NIST Technical Note 2105

Camp Fire Preliminary Reconnaissance

Alexander Maranghides
William "Ruddy" Mell
Steven Hawks
Mike Wilson
Will Brewer
Eric Link
Chris Brown
Cartier Murrill
Erin Ashley

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National Institute of Standards and Technology
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Alexander Maranghides
Engineering Laboratory

William "Ruddy" Mell
Fire and Environmental Research Applications
USFS

Steven Hawks
Mike Wilson
Will Brewer
Office of State Fire Marshal
CAL FIRE

Eric Link
Chris Brown
Cartier Murrill
Engineering Laboratory

Erin Ashley
Disaster Response
Atkins, Inc

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Walter Copan, NIST Director and Undersecretary of Commerce for Standards and Technology

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Cover Page Photo: Paradise, CA, Source NIST

Abstract

The Camp Fire ignited on the morning of November 8, 2018, in Pulga, CA. Fanned by high winds, the fire spread quickly through wildlands and burned into the wildland-urban interface (WUI) communities of Concow, Paradise, and Magalia, CA. Within hours, thousands of structures were destroyed as over 30,000 residents evacuated the area. The Camp Fire burned for 18 days, consumed 62,053 ha (153,336 ac), destroyed or damaged 19,531 structures, and resulted in 85 fatalities.

As part of the NIST Disaster and Failure Studies Program, a reconnaissance team was deployed to Butte County, CA to collect any perishable data, along with preliminary field data which would be used to assess the need and ability to fully reconstruct this fire. A multi-agency team consisting of NIST, US Forest Service, and Federal Emergency Management Agency members worked closely with the California Department of Forestry and Fire Protection (CAL FIRE) incident command. Data collected from two deployments, totaling 18 days in the field, were used in a preliminary assessment of the incident to determine the need for a more comprehensive case study research effort. The reconnaissance deployment team determined that the Camp Fire was unique in terms of the extreme fire behavior, losses, evacuation and notification challenges. Based on the unique opportunities to better understand the behavior and response to wildland-urban interface fires, and the availability of data to support in-depth studies, the team recommended that a more comprehensive study be undertaken.

Key words

Wildland-Urban Interface; field data collection; disaster resilience; wildfire; large outdoor fires.

Table of Contents

List of Tables

List of Figures

1. Introduction

The Wildland-Urban Interface (WUI) is defined as the location where structures and communities meet or intermingle with undeveloped wildland. In 2010 it was estimated that 32% of the US population in 2010 [1]. Significant loss of life and infrastructure can occur when large outdoor fires occur in WUI areas. Since the early 2000s, an average of over one thousand structures per year have been lost to WUI fires in the state of California alone; eight of the top 20 most destructive California fires occurred during the 2017 and 2018 fire seasons [2]. In 2017, the Tubbs Fire destroyed and damaged 5,636 structures; double the losses from the 1991 Oakland Hills Fire (Tunnel), which at 2,900 structures was the most destructive fire at that time.

An improved understanding of WUI fire dynamics and structure ignition mechanisms is critical to improving structure and community resistance to WUI fires (the "WUI fire problem"). The NIST WUI Fire Hazard Mitigation research effort is comprised of laboratory and field research projects to address this national fire problem. The WUI Fire Data Collection and Parcel Vulnerabilities Project is focused on understanding how WUI fire behavior is driven by the interactions among fuel, weather, and terrain and the roles played by heat flux, embers, and direct flame impingement. The NIST WUI Hazard Exposure Scale characterizes the interaction of fuels, weather, and topography and provides a framework that allows improved understanding of how communities are exposed to fire and embers during a WUI fire [3].

In support of the NIST Engineering Laboratory mission to enhance engineering technology in the interest of economic security and public safety, the NIST Disaster and Failure Studies (DFS) Program [4] provides a platform for research into building and infrastructure performance, emergency response, and evacuation procedures during disasters such as earthquakes, floods [5], high winds [6], and fires. As part of this program, reconnaissance teams are deployed to gather first-hand information from the scene after a significant disaster or failure event. These reconnaissance efforts provide critical input to determine feasibility and potential impact of further study or investigation into the disaster.

Specific to WUI fire disasters, building and community vulnerabilities identified through post-fire analysis [7-11] are further investigated through laboratory experiments. Post-fire analysis also shows how fire behavior is modified by active and passive defensive actions. Additionally, field-scale experiments provide data for development and validation of the NIST Fire Dynamic Simulator computer fire model for WUI applications [12].

The Camp Fire appears to have started in the early morning of November 8, 2018, in vegetative fuels near the small community of Pulga, CA, located 5 km (3 mi) to the northeast of Concow, CA, in the foothills of the Sierra Nevada mountains. Strong winds pushed the fire toward Paradise, CA, approximately 5 km (3 mi) further to the west. The Camp Fire destroyed or damaged over 19,000 structures and resulted in 85 civilian fatalities and 3 firefighter injuries.

