**After Action Report:
Activities, Observations and Findings from DHS
S&T Participation in the Shaken Fury 2019
Response and Recovery Exercise**

December 2019

Table of Contents

Shaken Fury 2019 Overview

Exercise Name	U.S. Department of Homeland Security (DHS) Science and Technology Directorate (S&T) Support to the DHS Federal Emergency Management Agency's (FEMA) National Exercise: Shaken Fury 2019
Exercise Dates	May 29 - June 7, 2019 and August 21-22, 2019
Scope	A series of tabletop, functional and full-scale exercises in partnership with FEMA, FEMA's National Urban Search and Rescue (US&R) Response System, the U.S. Department of Energy (DOE), the Department of Defense's (DoD) U.S. Northern Command (USNORTHCOM), the Central United States Earthquake Consortium (CUSEC), state and local governments and the private sector.
Mission Area(s)	Response and Recovery
Core Capabilities	- Planning - Public Information and Warning - Operational Coordination - Intelligence and Information Sharing - Risk and Disaster Resilience Assessment - Threats and Hazard Identification - Infrastructure Systems - Logistics and Supply Chain Management - Mass Care Services - Mass Search and Rescue Operations - On-Scene Security, Protection and Law Enforcement - Operational Communications - Public Health, Healthcare and Emergency Medical Services - Situational Assessment - Economic Recovery - Health and Social Services - Housing - Natural and Cultural Resources

DHS S&T Objectives	• Establish enhanced information sharing practices across the whole community to improve preparedness, response, recovery and mitigation in response to a catastrophic incident. • Demonstrate the ability of state and federal response and recovery efforts to collaborate with the whole community to adjudicate and allocate critical resources to affected communities. • Demonstrate integrated, real-time field reporting capabilities and incorporate field reports at appropriate scales in Emergency Operation Centers (EOCs). • Validate mutual aid resource planning and tracking capabilities to improve coordination among whole community partners.
Threat or Hazard	Earthquake
Scenario	The multi-state exercise simulated regional response to a 7.7 magnitude earthquake along the Cottonwood Grove Fault, the southwest segment of the New Madrid Seismic Zone (NMSZ), near Memphis, Tennessee.
Participating Organizations	The DHS S&T-funded activities in support of Shaken Fury are described in this document. Participating organizations are listed with the corresponding activity description.

Executive Summary

Shaken Fury 2019 (Shaken Fury) involved a series of tabletop, functional and full-scale exercises in partnership between the U.S. Department of Homeland Security (DHS) Federal Emergency Management Agency (FEMA) and DHS Science and Technology Directorate (S&T), FEMA's National Urban Search and Rescue (US&R) Response System, the U.S. Department of Energy (DOE), the U.S. Department of Defense (DoD) U.S. Northern Command (NORTHCOM) and National Guard Bureau (NGB), the Central United States Earthquake Consortium (CUSEC), state and local governments and the private sector. FEMA's intent for Shaken Fury was to evaluate and improve the whole community's response to a "no-notice" earthquake, identify gaps in resources, and implement a coordinated recovery strategy.

DHS S&T's role in Shaken Fury was to support FEMA's strategic priorities by introducing innovative solutions, technologies and tools that could be used by agencies to improve information exchange, enhance situational awareness, enable the prioritization of resources and improve overall resilience. DHS S&T leveraged Shaken Fury to facilitate the transition of technologies through operational uptake and adoption. DHS S&T brought together community partners to prepare for and participate in five technology development, experimentation and demonstration activities. The DHS S&T activities in support of Shaken Fury were:

CUSEC Regional Information Sharing	Military/ Civilian Information Sharing	US&R Technology Demonstration

Next Generation First Responder Operational Experimentation	Social Media Integration

DHS S&T was able to demonstrate success in developing, deploying and assessing technologies related to information sharing and collaboration through Shaken Fury. Assessment of the outcomes from these activities demonstrate significant increases in:

Information Sharing: The main focus of the DHS S&T Shaken Fury activities was to develop, demonstrate and assess information sharing capabilities to enhance public safety operations. Participant feedback reflects that S&T was successful in this endeavor. With the DHS-developed products being projected onto large screens at state emergency operations centers, hundreds of players were able to use the information provided. The utility of this information prompted the development of additional ad-hoc products during exercise play because agencies were able to realize the utility of the information and how it was displayed.

Relationship Building: DHS S&T was able to build and grow critical relationships that will be advantageous as it moves forward with future technology development projects. Working with end users in CUSEC states to advance the state of information sharing products, working with DoD to identify pathways for future development and working with US&R teams to better

understand capability gaps and needs are all examples of how the relationships established during these activities will enhance the success of S&T in the future.

Multi-Level Coordination: Feedback from stakeholders during many of the Shaken Fury activities indicated that the technologies being demonstrated and assessed improved the ability of agencies and groups to collaborate beyond the technical sharing of data. Not only were staff or groups able to consume information that they had never had access to before, but they were able to communicate with other organizations to solve problems and make decisions based on that data. Also improved was the ability for agencies to work in coordination with other levels of government. Participants noted that information was not flowing only upwards, but they were getting additional data "downward" from higher levels of government and other partners.

Operational Support: Of critical importance when assessing the success of a technology development program is the extent to which new solutions produce improvement in capability. During Shaken Fury, DHS was able to evaluate the success of those efforts to determine the extent that new technologies met operational needs. Participants in those states were pleased with the operational support provided by the DHS S&T-funded solutions.

Technology Advancement: One of the primary missions of DHS S&T is the development and transition of tools, technologies and knowledge products. The end goal is not the development of new technology solutions, but that end users will adopt these products and that they will help those communities be safer and more resilient. Through participation in Shaken Fury activities, DHS was able to evaluate several of its investments in an operational setting. In the months prior to Shaken Fury, the DHS S&T project team worked with end users to advance the state of technology by refining existing solutions to better fit stakeholder needs and to deploy new capabilities. The feedback from participants was overwhelmingly positive and end users commented on the significant improvements in their ability to share information and obtain far greater levels of situational awareness.

Integration into Governance & Process: It is critical that capabilities and technology solutions developed by DHS S&T can be incorporated into existing plans, processes and standards to the greatest extent possible. The inability to do so is a significant barrier to adoption. Many public safety organizations are resistant to change, and technologies that cause cascading disruptions may be abandoned before their potential benefit is realized. The extent to which the DHS-developed systems were able to be quickly integrated into daily and emergency response operations is a measure of success.

FEMA's Shaken Fury provided DHS S&T the opportunity to engage in a national emergency management event, to develop, showcase, demonstrate and transition new and innovative methods and technologies, while supporting the development and uptake of new national protocols and policies. The level of integration in the planning and delivery of the event also offered DHS S&T unique access into the operational sphere, earning trusted S&T-advisor status while being exposed to critical operator feedback and deep insights into the national emergency management operational environment.

Introduction

As part of the Federal Emergency Management Agency's (FEMA) National Exercise Program (NEP), the Department of Homeland Security (DHS) conducts exercises designed to assess and validate capabilities, improve coordination and identify areas for improvement and strengths.[1] As part of this mission, FEMA hosted Shaken Fury 2019. Within the scope of that exercise, DHS Science and Technology Directorate (S&T) collaborated with FEMA, Central United States Earthquake Consortium (CUSEC), the Department of Defense (DoD) and state and local agencies to develop, deploy and assess technologies that would improve response to and recovery from this type of incident.

This After Action Report (AAR) provides leadership, program staff and other stakeholders with a thorough understanding of the actions associated with each DHS S&T Shaken Fury activity, the outcomes and the impact of each activity. This document was developed to provide actionable insights based on the DHS S&T activities and inform near- and long-term decisions regarding future DHS S&T projects and investments.

This AAR is composed of two parts. The first part provides an overview of Shaken Fury and the suite of exercises that were conducted under the Shaken Fury umbrella. It also provides a description of associated objectives, scenarios and resources. The second part of this document provides a detailed description of the technology development, experimentation and demonstration initiatives carried out by DHS S&T as part of Shaken Fury 2019. The second part also contains the key findings from each DHS S&T initiative.

The findings in this document are organized into six themes that reflect their impact:

 Information Sharing: these findings address the extent that DHS-funded activities or solutions improve the ability for partners to quickly and efficiently exchange critical information;

 Relationship Building: these findings reflect the extent that DHS-funded activities or solutions bring new community partners together or do so in novel ways;

 Multilevel Coordination: these findings reflect the extent that DHS-funded activities or solutions improve collaboration among different levels of government;

 Operational Support: these findings reflect the extent that DHS-funded activities make management and response operations safer and more efficient;

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[1] "National Exercise Program," Federal Emergency Management Agency; viewed 20 September 2018. https://www.fema.gov/national-exercise-program
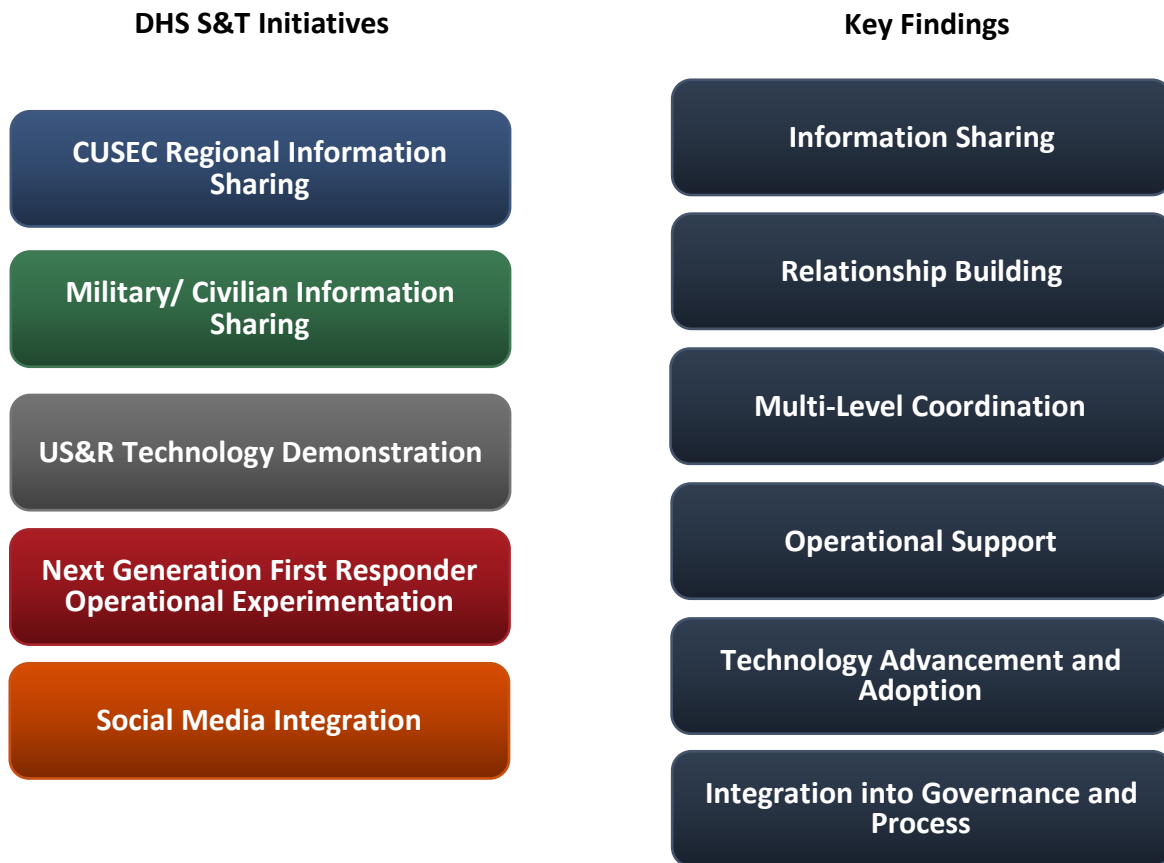
Technology Advancement and Adoption: these findings address the extent to which DHS programs have advanced the state of technology and/or have been implemented by community partners; and

Integration into Governance and Process: these findings address the extent to which DHS-funded solutions adhere to existing policies, processes and standards without causing additional barriers.

Figure 1. Themes of Shaken Fury Findings

This document can be read in two ways. Using a traditional approach, the reader can proceed through the document sequentially. Alternatively, one can use the links below to move to the section of interest. The links on the left correspond with the technology development, experimentation and demonstration initiatives carried out by DHS S&T as part of Shaken Fury. The links on the right correspond with themes of the key findings from those initiatives.

DHS S&T Initiatives	Key Findings
CUSEC Regional Information Sharing	Information Sharing
Military/ Civilian Information Sharing	Relationship Building
US&R Technology Demonstration	Multi-Level Coordination
Next Generation First Responder Operational Experimentation	Operational Support
Social Media Integration	Technology Advancement and Adoption
	Integration into Governance and Process

The DHS S&T project team used a collaborative approach to develop, implement, manage and assess S&T's Shaken Fury initiatives. The project team was comprised of federal staff and contractor support. For each activity, the team identified stakeholders and their objectives. The team executed a series of planning meetings in advance of each Shaken Fury activity. A

description of the planning events can be found in conjunction with the description of each activity in Part II.

In advance of Shaken Fury, the project team developed a Communications Plan and an Observation Plan. The purpose of the Communications Plan was twofold: 1) highlight the benefits and value of DHS S&T technologies featured in Shaken Fury; and 2) build relationships with Shaken Fury partners. Through the products of the Communications Plan, DHS S&T was able to increase the chances of consumer adoption and increase opportunities to exercise and showcase DHS S&T technologies in the future. The Observation Plan was designed to describe how the project team members would observe Shaken Fury activities and collect data on activity outcomes. The Plan also identified test measures designed to allow the team to assess the Shaken Fury outcomes against the exercise and stakeholder objectives. The project team developed a series of data gathering questionnaires for the Shaken Fury activities; these can be found in Appendix G. Data was collected by the project team members via interviews with stakeholders and participants prior to, during and after Shaken Fury, and through direct observation. The project team also reviewed post-exercise documentation and agency-specific after-action reports.

This document was developed using the contributions of multiple project team members and work products. Especially helpful for the development of this AAR was the G&H International Services, Inc. *Shaken Fury Observation Report.* Where applicable, other project documents are specifically referenced to guide readers to related information.

This document is the companion to an interactive web-based AAR. When available, a link to the AAR site will be included here.

PART 1: Shaken Fury 2019

Shaken Fury Exercise Activities

FEMA's Shaken Fury 2019 involved a series of tabletop, functional and full-scale exercises in partnership with DHS, Department of Energy (DOE), DoD U.S. Northern Command (NORTHCOM) and National Guard Bureau (NGB), CUSEC, state and local governments and the private sector. As noted previously, the purpose of Shaken Fury was to evaluate and improve the whole community's response to a "no-notice" earthquake, identify gaps in resources and implement a coordinated recovery strategy that prioritizes resources required for the response.[2] Most exercise activities took place from May 29 through June 7, 2019, and used a common earthquake scenario along the New Madrid Seismic Zone (NMSZ).

Shaken Fury included five linked exercises, as illustrated in Figure 2 below.

Figure 2. SF19 Linked Exercises
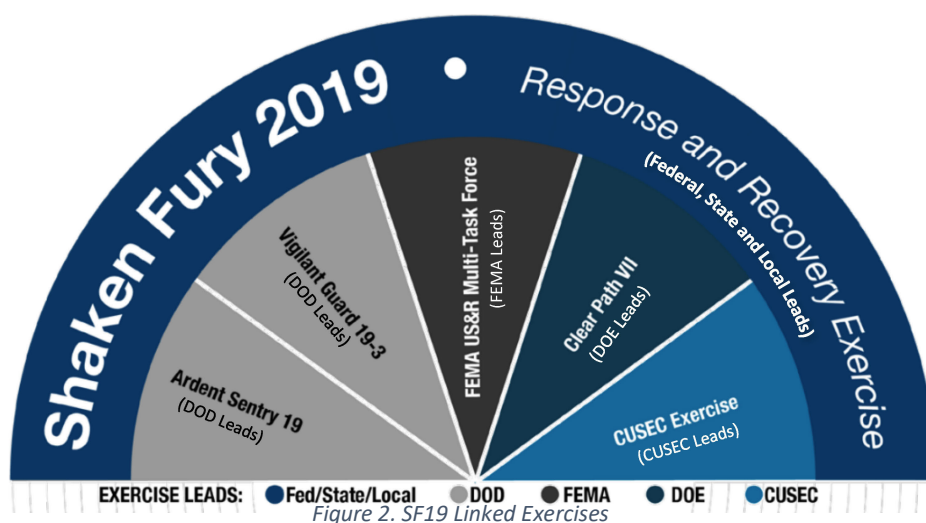
Ardent Sentry 19: The major annual DoD exercise focused on Defense Support of Civil Authorities.

