



# **A Human Factors Review of NIOSH Fire Fighter Fatality Investigation and Prevention Program Reporting**

**Submitted to the CDC and NIOSH**

**July 2022**

**The LUF Mission:** Preparing mission-oriented leaders and organizations to navigate physical, mental, emotional, and moral rigors in high-risk and lethal settings by developing strength of mind, body, character, and critical thought in order to optimize human performance under pressure.

## **Background – LUF Review of NIOSH FFFIPP Reporting:**

The Leadership Under Fire (LUF) human performance advisory team features a distinguished group of fire, police, and military leaders; coaches; college professors; sports psychologists and mental health clinicians. Collectively, the LUF team has extensive experience in improving individual and organizational performance in the military’s special operations community, professional sport, the fire service, and high-risk private industry. The LUF advisory team synthesizes evidence-based best practices, providing leaders and operators with a comprehensive understanding of human behavior in high-risk settings by focusing on the mental, emotional, and moral aspects of performance.

Since its inception in 1998, the National Institute of Occupational Safety and Health (NIOSH) Fire Fighter Fatality Investigation and Prevention Program (FFFIPP) has periodically solicited input from fire service leaders and organizations. In recent years, a LUF working group has been evaluating the methodologies used by fire service organizations to investigate line-of-duty deaths (LODD) resulting from fire or emergency operations. As a result of this work, the LUF team has identified trends related to the national data set of narratives, findings, and recommendations from LODD fires. Additionally, the LUF working group has consulted with two separate regional LODD committees during the past year, both of which are analyzing and documenting fire operations that claimed the lives of uniformed members. The LUF team is honored to have shaped the committees’ understanding of human performance, with an emphasis on performance under stress. In these instances, LUF has principally focused on human factors, as a growing body of research suggests that mental performance has a major impact on outcomes at fires and emergencies. Despite this, the human factor is largely absent from NIOSH LODD reporting. For this reason, the LUF advisory team is respectfully submitting a response to NIOSH FFFIPP’s invitation for views and recommendations in July of 2022.

### **Problem Set: Absence of the Human Factor**

While the professional fire service has greatly advanced its understanding of the physical sciences over the last decade as they relate to our operational environment, it has neglected the scientific disciplines that focus on human performance. In many instances, and despite the best of intentions, fire-service leaders attempt to address performance gaps with tactical and operational remedies that ignore or defy essential human-performance concepts.

NIOSH LODD research and reporting serves as the cornerstone of a national effort to learn from firefighter fatalities and prevent similar events. NIOSH LODD reports are a significant mechanism for learning—perhaps the most influential catalyst for change that exists in the American fire service. However, a cursory search of NIOSH LODD literature revealed that human performance and behavior are largely absent from report findings and recommendations. This deficiency raises several intellectual questions regarding the efficacy of the NIOSH FFFIPP program. LUF’s central question is: can NIOSH FFFIPP accomplish its mission of formulating

recommendations for preventing deaths and injuries if the most critical element, human behavior, is lacking from the analytical process?

### **LUF's Review Methodology:**

In July of 2022, the LUF human performance advisory team evaluated 12 separate NIOSH LODD fire reports to assess the degree to which human factors are examined in report findings and recommendations. Each report was examined by a different member of the team, with each team member using the same human factors analytical framework. All contributing members of the team are practitioners; they are experienced firefighters, company officers or chief officers. Many of the members have led and operated at fires where firefighters were in distress. All of the contributing team members possess a solid understanding of human performance under stress.

### **Scope and Limitations of LUF's Review:**

LUF determined that NIOSH published 92 LODD reports from 2003 to 2022 that examined structural fires where interior fireground operations resulted in the death of at least one member. We excluded reports involving cardiac-related events, vehicle-related events, exterior falls, electrocutions, and explosions in industrial facilities. The LODD reports that we examined involved urban, suburban, and rural jurisdictions and involved both career and volunteer departments. Five reports that we reviewed involved structural fires where multiple members were killed. In total, we reviewed 13 percent of the reports published during the past two decades. LUF acknowledges that our findings cannot be extrapolated to every report, but our study reveals patterns and gaps in the analysis of human factors in the NIOSH LODD reporting process. We intend to thoroughly examine additional reports in the future.

LUF team members reviewed the following reports:

[Fire Fighter Fatality Investigation Report F2003-36 | NIOSH | CDC](#)

[Fire Fighter Fatality Investigation Report F2007-28 | NIOSH | CDC](#)

[Fire Fighter Fatality Investigation Report F2009-23 | NIOSH | CDC](#)

[Fire Fighter Fatality Investigation Report F2010-13 | NIOSH | CDC](#)

[Fire Fighter Fatality Investigation Report F2012-08 | NIOSH | CDC](#)

[Fire Fighter Fatality Investigation Report F2014-02 | NIOSH | CDC](#)

[Fire Fighter Fatality Investigation Report F2014-09 | NIOSH | CDC](#)

[Fire Fighter Fatality Investigation Report F2014-14 | NIOSH | CDC](#)

[Fire Fighter Fatality Investigation Report F2014-25 | NIOSH | CDC](#)

[Fire Fighter Fatality Investigation Report F2016-18 | NIOSH | CDC](#)

[Fire Fighter Fatality Investigation Report F2018-03 | NIOSH | CDC](#)

## **Key Findings:**

LUF's review revealed several trends regarding the analysis of human factors in NIOSH LODD reports. Our key finding is that the human element, namely the mental aspect, is largely absent from the NIOSH LODD reporting methodology. More specifically, our analysis identified five major human factors deficiencies. The goal of this paper is to provide a succinct but thoughtful explanation of these five deficiencies. LUF believes that incorporating these factors into the NIOSH reporting process can help the organization achieve its mission of improving fireground performance while reducing the likelihood of catastrophic outcomes.