The NIST DFS program deployed a team to conduct an initial reconnaissance of the Camp Fire. The primary objective of the reconnaissance was to determine if the Camp Fire offered potentially unique data that, if collected and analyzed, could provide new technical insight into the WUI fire problem.

NIST WUI research for the Camp Fire was conducted in partnership with other federal agencies, including the US Forest Service (USFS), Federal Emergency Management Agency (FEMA), US Department of Homeland Security, US Fire Administration; state agencies, including California Department of Forestry and Fire Protection (CAL FIRE) and Texas Forest Service; Academia; fire service organizations including Western Fire Chiefs Association, International Association of Fire Fighters, and International Association of Fire Chiefs; and building codes and standards organizations, such as National Fire Protection Association (NFPA) and International Code Council (ICC). Research findings are used directly to guide the development of new standards and to provide the scientific basis for new performance-based requirements, with the intent to make structures and communities more resistant to fire and firebrand attack.

2. Camp Fire Overview – Disaster and Failure Studies Rating

The Camp Fire progression was monitored by NIST, and on November 9, 2018, NIST's internal National Construction Safety Team Act Preliminary Reconnaissance Decision Criteria were used to rate the fire to determine if NIST should conduct an initial field reconnaissance of the event. Appendix A contains the completed Camp Fire Preliminary Reconnaissance Decision Criteria worksheet.

Initial information from available news media reports indicated that the Camp Fire was started by an unknown cause at approximately 6:30 am on Thursday, November 8, 2018, near Pulga, California, and within two hours reached Paradise, California. The fire spread quickly and became very active and intense through the day. There were reportedly very strong winds and very low humidity levels in the area. More than 2,200 firefighting personnel worked to stop the flames and contain the fire, but the extreme fire conditions, including high winds, firebrand spotting, and dry fuels made it difficult. According to the CAL FIRE Camp Fire Incident Update (as of 8:00 pm on Thursday, November 8), there were no reports of firefighter or civilian injuries or fatalities, and the fire was 0% contained. Evacuation orders were issued for Paradise, Magalia, Concow, Butte Creek Canyon and Butte Valley as of Thursday night. Forest Ranch was also under an evacuation warning.

CAL FIRE's updated information on Friday, November 9, indicated that there were about 300 fire engines and 24 bulldozers fighting the fire. By this time, over 8,000 ha (20,000 ac) had been burned with 15,000 structures threatened; parts of Paradise had been destroyed, and the fire was burning toward Chico, a city of 93,000 people. Firefighters continued to be challenged by extreme fire and weather conditions including strong winds and long-range spotting.

News of the fire impact continued to change and was monitored by NIST personnel. On Monday, November 12, NIST generated a new Summary Assessment (see Appendix A) as the Camp Fire appeared to become the most destructive and deadliest wildfire recorded in California. Over the first 12 hours after ignition, the fire burned 8,000 ha (20,000 ac) and threatened 15,000 structures. Reports at the time indicated that the fire had burned more than 44,500 ha (110,000 ac) and that it had destroyed over 7,100 structures (6,453 residential, 260 commercial). In addition, it was reported that the fire had claimed at least 29 civilian lives

and injured 3 firefighters. Pushed by strong Jarbo Gap winds, the fire had moved rapidly towards Paradise, making evacuation difficult for residents there. At least four fatalities are reported to be due to fire overcoming people trapped in their cars while attempting to evacuate. By November 12, over 52,000 people had evacuated from Concow, Paradise, Magalia, and surrounding areas.

On November 12, CAL FIRE was contacted about a possible deployment to the Camp Fire and the integration of the NIST Team into the incident. On Thursday, November 15, the decision was made to assemble the team and deploy to the Camp Fire for an initial reconnaissance.

3. Reconnaissance Deployment Objectives

Preliminary indications were that the Camp Fire was unique in terms of extreme fire behavior, size, fatalities, and structural losses. Additionally, it appeared that the fire might also provide an opportunity to obtain new data on evacuation and emergency alert notifications from a fire of that magnitude. The reconnaissance deployment had two critical objectives: 1) to make contact with the local authorities and incident command to get a more in-depth understanding of the incident and local conditions, and 2) to assess the impact and feasibility of undertaking a more detailed case study. To meet these deployment objectives, a list of specific data collection goals was developed. The data collection goals for the deployment were the following:

1. Identify whether sufficient data existed for a detailed event timeline reconstruction. Recreating the event timeline is the first step in a case study of a WUI fire, as the timeline captures how the event developed, including effects of weather, fuels, defensive actions, notifications, and resident evacuation.