Vigilant Guard 19-3: DoD and the NGB's annual exercise focused on improving emergency coordination, response and recovery management with federal, regional, state, local and military partners.

FEMA US&R Multi-Task Force Exercise: The FEMA Operational Readiness Exercise and Evaluation Program Deployment Exercise focused on preparing FEMA's US&R task forces to meet system operational requirements and proficiency standards.

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[2] Factsheet: Shaken Fury 2019 Federal Emergency Management Agency [Washington, DC]. Publication date 11 March 2019.

Clear Path VII: The DOE annual exercise focused on testing and evaluating energy sector response plans.

CUSEC: The CUSEC Exercise designed to discuss and assess plans, policies and procedures related to information sharing and Emergency Management Assistance Compact (EMAC) operations during an earthquake event.

Shaken Fury began on May 29 with the DoD StartEx (start of exercise) for Ardent Sentry 2019 and Vigilant Guard 2019. FEMA's National Urban Search and Rescue (US&R) Response System Multi-Task Force began on June 1 and the FEMA StartEx on June 3. Shaken Fury concluded with a FEMA National Level Recovery Workshop on June 6-7. Figure 3 below illustrates the Shaken Fury exercise schedule.
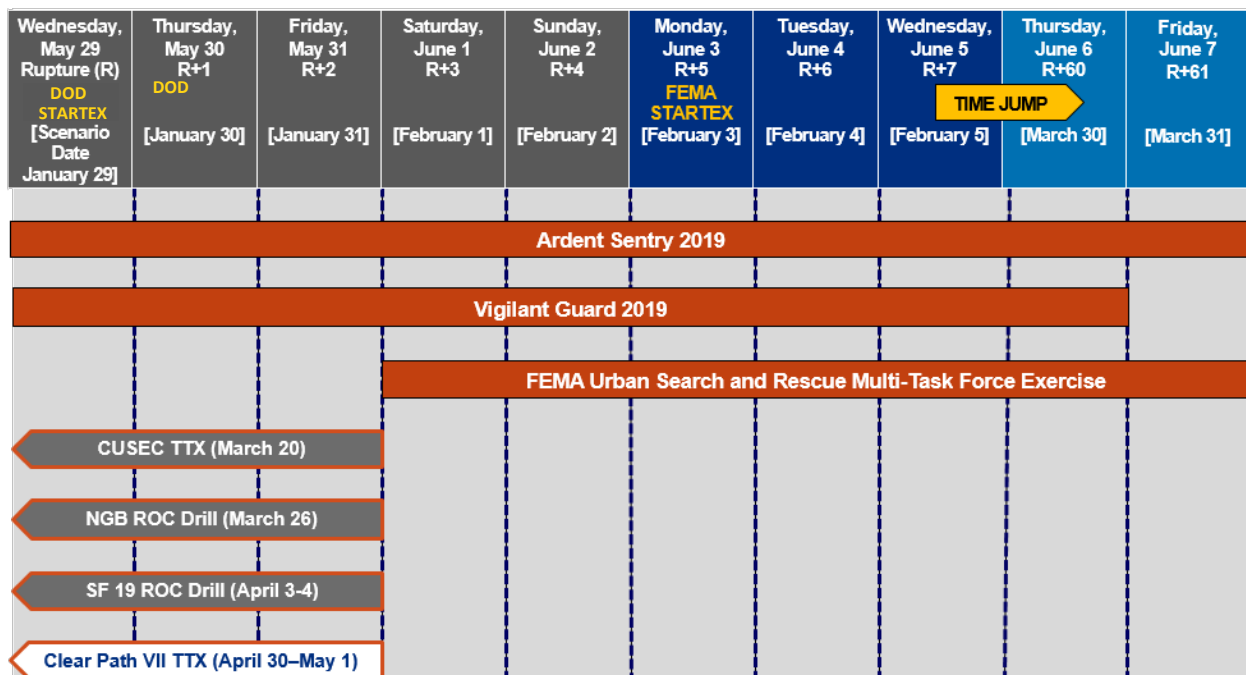
Wednesday, May 29 Rupture (R) DOD STARTEX [Scenario Date January 29]	Thursday, May 30 R+1 DOD [January 30]	Friday, May 31 R+2 [January 31]	Saturday, June 1 R+3 [February 1]	Sunday, June 2 R+4 [February 2]	Monday, June 3 R+5 FEMA STARTEX [February 3]	Tuesday, June 4 R+6 [February 4]	Wednesday, June 5 R+7 [February 5]	Thursday, June 6 R+60 TIME JUMP [March 30]	Friday, June 7 R+61 [March 31]
			Ardent Sentry 2019						
		Vigilant Guard 2019							
			FEMA Urban Search and Rescue Multi-Task Force Exercise						
CUSEC TTX (March 20)									
NGB ROC Drill (March 26)									
SF 19 ROC Drill (April 3-4)									
Clear Path VII TTX (April 30–May 1)									

Figure 3. SF19 Exercise Schedule

Objectives

A set of overarching objectives was identified to guide activities across the Shaken Fury exercises. Reviewed and validated by participating agencies, the objectives describe high-level goals for response and recovery operations. Focused on information sharing, collaboration and integration of effort, the objectives highlight the critical need for federal, state and local agencies, as well as non-governmental and private sector entities, to work together during disaster response. The Shaken Fury Interagency Overarching Objectives included the following:

Shaken Fury Interagency Overarching Objectives

1. Establish enhanced information sharing practices across the whole community to improve preparedness, response, recovery and mitigation in response to a catastrophic incident.

2. Demonstrate the ability of state and federal response and recovery efforts to collaborate with the whole community to adjudicate and allocate critical resources to affected communities.

3. Demonstrate integrated, real-time field reporting capabilities and incorporate field reports at appropriate scales in Emergency Operation Centers (EOCs).

4. Validate mutual aid resource planning and tracking capabilities to improve coordination among whole community partners.

5. Demonstrate federal capability to execute resource-phasing plans to meet state resource shortfalls.

6. Demonstrate the ability to integrate Emergency Support Functions (ESFs) and Recovery Support Functions to support whole community recovery.

7. Demonstrate the ability to organize, coordinate and deliver targeted public health and medical services including establishment of temporary medical facilities, medical surge operations and patient evacuation and transport to save lives and reduce suffering of disaster survivors.

8. Demonstrate the ability to coordinate and deliver mass care services to address the needs of disaster survivors.

9. Demonstrate the ability to expedite impact assessments and recovery prioritization of critical infrastructure assets to include development of courses of action for execution of temporary and/or permanent repairs and identification of cascading effects, in coordination with the whole community (to include private sector owners and operators).

Some organizations also developed their own supplemental exercise-specific or agency-specific objectives. Those objectives will be provided in later sections of this report as applicable.

Scenario

The multi-state exercise simulated regional response to a 7.7 magnitude earthquake along the Cottonwood Grove Fault, the southwest segment of the NMSZ, near Memphis, Tennessee. An earthquake of this magnitude is expected to cause considerable damage in buildings with partial collapse.

The geology of this area includes marine sedimentary rocks and river sediment. One potential result of this geologic situation is earthquake-induced liquefaction. As seismic waves pass

through the sediment, a slurry of materials moves toward the ground surface. Overlying soil begins to float on the liquefied sediment, causing landslides and lateral spreading that is commonly responsible for damage to infrastructure (e.g., bridges, roads, buildings) during major earthquakes.[3] It is anticipated that a 7.7 earthquake would cause a significant amount of damage throughout the region due to liquefaction.

The scenario affected the states of Alabama, Arkansas, Kentucky, Mississippi, Missouri and Tennessee. The scenario was designed to assess response and recovery planning and operations related to the following FEMA Core Capabilities: Planning; Public Information and Warning; Operational Coordination; Intelligence and Information Sharing; Risk and Disaster Resilience Assessment; Threats and Hazard Identification; Infrastructure Systems; Logistics and Supply Chain Management; Mass Care Services; Mass Search and Rescue Operations; On-Scene Security, Protection and Law Enforcement; Operational Communications; Public Health, Healthcare and Emergency Medical Services; Situational Assessment; Economic Recovery; Health and Social Services; Housing; and Natural and Cultural Resources.

The NMSZ is a series of active faults that extend 150 miles from Cairo, Illinois, to Marked Tree, Arkansas. It is one of the most active fault zones in the United States. Earthquakes in 1811 and 1812 caused 125 miles of river bluffs to collapse along the Mississippi and jets of sand to spout from the ground, along with damage across 232,000 square miles. There are, on average, more than 200 measured events per year with the potential to produce future large earthquakes in the NMSZ.
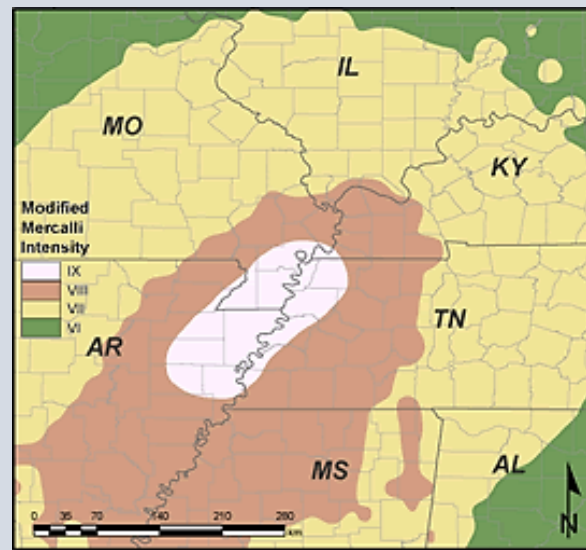

Figure 4. New Madrid Seismic Zone. Image courtesy of U.S. Geological Survey

Tools

Exercise planners and participants employed a set of resources throughout the planning and execution stages of Shaken Fury. These tools allowed participants to use a common framework and sources of information as they prepared for the exercise and conducted operations during the simulated response. These resources included:

FEMA Community Lifelines and Essential Elements of Information (EEIs): FEMA's 2017 Hurricane Season AAR identified the need to create a new operational prioritization and response tool that would:

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[3] "The Science of the New Madrid Seismic Zone," United States Geological Survey. Accessed 9 September 2019. https://earthquake.usgs.gov/learn/topics/nmsz/1811-1812.php.

- Characterize the incident and identify the root causes of priority issue areas to create effective solutions; and
- Distinguish the highest priorities and most complex issues from other incident information.

In response, FEMA developed the Community Lifelines construct. A Lifeline enables continuous operation of critical business and government functions and is essential to human health and safety or economic security. This construct helps decision-makers to rapidly determine the scope, complexity and interdependent impacts of a disaster. Figure 5 depicts the FEMA Community Lifelines:

Figure 5. FEMA Community Lifelines

Each Lifeline is composed of multiple components and EEIs needed to stabilize the incident. EEIs are pre-defined operational requirements that are used to inform decision-making for incident response. The status of area airports, for example, has been identified as an EEI within the Transportation Lifeline. The information and data associated with this EEI is intended to inform response personnel on the status and capabilities of airports and airspace that may be needed for incoming resources or to evacuate affected persons.[4] Figure 6 depicts the main components and associated EEIs of the Transportation Lifeline as an example.
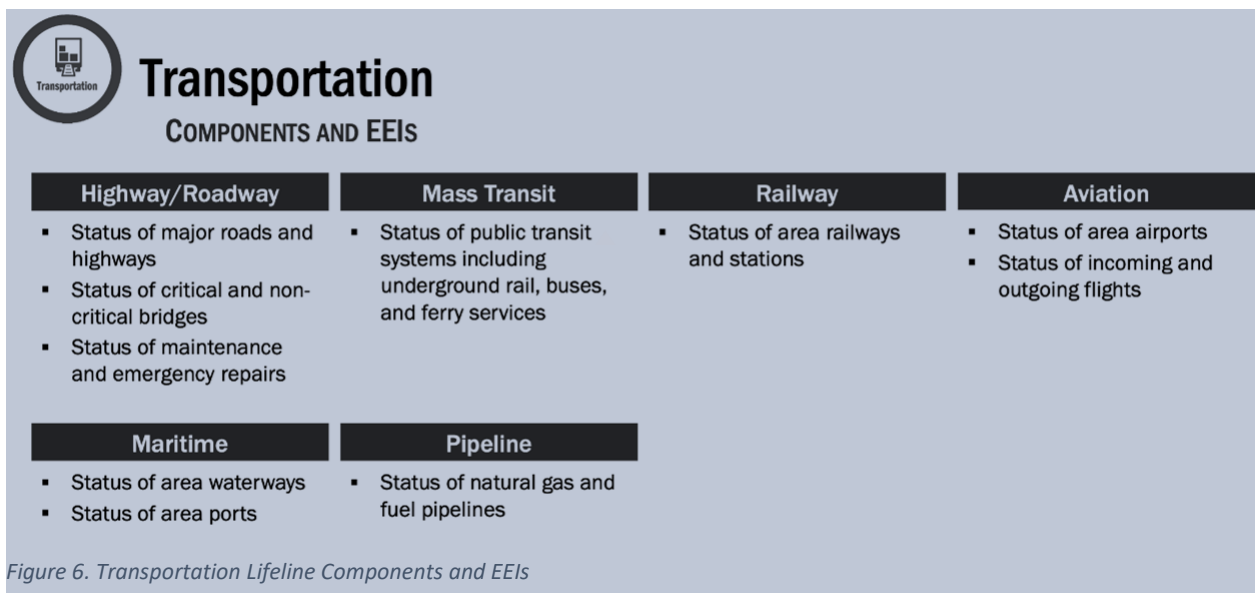

Transportation
COMPONENTS AND EEIs

Highway/Roadway	Mass Transit	Railway	Aviation
• Status of major roads and highways • Status of critical and non-critical bridges • Status of maintenance and emergency repairs	• Status of public transit systems including underground rail, buses, and ferry services	• Status of area railways and stations	• Status of area airports • Status of incoming and outgoing flights

Maritime	Pipeline
• Status of area waterways • Status of area ports	• Status of natural gas and fuel pipelines

Figure 6. Transportation Lifeline Components and EEIs

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[4] *Essential Elements of Information Publication Guidance,* (National Information Sharing Consortium), March 2015, p 21). https://www.nisconsortium.org/portal/resources/bin/NISC_EEI_Publication_1426695387.pdf

During an incident, response personnel assign a status to each Lifeline and component by integrating situational awareness reports and impact assessments from the appropriate partners. The relevant EEIs can change depending on incident circumstances.[5] Many of the Shaken Fury activities described below use Lifeline or EEI structures or data. Appendix A provides further detail about the Community Lifelines. CUSEC identified a set of EEIs most relevant to earthquake response for CUSEC states. The EEIs prioritized by CUSEC can be found in Appendix B.

FEMA Preparedness Toolkit: The FEMA Preparedness Toolkit (PrepToolkit) is a web-based application that allows stakeholders to access resources for scheduling, development, conduct and evaluation of exercise. The PrepToolkit was the primary resource used for the planning of Shaken Fury. Exercise planners and community partners were able to access a repository of all planning documents, message boards and calendars, as well as register for planning meetings via the PrepToolkit site.

WebEOC: Web Emergency Operations Center (WebEOC) is a crisis information management system used by state and local jurisdictions that provides real-time information sharing and situational awareness. It is the core application used by FEMA for incident-related information management.[6] It is used to collect situational awareness information in support of planning, mitigation, response and recovery phase activities for emergency situations.[7]

ArcGIS Online: ArcGIS is an information sharing platform that uses interactive maps and analytics to provide a real-time operational view of people, services, assets and events.[8] The ArcGIS Platform includes several components, including Survey 123, Operations Dashboard and ArcGIS Hub. Users can capture data in real time using Survey123, an ArcGIS information gathering capability. Data captured in Survey123 is immediately visible on the ArcGIS platform.