We commend all those individuals who have actively shaped and contributed to the NIOSH LODD reporting program. Their professionalism and objectivity is evident in the reports. Constructing a narrative around decisions, actions and outcomes that resulted in the deaths of courageous men and women is a grueling but important undertaking. Many elements of the NIOSH reporting program are valuable, including the technical analysis of the fire, building and personal protective equipment. However, we believe that structural firefighting is principally a human endeavor and the NIOSH LODD reporting program must make an increasingly concerted effort *to humanize the narrative* around what transpires at (and prior to) structural fires which claim the lives of firefighters.

### **Human factors deficiency #1: The impacts of operational stress on human performance are largely missing from NIOSH LODD analysis**

Based on the LUF study, none of the reports highlighted how the incident commanders and firefighters operating were impacted by operational stress at LODD fires. Nor did the reports identify sources of psychophysiological stress or the environmental elements that adversely impacted the cognitive function of decision makers being subjected to heightened or extreme pressure. This lack of attention to the human factor in NIOSH LODD reports suggests that investigators either discounted the impact of operational stress or were unaware of how incident commanders and members operating at these fires were impacted by these factors.

The LUF human performance advisory team contends that every member at every working structural fire is subject to operational stressors which impact the function of decision-making and physiological performance. Heightened and unregulated emotional and psychological stress has negative effects on human performance which may range from mild to catastrophic depending on many variables. Firefighters and fire officers (even the most seasoned and well-trained) operating at LODD fires are subjected to inordinate levels of physical, psychological, and emotional stress which impact individual and unit level performance, as well as the trajectory of the operation. This assertion is not an indictment, but rather a professional declaration that underpins the investigative methods, tools, and metrics used in the evaluation of decisions and actions at an LODD fire. We believe it vital that future NIOSH LODD reporting identify sources of psychophysiological related operational stress and highlight their impact on decision-making and performance.

## **Human factors deficiency #2: The fallibility of human memory is disregarded**

Human memory, particularly episodic memory following events where individuals were subjected to heightened levels of emotional stress is fallible. A published empirical study conducted by members of LUF in partnership with Columbia University's Cognitive Psychology Department revealed memory discrepancies commonly existed in the form of recall gaps as well as intrusions (instances where an individual recalled a false memory or a memory from a different fire), limited recall proportions, filtering (recalling only individual or unit level actions) and self-relevance (a member recalling only tactical radio transmissions involving himself). The study indicated that the margin of error in recall was remarkably higher at fires where members were subjected to heightened operational and emotional stress (i.e., fires where civilians were trapped, where firefighters were in distress, or where an uninitiated probationary firefighter was operating at a real-world fire structural fire.) Specifically, the recall of temporal details (timelines, sequence of events, etc.) and spatial descriptions are most susceptible to error. Vision is ordinarily the primary sensory data input for humans, and we surmise that the memory of fire fighters operating with limited to no visibility in a structure is particularly fallible.

None of the NIOSH LODD reports reviewed by LUF included a margin of error disclaimer regarding the accuracy of portrayal of conditions, decisions, and actions due to the fallibility of human memory under stress. LUF asserts that investigators should assume that any oral or written testimony detailing sensory input to include observations, rationale for decisions, and subsequent actions that are not corroborated by supporting digital, electronic, and/or physical evidence is potentially unreliable. In this regard, NIOSH should include a margin-of-error disclaimer with respect to the accuracy of interviewees' accounts due to the fallibility of human memory under stress. We also assert that there is value in identifying instances of contradictory testimony and/or detailing how contradictory testimony was reconciled.

The practice of interviewing members a week or two (or later) after a catastrophic fire increases the likelihood of memory distortion and contamination. We fully recognize that interview timelines are impacted by investigative resource constraints, work schedules, and, in some instances, union representation requirements, but it is imperative for investigative LODD interviews to be conducted in accordance with best practices that align with scientific findings on memory.

## **Human factors deficiency #3: Analysis begins with the receipt of the alarm**

LUF's review of NIOSH LODD reports revealed that the starting point for analysis in reporting largely begins at the receipt of the alarm. Human factors related sciences indicate that an individual's past (to include recent past) offers pertinent insight and context about their behavior and performance, particularly under stress. The mere documentation of years of service, formal training and a laundry list of training certifications offer insufficient context about human behavior in a high-risk environment.