2. Identify and collect perishable timeline data. Data in this category include Automatic Vehicle Location (AVL), dashboard camera recordings, radio logs, and 911 calls.

3. Identify potential notification and evacuation decisions and actions that were unique to this fire. Data in this category include decisions made, as well as field observations such as choking of egress arteries and notification challenges.

4. Identify whether there were damaged structures for which exposure information was available that could provide new information regarding structure ignition vulnerabilities.

5. Collect exposure data from damaged structures. Linking fire and ember exposure information to damage in the field enables the characterization of building response to these exposures.

4. Deployment Teams and Logistics

With the increased wildland fire activity in the western United States over the last decade, it made sense for NIST to anticipate the potential deployment of a reconnaissance team to a WUI event in California at some point. During a previous WUI fire investigation [10] NIST had worked in close partnership with CAL FIRE, and was familiar with the logistics for deploying a reconnaissance team to an active fire in California. Additionally, outcomes from previous post-fire case studies had been integrated into the data collection methodology [7-11]. Once the decision was made to deploy a reconnaissance team, the primary focus was to assemble the deployment (i.e., field) and support (i.e., shadow) teams and make travel arrangements.

The field team consisted of NIST, USFS, and FEMA representatives. Table 1 lists the area of expertise/role for each team member. An IT professional was deployed with the field team to facilitate data transfer and provide timely troubleshooting support. NIST WUI field kits were used during the reconnaissance deployments. The kits are maintained in a "ready-to-go" condition. Appendix B – NIST WUI Field Deployment Kit Contents lists the contents of each WUI kit.

Table 1. Field and Shadow Team Members, Agencies, and Roles

Field Team	**Agency**	**Role**
Alexander Maranghides	NIST	Field Data Collection and Team Lead
William (Ruddy) Mell	USFS	Wildland and WUI Fire Behavior Modeling
Eric Link	NIST	Field Data Collection
Chris Brown	NIST	Field Data Collection
Erin Ashley	FEMA	Disaster Field Specialist
Cartier Murrill	NIST	Information Technology Support/Field Data Collection
Shadow Team	**Agency**	**Role/Position**
Joannie Chin	NIST	Deputy Director, Engineering Laboratory Director's Office
Judi Mitrani-Reiser	NIST	Director, Disaster and Failure Studies Program
Nelson Bryner	NIST	Division Chief, Fire Research Division
Carolyn Rowland and Andrew Mundy	NIST	Information Technology Support
Sue Haga, Nicole Cooper and Becky Turnbull, Lucy Fox	NIST	Travel Logistics
Kathy Butler, Regina Avila and Keith Martin	NIST	Social Media Data Collection
Jennifer Huergo	NIST	Public and Business Affairs and Media Data Collection
Stephen Fink	NIST	Purchasing and Technician Support
Yasin Abul-Huda	NIST	Fire Protection Engineering Support
Dorianna Andrade, Melissa Lieberman, Mark Madsen, and Rajesh Nair	NIST	Legal Support

5. Deployment Summary and Timeline

A timeline depicting the reconnaissance and key events is depicted in Figure 1. During the initial days of the fire, news reports and official press releases were monitored to understand the significance of the event and gather preliminary information. The Field Team and the Shadow Team were identified and assembled on November 16. A kickoff meeting was conducted to coordinate logistics including travel arrangements and the final assembly of field equipment. The field team departed on November 17 for California, indicated in Figure 1 by the shaded "T" box, representing a day mostly dedicated to travel.

The NIST team assembled with the USFS and FEMA members in California and on November 18 drove to the Incident Command Post (ICP) in Chico, California where the NIST/USFS/FEMA Team was integrated into the Incident Command System (ICS). The reconnaissance objectives were discussed with CAL FIRE and a plan was developed for the four days in the field. The team met with CAL FIRE daily at the ICP at 0800, received an update on damage information collected by the field damage inspectors, and identified structures of interest for the day. One team member, with expertise in information technology, was assigned to the ICP throughout the deployment for the important role of facilitating data transfer and maintaining continuous contact with the CAL FIRE Damage Inspection Specialists (DINS). The remainder of the team worked directly with DINS officials to visit numerous locations within Paradise to observe damaged structures, become familiar with the location, and get a better understanding of the incident. Initial field data were collected on nine damaged structures. In addition to the field work, meetings with officials from CAL FIRE and the National Weather Service were held to identify additional perishable data.

The first reconnaissance lasted until November 22. The Field Team then returned to NIST to provide a briefing to Engineering Laboratory's leadership on the initial reconnaissance. Based on the data collected during the first deployment, it was determined that a second deployment was necessary, and on December 1, the Field Team redeployed to the Camp Fire until December 15. The NIST Team collected field data on an additional 123 damaged structures and had 4 technical discussions with first responders including the initial Incident Commander. After returning to NIST, the Field Team briefed Engineering Laboratory's leadership on the additional reconnaissance data collected and overall findings from both field deployments.

