NFPA 1700 Training Materials:
Development of Training Materials to Support the Implementation of NFPA 1700, Guide for Structural Fire Fighting

Final Report by:

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This project summary report has been prepared by the principal project team members consisting of Dr. Daniel Madrzykowski, UL FSRI, Andrew Klock, NFPA, Casey Grant, DSRAE, LLC, and Sreenivasan Ranganathan, FPRF. The Workshop was hosted by the Fire Protection Research Foundation (FPRF), and facilitated by Casey Grant, DSRAE, LLC on behalf of the FPRF.

The information contained herein is based on the input of a range of professionals and subject-matter-experts. While considerable effort has been taken to accurately document this input, the final interpretation of the information contained herein resides with the report authors. The content, opinions and conclusions contained in this report are solely those of the authors and do not necessarily represent the views of the Fire Protection Research Foundation, NFPA, Technical Panel or Sponsors. The Foundation makes no guaranty or warranty as to the accuracy or completeness of any information published herein.

About the Fire Protection Research Foundation
The Fire Protection Research Foundation plans, manages, and communicates research on a broad range of fire safety issues in collaboration with scientists and laboratories around the world. The Foundation is an affiliate of NFPA.

About the National Fire Protection Association (NFPA)
Founded in 1896, NFPA is a global, nonprofit organization devoted to eliminating death, injury, property and economic loss due to fire, electrical and related hazards. The association delivers information and knowledge through more than 300 consensus codes and standards, research, training, education, outreach and advocacy; and by partnering with others who share an interest in furthering the NFPA mission. All NFPA codes and standards can be viewed online for free.

Keywords: fire, fire fighter, fire service, structural fire, structural firefighting, NFPA 1700, training, professional qualifications, fire dynamics, contamination reduction, fire tactics, fire strategy, coordination, suppression, ventilation.

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Executive Summary

Over the years, significant amounts of time, effort, and resources have been allocated to provide a science-based understanding of the effects & impacts of firefighting strategy and tactics on fire dynamics in structures. Much of the firefighting research has been supported by the US DHS FEMA Assistance to Firefighters Grant program. There is a high importance to get firefighters the knowledge to perform their lifesaving and critical role in fire safety.

Today, firefighters are facing greater challenges, such as with modern building construction, synthetic furnishings commonly found in most structures, and new emerging hazards. Research has been conducted that is critical to saving lives and encouraging safe and efficient structural firefighting tactics and strategies. In recent years, new insights into how structural fires behave have led to some of the most significant tactical considerations the fire service has seen in decades.

To help bring this information together for local fire departments, several years ago fire service leaders proposed the development of a new NFPA guide to consolidate the science-based research on structural firefighting strategy, tactics, and tasks. This resulted in the development of NFPA 1700: Guide for Structural Fire Fighting with 2021 edition as its first issue. Both classroom and on-line training is necessary as fire departments everywhere work to implement the guidance provided by NFPA 1700. This project resulted in the development of an online digital 3-D immersive training tool to support the implementation of the first edition of NFPA 1700, Guide for Structural Fire Fighting and help local fire departments adapt and implement the information into their standard operating procedures and guidelines.

This online training was designed to help firefighters explain why firefighting tactics are changing based on modern construction, newer on-scene technology, and evolving fuel loads; understand how to assess and approach the scene of a fire based on the latest science-based fire dynamics research and testing; and be better prepared to assess a fire’s growth and spread and utilize up-to-date control methods. The training considers fundamental occupancy and building construction while addressing the health and safety of firefighters by reinforcing the need for personal protective equipment and methodologies for contamination control.

Online training has the ability to reach everyone, at all levels, in all corners of the fire service. This makes the materials readily accessible and customizable for entire fire departments, individual firefighters (career and volunteer), instructors, etc. The development of a 3-D immersive training tool provides an interactive training experience to reinforce concepts, techniques, and methods from NFPA 1700. This will provide a key educational background for first responders.
1) Background and Project Overview

1.1) Project Goal & Objectives:
This summary report is the documentation of a 2-year research project to develop training materials in support of NFPA 1700: Guide for Structural Fire Fighting\(^1\). The title of the research project is “Development of Training Materials to Support the Implementation of NFPA 1700, Guide for Structural Firefighting”. This project was funded by a DHS/FEMA Assistance to Firefighters Grant (AFG). This project is led by the Fire Protection Research Foundation (FPRF) with direct collaborative support from research partners: UL Firefighter Safety Research Institute (UL FSRI) and National Fire Protection Association (NFPA).

The overall goal of this project is to develop a digital training toolkit to support the implementation of NFPA 1700, *Guide for Structural Fire Fighting*. These training materials are intended to supplement the first edition of NFPA 1700 and help local fire departments adapt and implement the information into their standard operating procedures and guidelines. The following specific objectives support this overall project goal:

- **Objective 1**: identify, package, and develop as needed the fundamental materials for an online toolkit (e.g., using presentations, videos, multimedia, and other educational approaches) that provide the primary knowledge to support the implementation of NFPA 1700 in local fire departments.
- **Objective 2**: utilize emerging technology to provide an interactive and immersive educational experience that reinforces the fundamental materials.
- **Objective 3**: make the training materials openly available to the entire fire service in the United States and beyond.

1.2) NFPA 1700:
Initiated through a project request in 2015, NFPA 1700, *Guide for Structural Firefighting*\(^1\) is the first NFPA document connecting fire dynamics research to response strategy, tactics, and best practices for firefighters attempting to control fires within a structure. NFPA 1700 addresses fire control within a structure by establishing a basic understanding of fire science and fire dynamics.

As a guide, NFPA 1700 is a non-mandatory document. It does not specify how fire departments must fight structural fires. Instead, it recognizes that a primary responsibility of the fire service is to save lives, and its purpose is to provide a framework for the development of policies, procedures, guidelines, and training resources for fire service organizations. It consists of 13 chapters and four annexes which are designed to introduce science-based research into practical on-scene measures to benefit the safety of the public and the fire service, and to enhance property-conservation actions\(^2\). The scope of each chapter of NFPA 1700 are provided in Annex A of this report.

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The guide was developed using the fire science concepts in NFPA 921, Guide for Fire and Explosion Investigations\(^3\), the National Institute for Occupational Safety and Health’s (NIOSH) fire fighter line of duty death investigations, the National Institute of Standards and Technology’s (NIST) physics-based simulations of fire incidents, UL Firefighter Safety Research Institute’s (UL FSRI) large-scale testing and research findings in collaboration with multiple fire departments\(^4\) (in New York City, Chicago, Phoenix, and others) and input from stakeholders seeking to improve firefighter safety and lessen the damage caused by fire events. More than 30 research studies that were conducted to examine firefighting environments, time to structural collapse, the capabilities of firefighting gear, and the effectiveness of firefighting tactics are utilized to develop this guide. Given the high incidence of cancer within the fire service, results from cancer exposure reduction research conducted by NIOSH, the Illinois Fire Service Institute, and UL FSRI was incorporated into a chapter on firefighter health and hygiene.

1.3) Project Tasks:

With the issuance of the first edition of the NFPA 1700, the need to develop training materials in support of this new NFPA 1700 guidance document was critical to meet the demand for both classroom and on-line training as fire departments across the fire service to implement the guidance provided by NFPA 1700. The outcomes from this 2-year effort established training materials which outlined practices and protocols of the NFPA 1700. Further, this project provided an interactive online training platform in order to make the training materials openly available to the entire fire service in United States and beyond.