SimulationDeck: SimulationDeck is a web-based platform that allows participants to access information and data fabricated for exercise play. During Shaken Fury, simulated news stories (written and video), social media posts and weather forecasts were available to provide participants with additional information.
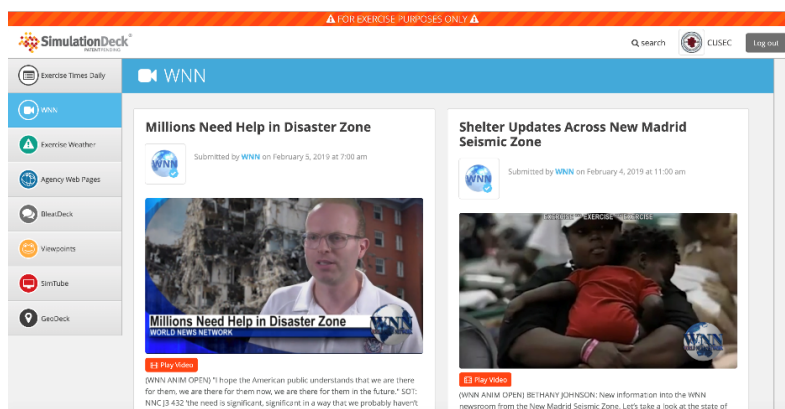

Figure 7. Shaken Fury 2019 SimulationDeck

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[5] *Community Lifelines Implementation Toolkit* (Washington: U.S. Department of Homeland Security; Federal Emergency Management Agency) February 2019. https://www.fema.gov/media-library-data/1550596598262-99b1671f270c18c934294a449bcca3ce/Tab1b.CommunityLifelinesResponseToolkit_508.pdf

[6] "Web Emergency Operations Center (WebEOC)," FEMA, viewed 1 July 2019, https://emilms.fema.gov/IS0293/groups/136.html

[7] ibid

[8] "Operations Dashboard for ArcGIS," Esri, viewed 15 July 2019, https://www.esri.com/en-us/arcgis/products/operations-dashboard/overview

PART 2: DHS S&T Shaken Fury Initiatives

DHS S&T Shaken Fury Initiatives

DHS S&T's role in Shaken Fury was to introduce innovative solutions, technologies and tools to improve information exchange, enhance situational awareness, enable the prioritization of resources and improve overall resilience. Through the Shaken Fury initiatives, DHS S&T collaborated with local, state and federal response agencies, as well as non-governmental organizations and the private sector to facilitate the transition and adoption of new technology solutions. Through these initiatives, DHS S&T participated in four of the five primary Shaken Fury exercises, including CUSEC, Ardent Sentry, Vigilant Guard and the FEMA National US&R Exercise.

Of the overarching Shaken Fury objectives listed above, DHS S&T chose to focus on the first four:

1. Establish enhanced information sharing practices across the whole community to improve preparedness, response, recovery and mitigation in response to a catastrophic incident.

2. Demonstrate the ability of state and federal response and recovery efforts to collaborate with the whole community to adjudicate and allocate critical resources to affected communities.

3. Demonstrate integrated, real-time field reporting capabilities and incorporate field reports at appropriate scales in Emergency Operation Centers (EOCs).

4. Validate mutual aid resource planning and tracking capabilities to improve coordination among whole community partners.

DHS S&T chose to focus on these objectives because they most closely align with its mission. Objectives 5-9 (see page 14) are more operational in nature and align with FEMA's operational responsibilities.

DHS S&T initiatives included three types of efforts: technology development, deployment and assessment.
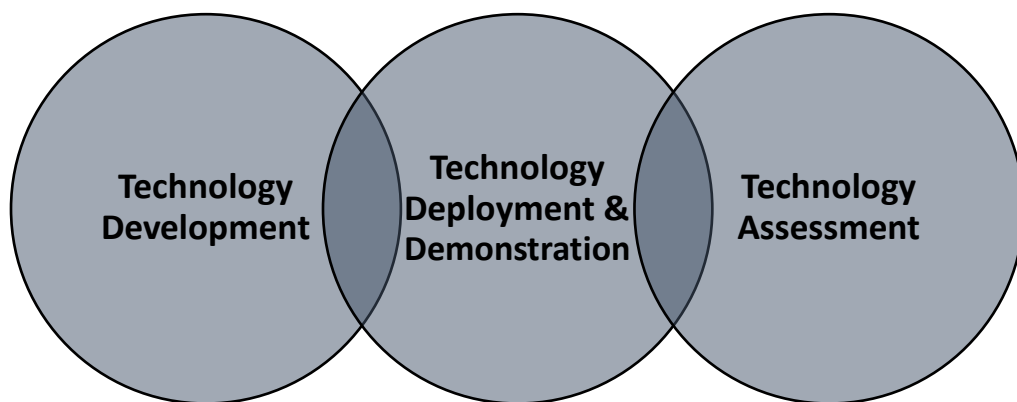

Figure 8. Types of DHS S&T Shaken Fury Initiatives

Technology development efforts are designed to create knowledge products and technology solutions that address existing public safety capability gaps and requirements. By working closely with state and local emergency managers and responders, DHS S&T identified specific areas where federal investment was needed to advance the state of technology and provide benefit for multiple stakeholders.

Technology deployment and demonstration efforts provide the opportunity for end users to see how new solutions work in an operational setting. During Shaken Fury, emergency managers, responders, search and rescue team members, military staff, and civilian agencies were able to visualize the products, ask questions of the vendors and provide feedback.

Technology assessment efforts are designed to evaluate the success of DHS S&T-developed solutions and identify pathways for transition and commercialization. These activities allow participants to use and test technologies during an operational scenario.

> "Being able to have end users test the technologies in a simulated disaster setting helps ensure the emergency management community is ready to use them when disaster strikes. Another great part is first responders, state and local governments and emergency managers all across the nation will hear about solutions that can work in their region, too. We hope to create a snowball effect where more and more people will want these technologies because they fit their unique needs and fill gaps to enhance safety for everyone."
>
> -Ron Langhelm, DHS S&T Program Manager

Initiative Overview

To support these technology development, deployment and assessment activities, DHS S&T engaged in multiple initiatives focused on the application of technology solutions to improve information sharing and collaboration:
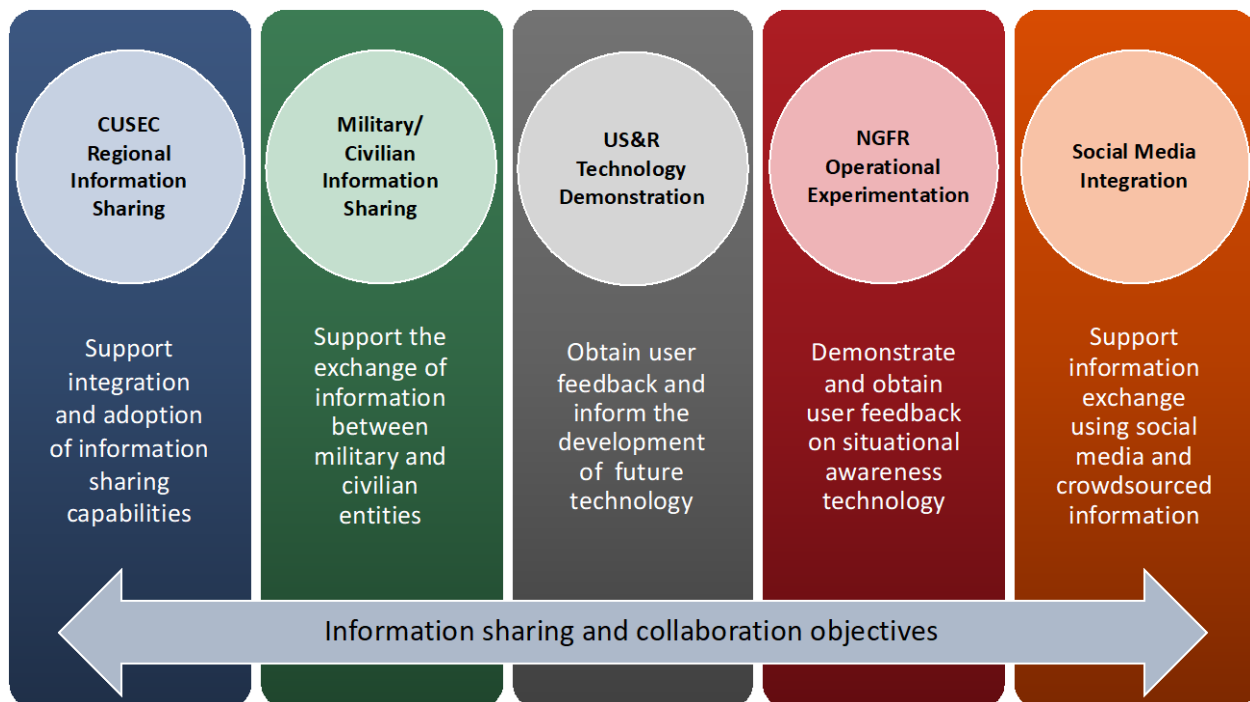
Figure 9. DHS S&T Shaken Fury Activities

DHS S&T Shaken Fury activities were held in four states and the District of Columbia.

- Tennessee and Kentucky hosted exercise play focused on response and recovery operations and featured extensive use of technologies developed by the DHS S&T project team. Tennessee also hosted the Master Control Cell (MCC), which was responsible for management and execution of exercise play.

  In the weeks preceding Shaken Fury, several real-life natural disasters hit the region, causing significant flooding in many areas. The Arkansas Department of Emergency Management (ADEM) and Missouri State Emergency Management Agency (SEMA) withdrew from participation because of ongoing flood and tornado response and recovery activities.

- Washington, DC hosted the Shaken Fury Recovery Tabletop and other exercise play at the National Response Coordination Center (NRCC).

- The Muscatatuk Urban Training Center (MUTC) in Indiana was the site of the FEMA US&R Multi-Task Force Exercise. New technologies developed by DHS S&T were demonstrated and employed during multiple exercise scenarios throughout the exercise.

- The City of Birmingham, Alabama, hosted the Next Generation First Responder (NGFR) Operational Experimentation (OpEx) to assess technology integration and mission impact at a stadium during an earthquake.[9] As part of the planning for the OpEx, the DHS S&T project team facilitated an Information Sharing Workshop to identify EEIs and information sharing requirements between the incident scene, local EOC and state and federal partners. It is

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[9] For more information on the NGFR Birmingham OpEx, see https://www.dhs.gov/publication/st-ngfr-birmingham-shaken-fury-operational-experimentation.

anticipated that the Shaken Fury activities will help prepare Birmingham and Jefferson County to support public safety activities during the 2021 World Games.

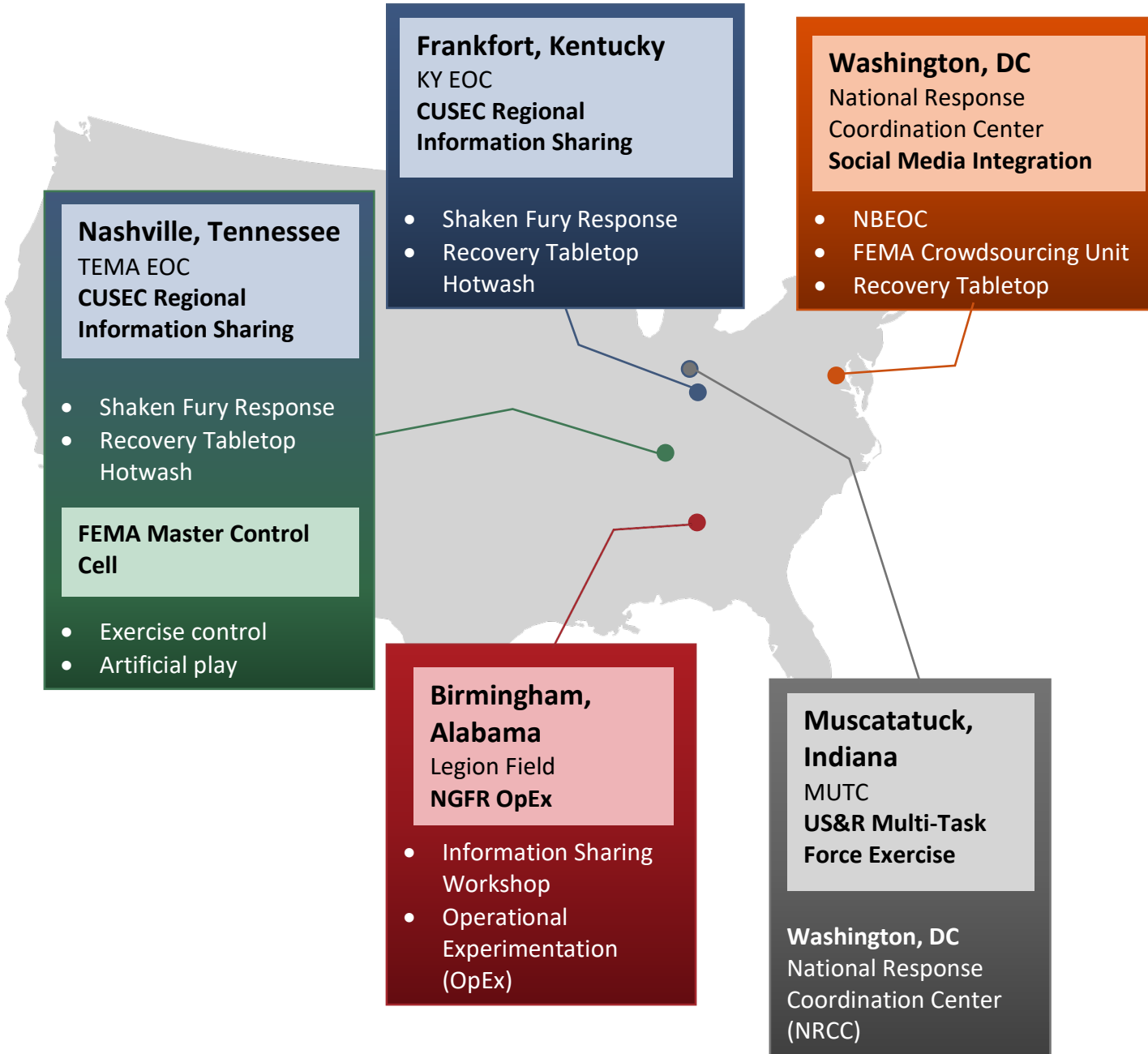The figure below illustrates the locations of DHS S&T initiatives during Shaken Fury.

Frankfort, Kentucky
KY EOC
CUSEC Regional Information Sharing

- Shaken Fury Response
- Recovery Tabletop Hotwash

Washington, DC
National Response Coordination Center
Social Media Integration

- NBEOC
- FEMA Crowdsourcing Unit
- Recovery Tabletop

Nashville, Tennessee
TEMA EOC
CUSEC Regional Information Sharing

- Shaken Fury Response
- Recovery Tabletop Hotwash

FEMA Master Control Cell

- Exercise control
- Artificial play

Birmingham, Alabama
Legion Field
NGFR OpEx

- Information Sharing Workshop
- Operational Experimentation (OpEx)

Muscatatuck, Indiana
MUTC
US&R Multi-Task Force Exercise

Washington, DC
National Response Coordination Center (NRCC)

Figure 10. Shaken Fury Exercise and Activity Locations

Central United States Earthquake Consortium: Regional Information Sharing

CUSEC is a partnership of eight member states and FEMA to reduce deaths, injuries, property damage and economic losses resulting from earthquakes in the Central United States.[10] DHS S&T and CUSEC partnered to develop nationally-deployable decision-support tools that enhance the data available to state and local emergency managers for managing operations, allocating resources and mitigating hazards.[11] In 2017, DHS S&T entered into a five-year Memorandum of Agreement (MOA) with CUSEC to develop, deploy and adopt technology and strategies to seamlessly share information necessary for preparedness, response and recovery.[12] As part of this MOA, DHS S&T funded the development and transition of several tools (Table 1) to enhance information sharing at the local and regional levels.