Two additional influential events are included in the Figure Figure **1** timeline: weather; and repopulation of the evacuated zone. Between the two deployment phases, a significant rainfall occurred over the fire region. It was observed that some physical data were affected by the weather. Additionally, at the end of the second deployment, the remainder of the evacuated areas was opened to allow residents to access their properties. Fire evidence can be compromised by weather (e.g.: rain), and by returning residents. This demonstrates the importance of implementing a plan to collect perishable data in a timely manner.

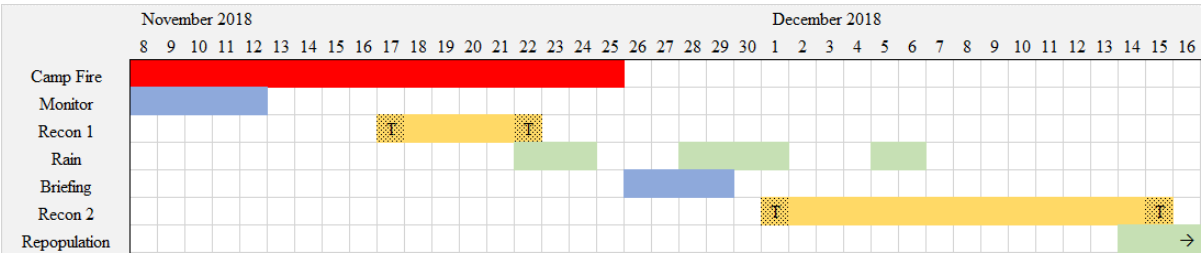

Figure 1. The fire reconnaissance timeline for deploying Teams 1 & 2.

6. Data Collection Summary

The first reconnaissance was used to collect some preliminary field data on the incident and to determine whether the event could provide new insights into the WUI fire problem. The four days in the field were used to conduct some preliminary documentation of damaged structures and to examine different types of damage and related exposures. Technical discussions with the Incident Meteorologists and first responders provided an overview of the Camp Fire. A data collection methodology was developed for the second reconnaissance and focused on damaged structures. That data collection had five primary components:

1. *Identify whether sufficient data existed for a detailed event timeline reconstruction.*

This was accomplished by identifying the potential data sources that provide reliable time and location information from key events and personnel during the incident. This includes data such as Automatic Vehicle Location (AVL) records, dashboard camera videos, 911 calls, and radio logs.

2. *Identify and collect perishable timeline data.*

A significant portion of incident-related data is time sensitive, whether it be physical evidence data from the disaster site, or recorded data. A formal request was made to CAL FIRE to save AVL, 911, and radio log data, which are not typically archived for long-term storage. Preliminary discussions were held with the Paradise Police Department (PPD) to arrange access to the PPD dashboard camera video recordings.

3. *Identify potential notification and evacuation decisions and actions that were unique to this fire.*

Preliminary information was collected on notification and evacuation decisions during the first 12 hours after ignition of the Camp Fire.

4. *Identify whether there were damaged structures where exposure information was available.*

With the assistance of CAL FIRE, the first reconnaissance (November 16 to 22) was used to inspect a representative sample of damaged structures. From this sample, it was determined that the Camp Fire-damaged structures could provide new and useful WUI exposure information. The large number of damaged structures from the Camp Fire was anticipated to

provide valuable support to ongoing work for the NIST WUI Fire Hazard Mitigation research effort.

5. *Collect exposure data from damaged structures.*

To characterize residential building response to different exposures, the deployment focus was on damaged, but not destroyed, structures, because much of the critical structure response information is lost when a structure is completely consumed by fire. Information on damaged structures can be used to characterize building vulnerabilities and develop hazard mitigation solutions. Damaged structures were located using the CAL FIRE Damage Assessment Geographic Information System (GIS) data.

Credentials enabled access to the evacuated area for data collection. A total of 132 damaged structures were documented using the NIST WUI data collection system. The NIST WUI 1 form was designed to capture specific construction and preliminary damage information about WUI structures [11]. The NIST WUI 2 GIS system was designed to capture geospatial parcel-level fire damage and fire behavior information [7].

For the Camp Fire Reconnaissance, the NIST WUI 1 form was modified to capture exposure data. The modified form is provided in Appendix C. Some geolocated information was also collected, so the form used can be viewed as a NIST WUI 1.5. In other words, the form was a combination of basic structure characteristics with limited specific geospatial information for exposures.

Community recovery efforts during the data collection included utilities work (replacement of utilities poles and conductors) and tree felling operations. To ensure team safety, field data collection activities avoided these community recovery efforts. Additionally, collecting uncompromised exposure data from damaged structures was accomplished by working in areas that were not yet repopulated. This helped to ensure that the fire scene had not been compromised or altered.