This project was comprised of six primary tasks. These tasks are outlined as follows:

- **Task 1: Project Initiation.** Led by the Fire Protection Research Foundation (FPRF), a technical advisory panel was established with key stakeholders for this project. The project team convened with panel to confirm all pertinent details, including timeline, project tasks, scope, project goal and anticipated deliverables.

- **Task 2: Work Plan.** Project team created an overview and outline of a digital online training toolkit (e.g., following the layout of NFPA 1700). This focused on outlining the details of overall course content, course timeline, online interface expectations, setting benchmarks and other preliminary details for formulating the online course.

- **Task 3: Baseline Content Development.** Development of the baseline material content that follows chapters of NFPA 1700. This included identifying, synthesizing, editing and consolidating the relevant course materials from past research and NFPA 1700 guide. UL FSRI led this effort in conjunction with NFPA leading the effort of developing the online course platform and incorporating the baseline material content.

- **Task 4: Evaluation Workshop.** A workshop was planned, conducted, with members of the fire service (including the project advisory panel and additional stakeholders) to review the draft content developed in Task 3. This was led by FPRF with UL FSRI and NFPA presenting the draft course content and online platform to seek the feedback and comments from the workshop participants. The proceedings of the workshop were developed by DSRAE on behalf of the FPRF.


\(^4\) UL Firefighter Safety Research Institute Research. Web: [https://ulfirefightersafety.org/](https://ulfirefightersafety.org/)
• **Task 5: Finalize Project Deliverables.** Project deliverables were revised and updated based on the feedback and guidance from the workshop. The final training material was provided to the project technical panel to facilitate further feedback. A web-platform was developed to host and support the dissemination of the training materials.

• **Task 6: Final Reporting and Outreach.** The principal project deliverable, the interactive digital training tool based on NFPA 1700, has been made freely available from a web-platform. In addition, an executive summary report (this document) has been generated that documents the overall effort. Online training is being broadly circulated through the extensive outreach venues and social media.
2) Workshop Program

2.1 Workshop Background & Attendees:
This chapter summarizes a one-day virtual workshop held on 21st April 2020. The workshop’s purpose was to review and provide feedback on the baseline content and materials being developed for the project titled “Development of Training Materials to Support the Implementation of NFPA 1700, Guide for Structural Firefighting”.

During this workshop, there are several baseline assumptions that have been clearly stated throughout the effort. These include the following: major change recommendations will possibly be applied to future follow-on efforts; current material development is attempting to follow the details and direction of NFPA 1700 as closely as possible; and, as NFPA 1700 evolves so too will the training materials and thus we expect future refinement and adjustment of all training materials.

Importantly, NFPA 1700, Guide for Structural Fire Fighting was a new document in the Annual 2020 revision cycle administered through the NFPA codes and standards process. The final document was not due to be fully processed until late summer of 2020, and thus at the time of this workshop the final version of the first edition of NFPA 1700 had not yet been issued. At the time of the workshop, further subsequent changes to NFPA 1700 will be minimal and/or not expected. NFPA 1700 was not subject to any technical changes after the workshop.

This workshop was originally scheduled as a one-day face-to-face meeting to be held on April 21, 2020, in Indianapolis IN, in conjunction with the Fire Department Instructors Conference (FDIC). However, the COVID19 Pandemic resulted in all travel and face-to-face meetings such as this workshop to be cancelled, postponed, or re-aligned as a virtual meeting. In late March 2020 it became apparent that it would be impossible to hold a face-to-face meeting and the decision was made to realign the meeting into a virtual meeting. To better facilitate a virtual workshop, extensive efforts were made to make the workshop more interactive for the participants. This is the genesis of the polling questions that were used during the workshop, to solicit feedback from the participants and engage in constructive dialogue.

The agenda and presenters for this one-day virtual meeting are shown in Table 1, Workshop Agenda:
The attendees for the workshop were invited from a range of fire service interests and backgrounds. The final attendance list is summarized in Table 2.

### Table 1: Workshop Agenda.

<table>
<thead>
<tr>
<th>TIME (Eastern Time)</th>
<th>Tuesday, April 21, 2020</th>
<th>Mins.</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:00-10:30</td>
<td>Call to order, Welcome and Meeting Preliminaries</td>
<td>Casey Grant, DSRAE, LLC. Sreeni Ranganathan, FPRF</td>
</tr>
<tr>
<td>10:30-10:50</td>
<td>Presentation: Baseline Content and Materials (15-20 mins)</td>
<td>Dan Madrzykowski, UL FSRI</td>
</tr>
<tr>
<td>10:50-11:20</td>
<td>Discussion 1: Technical Content</td>
<td>Participants</td>
</tr>
<tr>
<td>11:20-11:30</td>
<td>---Break---</td>
<td></td>
</tr>
<tr>
<td>11:30-12:30</td>
<td>Presentation: NFPA Training Module Workflow &amp; Outline</td>
<td>Allen Commun. Rep.</td>
</tr>
<tr>
<td>12:30-13:00</td>
<td>Lunch Break</td>
<td></td>
</tr>
<tr>
<td>13:00-14:15</td>
<td>Recap Training Module Workflow &amp; Discussion 2: Approach, Packaging &amp; Delivery</td>
<td>Participants</td>
</tr>
<tr>
<td>14:15-14:30</td>
<td>---Break---</td>
<td></td>
</tr>
<tr>
<td>14:30-15:15</td>
<td>Discussion 3: Future Issues</td>
<td>Participants</td>
</tr>
<tr>
<td>15:15-15:45</td>
<td>Next Steps &amp; Concluding Remarks</td>
<td>Casey Grant, DSRAE, LLC.</td>
</tr>
<tr>
<td>16:00</td>
<td>Adjourn</td>
<td></td>
</tr>
</tbody>
</table>

### Table 2: List of Workshop Attendees.

<table>
<thead>
<tr>
<th>First Name</th>
<th>Last Name</th>
<th>Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Rita</td>
<td>Anderson</td>
<td>Allen Comm</td>
</tr>
<tr>
<td>2 Brandon</td>
<td>Berrett</td>
<td>Allen Comm</td>
</tr>
<tr>
<td>3 Ian</td>
<td>Bolton</td>
<td>North Vancouver Fire &amp; Rescue Services</td>
</tr>
<tr>
<td>4 John</td>
<td>Cunningham</td>
<td>NAFTD, &amp; Nova Scotia Firefighters School</td>
</tr>
<tr>
<td>5 Sean</td>
<td>DeCrane</td>
<td>UL LLC</td>
</tr>
<tr>
<td>6 Rusty</td>
<td>Dunham</td>
<td>NVFC, &amp; Laramie Fire District</td>
</tr>
<tr>
<td>7 Jason</td>
<td>Emery</td>
<td>Emergency Training Solutions, &amp; Waterbury Fire Dept.</td>
</tr>
<tr>
<td>8 Robert</td>
<td>Fash</td>
<td>NFPA, &amp; NFPA 1700 Staff Liaison</td>
</tr>
<tr>
<td>9 Gerry</td>
<td>Fontana</td>
<td>Boston Fire Department</td>
</tr>
<tr>
<td>10 Michael</td>
<td>Gorin</td>
<td>NFPA</td>
</tr>
<tr>
<td>11 Casey</td>
<td>Grant</td>
<td>FPRF, &amp; DSRAE LLC</td>
</tr>
<tr>
<td>12 Sean</td>
<td>Gray</td>
<td>Cobb County Fire and Emergency Services</td>
</tr>
<tr>
<td>13 Gavin</td>
<td>Horn</td>
<td>UL FSRI</td>
</tr>
<tr>
<td>14 Joseph</td>
<td>Jardin</td>
<td>FDNY, &amp; NFPA 1700 Chair</td>
</tr>
<tr>
<td>15 Stephen</td>
<td>Kerber</td>
<td>UL FSRI</td>
</tr>
<tr>
<td>16 Andrew</td>
<td>Klock</td>
<td>NFPA</td>
</tr>
<tr>
<td>17 John</td>
<td>Lane</td>
<td>Metro Chiefs, &amp; Winnipeg Fire &amp; Paramedic Services</td>
</tr>
<tr>
<td>18 Murrey</td>
<td>Loflin</td>
<td>NIOSH FFFIPP</td>
</tr>
</tbody>
</table>
2.2. Workshop Presentations:
The Fire Protection Research Foundation hosted this workshop on NFPA 1700. The Foundation contracted with Casey Grant of DSRAE to facilitate the workshop. Grant welcomed the participants and clarified the goal and objectives of the workshop.

