NIST staff spoke of a lack of prioritization of safety by NIST leadership. This finding was also reported by Thomas Mason (Director, Los Alamos National Laboratory) in his 2022 NIST NCNR Reactor Incident Review (https://www.nist.gov/system/files/documents/2022/08/02/T.%20Mason%20Report%20on%20NCNR_2022.pdf): "…staff observation of the difficulty in resolving long standing safety concerns of a non-nuclear nature (examples cited include ladders and stairwells). This reflects a NIST challenge of deferred maintenance and insufficient funding to address infrastructure deficiencies that is not limited to NCNR, however the inadvertent message sent to staff that impacts the nuclear safety culture is that safety is not as important as the marquee scientific investments that do attract funding."

c. **RECOMMENDATION 11**: Analyze results from the 2023 National Safety Council's "Safety Culture Survey", along with previous safety culture surveys, to develop a robust safety culture improvement plan.

i. **FINDING**: Key actions identified from the 2017 safety culture survey do not include metrics to demonstrate implementation or sustained organizational and safety culture improvement. Both leading and lagging indicators should be considered to measure safety improvement.

ii. **FINDING**: The safety culture perception is inconsistent throughout NIST. A positive view of the current safety culture is possibly overrated by upper management and indicates an undesirable hierarchical difference in perception as to the confidence of staff. This is particularly concerning with respect to some staff views of upper management's attitude and support of safety.

4. Facilities and Infrastructure

a. **RECOMMENDATION 12**: NIST should implement an overall capital investment and infrastructure improvement plan as many buildings and facilities need significant renovations or replacement to addresss both research and safety issues. Safety issues alone should justify funding and guide all designs and implementations.

i. **FINDING:** The 2023 National Academies of Sciences, Engineering, and Medicine report "Technical Assessment of the Capital Facility Needs of the National Institute of Standards and Technology" highlights the significant infrastructure deficiencies at NIST by stating "*Most of the older laboratories that have not been renovated fail to provide the functionality needed by world-class scientists on vital assignments of national consequence.*"

ii. **FINDING:** While mentioning safety in context, "*A substantial number of facilities, in particular the general purpose laboratories, have functional deficiencies in meeting their environmental requirements for temperature and humidity, and of electrical systems for stability, interruptability, and for life safety*", the report fails to cite significant actual injuries, property damages, and close calls that resulted from substandard infrastructure.

iii. **FINDING**: There are many instances in decades old facilities where safety considerations were not incorporated in the design process (e.g., prevention

through design: https://www.cdc.gov/niosh/topics/ptd/default.html) making issues difficult to address in later stages of development and operation.

iv. **FINDING**: Aging infrastructure, deferred maintenance, deferred repairs, and numerous work-arounds have a negative impact on staff morale. The low staff morale in several areas contributes to a less favorable view of safety culture. The poor infrastructure and required workarounds *symbolically* convey a diminished concern by management about employee safety and well-being.

v. **FINDING**: These facility issues have not been systematically addressed with respect to their safety context for prioritization by NIST management thus inhibiting a robust organizational culture of safety.

5. Engagement and Implementation

a. **RECOMMENDATION 13:** NIST should meet with the NIST Safety Commission approximately 90 days after delivery of the final NIST Safety Commission report to allow discussions ensuring that the plans, actions, and associated schedules for implementation by NIST are consistent with the Commission's intent as set by these recommendations. This timeframe is before the termination of the Commission on November 30, 2023 as set forth by the Charter.

   i. **FINDING**: There has been a consistent pattern of incomplete responses and mixed success of corrective actions in relation to recommendations of NIST-created commissions and surveys, such as the 2008 and 2010 NIST Blue Ribbon Commissions and the 2017 Employee Engagement Survey.

b. **RECOMMENDATION 14**: NIST should obtain outside advice/expertise/oversight with external experts on its Safety Management Systems and plans, actions, and associated schedules for implementation as those are generated in response to the recommendations in the final NIST Safety Commission report.

   i. **FINDING**: Missing actions addressing recommendations from previous of NIST-created commissions and surveys and technical errors in the current NIST Safety Management Systems suggest that NIST could benefit from continuing outside advice and expertise.

c. **RECOMMENDATION 15**: As the world leader in metrics and standards, NIST should design and implement changes to their Safety Management Systems with a long-term vision to be a world class model for research safety.

   i. **FINDING**: NIST has not incorporated a robust audit system into its Safety Management System to provide metrics on the efficacy of safety programs.

   ii. **FINDING**: NIST has not effectively partnered with other federal agencies that use similar hazardous equipment, materials, and processes to establish and share successful practices for safe research.

   iii. **FINDING**: NIST has not effectively partnered with other federal agencies that have expertise in worker protection (such as the OSHA Voluntary Protection Program) to proactively design, implement, study, and analyze safety systems designed to prevent fatalities, injuries, and illnesses.

   iv. **FINDING**: NIST has not utilized resources available from, or even considered becoming, one of the NIOSH Centers of Excellence for *Total Worker Health*.

These Centers build the scientific evidence to develop innovative solutions to complex problems in keeping employees safe and productive.

v. **FINDING**: NIST has not benchmarked their safety management systems or safety leadership actions to other federal agencies working with high hazards such as NASA or DOE.