There was heavy rain during the last day of the first reconnaissance. It was determined early during the second reconnaissance deployment that data loss had occurred due to that rain. Specifically, wind direction data were lost because of rain-distorted needle freeze observed on some vegetation during the first reconnaissance.

A brief summary of collected and identified/requested data is listed here, while the data will be provided in a subsequent report [13]:

1. Residential damage and exposure information collected; 132 structures documented
2. Automatic Vehicle Location (AVL) data
3. 911 call recordings
4. Incident reports
5. Radio communications recordings/transcripts
6. Police dashboard cameras

7. Technical discussion with Incident Meteorologists (IMETs)
8. Technical discussion with Incident Commander
9. Technical discussion with Lead Investigator
10. CAL FIRE Damage Assessments (GIS data and map)

7. Reconnaissance Findings

The two reconnaissance field deployments generated the following reconnaissance findings:

1. The Camp Fire resulted in field data that could provide insight into the WUI fire problem.

2. Perishable data were identified and captured/requested. These included timeline information data and damaged structure exposure data.

3. Rapid fire spread and long-range firebrand spotting (>1.6 km (1 mi)) appeared to have contributed to the extensive destruction, and may have contributed to evacuation complications and fatalities, associated with the Camp Fire.

4. The significant number of damaged structures offered unprecedented information on exposure. Exposure information was captured prior to being compromised from the activities of electric/utilities crews, sawyers, residents, and due to weather.

5. Fire severity (losses) is the result of multiple factors including fuels, humidity and fuels moisture, fuels density and proximity, wind, and topography.

6. The Paradise community appeared to be representative of many other similar communities in California and other western states at risk of exposure to wildfire events.

8. Deployment Successes and Identified Future Improvements

The following are successes and areas identified for improvements for future deployments.

Successes:

1. Timely deployment was essential to collect time-critical data and prevent data loss. Pre-deployment team member training enabled the rapid deployment. The first deployment occurred within eight days from the date of ignition of the Camp Fire, while the second deployment data collection completed just as repopulation efforts expanded.
2. The NIST WUI Kits, which had been used during previous deployments, worked very well in the field in the two Camp Fire reconnaissance deployments.

3. The NIST WUI data collection system was successfully utilized to collect structure damage and exposure data.
4. Credentials enabled access to the evacuated area for data collection.
5. Deploying an IT professional with the field team facilitated data transfer and provided timely troubleshooting support.
6. Pre-incident collaboration and preparations to identify a suitable fire for study were effective in expediting this deployment.

Areas Identified for Improvement:

1. Uploading data was slowed by a "Monthly Data Cap" associated with the field hardware used. A solution that increases uploading efficiency has been identified and will be available for future deployments.
2. Maps for use in the field were not printed prior to deployment. During the deployment, CAL FIRE addressed the NIST/USFS/FEMA need by making and printing maps for the field team. NIST map-making capabilities will be improved for future deployments.

9. Summary

NIST, together with USFS, FEMA, and CAL FIRE, conducted two deployments to the Camp Fire in California between November 15 and December 15, as part of a Disaster and Failure Studies Initial Reconnaissance. The reconnaissance deployments identified that the Camp Fire was unique in terms of fire behavior, losses, and notification and evacuation data. The deployments enabled NIST to identify and collect perishable data for an event timeline reconstruction and for characterizing WUI exposures to residential structures. Perishable timeline data collected included AVL and 911 call data from CAL FIRE. Additionally, 132 damaged structures were documented with respect to exposure information.

Acknowledgments

The two reconnaissance deployments would not have been possible without the collaboration and support of CAL FIRE and the first responders that participated in the incident, including the Paradise Fire and Police Departments. The NIST Team would like to acknowledge the support of the then California State Fire Marshall, Dennis Mathisen. Chief Mathisen and the CAL FIRE Data Collection Team enabled the NIST Team to effectively access the scene, and using the CAL FIRE Damage Assessment Data, collect perishable data from the Camp Fire.

The field data collection would not have been possible without the effective support of the NIST Shadow Team. The Shadow Team enabled the field deployment by addressing all the

logistics challenges associated with a twenty-four-hour deployment timeline and provided support to the field team for the duration of the two deployments. The NIST Engineering Laboratory and Disaster and Failure Studies Program made the deployments possible by ensuring the field team was placed on Essential Employee Status to enable operations during a potential government shutdown.

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Appendix A – Disaster and Failure Studies Deployment Criteria for Camp Fire

This Appendix contains the final Summary Assessment for the Preliminary Reconnaissance of the Camp Fire. The first Summary Assessment was completed on November 9, with subsequent updates on November 12 and November 19 as new information came available.