Two primary presentations were provided at this workshop. These are included in this section and summarized in Figures 1 through 7.

The first presentation was presented by Dr. Dan Madrzykowski of UL FSRI. This provided an overview and summary of the technical content from NFPA 1700 for the on-line training class. The 30 slides used in this presentation are summarized in Figures 1 through 4. This presentation included introductory material, a review of fire dynamics, a discussion on strategy, a discussion on tactics, and final remarks on contamination reduction.

It was noted that the processing of NFPA 1700 in the NFPA codes and standards process was being finalized in the summer of 2020. In particular, there were still ongoing discussions on whether the topic of contamination control should be addressed in NFPA 1700, or be addressed in another NFPA document (i.e., NFPA 1500). This jurisdictional scope issue was unresolved at the time of this workshop, and the approach taken during the workshop was to continue to address the topic in the training material regardless of where it is finally addressed. The workshop attendees were clear in the feedback that contamination control is an important topic, and wherever the final requirements reside, there was agreement it is important that it is addressed.

The second presentation was by NFPA and AllenComm, who worked as a contractor on this project through NFPA. This presentation was led by Elena Samuels and Brandon Barrett of AllenComm, with assistance from Jason Emery of Emergency Training Solutions (who is also active as a Battalion Chief with the Waterbury CT Fire Department). Their presentation focused on the format, delivery and style of the online training material for NFPA 1700.

In particular, they addressed introductory materials, audience and learning objectives, the on-line training experience, pre- and post-assessment learner journey, teaching learner journey, the draft model, strategy, tactics, and closed with a discussion on a capstone project.
Slide 1

Introduction
- Chapter 1 Administration
- Chapter 2 Referenced Publications
- Chapter 3 Definitions
- Chapter 4 General

Slide 2

Introduction
- Chapter 1 Administration
- Chapter 2 Referenced Publications
- Chapter 3 Definitions
- Chapter 4 General

Slide 3

Introduction
- Chapter 1 Administration
- Chapter 2 Referenced Publications
  Most of the research that forms the basis of the strategic and tactical basis of NFPA 1700 can be found in the referenced report from Chapter 4.
  Highlight a few titles in the presentation.
  Provide the students with links to the reports as they present them selves in the training
- Chapter 3 Definitions
- Chapter 4 General

Slide 4

Introduction
- Chapter 1 Administration
- Chapter 2 Referenced Publications
- Chapter 3 Definitions
  Point out that NFPA 1700 contains an extensive collection of definitions relevant to Structural Firefighting. Highlight a few terms that may be considered new. Select definitions will be in pop-ups or have links to them when used in the course.
  Exercises:
  3.18 Structural vent - a building opening that serves as both an intake and exhaust vent of a fire path at the same time.
  3.14 Fire dynamics - the detailed study of heat transfer and transfer in elevations to influence fire behavior.
  3.14a Offensive strategy – the plan for the actions and movements of the department units to control the fire, effect rescue, start search for occupants, and extinguish the fire with the intent to commence operations inside the building.
- Chapter 4 General

Slide 5

Introduction
- Chapter 1 Administration
- Chapter 2 Referenced Publications
- Chapter 3 Definitions
- Chapter 4 General
  Why is NFPA 1700 important to the student?
  4.2.1 An understanding of fire dynamics applied within the context of structure fires can provide a fire officer or a fire fighter with means to assess how a fire will grow and spread within a structure and how best to control that growth.
  4.3.2 Changes in Fire Fighters’ Work Environment: Changes in construction materials, construction methods, energy efficient buildings, new technologies, amount of fuel, types of materials.
  4.3.4 Fire-fighting Equipment enables Changes in Fire-fighting Tactics: The tactics fire fighters use on the fireground have also changed. The reliance on indirect, or exterior, attack prior to entry changed to a focus on interior, direct fire control.

Slide 6

Introduction
- Chapter 1 Administration
- Chapter 2 Referenced Publications
- Chapter 3 Definitions
- Chapter 4 General

Slide 7

Introduction
- Chapter 1 Administration
- Chapter 2 Referenced Publications
- Chapter 3 Definitions
- Chapter 4 General

Slide 8

Introduction
- Chapter 1 Administration
- Chapter 2 Referenced Publications
- Chapter 3 Definitions
- Chapter 4 General

--- Page 1 of 40 ---
Slide 9

Fire Dynamics

- Chapter 5 Fundamentals of Fire Science
- Chapter 6 Fire Dynamics in Structures

Slide 10

Fire Dynamics

- Chapter 5 Fundamentals of Fire Science
- Fuel, Oxygen, & Heat are needed for a fire
- Natural fuels and synthetic fuels are different
- Smoke is fuel
- No Oxygen, no heat
- Heat release rate => fire size, fire hazard
- Hot flows to cold
- High pressure flows to low pressure
- Chapter 6 Fire Dynamics in Structures

Slide 11

Strategy

Ch 9: Strategic Considerations

9.1 Scope.
This chapter addresses the sources of information that can be utilized to initiate strategic decisions.

9.2 Purpose.
The purpose of this chapter is to provide key variables in the development and assessment of structural fire-fighting strategies.

9.3 Application

- Offensive Strategy: The plan for the actions and movements of arriving fire department units to control the fire, effect rescues, start searches for occupants, and extinguish the fire with the intent to commence operations inside the fire building.
- Defensive Strategy: The plan for actions or movements of arriving fire department units to protect exposures and contain the main body of fire within the already affected areas.

Slide 12

Strategy

Ch 9: Strategic Considerations

9.5 Initial Survey Factors

--- Page 15 of 40 ---
9.9 Identification of Strategy
- The initial IC should assess crew accessibility and fire control positioning. Consideration should be given to the ability to position apparatus to support the efficient use of tools and equipment and the ability of crews to access the structure via the most direct route to the fire location.
- Considerations may include the following:
  (1) Existence of barriers impeding the positioning of apparatus (fences, grade changes)
  (2) Existing barricades or security features on the structure to delay fire fighter access
  (3) Status of entrance and egress points on the structure and their integrity and operability under present and potential fire conditions.

9.9 Strategic Decision
- Once a thorough size-up has been performed, the IC must make all size-up considerations to formulate an appropriate strategic decision, whether offensive or defensive.
- Life safety is the greatest consideration when determining the overall incident strategy.

