Message from the NIST Director

On September 26, 2022, a NIST staff member on our Gaithersburg, Maryland, campus died after falling from a research structure that partially collapsed during demolition. No similar workplace death had occurred at a NIST facility in nearly 100 years, and it has had a profound effect on us. It has made clear that we must change how we think about and implement safety across the entire organization.

Following the incident, we immediately launched an internal investigation to understand its root cause and any contributing factors. The investigation was conducted by a team of safety experts and engineering staff. They interviewed NIST staff members, reviewed physical evidence, documentation and procedures, and brought in outside expertise to conduct modeling and analysis. The investigation team was also charged with developing corrective actions NIST could take to reduce the likelihood that anything like this would happen again.

This report contains the results of that internal investigation, as well as the results of an executive level review that recommended additional, NIST-wide corrective actions.

The investigation thoroughly evaluated all potential contributing factors and determined that a number of those factors converged on the day of the accident. It revealed critical gaps in our safety program, including the fact that it does not support adequate accountability for all hazardous work performed on the NIST campuses. For example, while a thorough safety hazard review was conducted for the experiment for which the structure was built, there was no safety hazard review performed for demolition of the surrounding structure. This meant the demolition of the part of the structure where the accident occurred was not adequately planned.

While NIST's internal investigation was underway, the Occupational Safety and Health Administration (OSHA) conducted its own investigation. On March 23, 2023, OSHA cited NIST for three serious and five other-than-serious violations, which we are working to correct. These are posted on the NIST website.

The internal investigation also found an insufficient safety culture at all levels. A strong safety culture requires commitment by management and staff, clear roles and responsibilities, accountability, and mechanisms for monitoring and continual improvement.

I also established the NIST Safety Commission to examine NIST safety more broadly and to advise us on actions we can take to improve our safety programs and our safety culture. The commission's interim final recommendations are also posted on the NIST website.

I am committed to ensuring that the factors that converged on the day of this tragedy are addressed, and that the changes we make now are institutionalized and provide a foundation for improvement and a stronger NIST. The NIST leadership team and I have already begun planning for implementation of the recommendations from this investigation and those of the Safety Commission.

This death has shaken all of us. It has revealed weaknesses and gaps in our systems and in our attitudes toward safety. We must do everything we can to prevent other avoidable tragedies. This will require commitment at all levels of the organization. We must make immediate and sustained changes to prioritize safety and make it a core part of everything we do. We must do better for our staff members, their loved ones, and everyone who depends on the work NIST does.

I would like to express my gratitude to the investigation team and all the staff members who supported their work, especially in the NIST Fire Research Laboratory. The many hours they spent making sure this investigation was thorough will have a lasting impact on NIST. We will do right by them and honor the memory of our colleague by becoming a better, safer organization.

Laurie E. Locascio
Under Secretary of Commerce for Standards and Technology &
NIST Director

INVESTIGATION OF THE FATALITY AT THE NATIONAL FIRE RESEARCH LABORATORY

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National Institute of Standards and Technology
Department of Commerce
Gaithersburg, MD 20899

ABSTRACT

In response to the work-related fatality at the National Fire Research Laboratory on September 26, 2022, the National Institute of Standards and Technology (NIST) initiated a planned, two-step process to understand the causes of the incident and identify actions necessary to prevent future incidents.

- **Incident investigation and development of an incident corrective action plan**. The investigation was conducted by staff from the NIST Office of Safety, Health, and Environment and the NIST Engineering Laboratory. The focus was on identifying the causal factors, root causes, and contributing factors of the specific incident. Corrective actions were developed to address the deficiencies identified, as well as other recommendations for NIST leadership to consider. The results of this effort are presented in Part A of this document.

- **Executive Team review and development of a NIST-level corrective action plan**. Subsequently, a subcommittee of NIST's Executive Safety Committee assessed the report and considered the NIST-wide applicability of the corrective actions identified. The Executive Review Team extended corrective actions and recommendations, as necessary, to ensure sufficient breadth, depth, and sustainability of these actions across NIST. Their work is included in Part B of this report.

Through these two activities, NIST shall strengthen its safety management system and address existing shortcomings in its safety culture to protect the safety and health of all staff.

EXECUTIVE SUMMARY
OF THE NIST INCIDENT INVESTIGATION REPORT

On September 26, 2022, a National Institute of Standards and Technology (NIST) staff member was performing demolition work on a two-story, steel-framed test structure. The test frame, which is located in the National Fire Research Laboratory (NFRL) on the NIST-Gaithersburg campus, was used in a fire research project over the past three years and was scheduled for demolition with the completion of the experimental work. The staff member was sectioning a large, concrete slab (approximately 12 ft long by 5 ft wide with minimal thickness of 3.25 in.) from a floor which was elevated 13 ft above the lower level of the workspace. The removal process entailed using a walk-behind floor saw to cut the slab from the surrounding floor. An overhead crane would then lift it out with rigging slings, attached via rigging hardware located in the slab corners approximately 1 ft away from each edge, to the lower level for disposal. The staff member used the same technique to remove three other slabs of different shapes and sizes in the two weeks prior.

By lunchtime, the staff member had completed cuts to 3 of the 4 sides and attached the rigging slings to the slab. Upon returning from lunch, the staff member moved the floor saw across the slab and began cutting the last face. With the final cut completed, the slab was now completely free of the surrounding floor and suspended by the rigging slings and overhead crane. The staff member shut the floor saw off and, in an effort to move it out of the way to lift the slab out, pulled the floor saw backwards onto the mid-span (middle) of the slab. This action resulted in an overloading of the suspended slab, with the weight of the staff member and the floor saw, causing the slab to instantaneously and catastrophically fracture beneath him. The staff member fell through the resulting opening in the floor to the level below, suffering fatal injuries.