The LUF human performance advisory team asserts that the behavior and performance of chief officers, company officers, and firefighters are overwhelmingly shaped by their experiences, training scenarios, professional development curricula, mentors, and interpersonal relationships – all of which existed prior to the receipt of the alarm. Additionally, unit and organizational climate factors are of great contextual value as they illuminate how morale, cohesion, collective mindset, and risk tolerance influenced decisions, actions, and performance. We encourage future NIOSH LODD investigative efforts to provide readers with greater exposure to cultural, performance, and leadership prologue that predated the receipt of the alarm. We believe that insight into an individual’s relationship with their colleagues, authority, subordinates, risk, and adversity provide important context.

#### **Human factors deficiency #4: Performance narratives and causality fail to distinguish between inexperience, insufficient training, or a uniquely complex predicament**

The LUF review revealed that NIOSH LODD analyses failed to acknowledge whether a member’s vulnerability to death or serious injury was the consequence of 1) a lack of operational experience; 2) inadequate training that left the member unprepared for rigors of the environment; or 3) because an experienced and well-trained member was outmatched by a uniquely complex predicament (outlier, “black swan,” etc.). These three different performance narratives provoke fundamentally different preventative strategies as leaders and organizations seek to meaningfully learn and change behavior. NIOSH LODD reports make no effort to explicitly delineate or make a distinction between these three performance narratives in determining contributing factors and causality. The American fire service arguably possesses a detailed understanding of *how firefighters die*, but LUF members are of the collective belief that the American fire service lacks an understanding of *why firefighters die*.

LUF recommends that NIOSH LODD research efforts implement a more elaborate cause-effect performance analysis that includes greater insight into prior training and firefighting experience. For example, a quantitative and qualitative assessment of members’ prior experience at similar fires in similar occupancies would offer important context. Increased transparency about experience levels, training regimens, and human factors data points will strengthen the performance causality and yield a more nuanced risk profile narrative. Future NIOSH LODD reports will continue to inspire improved training and education in the fire service while also fostering operational and occupational humility. Furthermore, NIOSH research efforts offer a compelling opportunity for the American fire service to determine and define the role that experience, training, and environmental complexity play in both performance and outcomes at structural fires.

#### **Human factors deficiency #5: Outcome bias trivializes fireground uncertainty and dramatically alters the risk profile narrative**

LUF’s review detected a discernible degree of outcome bias in LODD research and reporting. NIOSH LODD narratives consistently diminished the persistent and abundant element of operational uncertainty at LODD fires. Reports did not highlight the burdensome unknowns that plagued decision-making, strategy adoption, and tactical actions. Many of the reports failed to detail a single unknown or connect decisions and/or actions to assumptions and reports that later

proved false. It is both curious and unfortunate that the subject of uncertainty receives so little attention in LODD reports.

Chief officer, company officers, and firefighter, are heavily reliant on key environmental information that is frequently laden with uncertainty. Environmental unknowns often include details about the main body of fire location, fire volume, occupancy layout, presence of lightweight construction, structural alterations, as well as the presence, location, and viability of trapped civilians. Additionally, it is not uncommon in for fireground decision-makers to be unfamiliar with how their subordinate leaders or units will function under heightened pressure. This pervasive uncertainty impacts not only human performance, but the operational risk profile as well as decisions involving strategy and actions. Chronological narratives that trivialize looming information gaps inadvertently alter the character and context of the fire.

Those NIOSH LODD reports which neglected operational uncertainty were most prone to advocate for the implementation of alternate strategies and/or varied risk profiles. These recommendations were commonly based on the benefit and luxury of more complete information than the incident commander and key decision-makers enjoyed until after the fire, and the outcome was known. The implication that an alternate risk profile and/or varied tactical actions would have produced a different and less catastrophic outcome is often debatable, unsupported, and scientifically suspect.

LUF feels it imperative for NIOSH LODD reports to humanize operational uncertainty by illuminating the fact that firefighters and fire officers routinely make rapid decisions with incomplete, limited, and in some instances erroneous information. LUF encourages future NIOSH efforts to identify and highlight the most significant sources of operational uncertainty and detail their impact on decisions and actions. Investigative efforts should not merely disclose what incident commanders, company officers, and firefighters knew after the fire was over, but amplify what they knew, or thought that they knew at key decision points during the operation. We also encourage future NIOSH LODD reports to humanize the narrative by conveying the confusion, chaos, frustration, and emotion that were present and impacted human performance. The human condition is overwhelmingly palpable in the tactical radio traffic at LODD fires and we firmly belief that it should be readily discernible in NIOSH reports.

Respectfully Submitted:

Jason C. Brezler, LUF Founder / FDNY  
Gabriel Angemi, Camden (NJ) Fire Department  
Jason Cascone, FDNY  
Paul Conway, Milwaukee Fire Department (Ret)  
Jacob "Pete" Dutton, FDNY  
Jeffrey Facinelli, FDNY  
James McNamara, FDNY  
Brian McNulty, Milwaukee Fire Department  
Daniel Saalfrank, FDNY  
Gerard Smith, Baltimore City Fire Department  
Robert Staulters, FDNY

Tristan Tricarico, Baltimore City Fire Department  
Andrew Whitehead, Baltimore City Fire Department