9.11 Strategy Implementation
- The IC should make the strategy known via verbal or radio communications through the chain of command so that all on-scene personnel are aware.
- Whenever there is a change of strategy, the IC should make the new strategy known via verbal or radio communications through the chain of command so that all on-scene personnel are aware.

10.1 Scope
- This chapter addresses the tactical considerations for coordinated fire control and extinguishment operations.

10.2 Purpose
- The purpose of this chapter is to provide guidance on fire control and extinguishment options for tactical consideration.

10.3 Application
- The intent of this chapter is for fire-fighting personnel to apply science-based tactical considerations for fire control and extinguishment.

Figure 3: UL FSRI Slides 17 through 24
Tactics
Ch 10. Tactical Considerations for Fire Control and Extinguishment

Importance of a Closed Door – Occupant Tenability
- An occupant located in a room during a search with a closed door between them and the fire has a much higher likelihood of survivability than an occupant with an open bedroom door.
- If the door is open, and/or smoke and heat are communicating between two spaces, the proximity to the fire compartment increases the exposure to toxic gases and thermal injuries.
- A closed door gives the highest chance of occupant survival, although places further from the compartment of origin and low in the space increase the occupant(s) chance of survival. Places closest to the fire and high in the space have the least chance of survival.

Importance of a Closed Door – Fire Room
- Isolate fire/limit fire growth and spread

Tactics
Ch 10. Tactical Considerations for Fire Control and Extinguishment

Water
- Exposure Control
- Exterior Control – Exterior Water Application
- Interior Advancement – Interior Water Application
- Interior Fire Control
- Interior Indirect Attack

Tactics
Ch 10. Tactical Considerations for Fire Control and Extinguishment

Air
- Non-ventilation (door control as an example)
- Horizontal Ventilation
- Vertical Ventilation
- Positive Pressure Attack (PPA)
- Positive Pressure Ventilation (PPV)
- Hydraulic Ventilation
- Negative Pressure Ventilation

Contamination Reduction
Ch 11. Exposure and Hygiene Considerations
- The purpose of this section is to provide science-based information to fire-fighting personnel regarding procedures to minimize the exposure and health risks of firefighting.
- Proper use of PPE and SCBA during and after fire
- Gross on scene “decon” (contamination reduction)
- Avoid cross contamination when doffing, transporting or storing gear

DISCUSSION – Technical Content

Figure 4: UL FSRI Slides 25 through 30
**Introduction**

- Using NFPA 1700 as basis, NFPA and Allen Communications set out to construct a 3D learning environment to instruct and guide firefighters through the selection of appropriate strategies and tactics at a residential structure fire.

- Integrating the dynamic research and findings from UL, the goal was to build a visually interactive, impactful learning environment that allows the firefighter to participate in various simulated fire scenarios.

- Users will experience a self-paced, guided exploration of the dynamics and will have the opportunity to access additional documentations, animations, and videos of supporting studies, testing, and the footage through links built into the interface.

**Introduction**

- The simulation-based learning environment will test the responder’s knowledge and understanding of the dynamics and other concepts addressed in NFPA 1700. This includes the selection of appropriate strategies and tactics given different fire conditions and locations within the structure.

- As the user moves through the scenarios, the fire conditions will either improve or degrade based on the strategy and tactical decisions made in a simulated environment. This allows the student to gain a deeper understanding of the impact these choices can have on fire operations, either positive or negative.

- All modules, simulations, scenarios, and functions are designed to be used on a wide range of devices and operating systems, including laptops, phones, and tablets for maximum flexibility.

**Audience & Learning Objective**

- Senior officers and firefighters are the old guard and may not be sold on the idea of web-based training (WBT).

- After the initial firewall and 10 training, subsequent training varies from department to department.

- Currently, for firefighters there is no renewal or continuing education requirement to maintain their firefighter I or II certification.

- Some officers and firefighters may not have received any additional training in this area since their initial certification.

- Fire officers and firefighters may need to be convinced that the research and science at the heart of NFPA 1700 is compelling enough to adjust their current way of thinking about firefighting operations.

**Learner Transformation:**

- Firefighters use science-based research to develop strategies and tactics that lead to decreased fireground arrival time and increased firefighter and occupant safety.

*Figure 5: NFPA and AllenComm Slides 1 through 8*
**Strategy**

Once firefighters arrive on scene, they first perform a 360 assessment of the residential structure, which includes other variables such as weather, accessibility, building construction and geometry. 12 Initial Attack Factors, e.g., fire dynamics, then develop an effective strategy for fire extinguishment. Building construction and geography include all 12 Initial Attack Factors (NFPA 720, 2005).  

Scenario 51: Fire started in the first-floor family room. At time of arrival, the fire is in advanced stage due to lack of oxygen. All 150 walk-around checks are off. If there are windows that are hot, you can assume “fire” would be the greatest threat at the structure. Open door and frame conditions have smoke flow out the upper level of the structure and call an option for the structural. Close door and prepare for offensive strategy with interior attack. Crews on site to enter.  

Scenario 52: Fire started in the garage. A grill on the near dock located 5 stories off the ground due to the presence of a walk out basement. The is well established on the first and second floor and into the attic. Initially difficult to determine due to the wind. But it becomes evident that fire is coming from the eaves. Use thermal imaging “View” to show a heat signature along the eaves. Fire is growing rapidly.

**Capstone**

The Capstone Module will bring together the elements of the fire dynamics, strategy and tactics modules in the following seminar with decision points to be outlined in a decision tree by NFPA.  

Scenario: Contraction of Fire Dynamics/Strategy/Tactics: Fire burning in the basement. Baseline is walk out basement with door and several windows. Interior door opens to the basement. A person on arrival with smoke coming out of the eave and going in the basement. Assess the condition of the door and eavestrough of the basement. Leavers will have to assess what will happen. Demolition could open the walk-out door, and consequences of that. Leavers could open basement door and put a hose down the stairs with those consequences. Would highlight common instances firefighters make in this situation. Click showing how long the fire is estimated to have been burning.

*Figure 7: NFPA and AllenComm Slides 1 through 8*
2.3. Workshop Polling Discussion:
To provide structure and engagement to the virtual meeting, multiple polling questions were presented to the participants. Figures 8 through 11 summarize the actual polling questions.

**Figure 8: Summary of Meeting Poll Questions – Page 1 of 4**

NFPA 1700 Polling Questions, for Research Project Workshop – 21 April 2020
Version 3.0 (2020.04.07)

**NFPA 1700, Guide for Structural Fire Fighting, Proposed Edition**

Base assumptions for all questions:
- a) Major change recommendations will likely be applied to future follow-on efforts, recognizing that current training program material development is already partially developed (with the opportunity for some but not all adjustments).
- b) Current material development is attempting to follow the details and direction of NFPA 1700 as closely as possible.
- c) As NFPA 1700 evolves, so too will the training materials, and thus we expect future refinement and adjustment of all training materials.
- d) Polling questions are intended to provide guidance and feedback, and do not imply approval or a formal vote of any kind.