Questions and Summary Assessment for Preliminary Reconnaissance Camp Fire, Paradise, CA – 11/09/2018 prelim, 11/12/2018 and 11/19/2018 updates

1. What is the unique new knowledge that would be potentially gained from this study?

Preliminary information has been limited to media reports and CAL FIRE incident update, and the NIST staff continues to pursue information related to the event. The severity of the event appears to be due to a combination of hot, dry weather, moderately high winds, and fire spread toward a large town. The fast fire spread, proximity to a populated area, and difficulty preventing spread raise concerns that this could be a devastating fire for structural loss.

2. What is the anticipated potential impact on standards, codes and practices?

Data collection on ignition and fire spread, fire service response, evacuation, and existing fire code compliance would support development of improved WUI building and fire codes and emergency communication and evacuation practices during WUI fire events.

3. Do we have sufficient resources (people and funding) to support a study? If there is an existing study in the same hazard area, what is the impact on the current study?

Unknown.

4. What is a current assessment of how site conditions would affect safety for a field deployment? Would current site conditions affect the timing of the field deployment?

The fire is ongoing and only 0 % contained. No deployment could be considered until the fire is at least majority contained and burned areas are deemed safe.

Update 11/12/2018 Fire is now 25% contained.

Update 11/19/2018 Fire is now 66% contained.

5. Is there a request for NIST to conduct a study by others (local, state, Federal)? If so, would NIST provide complimentary expertise or would NIST have primary expertise?

No.

6. Does NIST have primary authority? If so, would NIST collaborate with other agencies where NIST provides complimentary expertise or would NIST have primary authority and/or expertise?

No primary NIST authority. If NIST were to go in, we would work closely with local and state fire authorities and building code enforcement officials.

Summary Assessment
Camp Fire, Paradise, CA – 11/09/2018 prelim, 11/12/2018, and 11/19/2018 updates

The Camp Fire started by unknown cause at about 6:30 am on Thursday (November 8, 2018) in Paradise[a], CA, a town of 26,000 residents. The fire spread quickly and became very active and intense throughout the day. There were reportedly very strong winds and very low humidity levels in the area. There were more than 2,200 firefighting personnel working to stop the flames and get the fire under containment, but the extreme fire conditions made that difficult. There were 24 bulldozers along with about 300 fire engines to fight the fire, according to CAL FIRE. So far, 20,000 acres have been burned with 15,000 structures threatened with parts of Paradise destroyed by the intense fire. Friday morning the fire was burning to the outer edges of Chico, a city of 93,000 people. According to CAL FIRE Camp Fire Incident Update (as of 8:00 pm on 11/8/2018), there were no reports of firefighter and civilian injuries and fatalities, and the fire was 0 % contained. Evacuation orders have been established for Paradise, Magalia, Concow, Butte Creek Canyon and Butte Valley as of Thursday night. Forest Ranch is under evacuation warning. Firefighters continue to be challenged with extreme fire and weather conditions including strong winds and with long range spotting.

11/12/2018 Update
Fire appears to be most destructive and deadliest wildfire recorded in California. Having burned more than 110,000 acres, it is reported to have destroyed over 7,100 structures (6,453 homes, 260 Commercial). In addition, it has claimed at least 29 civilian lives and injured 3 firefighters. Reportedly pushed by strong Jarbo Gap winds, the fire moved rapidly towards Paradise and made evacuation difficult for residents of Paradise. Within 12 hours, fire had burned 20,000 acres and threaten 15,000 structures. At least four fatalities were due to the fire overcoming people trapping in their cars while they were attempting to evacuate. By 11/1, over 52,000 people had evacuated.

11/19/2018 Update
Fire has now burned more than 151,000 acres and destroyed 11,713 residences, 472 commercial, and 3,388 other buildings. Cal Fire is reporting 77 civilian fatalities and 3 injuries. Nearly 1,300 individuals are still missing. Total fire personnel are 5,332, 597 engines, 28 helicopters, and 83 dozers.

Additional information is emerging of evacuation issues. The town of Paradise had experienced a wildland fire approximately 10 years ago. During that fire incident (which did not significantly enter the town) the evacuation plan was not effective in getting the town residents evacuated because of roads blocked by fire and clogged with traffic. Subsequently, the town used a contractor to develop a new evacuation plan that featured staged evacuation and a notification system (voluntary). Apparently only 30% of the town population had signed up for notifications. During 2018 incident, the new evacuation system was not effective, apparently because fire line moved very quickly, only 30% of population received notification, clogged egress roadways, and fire closed highways.

[a] Note: The Camp Fire started in Pulga, CA but at the time of the assessment this information was not clear to the NIST Team.