Timely and effective sharing of information across jurisdictions, disciplines and organizations is essential for successful disaster response. This section describes the DHS S&T activities in support of CUSEC and observations and outcomes from exercise play.

Shaken Fury Activities

As described above, DHS S&T efforts focused on three types of activities. Each type of activity was carried out in conjunction with the CUSEC exercise.

Technology Development → Technology Deployment → Technology Assessment

Figure 11. DHS S&T Regional Information Sharing Activities

Technology Development: One of the key goals of the DHS S&T and CUSEC partnership was to develop and refine technologies and solutions that enhance existing information sharing capabilities: regionally among states; between states and FEMA regional offices/headquarters; and between states and the private sector. Table 1 highlights four technology solutions that DHS S&T developed.

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[10] "Our Mission," CUSEC. Viewed on 8 April 2019. https://cusec.org/our-mission/

[11] Factsheet: DHS S&T and Central United States Earthquake Consortium Partnership Promotes Community Resilience [Washington, DC]. Publication date: May 10, 2017.
https://www.dhs.gov/sites/default/files/publications/cusec_factsheet_190524-508.pdf

[12] ibid

Table 1. DHS S&T-Funded Technology Solutions

Solution	Objective(s)	Description
CUSEC Regional Information Sharing Platform (RISP)	• Provide access to data and web applications related to specific EEIs to enhance situational awareness for decision support	• Cloud-based, information sharing solution based on Esri's ArcGIS Online and Amazon Web Services (AWS) capabilities • Includes the Regional Common Operating Picture (RCOP) viewer and dashboards
Essential Elements of Information and FEMA Community Lifelines	• Organize actionable information to provide decision makers with situational awareness during emergencies • Align operational information processes	• Built on existing state processes involving their WebEOC and ArcGIS Online platforms • Provides local and regional summary reports
FEMA WebEOC Integration	• Integrate Lifelines among states, FEMA Region and FEMA Headquarters (HQ) • Further standardize the Community Lifeline reporting process	• WebEOC Boards to support Community Lifeline reporting processes
Building Safety Assessment Application	• Develop a standard field reporting capability to help streamline information collection • Provide a near real-time situational awareness of building safety reports	• Mobile application for real-time data collection • Common summary dashboard • Standardized deployment tools and training materials • Based on ArcGIS platform

Technology Deployment: Prior to Shaken Fury, the DHS S&T project team provided CUSEC member states and other partners with access to the technology solutions, trained participants on how to use the systems and assisted participants in validating whether the systems addressed operational requirements.

Technology Assessment: During Shaken Fury activities, other members of the DHS S&T project team observed how the technology solutions were used during exercise play. The team used observation, data capture, direct conversations and interviews to gather assessment data. This

data will be used to provide feedback intended to improve technology solutions and identify deployment lessons learned, implementation requirements and barriers to adoption.

Each of these activities is discussed in further detail in the sections below.

Technology Development

The DHS partnership with CUSEC and its member states led to the development and transition of the tools listed in Table 1 above to enhance information sharing at the local and regional levels. Lessons learned from previous exercises prompted development of the RISP, which enables information sharing across CUSEC member states and their partners using ArcGIS Online. The RISP was the primary information sharing tool used during the CUSEC exercise play.

One of the goals for Shaken Fury was to expand usage of the CUSEC RISP. This was accomplished through engagements leading up to and during Shaken Fury with local, state, regional, federal, non-profit, private sector and DoD stakeholders.

The DHS S&T-funded technology solutions are designed to maximize existing investments within the emergency management community. For that reason, Esri's ArcGIS Online platform and Juvare's WebEOC system are referenced throughout this document because they represent the primary Geographic Information System (GIS) and Incident Management System (IMS) in use by both state and federal government.[13]

> "This exercise involves eight states that are joining together to share data, to share situational awareness. In this construct, it is called the Regional Information Sharing Portal."
>
> -Michael Dossett, Director, Kentucky Division of Emergency Management

CUSEC Regional Information Sharing Platform

The RISP is a cloud-based, information sharing solution based on Esri's ArcGIS Online. The RISP is designed to give CUSEC members and their partners access to data and web applications related to specific EEIs to enhance situational awareness for decision support. The RISP also makes use of automation scripts hosted on a CUSEC-managed Amazon cloud server (EC2) instance and serverless Amazon Web Services (AWS) Lambda functions. These scripts support data integration from external sources and translate the data into a standard map feature service output that can be shared with partners and/or integrated with CUSEC information products.

In preparation for the Shaken Fury Exercise, the project team developed four information products in CUSEC's RISP to support whole of community information sharing. These information products support EEIs prioritized by CUSEC and are built using the configurable ArcGIS Operations Dashboard. The information products include:

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[13] Web Emergency Operations Center (WebEOC) is a crisis information management system used by state and local jurisdictions that provides real-time information sharing and situational awareness. It is the core application used by FEMA for incident-related information management.

- **Power Outage Dashboard:** Consolidates data from more than 100 different electric utilities across the region to provide a county level summary of customers affected;

- **Communications Status Dashboard:** Uses data provided by the Federal Communications Commission (FCC) Disaster Information Reporting System (DIRS) to provide information on communications infrastructure;

- **Fuel Status Dashboard:** Documents fuel status in the CUSEC region and provides summary reports using data from GasBuddy; and

- **Private Sector Status Dashboard:** Identifies business disruption data from the Single Automated Business Exchange for Reporting (SABER) in the CUSEC region, while also aggregating data at the county level for a regional picture of business disruption.

With the opportunity to create more awareness of the RISP and their efforts to coordinate information sharing, CUSEC and DHS S&T identified the following goals for Shaken Fury:

- Coordinate access and usage of the RISP for Shaken Fury with the Shaken Fury Information Sharing Task Force (ISTF) and CUSEC working groups; and

- Develop new standard RISP products and documentation demonstrating the value of CUSEC coordination for external data sharing.

In advance of Shaken Fury, the project team completed enhancements to improve coordinated information sharing, information products, automation scripts and a historical data archive. The *Shaken Fury Support Project: CUSEC Technology and Solution Enhancement Report* provides a detailed description of these technical enhancements.[14]

The RISP dashboards were made available to participants and shared through a CUSEC RISP Shaken Fury Group.[15] The CUSEC RISP Shaken Fury Group allowed participants to share information across organizations. Prior to the exercise, the Esri Disaster Response Program (DRP) provided 250 temporary accounts for CUSEC's ArcGIS Online Organization for use during the exercise. These accounts were used to provide access to participants that did not have an account through their own organization.

To facilitate access to the CUSEC RISP Shaken Fury dashboards and group, the project team developed the CUSEC RISP Shaken Fury Hub Site, built using ArcGIS Hub, that provided a 'front end' to content shared with the Shaken Fury Group (see Figure 12 below).[16] The Shaken Fury Hub provided similar content as the main CUSEC RISP Hub site, but was geared to providing simulated data for the exercise. The intent of the site was to provide a nearly identical version of the CUSEC RISP site,[17] but include exercise content (both simulated and live-play) rather than actual data.

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[14] G&H International Services, Inc. "Shaken Fury Support Project: CUSEC Technology and Solution Enhancement Report," for Department of Homeland Security, Science and Technology Directorate. 3 September 2019.
[15] "CUSEC Shaken Fury Sharing Group," ArcGIS URL: http://bit.ly/SF-Group
[16] URL: http://shakenfury.cusec.org
[17] URL: http://risp.cusec.org

The Shaken Fury Hub provided easy access to the key information products shared by CUSEC and its partners. Highlights of this site include:

Figure 12. CUSEC RISP Shaken Fury Hub Site

- Featured information products, enabling a quick jump-off place for most commonly accessed items (e.g., Power dashboard, SABER, GasBuddy, RCOP Dashboard series, etc.);
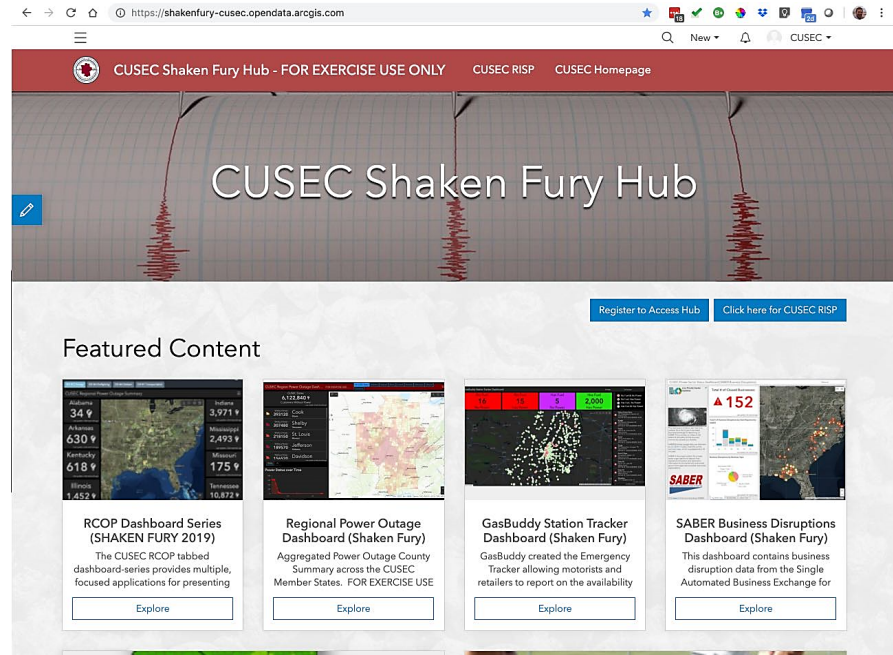- Information organized by Lifeline utilizing separate pages for each one;
- Group-level sharing (RISP and Shaken Fury Groups) and tagging structure (tag identifying data producer) to highlight shared partner content;
- Easy curation of the site for administrators (CUSEC staff and S&T project team staff) to allow for the addition of featured maps/apps and to highlight additional data contributors;
- Metrics captured via Google Analytics on important usage data (e.g., usage over time, what pages were most viewed, types of devices accessing site, where users were located); and
- The CUSEC Power Outage Dashboard provided participants with simulated power outage data throughout the exercise, ranging from rupture to 90 days after the event.

Essential Elements of Information and Community Lifeline Implementation

With the introduction of the Community Lifeline concept, the CUSEC board decided the Shaken Fury exercise provided an opportunity to evaluate how their information processes supported or could be adapted to support the Lifeline reporting process.

The Tennessee Emergency Management Agency (TEMA) and Kentucky Emergency Management Division (KYEM) offered to lead the effort to demonstrate Lifeline reporting by mission/resource requests by sharing historical WebEOC content used for building prototype applications. With support from S&T project staff, they updated their WebEOC boards with a Lifeline field and trained staff on how to tag requests and missions by Lifeline. The DHS project team developed and customized dashboards to allow viewing and filtering of mission status content by Lifeline.

To support Lifeline reporting efforts, the DHS project team built automated summary reports (Figures 13 and 14) using a CUSEC RISP-based service. These reports include GasBuddy fuel status tracking and statewide power outage reports. In addition to providing information about each information product, the reports provided data to support the FEMA Community Lifeline reporting processes. These summary reports rely on CUSEC's automation scripts and were updated on a 30-minute continual basis. The reports were viewable through web-accessible URLs or shared in an email attachment as static PDF-type reports.

Figure 13. Kentucky Power Outage Report

Figure 14. GasBuddy Status Report

Critical Infrastructure and Key Resources (CIKR) status is an important EEI aligned to multiple Community Lifelines, and thus important information for emergency managers to be able to access. In the months leading up to the exercise, the DHS project team staff worked directly with KYEM and the Kentucky Division of Water Resources to model a process for reporting and visualizing infrastructure updates using existing tools, including Survey123 and the Operations Dashboard (see Figure 15). The intent was to provide a streamlined approach for agencies to report status of infrastructure in a way that could be tracked over time and align this process to the FEMA Community Lifelines.
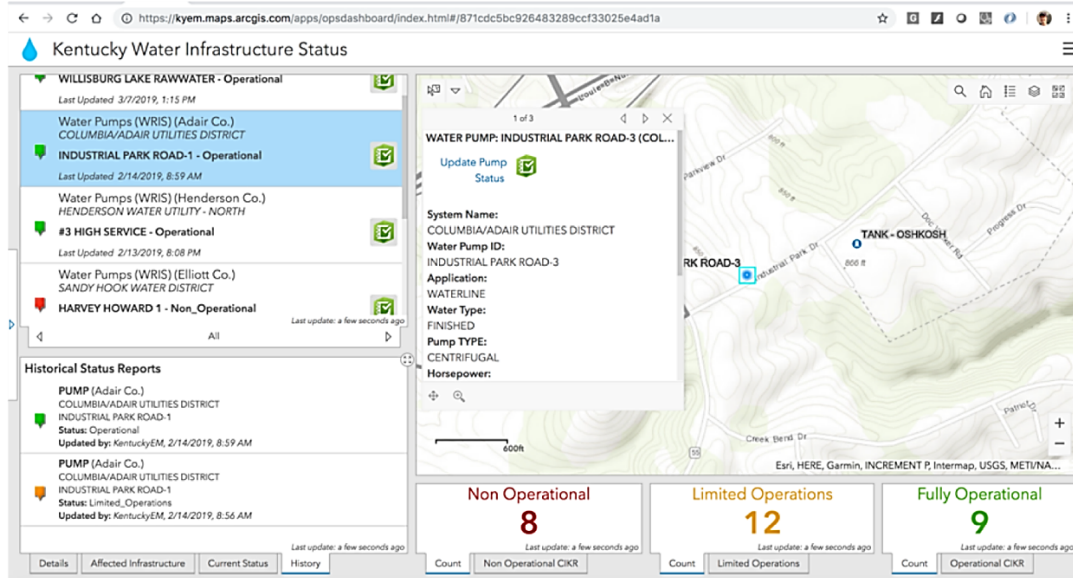
Figure 15. Water Resources Infrastructure Status Dashboard - created in partnership between DHS S&T, KYEM and KY Division of Water Resources

In addition to the work with KYEM, Missouri State Emergency Management Agency (SEMA) staff developed another approach for infrastructure status updates, leveraging the Maps for Office and Operations Dashboard. They trained their ESF leads to share details of this approach during a pre-Shaken Fury training webinar focused on infrastructure updates. Additionally, the Operations Dashboards that they created for the infrastructure updates were shared to the CUSEC RISP and RISP Shaken Fury Groups.

To assist ESF leads in reporting Lifeline status, DHS S&T project team staff created a Survey123 form that aligned with the FEMA Lifeline Implementation Toolkit and the FEMA WebEOC board. The form allowed ESF leads to report to ESF-5 (Information and Planning Support Function) in a structure that matched the WebEOC Lifeline board input form. The Situation Unit leads also helped establish a dashboard for the ESF Lifeline surveys that could sort and filter content by ESF and reporting day to aid in their reporting processes. Together, the Survey123 form and Operations Dashboard for Lifelines were intended to streamline the workflow for ESF-5 to review all inputs and translate them to the FEMA Lifeline board as well as contribute to the normal situation reports. Figure 16 shows the TEMA Lifeline ESF dashboard used to compile data for use in reporting and Figure 17 depicts the Survey123 forms used by ESFs to submit reports to ESF-5.

Figure 16. TEMA Lifeline ESF Report Dashboard used by ESF-5 to compile for use in reporting

Figure 17. Survey 123 Form

Local and State WebEOC Integration

To address the significant time requirements involved with the FEMA Community Lifeline reporting, FEMA sought to develop WebEOC Boards that would streamline Lifeline reporting processes. The end goal was to integrate Lifelines among and with states, FEMA Region and FEMA HQ. The Lifeline reporting process involves a four-tiered structure, with status updates coming from FEMA Regions (see Table 2).