**1. Technical Content:** Review of actual technical content.

1.1 General Approach: In terms of priority of the current structural fire fighting research, where should further efforts be focused to expand our knowledge and understanding? (Per DM slide 8)
(pick only 3 of 8 initial choices; if appropriate repeat question three times without top pick, using modified ranked choice voting approach)
- a) Time to Flashover
- b) Structural Collapse
- c) Wind-Driven Fires
- d) Fire-fighting Ventilation
- e) Fire-fighting Suppression
- f) Cardiovascular and Carcinogenic Exposures
- g) NIOSH FFFIPP
- h) Other

1.2 Fire Dynamics: It is important to provide fire dynamics and a review of fundamental concepts, but should more or less content be provided on this topic area? (See DM slides 9-11)
(pick only 1 of 6 initial choices)
- a) Provide a lot more
- b) Provide more, but not much
- c) Just right
- d) Provide less but not much
- e) Provide a lot less
- f) Not applicable

1.3 Strategy: For a typical structural residential fire, have all the critical factors been satisfactorily addressed to be included in the strategic evaluation? (See DM slides 13-16)
(pick only 1 of 6 initial choices)
- a) Yes, feel strongly
- b) Yes, feel somewhat
- c) Neutral
- d) No, feel somewhat
- e) No, feel strongly
- f) Not applicable

1.4 Tactics: Are there key sub-areas that need to be addressed for the Tactics Library that are not adequately captured or included elsewhere? (See DM slides 23-27)
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pick only 1 of 6 initial choices
a) Yes, feel strongly
b) Yes, feel somewhat
c) Neutral
d) No, feel somewhat
e) No, feel strongly
f) Not applicable

1.5 Contamination Reduction: Indicate your areas of greatest concern for contamination reduction that should be further emphasized. (Per DM slide 29)
pick only 3 of 10 initial choices; if appropriate repeat question three times without top pick, using modified ranked choice voting approach
a) Post incident gear & cleaning
b) Suppression specific concerns
c) Incident commander and driver/operator specific concerns
d) Overhaul specific concerns
e) Apparatus
f) Support personnel
g) Operational hygiene at the fire stations
h) Fireground tactical consideration: gross on-scene contamination reduction
i) Fireground tactical consideration: rehabilitation
j) Other

1.6 Overall Content Direction: In terms of consistency with NFPA 1700, should the Training Materials deviate from the structure of NFPA 1700? (per DM slide 4)
pick only 1 of 6 initial choices
a) Yes, feel strongly
b) Yes, feel somewhat
c) Neutral
d) No, feel somewhat
e) No, feel strongly
f) Not applicable

2. Roadmap and Packaging: Review of outline, structure and packaging of the material (i.e., the roadmap).

2.1 Scenario Based Approach: The current project uses a scenario-based approach. Going forward, do you believe this provides an adequate approach for addressing NFPA 1700 training materials?
pick only 1 of 6 initial choices
a) Yes, feel strongly
b) Yes, feel somewhat
c) Neutral
d) No, feel somewhat
e) No, feel strongly
f) Not applicable

2.2 Scenario Based Approach: For the future, how should the scenario-based approach be changed to address NFPA 1700 material?
pick all that apply of 5 initial choices
a) Continue with the same approach, with enhancement of existing scenarios
b) Continue with the same approach and supplement with more scenarios (possibly many)
NFPA 1700 Polling Questions, for Research Project Workshop – 21 April 2020

- Re-align the current approach with minor adjustments
- Re-align the current approach with major adjustments
- Use an entirely different approach

2.3 Style and Tone: From the student perspective, is the presentation style and tone of the training material adequate and appropriate?

(choose 1 of 6 initial choices)
- Yes, feel strongly
- Yes, feel somewhat
- Neutral
- No, feel somewhat
- No, feel strongly
- Not applicable

2.4 Diagnostic Feedback: Is the diagnostic feedback for the training material user adequate and appropriate?

(choose 1 of 6 initial choices)
- Yes, feel strongly
- Yes, feel somewhat
- Neutral
- No, feel somewhat
- No, feel strongly
- Not applicable

2.5 Technical Platforms: Should separate training packages be used depending on the users' capabilities to accept the package, i.e., desktops vs. laptops vs mobile devices, etc.?

(choose 1 of 6 initial choices)
- Yes, feel strongly
- Yes, feel somewhat
- Neutral
- No, feel somewhat
- No, feel strongly
- Not applicable


3.1 Future Applications for Residential Occupancy: Indicate your areas of greatest concern for additional structural fire fighting applications that should be considered with NFPA 1700 One & Two Family Residential Occupancies and associated training material development.

(choose 3 of 12 initial choices; if appropriate repeat question three times without top pick, using modified ranked choice voting approach)
- Concealed Space Fires (12.6)
- Garage (12.7)
- Manufactured and Modular Dwellings (12.8)
- Large Estate Dwellings (12.9)
- Buildings Converted to Residential or Multiple Dwellings (12.10)
- Multifamily Dwellings (12.11)
- Multi-Unit Residential Buildings (12.12)
- Abandoned and Vacant Structures (12.13)
- Buildings Under Construction/Demolition (12.21)
Efforts were made beforehand to facilitate engagement and discussion because the need to utilize a virtual meeting. The polling questions served this purpose. Figures 12 through 25 summarize the discussion results of each polling question based on the feedback provided by the workshop participants during the meeting.
1.1 General Approach: In terms of priority of the current structural fire fighting research, where should further efforts be focused to expand our knowledge and understanding? (Per DM slide 8) Rank the following answers 1 through 8, with 1 being most preferred.

Answered: 18  Skipped: 0

- a) Time to Flashover (3)
- b) Structural Collapse (4)
- c) Wind-Driven Fires
- d) Fire-fighting Ventilation (2)
- e) Fire-fighting Suppression (1)
- f) Cardiovascular and Carcinogenic Exposures (5)
- g) NIOSH FFFIPP
- h) Other

Figure 12: Results for Question 1.1 - General Approach

1.2 Fire Dynamics: It is important to provide fire dynamics and a review of fundamental concepts, but should more or less content be provided on this topic area? (See DM slides 9-11)(pick only 1 of 6 initial choices)

Answered: 18  Skipped: 0

Figure 13: Results for Question 1.2 – Fire Dynamics
1.3 Strategy: For a typical structural residential fire, have all the critical factors been satisfactorily addressed to be included in the strategic evaluation? (See DM slides 13-16) (pick only 1 of 5 initial choices)

Answered: 17  Skipped: 1

![Diagram showing results for Question 1.3 - Strategy]

Figure 14: Results for Question 1.3 - Strategy

1.4 Tactics: Are there key sub-areas that need to be addressed for the Tactics Library that are not adequately captured or included elsewhere? (See DM slides 23-27) (pick only 1 of 6 initial choices)

Answered: 17  Skipped: 1

![Diagram showing results for Question 1.4 - Tactics]

Figure 15: Results for Question 1.4 - Tactics
1.5 Contamination Reduction: Indicate your areas of greatest concern for contamination reduction that should be further emphasized. (Per DM slide 29)

Rank the following answers 1 through 10, with 1 being most preferred of greatest concern.