National Construction Safety Team Act
Table 1. Preliminary Reconnaissance Decision Criteria

Camp Fire, Paradise, CA – 11/09/2018			
Preliminary Reconnaissance Criteria	Low (1)	Med (3)	High (5)
1. Substantial Loss of Life or Disabling Injury			
A. Facility context	0	1 to 2	>2
B. Community context	0 to 3	4 to 9	>10
C. Regional context	0 to 5	6 to 19	>20
2. Significant Potential for Substantial Loss of Life: Exposed Population			
A. Facility context	<100	100 to 499	≥500
B. Community context	<1 000	1 000 to 9 999	≥10 000
C. Regional context	<100 000	100 000 to 999 999	≥1 000 000
3. Hazard and/or Failure Event(s)			
A. Earthquake	≤ MMI IV	MMI V to VII	≥MMI VIII
B. Hurricane at Landfall	≤Cat 3	Cat 4	Cat 5
C. Tornado	≤EF3	EF4	EF5
D. Coastal Inundation	< 3 ft	3 to 9 ft	≥ 10 ft
E. Fire Spread in Structures	Fire spread not beyond area of origin	Fire spread throughout a structure	Fire spread beyond structure of origin
F. Wildland Urban Interface Fire (WUI)	High Forest Service Fire Danger Rating	Very High Forest Service Fire Danger Rating	Extreme Forest Service Fire Danger Rating
G. Blast	< 99 lbs. TNT-equivalent	100 - 999 lbs. TNT-equivalent	> 1000 lbs. TNT-equivalent
H. Impact	< 1 x 10^6 ft lb/sec	1 x 10^6 to 1 x 10^7 ft lb/sec	> 1 x 10^7 ft lb/sec
4. Consequences to resilience			
A. Failure during Construction or in Service	Minimal physical damage and/or loss of function	Moderate physical damage and/or loss of function	Severe physical damage and/or loss of function
B. Engineered Building Systems	Minimal physical damage and/or loss of function	Moderate physical damage and/or loss of function	Severe physical damage and/or loss of function
C. Transportation & Utility Systems	Minimal physical damage and/or loss of function	Moderate physical damage and/or loss of function	Severe physical damage and/or loss of function
D. Non-Engineered Building Systems	Minimal physical damage and/or loss of function	Moderate physical damage and/or loss of function	Severe physical damage and/or loss of function
Score: 14/4 = 3.5 11/09/2018	1 x 1	1 x 3	2 x 5
Score: 18/4 = 4.5 11/12/2018	0 x 1	1 x 3	3x 5

5. Evacuation and Emergency Response			
A. Evacuation	Normal evacuation	Moderate evacuation challenges	Severe evacuation challenges
B. Emergency Response	Normal operations	Moderate operational challenges	Severe operational challenges
Score: 6/2 = 3.0 11/12/2018	0 x 1	2 x 3	0 x 5
Score: 8/2 = 4.0 11/19/2018	0 x 1	1 x 3	1x 5

6. International Events			
A. Codes, standards and enforcement	No building codes, standards, or enforcement	Building codes and standards, but no enforcement	Building codes and standards, with enforcement
B. Construction practices similar to the US	Minimally similar	Moderately similar	Significantly similar
International Factor: Sum	$(0.8)^n$	$(0.9)^n$	$(1.0)^n$

- **n is 0,1, or 2, depending on the number of selected items under each ranking category (i.e., Low, Med, or High) for Criteria 6. The factor applied to the Total Score is the product of all three factors.**

Appendix B – NIST WUI Field Deployment Kit Contents

- Large Backpack
- Small Backpack
- 400W Power Inverter
- Communication Radios (x2)
- Range Finder
- GPS Unit
- Clinometer
- Compass
- Weatherproof Notebooks and Pens
- 25 ft Tape Measure
- Flagging Tape
- Multitool
- Flashlight
- Magnetic Car Signs
- First Aid Kit
- Hard Hats (x2)
- Safety Glasses (x2)
- Earplugs
- Safety Vests (x2)
- Leather Gloves (x2)
- Satellite Phone with Chargers

Additional Information Technology (IT) Field Equipment:

- Portable Printer with Spare Ink Cartridges
- Remote Wi-Fi Hub
- Power strips
- External Hard drives
- Encrypted Hard Drive
- External Power Packs

Additional Supplies:

- Batteries
- Pens and Notepads
- Trash bags
- Maps Tube
- Insect Repellant
- Hand Sanitizer
- Disinfectant Wipes
- Resealable Plastic Bags

Appendix C – WUI Data Collection Form

NIST
National Institute of Standards and Technology
U.S. Department of Commerce

DAMAGE ASSESSMENT REPORT

1 COLLECTION DETAILS

Incident Name: Camp Fire Recording Date: ____ / ____ / ____ Time Recorded: _____

Photo Release Form Approved: ☐ Yes ☐ No ☐ N/A Photo Numbers: –

2 ADDRESS ☐ Fixed ☐ RV/Travel Trailer ☐ Manufactured Home

Street Number Street Name Unit No.