Table 2. FEMA Lifeline Tiers and Associated Content

Lifeline Tier	Tier Content
Tier I: Disaster Summary	• Executive Summary • Significant FEMA and/or Interagency Actions ○ Lifelines prioritized by effect on overall stabilization, based on Tier II information
Tier II: Lifeline Overview	• Synopsis of Lifeline status ○ Prioritized Lifeline component information
Tier III: Lifeline Component Status	• Granular information regarding Lifeline components to include: status, actions, key messages, limiting factors ○ Charts, graphs, GIS products
Tier IV: Lifeline Essential Elements of Information (data collection)	• Board modernization enabling multiple data inputs and data connectivity for potential incident dashboards ○ Data collection from all incident levels to include: Field, regions, state and interagency

Prior to Shaken Fury, FEMA coordinated with CUSEC and the DHS project team to engage with CUSEC member states and collect requirements and feedback on their WebEOC board. Shaken Fury presented an opportunity for FEMA to test the WebEOC reporting process among states, FEMA Incident Management Assistance Teams (IMAT), FEMA Regions and HQ. FEMA informed states that they could report on their Lifeline status either by logging into FEMA's WebEOC or connecting to FEMA's Lifeline WebEOC boards from a state WebEOC instance using Juvare Exchange. However, because Juvare Exchange is not approved by the Federal Risk and Authorization Management Program (FedRAMP), FEMA halted the use of Exchange to connect FEMA's Lifeline WebEOC boards with a state WebEOC instance. Therefore, states had to resort to other means to relay information into FEMA's WebEOC boards. While Kentucky used an IMAT member to input information, Tennessee used state EOC staff who logged in directly to FEMA's WebEOC to input information. Lifeline status information added by states at the Tier IV level was rolled up by FEMA Regions into a FEMA WebEOC Tier II Lifeline board, as shown in Figure 18.
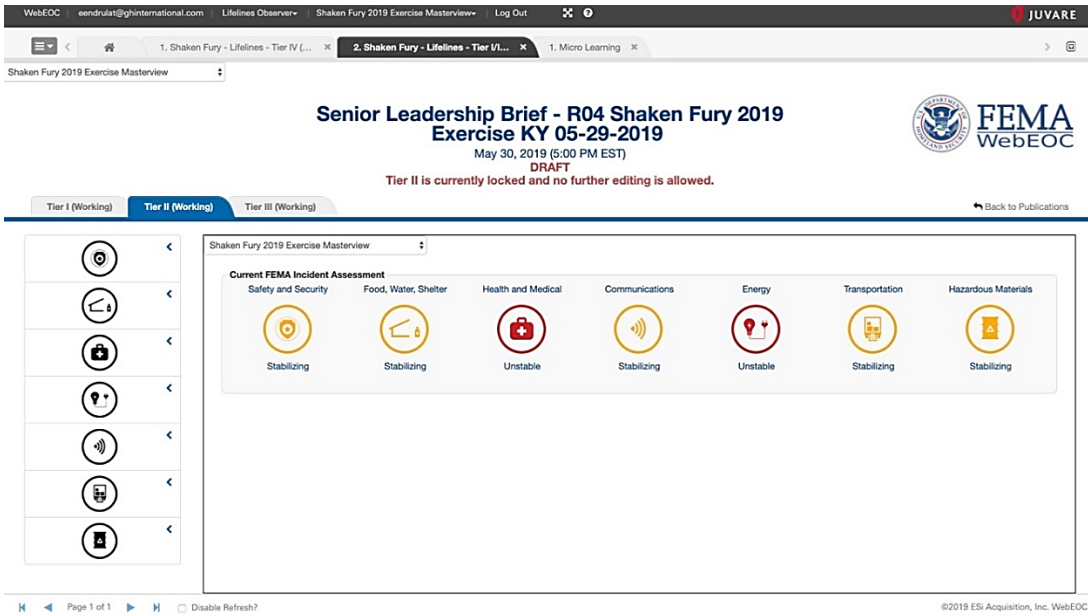
Figure 18. FEMA WebEOC Tier II Lifeline Board

The FEMA Geospatial Information Office (GIO) also used the exercise to build a series of Operations Dashboards for each of the seven Lifelines. These Lifeline dashboards presented data from the exercise ground truth, and together, these formed Tier III Lifeline content (see Figure 19).
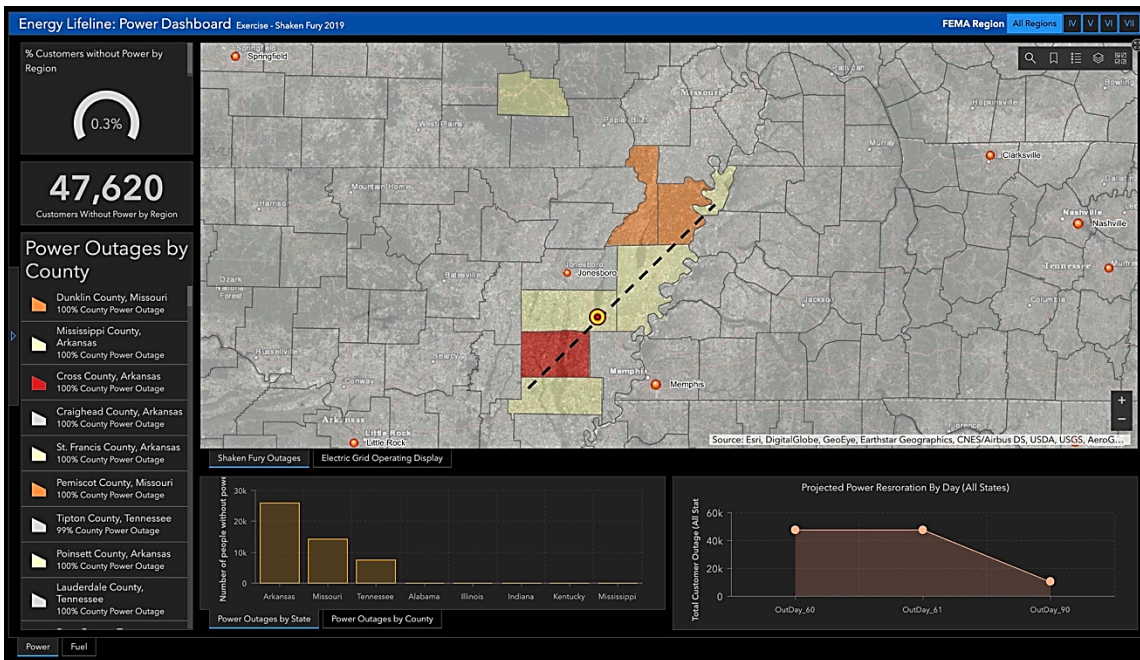
Figure 19. Example of a FEMA Tier III Lifeline Product

In the week before the Shaken Fury exercise, the TEMA planning branch manager requested help with the Lifeline reporting process. DHS S&T project team staff created a Survey123 form that aligned with the FEMA Lifeline Implementation Toolkit. This form allowed state ESF

partners to funnel reports to ESF-5 in a structure that matched the Tier IV WebEOC Lifeline Board input form. This ESF-based Lifeline reporting tool, in combination with the alignment of the MCC Board, aided TEMA's staff in providing reports to the Tier IV Lifeline Board.

CUSEC Building Safety Assessment Application

The DHS project team developed two types of field reporting technology solutions at the request of the CUSEC State Geologists working group, including the Building Safety Assessment Application and the State Geologist Report.

The Building Safety Assessment Application (app) is a solution developed by CUSEC in conjunction with DHS S&T and Delta Regional Authority to support the safety assessment programs in Missouri, Tennessee, Arkansas, Illinois and Indiana. These volunteer organizations of architects, engineers and other professionals were formed to address an identified gap in the number of trained building safety assessors that would be necessary to respond to a major disaster.

Prior to the exercise, CUSEC and S&T worked together to update the app, develop training materials and transition it to member states (including Missouri, Tennessee, Arkansas, Illinois and Indiana) for their local structural assessment and visual evaluation (SAVE) coalition teams to employ during exercise and for real-world use (see Table 3). During Shaken Fury, states coordinated with CUSEC to share data services for access in the RISP.
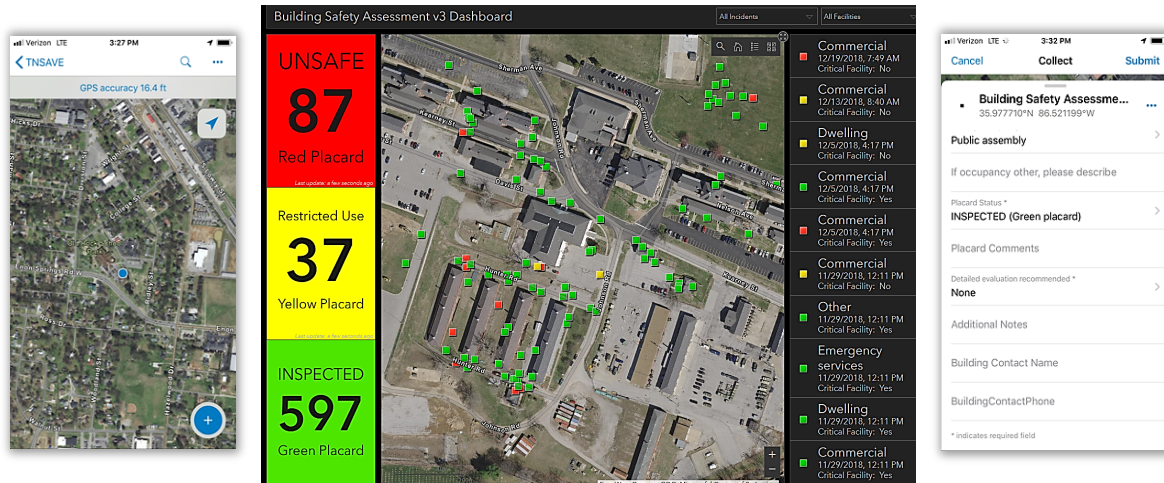
Figure 20. Building Safety Assessment Application

The CUSEC State Geologists (SG) working group requested support in developing a simple field reporting capability that would allow them to share updates directly with their state emergency management agency. During a large-scale New Madrid seismic event, state geologists typically collect information on the location, descriptions and photos of landslides, liquefaction, lateral spreading and other earthquake-related observations. This information is important for emergency managers as it can be used to identify roads and bridges that may be impassable or require inspection, areas underground that may contain failed pipes and storm water drains, and potential issues for groundwater supply amount and quality.

Based on a field report data model provided by the state geologist group, contract staff prototyped a reporting tool using the ArcGIS Survey123 tool, now hosted on the CUSEC RISP. The Survey123 survey provides a web/mobile-based form for field geologists to capture observations. Reports contain critical information such as the location of the observation and photo documentation. The Safety Assessment App allows assessment teams to reduce the time spent on documentation, standardize the collection process and improve situational awareness. The three components of the app include:

- o *Collector App:* allows data entry via phone or tablet;
- o *GeoForm:* allows data entry via browser; and
- o *Dashboard:* graphical user interface providing situational awareness.

Six agencies have already adopted the Building Safety Assessment Application. Table 3 lists the organizations that have deployed the application within their state emergency management agencies.

Table 3. States that have deployed the Building Safety Assessment Application

Deploying Entity	Effective date
TEMA	January 29, 2019
SEMA	January 31, 2019
Indiana Department of Homeland Security (IDHS)	January 30, 2019
ADEM	February 5, 2019
Illinois Emergency Management Agency (IEMA)	February 5, 2019
Mississippi Emergency Management Agency (MEMA)	March 14, 2019

Injects were added into the Master Scenario Events List (MSEL) to prompt states to provide data and review information summaries from these technology solutions. A list of MSEL injects related to this activity are included in Appendix C. S&T supplied injects were reviewed and vetted among the interagency exercise planning team during the MSEL Sync meeting (March 12-14, 2019).

In addition to inject development, the S&T project team also developed simulated data for several information products, including GasBuddy, SABER and Building Safety Assessments. These simulated datasets were developed by intersecting the exercise scenario impact model developed by the United States Geological Survey (USGS) with base data and projecting status changes over the course of the exercise using reference assumptions provided by the FEMA ground truth team. The resulting simulated datasets were provided to FEMA to be entered into the exercise Ground Truth, which provided exercise control staff with a common understanding of the status of damage at different time points following the earthquake.

SUCCESS STORY: The Missouri Structural Assessment and Visual Evaluation (MOSAVE) Coalition is a volunteer cadre of architects, engineers and building construction professionals who support SEMA in performing safety assessments of buildings following disasters. For the Shaken Fury exercise, MOSAVE was going to test field data collection procedures using the Building Safety Assessment App. On May 22, 2019, an EF-3 tornado struck Jefferson City, Missouri. In the days after the tornado, MOSAVE volunteers responded quickly to help local officials determine the condition of their buildings. Because of the advanced planning for Shaken Fury, MOSAVE successfully used the Building Safety Assessment App to assist in data collection, reporting and situational awareness. The Jefferson City response was the first time the app was used in a real-world deployment. Data collected by the assessment teams was able to be displayed in near real-time by the local jurisdiction and at the State Emergency Operations Center. As a result, officials had access to immediate information on assessment progress and detailed results for every building.

"After using the app in deployment, and seeing its ease of use and how quickly results are available to local officials, there's no doubt this will now be SAVE's primary assessment tool going forward." – Ben Ross, Chairman of the SAVE Coalition

While the tornado response prevented Missouri and MOSAVE from participating in Shaken Fury as originally planned, the Jefferson City deployment provided an invaluable opportunity to test their notification, deployment and data collection systems. MOSAVE and SEMA held a deployment after action review and noted that the Building Safety Assessment App met all expectations and would be used as the data collection tool of choice for future deployments.

Figure 21 depicts the MOSAVE Building Safety Assessment Dashboard from the Jefferson City tornado response.
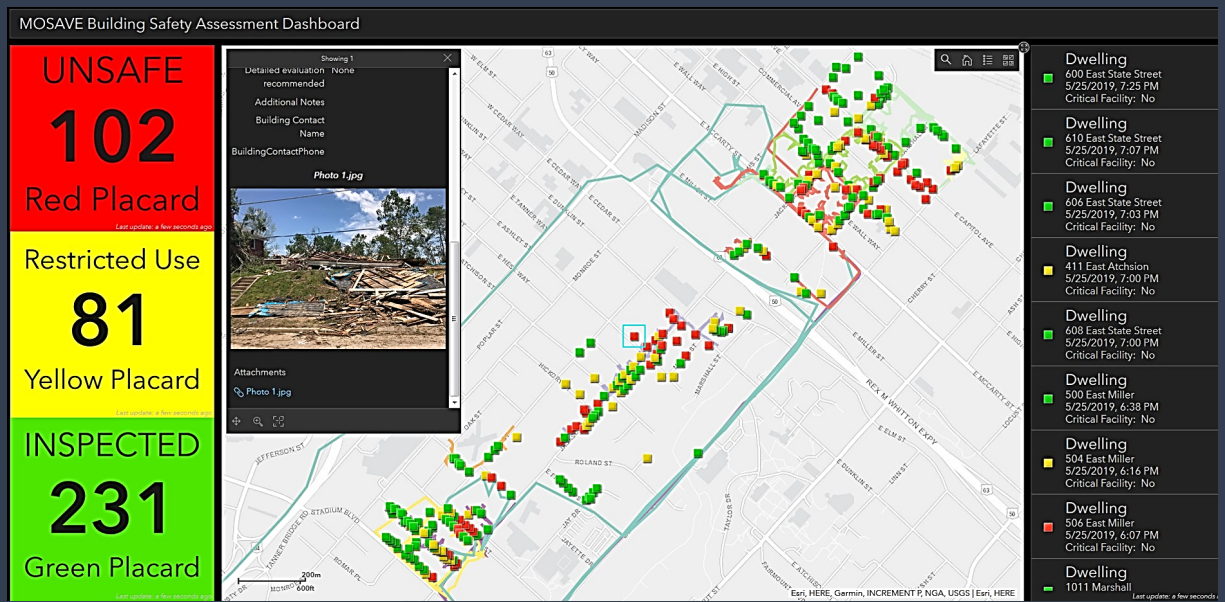
Figure 21. MOSAVE Building Safety Assessment Dashboard

Technology Deployment

After working closely with staff in CUSEC member states to develop and refine technology solutions that enhance information sharing during disaster response, the DHS S&T project team completed a series of activities to: introduce those technology solutions; train users on access, usage and sharing content; and brief stakeholders on exercise information.