Answered: 17 Skipped: 1

a) Post incident gear & cleaning (1)
b) Suppression specific concerns (4)
c) Incident commander and driver/operator specific concerns
d) Overhaul specific concerns (2)
e) Apparatus
f) Support personnel
g) Operational hygiene at the fire stations
h) Fireground tactical consideration: gross on-scene contamination reduction (5)
i) Fireground tactical consideration: rehabilitation
j) Other

Figure 16: Results for Question 1.5 – Contamination Reduction

1.6 Overall Content Direction: In terms of consistency with NFPA 1700, should the Training Materials deviate from the structure of NFPA 1700? (per DM slide 4) (pick only 1 of 6 initial choices)

Answered: 17 Skipped: 1

Figure 17: Results for Question 1.6 – Overall Content Direction

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2.1 Scenario Based Approach: The current project uses a scenario-based approach. Going forward, do you believe this provides an adequate approach for addressing NFPA 1700 training materials? (pick only 1 of 6 initial choices)

Answered: 13 Skipped: 0

![Bar Chart for Question 2.1]

**Figure 18: Results for Question 2.1 – Scenario Based Approach**

2.2 Scenario Based Approach: For the future, how should the scenario-based approach be changed to address NFPA 1700 material? (pick all that apply of 5 initial choices)

Answered: 13 Skipped: 0

![Bar Chart for Question 2.2]

**Figure 19: Results for Question 2.2 – Scenario Based Approach**
Figure 20: Results for Question 2.3 – Style and Tone

2.3 Style and Tone: From the student perspective, is the presentation style and tone of the training material adequate and appropriate? (pick only 1 of 6 initial choices)

Answered: 13  Skipped: 0

- Yes, feel strongly: 23.08%
- Yes, feel somewhat: 53.85%
- Neutral: 15.38%
- No, feel somewhat: 0%
- No, feel strongly: 0%
- Not applicable: 7.69%

Figure 21: Results for Question 2.4 – Diagnostic Feedback

2.4 Diagnostic Feedback: Is the diagnostic feedback for the training material user adequate and appropriate? (pick only 1 of 6 initial choices)

Answered: 12  Skipped: 1

- Yes, feel strongly: 8.33%
- Yes, feel somewhat: 50.00%
- Neutral: 41.67%
- No, feel somewhat: 0%
- No, feel strongly: 0%
- Not applicable: 0%
2.5 Technical Platforms: Should separate training packages be used depending on the users capabilities to accept the package, i.e., desktops vs. laptops vs mobile devices, etc.? (pick only 1 of 6 initial choices)

Answered: 13  Skipped: 0

Figure 22: Results for Question 2.5 – Technical Platforms

3.1 Future Applications for Residential Occupancy: Indicate your areas of greatest concern for additional structural fire fighting applications that should be considered with NFPA 1700 One & Two Family Residential Occupancies and associated training material development? Rank the following answers 1 through 12, with 1 being most preferred.

Answered: 13  Skipped: 0

a) Concealed Space Fires
b) Garages
(c) Manufactured and Modular Dwellings (12.8) [3]
d) Large Estate Dwellings (12.9) [3]
e) Buildings Converted to Residential or Multiple Dwellings (12.10)
f) Multifamily Dwellings (12.33) [3]
g) Multi-Unit Residential Buildings (12.12) [3]
h) Abandoned and Vacant Structures (12.13)
i) Buildings Under Construction/Demolition (12.21)
j) Photovoltaic Systems (12.22)
k) Other (12.23) [3]
l) Other

Figure 23: Results for Question 3.1 – Future Applications for Residential Occupancy
3.2 Future Occupancy Applications: Indicate your areas of greatest concern for structural fire fighting applications that should be considered with NFPA 1700 and associated training material development? Rank the following answers 1 through 11, with 1 being most preferred.

Answered: 11  Skipped: 0

a) Abandoned and Vacant Structures (12.13) (4)
b) Large-Space Buildings (12.14) (3)
c) Warehouses (12.15)
d) Varied Grade (Hillside) Building (12.16)
e) Hospital/Health Institution (12.17)
f) High-Rise (12.18) (2)
g) Basement (12.19) (1)
h) Strip Malls (12.20)
i) Buildings Under Construction/Demolition (12.21)
j) Photovoltaic and Energy Storage Systems (12.22)
k) Other [e.g., WUI, etc.]

Figure 24: Results for Question 3.2 – Future Occupancy Applications

3.3 Next Generation Features: Indicate your areas of greatest interest for next generation of features for NFPA 1700 training materials. Rank the following answers 1 through 8, with 1 being most preferred.

Answered: 13  Skipped: 0

a) Enhanced Feedback Features (that introduce complicating factors during an exercise) (3)
b) New Residential One & Two Family Structural Fire Fighting Scenarios (4)
c) New Structural Fire Fighting Scenarios for other Applications (4)
d) Addressing New Emerging Threats & Hazards (e.g., Energy Storage Systems)
e) Addressing Changing Demographics (e.g., elderly population, growing WUI, etc.)
f) Addressing Advancing Fire Fighting Technology (e.g., physiological monitoring, drones, heads-up displays, building system or mobile device interaction, etc.)
g) Multiple Users in Training Scenarios (enabling multiple interactive end users in a single exercise) (4)
h) Other

Figure 25: Results for Question 3.3 – Next Generation Features
2.4. Workshop Summary Observations:
The primary summary Observations were structured around the Polling Questions and are addressed in the following sections.

An additional important comment received after the workshop discussion was the on-going importance of matching training materials to the JPRs (Job Performance Requirements) of the NFPA Professional Qualifications standards. This is because the fire service training academies are significantly dependent on these JPRs for their programs. The more that forthcoming training materials match and coordinate with the JPRs, the better. This is further reflected in section 2.4.1.3 below.

2.4.1) Overview and General
This section highlights the overview and general summary observations of the training program.

2.4.1.1) GENERAL ISSUES:
   a) Need to do a good job on this first project. Embracement by the fire service of NFPA 1700 in the future will be contingent on this effort being good quality and being respected.
   b) At this time, reference is made back to the publicly available draft of NFPA 1700 (with final modifications to be made this summer when the first edition is finalized) but there were no changes to NFPA 1700 that impacted the current project.
   c) In all applications, do not show dirty fire fighter gear, and maintain the theme of providing “clean” is the new good.
   d) The information available on the project deliverables at this time is still somewhat abstract, and this is a challenge on providing comments at this time.

2.4.1.2) KEY ASSUMPTIONS:
   a) Major change recommendations will likely be applied to future follow-on efforts, recognizing that current training program material development is already partially developed (with the opportunity for some but not all adjustments).
   b) Current material development is attempting to follow the details and direction of NFPA 1700 as closely as possible.
   c) As NFPA 1700 evolves, so too will the training materials, and thus we expect future refinement and adjustment of all training materials.
   d) Polling questions are intended to provide guidance and feedback, and do not imply approval or a formal vote of any kind.

2.4.1.3) SPECIFIC RECOMMENDED ENHANCEMENTS:
   a) Consider providing direct references and tie-ins to the NFPA professional qualification standards and related fire service standards. This is particularly important for the training academies and similar groups that will be looking to implement these materials. Consider the standards for ProQual (especially FFI, FFII, and Fire Officer), the training standards, and the NFPA 1500 series standards. Consider three possible next steps, in order of effort required for this tie-in:
      i. Establish a roadmap of matching requirements in the NFPA Standards based on citations.
ii. Outline the specific ProQual JPR objectives and learning objectives of the training materials (Note: “ProQual JPR” refers to the Job Performance Requirements addressed by the series of approximately two and a half dozen NFPA Professional Qualification standards).

iii. Provide specific questions that can be used to meet the specific objectives.

2.4.2) Training Program Content
This section highlights the summary observations of the training program content.

2.4.2.1) GENERAL CONTENT APPROACH:
   a) Key issues with the general approach are ventilation and suppression. Also important are time to flashover, structural collapse, and cardiovascular and carcinogenic exposures
   b) Cardiovascular and carcinogen exposures have risen to become a major issue for today’s fire service, and thus should be considered a priority.
   c) We have more to learn on both ventilation and suppression, and the coordination thereof.