City State ZIP

Property Owner Last Name (if known)

3 DAMAGE TO STRUCTURE

Extent of Damage: ☐ Affected ☐ Minor ☐ Major ☐ Destroyed ☐ No Damage

Ignition/Damage Exposure Type: ☐ Embers ☐ Radiation / Convection ☐ Undetermined

Damaged Feature Assessment:

Feature	Damaged	Feature	Damaged	Feature	Damaged
Roof	☐	Eaves	☐	Windows	☐
Roof Valley / Transitions	☐	Gutters	☐	Doors	☐
Dormers	☐	Siding/Walls	☐	Decking	☐

Window Details:	☐ Single Pane ☐ Double Pane	☐ Frame Damage ☐ Seal Damage	☐ Vinyl ☐ Fiberglass	☐ Wood ☐ Other	☐ Metal ☐ N/D
Door Details:	☐ Window Damage ☐ Door Damage	☐ Frame Damage ☐ Seal Damage	☐ Vinyl ☐ Fiberglass	☐ Wood ☐ Other	☐ Metal ☐ N/D
Decking Details:	☐ Top Side ☐ Posts ☐ Bottom Side		☐ Wood	☐ Composite	☐ Other

4 NOTES/DESCRIPTION
(brief description of damage, general observations, details for Section 3)

SIDE 1

5 PARCEL SKETCH

1. Document address
2. Form photo
3. Street 360
4. Damage 360
5. Damage detail
6. Mark distances to potential exposures
7. Evaluate wind direction (if possible)
8. Sketch

SIDE 2

Damage Assessment Report
Property Information Sheet Instructions

Section 1. Incident & Field Collector Information

Record the Incident Name, Date, and Time.

Obtain photo use approval if necessary. Mark the appropriate box.

Section 2. Address
Complete address information. If information is unknown or uncertain enter 'N/D' (not determined). Mark the type of residence on the property as a Fixed, RV/Trailer, or Manufactured Home. Multi-unit dwellings (e.g., duplexes) should be assessed on a single form, noting all addresses of the structure in the address (123/125 Main St.).

Take a photo of Sections 1 and 2 of the form. This indicates a new damage assessment in the photo record.

Take a 360° photo set from the street.

Section 3. Damage to Structure

Mark the damage level of the structure, typically sourced from CALFIRE assessment. Any parcel, residential or commercial, can have more than one primary structure. This situation will occur in apartments/condominiums, trailer parks, agriculture parcels and other situations for residential areas. These situations require completing a separate form for each primary structure found on the parcel.

EXTENT OF DAMAGE: Determine the damage based upon the CALFIRE assessment, or the following criteria: **Minor** - localized combustion of an element on the exterior house that has **not spread** to other elements, or localized damage that requires rectification for normal house function, e.g. cracked or broken windows, burned window frame and eaves; **Minor** – more significant damage to the structure, primarily to the exterior; **Major** - flames have entered the house and engulfed at least one room in the structure, or sufficient external combustion to compromise the structural integrity of the house; **Destroyed** - more than 50% of the floor area of the structure is burned and no longer habitable; **No Damage** - the structure has not been damaged

IGNITION/DAMAGE EXPOSURE TYPE: Assess the nearby exposure with potential to cause the damage to the structure. If there are no viable sources of radiation or convection, and the damage is limited to an ember ignition, mark **Embers**. For damage caused by radiative or convective heating (e.g., nearby destroyed/burned structure or other combustibles, or signs of heat exposure such as bubbling paint or melted exteriors), mark **Convection/Radiation**. For cases which this cannot be determined, mark **Undetermined**.

Take a 360° photo set that shows the damaged portion of the structure and the surrounding area.

DAMAGED FEATURE ASSESSMENT: Mark the appropriate boxes for the feature of the structure that show signs of fire damage.

Take zoom photos of the damaged features as necessary for future reference.

WINDOW DETAILS: If windows are damaged, indicate whether they are Single or Double Paned, and indicate if the frame or sealing of the window is also damaged. Mark the material of the window frame if possible. If material is undetermined, mark **N/D**.

DOOR DETAILS: If the door is damaged, mark whether it has window, frame, or door damage. Also mark the material of the door.

DECKING DETAILS: Mark the location of the damage on the deck, as well as the material of the deck. Make any additional notes in Section 4.

Section 4. Notes/Description
Briefly describe the damage and the potential exposure. Note any other notable observations.

Section 6. Parcel Sketch
Draw a sketch of the main structure. Document the location, size, and description of potential source of convection or radiation heat damage. Mark the approximate location of the 360° photo sets. Also note any signs of wind direction during the fire event.