Technology Solution Training

The DHS S&T project team held a series of events to provide training on access and usage of the CUSEC RISP, as well as instruction for a streamlined process for infrastructure status updates. The table below provides an overview of the training activities:

Table 4. Regional Information Sharing Training Activities

CUSEC Regional Information Sharing Training Activities	
Jan-Mar 2019	Safety Assessment Deployment Training
Feb 20, 2019	Resource Request Lifeline Alignment (KYEM)
Mar 15, 2019	Resource Request Lifeline Alignment (TEMA)
Apr 11, 2019	CUSEC RISP Overview for FEMA GIS
May 2, 2019	RISP Access and Usage I
May 16, 2019	Reporting Workflows for Infrastructure Updates
May 23, 2019	RISP Access and Usage II

A list of all Shaken Fury planning meetings and events, including the task force meetings, can be found in Appendix D.

Information Sharing Task Force

In preparation for the exercise, project team staff coordinated activities through a Shaken Fury Information Sharing Task Force, co-chaired by CUSEC and DHS S&T. The Task Force allowed participating agencies to provide input to Shaken Fury activities and the development of technology solutions. The goals of the task force were to:

1. Develop a coordinated approach to information sharing across the whole community around a NMSZ earthquake event;

2. Enhance decision-making capabilities by providing actionable information;

3. Collaboratively identify gaps in present day information sharing capabilities, identify existing solutions to address those gaps or develop new solutions as needed, and implement these solutions during Shaken Fury; and

4. Drive adoption of tools and solutions that show their value by increasing information sharing capabilities during Shaken Fury.
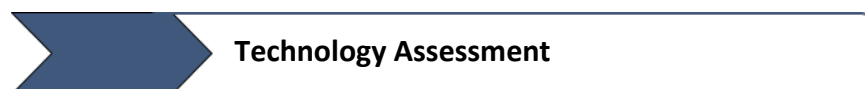
Task Force meetings were held in the months leading up to Shaken Fury. Participants received briefings on technology solutions and exercise information. The table below summarizes the discussions during each meeting.

Table 5. Regional Information Sharing Task Force Meetings

CUSEC Regional Information Sharing Task Force Meetings	
Nov 1, 2018	• Task Force kickoff • Purpose, scope and desired outcomes • Approach and timeline • Structure and logistics
Nov 15, 2018	• EEI/Lifeline alignment and reporting processes • Information Sharing Overview – ArcGIS Online
Dec 13, 2018	• Recap of Shaken Fury Planning Meeting • Private Sector Information Sharing and Privacy considerations
Feb 14, 2019	• FEMA Lifeline WebEOC Board • State EEI reporting tools
Mar 28, 2019	• Update on FEMA geospatial information products • Update on CUSEC geospatial information products
July 9, 2019	• Post-exercise review

Task Force members include federal, state and local response agencies, as well as the private sector. Representatives from the following organizations participated in the task force meetings: CUSEC; DHS S&T; FEMA headquarters; FEMA Regions IV, V, VI and VII; USGS; Alabama Emergency Management (ALEMA); ADEM; Indiana Department of Homeland Security (IDHS); Illinois Emergency Management (IEMA); KYEM; Missouri Emergency Management (SEMA); Mississippi Emergency Management (MEMA); TEMA; DoD/J6; Shelby County EMA; NGB; the National Information Sharing Cooperative (NISC); the North Carolina Emergency Management Association (NCEMA); SABER; and the private sector.

Technology Assessment

As mentioned previously, Shaken Fury consisted of a series of tabletop, functional and full-scale exercises. During these events, end users were able to use and evaluate the technology solutions developed by the DHS S&T project team.

Shaken Fury Tabletop

In collaboration with FEMA's National Exercise Program, CUSEC participated in a tabletop exercise on March 20, 2019, in Springfield, Illinois. The exercise provided CUSEC states and other key stakeholders an opportunity to come together, in advance of the Shaken Fury Exercise, to discuss and assess plans, policies and procedures related to information sharing integration and Emergency Management Assistance Compact (EMAC) operations following a NMSZ earthquake.

The tabletop exercise had two primary objectives:

1. Test information sharing and information integration as well as agreements and relationships established to address energy/fuel prioritization, main supply route command and control, evacuation routes, and state geology resources; and
2. Discuss operational reporting, tracking and management of deployed EMAC resources.

During the first module of the tabletop exercise, participants reviewed existing platforms for information sharing and discussed how they may be used to share EEIs. Participants further discussed which partnerships were in place and which were needed for successful information sharing during disaster response. A follow-on discussion included consideration of what would need to be done to secure new partners. The module concluded with a review of the roles of the private sector. The second module of the tabletop exercise included training by the National EMAC Coordinator on how to develop pre-scripted mission plans and other tools.[18]

Shaken Fury Exercise

The functional exercise began on Wednesday, May 29, 2019, with the rupture of the Cottonwood Grove fault line. It is important to note that one of the artificialities of the activity was that exercise play did not occur in real time. For instance, Wednesday, May 29, 2019, is scenario date January 29, 2019. Other artificialities included scripted weather, "state-of-the-world" data and not experiencing aftershocks.[19]

The time period between May 29 – June 2, 2019, included DoD play only. DoD and FEMA play began on Monday, June 3, 2019, (i.e., February 3, 2019) and lasted through Wednesday, June 5. Figure 22 illustrates the exercise timeline. As planning for the Shaken Fury exercise progressed in fall 2018 and spring 2019, several CUSEC member states were impacted by real-world events that limited their participation in the exercise. As a result, only two states—Kentucky and Tennessee—fully participated in Shaken Fury and efforts to demonstrate CUSEC regional information sharing capabilities was limited to those states.

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[18] The National EMAC Director noted that further guidance and resources are available at
https://www.emacweb.org
[19] Note: Simulated weather and "State-of-the-World" information used for June 4-6 in included in Appendix F. The "State-of-the-World" data was categorized by the seven FEMA Lifelines.

To capture feedback on the information sharing capabilities listed above, project team staff were stationed in various locations during the week of Shaken Fury to gather information. Detailed interview questions that DHS S&T project team staff used to gather information can be found in Appendix G.

Each day began with a welcome, introduction and broadcast of a simulated newscast video updating the nation on the effects of the earthquake and the status of response and recovery efforts. During the ensuing exercise play, state EOC staff used the RISP to perform their normal duties. Groups were organized by ESF and generally worked independently throughout the day; though at times, multiple ESFs worked in collaboration. Periodically, the ESFs regrouped to brief out their progress and provide updates. The ESFs were also required to submit this information by 12:00 p.m. each day to contribute to the Situational Report (SitRep), which offered a more formal update.
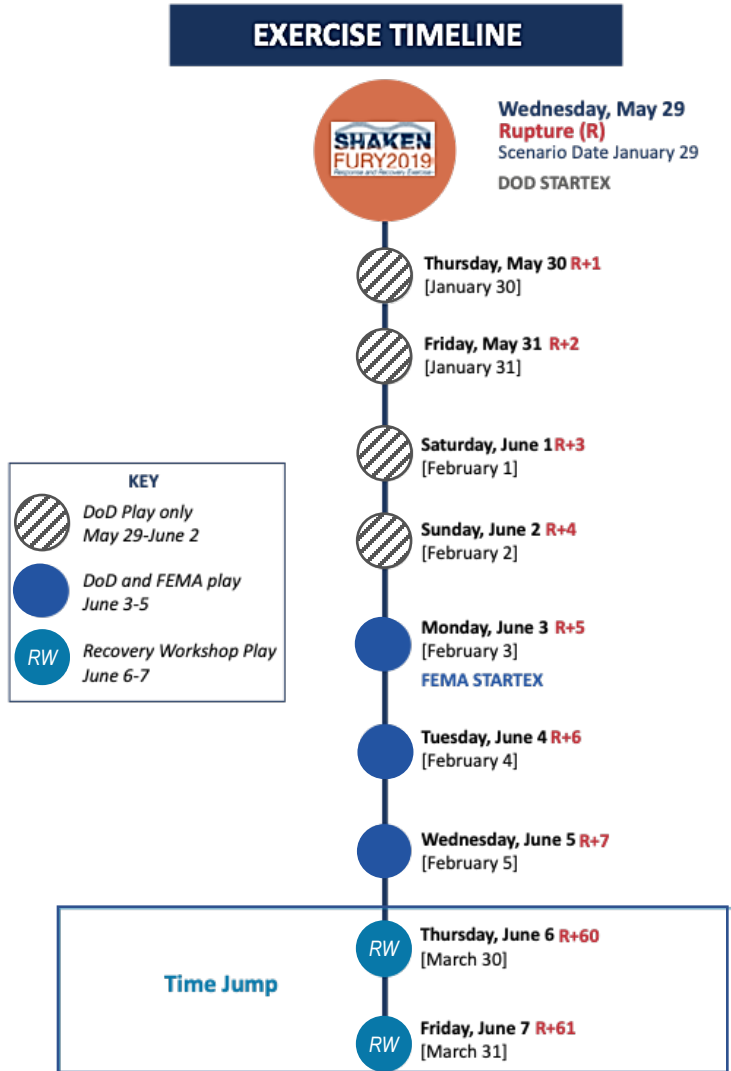
Figure 22. Shaken Fury 2019 Exercise Timeline

The last exercise day focused on recovery activities. After working on each inject for several hours, the groups briefed out to the larger audience. Notably, there was a significant 60-day time jump from response to recovery for this exercise. A hotwash was held in both Tennessee and Kentucky on Friday, June 7, 2019, to capture the lessons learned from successes and failures of the exercise, with the goal of

improving future performance of response and recovery efforts. Most of the discussion centered around successes and failures of the exercise itself, rather than the technologies used. See the *Observations & Outcomes* section below for more information on the key findings from the exercise.

National Level Recovery Workshop: The Shaken Fury 2019 National Level Recovery Workshop was held on June 6-7, 2019, in Washington, DC. It focused on the integration and support of state and local recovery operations at the national level. Participants divided into three breakout groups that examined Housing, Infrastructure Systems and Economic Recovery Core Capabilities.

SUCCESS STORY: KYEM staff created a Large Animal Shelter Dashboard during the response phase of the Shaken Fury 2019 Exercise. Using Survey123 for ArcGIS, KYEM staff were able to create this new dashboard, as part of the KYEM RISP Dashboard, at the request of one of the Emergency Support Function (ESF) representatives. The Large Animal Shelter board provides a GIS-enabled map of the locations of all large animal shelters in the state, along with point of contact information. Including only Kentucky shelters at development, regional expansion of this board would provide decision-makers with information necessary for large animal evacuations. This success story demonstrates that the RISP platform concept was used as needed during SF19 response operations to create a new product for sharing information. Further, as part of the hotwash in Kentucky at the conclusion of Shaken Fury, ESF participants identified additional dashboards that could support future response operations.

Observations & Outcomes

During the exercise, the use of information sharing and collaboration capabilities, including those technologies that DHS S&T developed, were observed and evaluated. Observations were gathered through direct surveillance of exercise play and outcomes and through formal and informal interviews with stakeholders and participants. The following section includes observation findings focused on the types of information shared during the exercise, how well that information was exchanged with the new technologies, any barriers to the adoption of these tools, as well as exercise achievements.

As mentioned above in the discussion of Technology Development activities, the CUSEC RISP Shaken Fury Group was created to share information across organizations during the exercise. At the time of the exercise, there were a total of 297 members in the group who collectively shared 246 items.[20] Members of the group included representatives from CUSEC, CUSEC member states, FEMA, NGOs, private sector and the military.

The CUSEC RISP Shaken Fury Site was widely used by exercise participants across all of the venues participating, with 282 individual users accessing the site. Users were located across three countries (278 in the U.S., two in South Korea, and one each in the UK and India).[21] In the U.S.,

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[20] Items include apps, web maps, map services and other documents.

[21] It is important to note what these statistics can and cannot show. They can provide a way to compare how much the information products were used relative to each other as well as general patterns in usage over time. The statistics do not provide an accurate picture of how many individuals actually viewed the operations dashboard. For example, information products from the CUSEC RISP were prominently displayed on large screens at multiple

users accessed the site from 57 distinct metro areas, with the majority (56%) located within the eight CUSEC member states.

The power outage dashboard (Figure 23) was the most visited of the CUSEC information products, with 1,149 page views over the course of the exercise. Power outage data was updated daily by S&T project team staff based on DOE simulation data provided for the exercise ground truth. The intent of the dashboard was to mimic the 'real-time' power outage dashboard operated by CUSEC, which provides updates every 30 minutes from over 100 power providers across the CUSEC region.
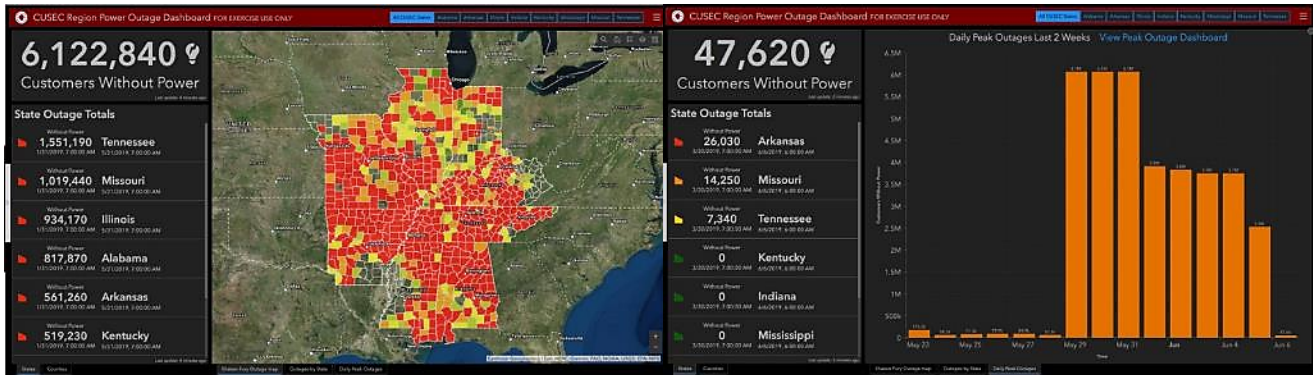
Figure 23. CUSEC Shaken Fury Power Outage Dashboard showing county level outages (left) and trend of outages by day (right).

The GasBuddy Dashboard displayed simulated gas station fuel and power status based on information entered into the exercise Ground Truth (Figure 24). The dashboard was viewed 782 times during the exercise. The GasBuddy Dashboard was used in the Recovery TTX kick off to provide a *State of the Region* situation report.

Figure 24. GasBuddy Dashboards, showing fuel and power status map (on left) and trends in restoration status (right).

The tables below contain the key findings related to Regional Information Sharing from Shaken Fury activities:

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locations (e.g., KYEM SEOC, TEMA SEOC, AL National Guard, NRCC) and the statistics cannot capture the hundreds of individuals located at the various EOCs that viewed the dashboards on the displays. Additionally, screenshots of various information products were included in daily Situation Reports prepared by states, as well as the bridging reports prepared in the MCC that were not captured in the Google Analytics or ArcGIS Online statistics.

Information Sharing
RISP
The CUSEC RISP Shaken Fury Hub Site was used during the exercise to provide a "front end" to content shared with the Shaken Fury Group. Participants used the site to access the key information products shared by CUSEC and CUSEC partners. Participants were able to feed information into the RISP and were able to get information from it.
In the lead up to the exercise, a total of 162 individuals requested access to the CUSEC RISP and RISP Shaken Fury sharing groups.
In Kentucky, RISP information products as well as KYEM Task Log, Resource Requests, County Mutual Aid, Water Status, Large Animal Shelters and the CUSEC Shaken Fury Hub site were prominently displayed in the State Emergency Operations Center (SEOC) during KYEM's exercise play. KYEM incorporated the dashboards from the CUSEC RISP directly into their own products to provide a state and regional view.
CUSEC RISP information products (Power, GasBuddy, Saber) as well as the TEMA ArcGIS MCC Dashboard, ESR & Shelter Map and TNSAVE Dashboard were prominently displayed in the SEOC during the entirety of the Exercise.
Partners that shared with the RISP during the exercise included CUSEC states, FEMA Regions and headquarters, state and federal ESF partners, private sector, non-profit organizations, and the DoD.
The CUSEC RISP Shaken Fury site was the most visited as this was the main landing page that participants were directed to, with nearly 1,500 page views during the exercise.
Usage of the RISP expanded significantly during Shaken Fury with over 290 total users either using or requesting access to the RISP.
The power outage dashboard was the most visited of the CUSEC information products during the exercise, with 1,149 page views over the course of the exercise.
Participants in the State EOCs used information from the power status dashboard to inform their daily SitReps.
Exercise participants stated that the graphical summaries of power outages over time provided a useful way to assess trends in power restoration by state or region.
PDF snapshot reports provided participants with a point-in-time summary of power outages by state.