2.4.2.2) FIRE DYNAMICS CONTENT:
   a) Fire dynamics is just about right, though it could still provide a little more but not too much more.
   b) The sub-components of the Fire Dynamics need to be incremental and clear, to:
      i. support use by the full spectrum of program participants, and
      ii. optimize the learning experience for the most program participants.
   c) If not already included, consider a feature on the screen where the learner can click to see the navigational instructions.
   d) Consider including a “go / no-go” temperature, effect of gases being cooled, etc., though recognizing this is variable dependent and could be challenging to consider.

2.4.2.3) STRATEGY CONTENT:
   a) The strategy component is being well addressed.

2.4.2.4) TACTICS CONTENT:
   a) The tactics component is being adequately addressed.

2.4.2.5) CONTAMINATION REDUCTION CONTENT:
   a) Key issues with contamination reduction are post incident gear cleaning, and overhaul specific concerns. Also important are gross on-scene contamination reduction and suppression specific concerns.
   b) Going forward we need to be clear on what is meant by “exposure control”
   c) This is currently a jurisdictional scope issue on the inclusion of contamination reduction guidance in the upcoming edition of NFPA 1700, and the training material should still address this topic regardless of it remains in NFPA 1700 or is placed in another NFPA document to be referenced by NFPA 1700.

2.4.2.6) OVERALL CONTENT DIRECTION:
   a) We are generally guided by the document NFPA 1700, and any critical decisions on content should ultimately be guided by the full consensus process.
   b) As NFPA 1700 evolves, so too must the training materials. This is a journey, that requires addressing the current project and preparing for the future.
2.4.3) Packaging and Delivery
This section highlights the summary observations of the training program packaging and delivery.

2.4.3.1) SCENARIO BASED APPROACH:
   a) Using a scenario-based approach is preferred.
   b) The Scenario based approach lends itself well to the NIOSH FFFIPP fire service LODD reports. NIOSH has long thought that it would be ideal to have recommended training either accompany or be tied to specific training to help prevent re-occurrence. This should be considered for the future.
   c) Provide support material that will address the limitations of accurately reflecting real world conditions, with consideration of the countless variables affecting actual conditions such as the cooling action of water on fire growth.

2.4.3.2) DELIVERY:
   a) Consider the different learning characteristics of the different generations of the participants. For more information on the generational differences of fire fighters, see the presentation by Lori Moore-Merrill as follows: "Generational Differences in the Workplace" link - 13th item on the list of presentations https://www.nfpa.org/NFPA-Membership/Membership-resources/Member-Sections/Metropolitan-Fire-Chiefs/Archive-presentations
   b) The training materials are particularly important for fire service personnel at the company officer level.

2.4.3.3) STYLE & TONE:
   a) The current style and tone seem to be reasonable and appropriate.
   b) The training package must have really good quality, if it is to be respected and realistically embraced by the fire service.

2.4.3.4) DIAGNOSTIC FEEDBACK:
   a) The current diagnostic feedback mechanisms are appropriate.

2.4.3.5) TECHNICAL PLATFORMS:
   a) It is important that the have the ability to seamlessly move between technical platforms. This is a feature that if not done well, will inhibit widespread acceptance.
   b) In the future, consider using virtual reality and similar technology.

2.4.4) Future Direction
This section highlights the summary observations of the training program future direction.

2.4.4.1) FUTURE APPLICATIONS FOR RESIDENTIAL OCCUPANCIES:
   a) The key future applications for residential occupancies to consider are multifamily dwellings, multi-unit residential buildings, manufactured and modular dwellings, attics, and large estate dwellings.

2.4.4.2) FUTURE OCCUPANCY FEATURES:
   a) Key future for occupancies to consider are basements, high-rise, large-space buildings, and abandoned and vacant structures.

2.4.4.3) NEXT GENERATION FEATURES:
a) Key future features to consider are new scenarios for one- and two-family dwellings, new scenarios for other applications, enhanced feedback features for complicated exercises, and multiple simultaneous users.

b) Multiple simultaneous end-users will be an important future enhancement. This is becoming widespread in the gaming world and will become a strongly desired feature to allow multiple units to engage at the same time consistent with a real fire scene.

c) Demographics of the scenario environments is an important variable that requires consideration during the strategy section.
3) Summary of Project Deliverable: Online Training Course

The principal deliverable from this project effort is a free NFPA 1700 online training course\(^5\) for firefighters to learn safer and more effective ways to handle fire incidents involving modern-day materials and contents. NFPA 1700 is the first NFPA document connecting fire dynamics research to firefighter response strategy, tactics, and best practices. Similarly, the online training is based on extensive scientific research and testing on contemporary structures led by the UL Firefighter Safety Research Institute in collaboration with multiple fire departments.

The course provides guidance on interacting within a burning structure to achieve the most successful outcome based on documented fire investigations, research, and testing; interactive modeling of residential structural firefighting with simulated training scenarios and coaching exercises; and concepts based on NFPA 1700 principles and tactical advice for effective search, rescue, and fire suppression operations, as well as civilian and responder safety.

The online training developed is in an immersive virtual environment that offers a 360-degree, 3D experience featuring realistic scenarios and requires the students to make observations and decisions on how to respond and fight the fire. The course includes 14 individual modules covering how to enter buildings, where to apply hose streams, and when to change strategies, based on changes in fire conditions, culminating with an exam to help firefighters synthesize learning and put knowledge to the test.


At the time of documenting this report (end of July 2021), the online course has received over 2770 registrations.

The online course consists of the following 14 individual modules and the following section provides a brief abstract of each chapter modules:

1) **Introduction to NFPA 1700 Guide**: The introduction chapter provides an understanding of today’s fire environment by providing an overview of the changes that has occurred in the work environment of firefighters including the changes due to new construction methods, building materials, fuel loads, power generation and storage technologies to list a few. It also clarifies the modern challenges posed due to these changes with the help of examples from research experiments and findings that reveal the change in fire dynamics in today’s modern homes and firefighter exposure to contaminants.

2) **Fire Dynamics: Pre-Assessment**: This chapter explore how and why a fire grows and spreads and emphasizes the criticality of understanding fire dynamics to a firefighter’s job. This is


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demonstrated through an interactive Q&A portion based on a structural fire scene. What firefighters observe about a scene, details like open doors and windows or wind speed and direction, can give vital information about how a fire is acting and how it will grow and spread. These observations will have an impact on firefighting tactics.

3) **Fire Dynamics: Training:** This chapter explains the fundamentals of combustion and heat transfer during a fire growth from the time of ignition to a stage of flash over. This also discuss the effect of wind-driven fires and different types of flow paths and effect of ventilation on flow paths. Due to changes in fuel materials, construction methods, and other changes, the understanding of fire dynamics is critical. This chapter activity is aimed to fill in any gaps in the current knowledge of fire dynamics.

4) **Fire Dynamics: Post-Assessment:** This chapter provides a new scenario based interactive assessment of the basic of fire dynamics learned through the previous two chapters.

5) **Fire Strategy: Pre-Assessment:** This module covers the basics of fire strategy and how an understanding of the fire dynamics at play on a scene affects decision-making about attacking a fire. This activity simulates the experience of assessing the scene of a fire to determine strategy before making tactical decisions on how to attack the fire. It is important to outline initial factors and perform 360 assessments to observe conditions, understand risks and priorities in order to most effectively save lives and property.