Within 24 hours of the incident, NIST's Chief Safety Officer authorized an incident investigation team to examine the facts surrounding the incident, determine the causal factors and root causes, identify necessary corrective actions, and provide additional recommendations. The investigation team was composed of staff from NIST's Office of Safety, Health, and Environment (OSHE) and Engineering Laboratory (EL) with the appropriate level of expertise and knowledge to complete the assigned task. The team worked over the next five months reviewing in detail available information and records related to the project work, interviewing NIST staff members and line management, and performing physical and computational analysis of the failed slab.

As a result of this investigation, two actions were identified as causal factors:

1. **Inadequate planning of Slab 4 removal**, specifically, the failed slab was rigged with a very small safety factor. This occurred through a combination of root causes:
    a. The initial hazard review for demolition work on another part of the test frame was inadequately reviewed. There was no evaluation by a demolition safety subject matter expert to identify the appropriate control measures necessary to safely perform the task, and this lack of expertise was carried throughout the multiple stages of demolition work.
    b. The removal technique used during the incident was outside the scope of the approved hazard review. Through its initiation and continued use during earlier demolition work, it

became an acceptable demolition method without an appropriate assessment of the hazards associated with performing the demolition work in that manner.

c. The hazard review for the specific demolition work being performed at the time of the incident was inadequately re-reviewed. Project management was aware of the change in demolition technique compared to what was approved in the original demolition hazard review and erroneously decided not to perform a re-evaluation of the work to assess any new hazards.
d. Work authorization requirements for the demolition work did not have the same rigorous safety scrutiny as the experimental tasks. Many of the attitudes and assumptions made during the approval for demolition work during the incident would not have been acceptable during the testing phase of the project.
e. There was no mechanism to ensure a quality hazard review was developed, approved, and re-viewed and re-approved as necessary. As such, there was a trend in the group's hazard reviews that was not identified, *i.e.*, the focus of hazard reviews was almost exclusively on the experimental activity and less on the "set-up" and "teardown" which is also hazardous work required to perform the experiments.

2. **Accidental loading of Slab 4**, specifically, the staff member pulling the floor saw onto the slab while it was fully suspended by the rigging and crane. This occurred through a combination of root causes:
    a. Standard safe operating procedures were not developed for the demolition work performed at the time of the incident. As a result, the staff member performed numerous unsafe acts while in the process of removing the slab by not properly planning the cuts out in advance, including pulling the floor saw onto the suspended slab.
    b. Staff were authorized to perform this demolition work without the appropriate knowledge of hazards associated with the task. In addition to staff not completing the required training identified by the hazard review, more importantly, there was a gap in the training requirement as no demolition training was identified which would have provided the knowledge on how to plan and perform the work correctly and safely.
    c. Due to project management absence at the worksite, staff became "lax" regarding the implementation of required hazard control measures and the use of safety best practices. The staff member continuously performed unsafe acts, such as walking on a partially or fully suspended slab, as project management was not present to correct this behavior.
    d. In addition to the absence of project management from the worksite, safety responsibilities for the demolition work were consolidated in the staff member performing the work at the time of the incident. Project management failed to ensure adequate division of safety responsibilities between those responsible for overseeing the safety of the work and those performing the work.
    e. Management relied too heavily on the staff member's experience, perceived or otherwise. It was believed the staff member had significant experience from a previous job, and thus, they relied on this individual for both planning and performing the demolition work with no check and balance on either.
    f. Work operations were not continually monitored and updated for compliance by project management. There were multiple opportunities for project management to observe the

work being performed but they did not do so as it appeared project management themselves were not being held accountable for engaging in this responsibility.

The avoidance of these two causal factors was very possible. Through appropriate planning and compliance with established hazard review requirements, in addition to appropriate project management oversight, the slab could have been removed safely by either:

- Rigging it with a higher safety factor through either decreasing the distance between the rigging point locations on the slab or shortening the slab length (which effectively would reduce both the rigging point distance and slab weight); or
- Identifying and implementing hazard control measures to ensure the staff member would not load the slab, such as developing an appropriate cutting and lifting plan or establishing administrative requirements prohibiting the slab from being loaded by any means once it is supported by the rigging and crane.

Multiple other factors contributed to this incident, but not as directly as those described above, and are also documented within this report.

Subsequent to root cause and contributing factor identification, 26 corrective actions were developed to address those issues specifically, as well as prevent any future occurrences. These corrective actions fell into four general categories:

- Strengthening requirements for and improving implementation of EL's policy and procedures for work and worker authorization;
- Improving EL line management oversight of hazardous work;
- Increasing EL line management accountability with respect to safety; and
- Addressing gaps in NIST's safety management system in the areas of:
  - Overhead cranes and rigging; and
  - Audits and assessments.

Further, the Team identified concerns that did not contribute to the incident but should be addressed. As such, eleven recommendations were provided for consideration which focused on weaknesses of the NIST safety management system and insufficiencies of the NIST safety culture.

Acknowledgements

It is with gratitude the NIST Incident Investigation Team acknowledges the contribution of many NIST staff members for their assistance with the conduct of this investigation.

The Team acknowledges NIST Senior Leadership for providing us the resources necessary to perform our work and the autonomy to conduct this investigation in an impartial and objective manner.

The Team acknowledges our direct line management for providing us the time necessary to conduct this investigation.

Our deepest gratitude is reserved for the co-workers of the staff member who without their willingness to participate in this investigation and their candid responses during a very difficult time we would not have been able to complete this work.