Conversations with ESFs and participants from other state agencies supporting the exercises in Kentucky and Tennessee revealed they had not previously been aware of the RISP or the availability of Power Outage Status information until Shaken Fury. This is critical to DHS's objective for Shaken Fury to increase awareness and adoption of these systems.
The GasBuddy Dashboard informed emergency managers on regional and state gas station fuel and power status, and the trends in status over time. This information provided emergency managers with a solid evidence base to inform timely decisions regarding resource allocations, such as generator placement to restore power to a station with fuel but no power.
EEIs/FEMA Community Lifelines
The exercise provided all participants with a hands-on introduction to the Community Lifeline construct, and how this would be used to help standardize reporting efforts during the response phase of a disaster with the end goal of stabilizing Lifelines.
Seven Tier III FEMA Community Lifelines Dashboards were shared with the CUSEC Shaken Fury Group for all participants to access.
During Shaken Fury, FEMA exercised the use of their Lifeline WebEOC Boards (Tier I, II, IV) as well as the Lifeline-based information products (Tier III). The exercise demonstrated how the states, FEMA Regions and FEMA Incident Management Assistance Teams could report Lifeline status updates based on the Community Lifeline construct.
The Resource Request (KYEM) and MCC (TEMA) WebEOC Boards were adapted to provide mission status information for these states aligned with Lifelines shared in the RISP Hub.
The Lifeline reporting function was used to export content for Situation Reports.
The TEMA MCC Dashboard and MCC Lifeline report generation tool was used prior to Shaken Fury for a real-word event, during the exercise and then the week following Shaken Fury for a Department of Energy exercise. This demonstrates that the goal of providing a capability that could immediately be used following Shaken Fury was achieved.
KYEM and the Kentucky Division of Water were able to test the water infrastructure reporting capability, and this was used to demonstrate potential capabilities for other ESFs.
KYEM's approach to use Survey123 for coordinating inputs from their State Division of Water represents a repeatable approach that could be applied to other State ESFs.
SEMA developed workflows to report infrastructure status using Esri Maps for Office with Excel demonstrates an easily trainable workflow for users on the same network.

The State ESF Partners in Tennessee that provided inputs to the ESF Lifeline Survey were pleased with the simplicity of the reporting process.

The automated reporting (print to PDF) functionality demonstrated with the MCC Lifeline reporting tool was implemented on a TEMA server to support post-exercise data reporting.

FEMA will continue to drive the Lifeline reporting process forward and is committed to continued partnership with DHS S&T and CUSEC in order to help with coordination and engagement with States for training and roll out of the WebEOC Boards.

FEMA WebEOC Integration

The Shaken Fury exercise provided an opportunity for FEMA to validate new approaches to better automate the way gathering information from states and regions aligned with the Community Lifeline construct and facilitated turning this information into a standard Senior Leadership Brief (SLB) product.

Overall, participants stated that the FEMA WebEOC Integration worked well during the exercise.

Although states had prepared to use the Juvare Exchange solution to connect to FEMA's Lifeline Boards during the exercise, this was not used during the exercise due to a security concern raised prior to the exercise. The concern was related to using Juvare Exchange to connect the FEMA and state systems together without Juvare Exchange meeting FedRAMP requirements.

Building Safety Assessment Application

The CUSEC Building Safety Assessment program represents the most mature implementation of S&T-supported technology demonstrated during Shaken Fury.

During the exercise, the Tennessee Structural Assessment and Visual Evaluation (TNSAVE) coalition tested their activation and field collection processes. Fifteen TNSAVE volunteers across the state provided a total of 51 reports between May 28 - June 7 to test the Collector app and Dashboard.

The ISTF training, Shaken Fury Exercise and real-world deployments of Missouri Safety Assessment and Visual Evaluation (MOSAVE), provided a wide platform to demonstrate the capabilities and value of these Safety Assessment Programs.

Local SAVE coalition teams used the Building Safety Assessment Application to share information regarding critical infrastructure during the exercise. Specifically, it was used to report information such as number of unsafe, restricted use and inspected buildings.

The TEMA Situation Unit Leaders coordinated with FEMA IMAT staff to share content for reporting.

A frequently heard comment throughout the exercise was that the RISP and dashboards give TEMA access to Federal Communications Commission (FCC) data, SABER data (e.g., store statistics), fuel data (through GasBuddy) and power outage data all in one place and in real-time. This aspect appeared to be the most strongly favored by participants.

The TEMA Fixed Nuclear Facilities Specialist explained that dashboards are commonly used at TEMA; however, current dashboards are not equipped for such a large-scale incident, like the new dashboards are. It was also stated that being able to see the status of all of the other states is key in successful response and recovery.

Relationship Building

The TEMA GIS Specialists commented that they learned a lot through the FEMA IMAT teams and from meeting their FEMA counterparts, many of whom they had not met before.

Multiple participants stated that one of the biggest benefits of the exercise was building a relationship with CUSEC, other states and TNSAVE.

Stronger connections were made during the exercise because of the RISP dashboards. Participants noted that the large display of the RISP highlighted that only some EEIs were included in the existing dashboards. This prompted conversations between KYEM and the ESF leads and the development of new dashboards.

Multi-Level Coordination

Shaken Fury provided an opportunity to highlight the need for standardization of regional or national level products to support consistent Lifeline reporting processes.

FEMA shared over 195 layers of information in the CUSEC group. Participants stated that being able to see the information that FEMA shared via the RISP was unique because information is usually provided to FEMA with less information flowing from the federal agency.

The emergency service routes shared by TEMA were used by FEMA Region IV for resource planning and allocation decisions.

The EEI and FEMA Community Lifelines Integration provided participants with local and regional summary reports. These automated reports included GasBuddy Fuel Status tracking and Statewide Power Outage Reports, both used during the exercise to share information regarding fuel and power outage status.

During the exercise, FEMA successfully incorporated information shared by states into their own Lifeline-based information products. Because the Lifeline reporting was a new process, the ability to ingest and use this information was an achievement.

The exercise allowed collaboration between the ESFs and Federal IMAT teams, which enabled better coordination within the EOC. As a result, ESFs were interested in exploring additional opportunities to share data to enhance state dashboards, develop new products to assist with Lifeline implementation and align EEIs to Lifelines to enhance reporting.

FEMA WebEOC boards were used by states, FEMA IMAT Teams, FEMA Regions and HQ to report information by FEMA Community Lifelines.

Operational Support

Tennessee adopted use of the CUSEC RISP dashboards by integrating them into their own state Operations Dashboards to provide information for key EEIs. Exercise participants noted the value of how the information was displayed in the RISP and, as a result, ESFs in both states explored ways to better integrate information from their specific agencies into the SEOC dashboards.

The trends of Power Outages and Fuel Status were determined to be essential components of the dashboards.

The TEMA GIS Specialist stated that the two most key decision points in which information was being shared during the exercise were Emergency Medical Services (EMS) routing and sheltering decisions.

A Survey123 form allowed ESFs to report to ESF-5 in a structure that matched the Tier IV WebEOC Lifeline board input form. In addition, alignment of the MCC Dashboard to Lifelines helped ESF-5 to summarize status in the Tier IV FEMA Community Lifeline Board.

The private sector and other partners used the National Business Emergency Operations Center's (NBEOC) situational awareness platform to ask questions and get answers during the exercise.

The TEMA Situation Unit Leaders worked together to collect and organize content from the ESFs, and input this into the FEMA Tier IV Lifeline Board while also developing the daily situation reports.

The TEMA Planning Branch Administrator stated that the RISP has a lot of capabilities that were previously unavailable to TEMA and thought that the RISP information products were useful.

The TEMA GIS Specialist was interested in the RISP functionality to automate the creation of summary PDF reports from GIS content and is interested in adapting some of the RISP scripts for other uses.

The TEMA Situation Unit lead provided a lot of positive feedback about how useful the RISP was to have organized information flows to feed the reporting process.

The GasBuddy Dashboard was seen as an important source of information by several ESFs, including ESF-3 and ESF-12. ESF-12 used the Power Outage and GasBuddy Dashboards during the exercise, giving a positive review about how well it summarized the information with totals and graphs.

The TEMA Mission Coordination Center (MCC) Board that was modified based on the FEMA Community Lifelines (with the Lifeline tag, ArcGIS Online Dashboard and reporting feature) seemed to be a popular feature among exercise participants, particularly in regard to the dropdown box that was used to select a Lifeline.

The TEMA Planning Branch Administrator stated that the MCC dashboard was one of his favorite things that came out of the exercise. He stated "the dropdown box for the FEMA Lifelines that connected to the dashboards was a really good addition to help with FEMA reporting as it allowed us to see statuses based on regions and counties, filter by Lifelines, see automated maps and what counties were activated for Lifelines, etc."

TEMA staff thought the MCC Dashboard and summary Lifeline reporting process worked extremely well. Several ESFs had complained that the MCC Board did not have the same ability to filter by Lifeline as the dashboard.

KYEM hotwash participants noted that the availability of the data enhanced their decision-making during the exercise.

Multiple ESF leads at the KY EOC asked about creating additional layers for their own data in the dashboard.

Technology Advancement and Adoption

The TEMA Planning Branch Administrator stated that because the RISP and dashboards were customized for TEMA processes through the CUSEC partnership and were already integrated, the technologies were considered already adopted by participants.

The most cited barrier was the staff support needed to sustain any dashboard, or any other types of changes. Particularly mentioned were the FEMA WebEOC Boards and the staff that would be required to enter the information into those.

Other barriers to adoption mentioned by participants included: resistance to new technology, resistance to change (e.g., adoption of FEMA Lifelines) and learning curves.

Several of the sites experienced bandwidth issues that impacted their ability to access data. This occurrence has implications for future technology development as potential solutions may need to optimize bandwidth usage.

Integration into Governance and Process

Screenshots and automated reports generated from the RCOP Dashboard series were used in reporting workflows by several different agencies as well as the state emergency management.

Multiple exercise participants agreed that the RISP and the dashboards provided good situational awareness, especially in areas in which they did not have situational awareness prior (e.g., one participant stated that TEMA usually has to create their own power outage data).

To support integration of Lifelines in state processes, KYEM aligned their ESFs to Lifeline components. KYEM prepared a Lifeline-based dashboard, incorporating a blend of information obtained from within Kentucky as well as regional/national information from the CUSEC RISP.

The TEMA ESF-5 Planning Branch worked with DHS S&T contract staff to modify the TEMA MCC Board to include a Lifeline tag allowing MCC content to be more easily sorted, filtered and reported by Lifeline, and guide the development of an Operation Dashboard for the MCC and PDF report.

The TEMA planning branch manager thought the RISP information products were useful and the "print to PDF" functionality supported the Situation Reporting process.

Many of the ESFs' existing workflows observed during the exercise leveraged spreadsheets or databases that could be integrated with ArcGIS Online in the future to allow easier updating and sharing of information.

CUSEC's Building Safety Assessment Application has been integrated into the operational processes of multiple CUSEC state SAVE coalitions and was demonstrated during Shaken Fury and in a real-world scenario.

Based on TNSAVE play during Shaken Fury, several gaps were identified that point to the need to review state plans concerning Safety Assessment capabilities, as well as to create additional opportunities to train on using these capabilities in exercises.

Based on feedback from TEMA, including the Planning Branch Administrator and other planning staff, the Survey123 ESF report workflow as part of the FEMA WebEOC Integration was an improvement on other reporting workflows tested thus far (WebEOC, email, etc.) and they plan to review the process with ESFs to see what can be improved upon.

> The Director of TNSAVE spoke highly of the Building Safety Assessment App, stating that it is the "first really good digital application that can assess infrastructure, provide images and related data, and put individual data points together into one view scaled for an incident this large…Prior to this tool, people had to write this information down on a clipboard on paper…this takes time and is less efficient. In addition, it was also stated that this application has the ability to assess large-scale incidents, unlike existing technology."

> Following the Jefferson City, Missouri, tornado that struck on May 22, 2019, Missouri's MOSAVE successfully used the Building Safety Assessment App to assess the condition of over 600 buildings in Jefferson City and Cole County. This allowed them to better direct emergency resources and save lives. This event served as a timely real-world validation of the capability.

Participants

Participants in CUSEC Regional Information activities for Shaken Fury are included in Table 6 below.

Table 6. CUSEC Regional Information Sharing Participants and Roles

Participants	
Central United States Earthquake Consortium (CUSEC)	
CUSEC Member States	
Arkansas	Kentucky
Mississippi	Missouri
Tennessee	
SAVE Coalitions	
Missouri SAVE	Arkansas SAVE
Tennessee SAVE	
Federal Agencies/Organizations	
DHS S&T	FEMA Operations Capabilities Office
FEMA Planning & Exercise Division, Response Geospatial Office (RGO)	FEMA Private Sector Planning Group
FEMA Region IV	FEMA Region V
FEMA Regions VI	FEMA Regions VII
Other Organizations and Associations	
Crowd Emergency Disaster Response Digital Corps (CEDR)	Florida SAR
Single Automated Business Exchange for Reporting (SABER)	

Military/Civilian Information Sharing

DoD's NORTHCOM is a primary agency for Emergency Support Function #9 (Search and Rescue). ESF-9 rapidly deploys Federal search and rescue resources when requested by state, tribal and local authorities.[22] If designated as the Overall Primary Agency during incident response, NORTHCOM would require coordination and situational awareness for Catastrophic Incident Search and Rescue (CISAR) as part of their support to Domestic Operations (DOM OPS). NORTHCOM is also the primary support for Defense Support of Civil Authorities (DSCA) to FEMA.

Both DoD and DHS have mission requirements to interoperate with other Departments, agencies and non-federal partners. With the belief that collaboration on interoperability may result in their ability to share information effectively, the DoD Joint Staff J6 and DHS Information Sharing and Service Office authored an MOU with the stated purpose:

> [To] explore and document the general understanding of the areas of cooperation that may be pursued to increase collaborative information interoperability between DHS and the DoD. The parties hoped to increase the effectiveness of information sharing across the Departments, while defining and creating integration and interoperability efficiencies among capabilities to enhance mission success.[23]

The committee implementing the MOU drafted a list of key topics and capabilities for future research, and the committee approached DHS S&T to help research and collect lessons learned from the preparation and execution of the Shaken Fury 19 exercise. The topics listed below were deemed most relevant to the exercise:

- Enhanced Common Operating Picture (ECOP) viewer/User Defined Operational Picture;
- National Level Exercise; and
- Geospatial Information and Services Integration.

Using the DoD/DHS MOU as the basis for collaboration, the DHS S&T project team staff developed a list of topics and objectives to pursue that would fulfill the directives of the document. To identify and build out capabilities to support the MOU topics, DHS S&T formed the DoD/NGB/DHS Chief Information Officer (CIO) Working Group, supported by project team staff. Participants in the Working Group included the DHS Chief Information Officer (CIO), DHS S&T, DoD Joint Staff J6, DoD US NORTHCOM and NGB. For the Shaken Fury 2019 exercise, the working group pursued the following activities:

1. Identifying Shaken Fury objectives that would provide ground truth for validating topics in the MOU.

2. Partnering with Shaken Fury Exercise leads to seek opportunities for modifying their MSEL to include activities that could support exploring MOU topics.

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[22] "Emergency Support Function #9 – Search and Rescue Annex," National Response Framework. [Washington: Department of Homeland Security]

[23] *Final Report: Memorandum of Understanding (MOU) Between the Department of Homeland Security (DHS) and the Joint Staff, Department of Defense (DOD) for Collaborative Information Interoperability Efforts*

3. Working with DoD and civilian agencies who are participating in Shaken Fury to build out use cases for testing bi-directional collaboration between mission-specific applications.