6) **Fire Strategy: Training:** This chapter reviews the basics of fire strategy and the observations needed to determine the strategy. NFPA 1700 details 13 initial factors firefighters should consider for overall evaluation of conditions immediately upon arrival to a fire scene. This followed by the 360 Assessment (visual assessment of all four sides of the structure) is essential to layout the incident action plan. This training chapter teaches risk management by laying out the responsibilities at the scene of a fire and decisions about how to attack a fire based on data and observations.

7) **Fire Strategy: Post-Assessment:** This chapter provides a new scenario based interactive assessment of the fire strategy lessons learned through the previous two chapters.

8) **Fire Tactics: Pre-Assessment:** This module helps in understanding how fire dynamics and strategy impact tactical decisions toward decreased time to fire extinguishment and increased safety of civilians and fire fighters.

The next three modules of the online course are about different tactics used by firefighters based on the strategy. Tactics are the deployment and direction of resources on an incident to accomplish the objectives designated by the strategy and it is driven by the fire conditions, staffing, and resources.

9) **Coordination:** This module covers the significant elements of working together on the fireground using sequential or simultaneous tactics.
10) **Suppression**: This module discusses ways to use hose streams to optimize the water’s effectiveness in fire extinguishment. Fire control is the coordinated task of delivering an extinguishing agent (e.g., water) to fire and hot gases while managing the flow of air, smoke, heat and fuel(s). They are presented in this chapter in an order that moves from the outside to the inside of a structure (in terms of water use): exposure fire control, exterior fire control, interior advancement, interior fire control, and interior indirect control.

11) **Ventilation**: This module explains the different types of ventilation tactics that need to be coordinated with the suppression tactics. The decision about when, where, and how to ventilate is guided by an understanding that, in the absence of effective water application, air increases the heat release rate and potential for rapid fire development. With this understanding of the impact of air on fire growth and the requirement for coordinated water, the tactical options are for either non-ventilation or ventilation.

12) **Fire Tactics: Post-Assessment**: This chapter provides scenario based interactive assessment of the fire tactics lessons learned through the previous chapters.

13) **Capstone**: This capstone chapter provides scenario based interactive assessment of the lessons learned through the previous chapters by observing the scene and making tactical decisions. The student will need to utilize the learning from all the prior chapters.

14) **Contamination Reduction**: The final chapter of this online course covers current best practices for on-scene and fire station contamination reduction techniques. Every fire contains harmful contaminants, but today’s firefighters are exposed to smoke from a wider variety of burning materials. In some fire stations, additional contamination may occur from dirty equipment or from diesel exhaust. This likely results in more varied and unknown risks from smoke exposure. The risk of exposure to toxic chemicals is still high even after a fire has been extinguished. After a fire is extinguished, there is still a need to maintain focus on controlling exposure risk through contamination reduction. Contamination reduction is the systematic removal of the byproducts of the fire ground from tools, equipment, and PPE. This module covers the steps fire department can take to reduce firefighter exposure to the harmful products of combustion on the fireground and back at the fire station.

In summary, this online training is designed to help firefighters explain why firefighting tactics are changing based on modern construction, newer on-scene technology, and evolving fuel loads; understand how to assess and approach the scene of a fire based on the latest science-based fire dynamics research and testing; and be better prepared to assess a fire’s growth and spread and utilize up-to-date control methods. The training considers fundamental occupancy and building construction while addressing the health and safety of firefighters by reinforcing the need for personal protective equipment and methodologies for contamination control.
4) References & Other Resources


4. UL Firefighter Safety Research Institute Research. Web: [https://ulfirefightersafety.org/](https://ulfirefightersafety.org/)


Annex A: NFPA 1700 Document and Chapter Scopes

This annex provides a summary of NFPA 1700 document scope, as well as scopes of significant chapters (NFPA 1700, 2021 Edition).

<table>
<thead>
<tr>
<th>NFPA 1700 Outline, for Research Project Workshop – April 2020</th>
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</thead>
<tbody>
<tr>
<td><strong>Document and Chapter Scopes</strong></td>
</tr>
<tr>
<td><strong>Chapter 1 Administration.</strong></td>
</tr>
<tr>
<td><strong>1.1 Scope.</strong> This guide addresses structural fire-fighting strategy and tactics as supported by science-based research.**</td>
</tr>
<tr>
<td><strong>Chapter 4 General</strong></td>
</tr>
<tr>
<td><strong>4.1 Scope.</strong> This chapter will provide a brief overview of the research conducted with the fire service that applied fire dynamics principles to structural firefighting and demonstrated the impact that changes in fuel loads and construction methods have had on the fire environment.**</td>
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<tr>
<td><strong>4.1.2.</strong> These changes have altered the model of fire behavior taught to the fire service for decades. In addition, fire fighter protective and safety equipment has also changed over the years. All these factors led to an assessment that fire-fighting tactics needed to evolve to improve the effectiveness of fire-fighting strategies and tactics.**</td>
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<tr>
<td><strong>Chapter 5 Fundamentals of Fire Science</strong></td>
</tr>
<tr>
<td><strong>5.1 Scope.</strong> This chapter addresses the fundamentals of fire science knowledge.**</td>
</tr>
<tr>
<td><strong>Chapter 6 Fire Dynamics in Structures</strong></td>
</tr>
<tr>
<td><strong>6.1 Scope.</strong> This chapter addresses only the basic and fundamental knowledge of fire dynamics required to sufficiently understand the concepts presented in this guideline. This chapter is not intended to serve as a complete source of education.**</td>
</tr>
<tr>
<td><strong>Chapter 7 Building Construction and Structural Considerations</strong></td>
</tr>
<tr>
<td><strong>7.1 Scope.</strong> This chapter addresses information on building construction and structures and how they interact with fire.**</td>
</tr>
<tr>
<td><strong>Chapter 8 Fire-Fighting Protective Clothing and Equipment Characteristics and Limitations</strong></td>
</tr>
<tr>
<td><strong>8.1 Scope.</strong> This chapter addresses protection characteristic and limitation of fire-fighting protective clothing and equipment when exposed to products of combustion.**</td>
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<tr>
<td><strong>Chapter 9 Strategic Considerations</strong></td>
</tr>
<tr>
<td><strong>9.1 Scope.</strong> This chapter addresses the sources of information that can be utilized to initiate strategic decisions.**</td>
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<tr>
<td><strong>Chapter 10 Tactical Considerations for Fire Control and Extinguishment.</strong></td>
</tr>
<tr>
<td><strong>10.1 Scope.</strong> This chapter addresses the tactical considerations for coordinated fire control and extinguishment operations.**</td>
</tr>
<tr>
<td><strong>Chapter 11 Exposure and Hygiene Considerations</strong></td>
</tr>
<tr>
<td><strong>11.1 Scope.</strong> This chapter provides the fundamental linkage between fire dynamics research and the need for implementing health hygiene policies for the fire service.**</td>
</tr>
<tr>
<td><strong>Chapter 12 Fire Specific Tactical Considerations</strong></td>
</tr>
<tr>
<td><strong>12.1 Scope.</strong> This chapter addresses the information, factors, and observations needed to develop the initial and ongoing operational strategy required for fire control for special circumstances.**</td>
</tr>
<tr>
<td><strong>Chapter 13 Implementing NFPA 1700</strong></td>
</tr>
<tr>
<td><strong>13.1 Scope.</strong> This chapter addresses the implementation of NFPA 1700 within fire-fighting organizations.**</td>
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