4. Observing and recording Shaken Fury 19 participants' activities related to the use cases.

5. Closing out the Shaken Fury activity by supporting development of the After Action Report.

The DoD/NGB/DHS CIO Working Group was focused on testing the sharing of content between players in Ardent Sentry 19, Vigilant Guard, Shaken Fury 19 and the US&R Joint Task Force. The data that this group identified as strategically important for planning and situational awareness included:

- Safety assessment of structures;
- Search and rescue (SAR) field reporting;
- Friendly force tracking; and
- Mission request tasking.

Activities

Military/civilian information sharing was demonstrated primarily at the Master Control Cell (MCC), operating in Nashville, Tennessee from May 29 through June 5, 2019. The MCC provided overall exercise control and coordination for the various Venue Control Cells (VCCs). The controllers, including those for the DoD linked exercise events, along with several simulators, were also located at the MCC.

In alignment with the MOU, DHS and DoD demonstrated information sharing capabilities at the regional level through sharing of information between the RISP platform and the NGB Joint Information Exchange Environment (JIEE) 2.0, which was based on ArcGIS Online. Although DHS S&T was not an active participant in Ardent Sentry, project team staff evaluated the extent and success of information sharing between NORTHCOM and civilian entities during the exercise.

SUCCESS STORY: Members of DoD staff requested information on the RISP dashboards at the State of Kentucky EOC during Shaken Fury. Representatives from the U.S. Navy and U.S. Air Force attended the exercise as DoD liaisons to the Kentucky Emergency Management Agency. Their purpose at the EOC was to obtain information on ongoing and potential needs that the state would not be able to meet. Given the 96-hour timeline for assignment of DoD resources, advanced knowledge of upcoming or anticipated shortages allows DoD to better plan for resource requests and allocations. One specific area of interest was the GasBuddy Station Tracking dashboard, which would allow DoD to identify where fuel is available along transport routes and where fuel point of distribution (POD) sites may be necessary. DoD staff requested further information on the RISP dashboards. This success story highlights the interest in a common operational picture to share data between federal, state and local partners.

The NGB achieved some level of success during the exercise regarding regional information sharing. DHS S&T contract staff were able to enroll over 100 NGB portal users into the CUSEC Shaken Fury Sharing Group, and the NGB users were successfully able to use content found in the group to support a situational awareness view of operations near Cape Girardeau, Missouri.

Figure 25 below shows the use of data from the Missouri Department of Transportation (MoDOT) and MoSEMA inside the NGB Situational Awareness Viewer. In addition, the NGB was able to input Events and Missions into their Guard ArcGIS environment, which is their access point for collaboration with CUSEC.
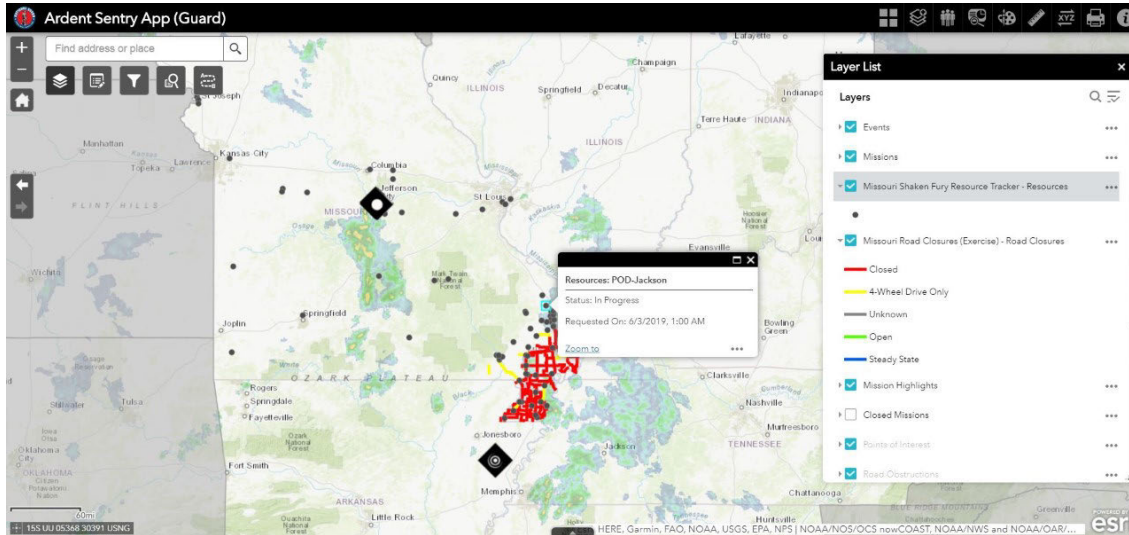
Figure 25. Ardent Sentry Situational Awareness Viewer Showing Integration of Missouri DOT data

Additionally, the NGB team shared a Mission View service, containing unit locations involved with active operations, with the CUSEC RISP Sharing Group (Figure 26). This bi-directional sharing demonstrated during Shaken Fury supports the goals of the MOU.
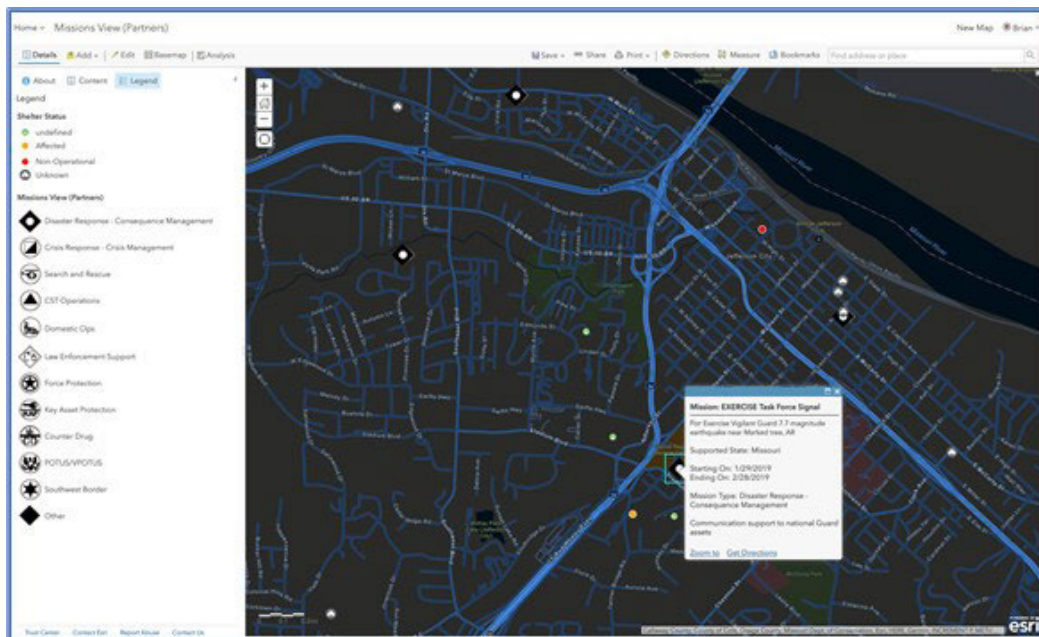
Figure 26. NGB Unit Locations Shared in CUSEC RISP Sharing Group

The NORTHCOM COP team based in Colorado Springs, Colorado, worked with project staff to leverage the EEI and general situational awareness content found in the CUSEC RISP Sharing

Group. The NORTHCOM team leveraged the following information from the CUSEC RISP Sharing group during the exercise: GasBuddy, National Guard Mission View, Missouri DOT road status, SABER business data and the Regional Power Status.

Despite multiple efforts to support the integration of the DoD "Guardian" SAR application with content from the RISP, the use case for collaborating between DoD and civilian agencies for SAR missions was not achieved during the exercise.

Observations & Outcomes

The tables below summarize the key findings related to military/civilian information sharing activities:

Information Sharing
Over 100 NGB portal users were enrolled into the CUSEC Shaken Fury Sharing Group and the NGB users were successfully able to use content via their JIEE 2.0 platform to support a situational awareness view of operations.
The NORTHCOM COP team based in Colorado Springs, Colorado, worked with project staff to leverage the EEI and general situational awareness content found in the CUSEC RISP Sharing Group.
The integration of the DoD SAR application called Guardian with content from the RISP was not achieved during the exercise.

Relationship Building
The DoD/NGB/DHS Working Group provided DHS S&T with the opportunity to work with stakeholders with whom they had not previously engaged.
Representatives from the U.S. Navy and U.S. Air Force attended the Shaken Fury Exercise as DoD liaisons to the Kentucky Emergency Management Agency, allowing for relationship building.
A planning and integration liaison between NORTHCOM and FEMA suggested that the RISP be utilized in the National Level Exercise that will take place in 2020.

Multi-Level Coordination
The NGB experienced issues with bandwidth throttling, which impacted their ability to collaborate during exercise play.
DoD included RISP dashboards in daily bridging reports.

Operational Support

The NGB team shared a Mission View service, containing locations of units involved in active operations, with the CUSEC RISP Sharing Group.

One specific area of interest was the GasBuddy Station Tracking dashboard, which would allow DoD to identify where fuel is available along transport routes and where fuel POD sites may be necessary. DoD staff requested further information on the RISP dashboards.

DHS and DoD demonstrated information sharing capabilities at the regional level through the CUSEC RISP platform.

Technology Advancement and Adoption

DoD awareness of the RISP dashboards increased during Shaken Fury exercise play, but the participants at the MCC were not necessarily the correct audience to use RISP data.

NGB use of ArcGIS Online for the JIEE 2.0 system improved and simplified interoperability with state agencies.

Integration into Governance and Process

No findings related to governance and process integration.

Participants

Each member of the DoD/NGB/DHS CIO Working Group contributed to working group meetings to help define and refine the activities in Shaken Fury 2019 that will support research into topics listed in the MOU. The specific participants and their roles are detailed in Table 7 below.

Table 7. DOD/NGB/DHS CIO Working Group Participants and Roles in Shaken Fury

Participants	
DoD (NORTHCOM)	NGB
DHS CIO	JS J6

FEMA Urban Search and Rescue Multi-Task Force Exercise

The 2019 Urban Search and Rescue Joint Task Force/Region 5 Full-Scale Exercise (FSE) was designed to test mobilization of the FEMA US&R system. The Muscatatuck Urban Training Center (MUTC) in Butlerville, Indiana, was the primary exercise venue for the Operational Readiness Exercise and Evaluation Program (OREEP) exercise. The activities in the exercise focused on preparing US&R teams to meet their exercise requirement for mobilization, ground movement, base of operations establishment, US&R operations and demobilization. Participating domestic and international search and rescue teams executed tactical operations as part of the Shaken Fury earthquake scenario.

DHS S&T facilitated the introduction of technologies that are relevant to the search and rescue mission. There are several cutting-edge technologies, especially in the areas of power generation and situational awareness that may be beneficial to search and rescue task forces.

Activities

Shaken Fury brought together multiple state and international participants, including 13 US&R teams from around the country as well as from Canada and Australia (see the Participant table at the end of this section), to perform field exercises both singularly and in groups. While the field exercises were ongoing, the US&R teams also had the opportunity to learn about technologies that are relevant to the search and rescue mission.

> "The collaboration with the Department of Homeland Security Science and Technology Directorate has been phenomenal for us. I've received tremendous feedback from the responders that are here."
>
> -Brian Smith, Program Specialist, US&R Branch, FEMA
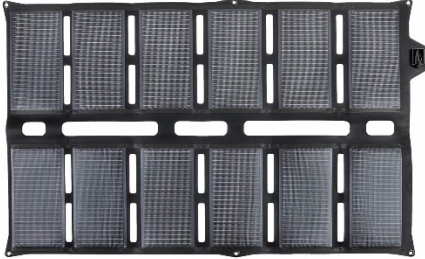
> "Our role within Shaken Fury is to bring in capabilities around science and technology to enhance not only the resilience, but to bring in a stronger culture of innovation within the responder space. We are offering the opportunity for the technology developer to meet with the responders and get the feedback to understand whether or not their technology has any hope of actually functioning within an operational world. That is very valuable."
>
> -Colin Murray, Exchange Officer to DHS S&T from Defence Research & Development Canada

DHS S&T hosted a showcase during the US&R exercise to demonstrate these technologies.

Ten technologies were displayed in the DHS S&T tent during Shaken Fury. The tent was open for visitation by the participating US&R team members from 9:00 a.m. – 4:30 p.m. on June 4-5, 2019. During this time, about 400 exercise participants were able to view the technologies and discuss requirements with the subject matter experts. These technologies included:

Table 8. Technologies demonstrated at Shaken Fury US&R exercise

Technology Solution	Description
ASCENT SOLAR **Portable Power Solutions** 	Ascent Solar develops portable power solutions, including portable USB Solar chargers, large-format Battery/Radio chargers, a UAS Solar wing and micro-modules for use with sensor applications. The solar technology is lightweight, flexible, ruggedized and portable. The technology can directly integrate into many applications to produce power at the point of need.
AUSPION **Wireless Power Transfer System** 	Auspion has developed a wireless power transfer system, capable of using radio waves to send power through the air over distance, enabling smartphones, computers, security cameras, robots and drones to function without wires or charging cables. The technology can transfer electric power over a distance of 3-10 feet from a generator unit to a smartphone-sized recovery unit with the ability to concentrate power at the unit and safely shut off the power transfer of power in presence of obstructions or movement.
FIELD FORENSICS **Portable Chemical Detection Systems** 	Field Forensics develops field portable devices with the capability to detect and identify explosives, narcotics, toxic chemicals, precursor compounds and many other organic chemicals quickly (~1 minute) and with minimal sample preparation or handling. Mobile device-based processing allows HAZMAT, bomb squad and drug interdiction teams to rapidly identify chemical substances, ensuring they have time to take appropriate protective measures.

Technology Solution	Description
GATES DEFENSE SYSTEMS **VanguardX and Airbox MOSAIC** 	Gates Defense Systems offers VanguardX and Airbox MOSAIC. VanguardX is a web-based apparatus that employs multiple, disparate data sources to create an information intelligence and decision-making tool. VanguardX is scalable ranging from providing localized threat assessments to a full command and control capability with geospatial overlays and plume modeling. MOSAIC is a comprehensive situational awareness tool. MOSAIC's software provides a common operating picture for teams allowing for safer, more efficient and accurate operations. The MOSAIC application can be deployed via tablets, smartphones and wearable technology.
IMAGE INSIGHT, INC. **GammaPix** 	Image Insight, Inc. has developed the GammaPix which provides a low-cost, pervasive detector network to monitor for ionizing radiation. The technology software employs the inherent sensitivity of digital cameras to gamma radiation and allows millions of unmodified, internet-connected fixed and mobile cameras to detect gamma rays. The data is then fused into a monitoring network, which is supported through Wi-Fi and cell networks.
PLUM LABORATORIES, LLC **Plum Cases** 	Plum Laboratories provides a line of portable, secure and robust communications units (i.e., Plum Cases). The cases range in capability from supporting four Wi-Fi networks for 128 concurrent connections to eight Wi-Fi networks accommodating up to 248 users. The cases feature automatically chosen multiple cell carrier connections as well as both static and dynamic satellite fail-over options.

Technology Solution	Description
ROBOTIC RESEARCH **WarLoc** 	Robotic Research has developed the WarLoc sensor. It is typically worn on the boot. The sensor is a GPS/GPS-denied localization system for first responder teams that provides 6-Degrees of Freedom positioning in X-Y-Z planes in GPS-denied environments. The tracks of each person wearing the sensor are displayed on an Android Device. The sensor's flexible design allows for it to be boot mounted, embedded within the heel of the boot or worn on a canine harness. This technology was previously funded by DHS S&T under a Small Business Innovation Research (SBIR) program.
SCITI LABS IoT technologies **Airgility UAS** **One Engineering HALO UAS** **Third Insight Software Platform** 	Smart City Internet of Things Innovation (SCITI) Labs initiative leverages cutting-edge Smart City and Internet of Things (IoT) technologies to enhance public safety. SCITI is currently focusing on three specific technologies, which were demonstrated during the US&R field exercises: • <u>AIRGILITY</u> is currently developing multi-mission UAS to deliver supplies and conduct search and rescue operations. • <u>ONE ENGINEERING</u> is developing the HALO UAS platform that provides artificially intelligent/neural network-based 3D imaging, navigation and machine reasoning in a GPS-denied and confined environment. • <u>THIRD INSIGHT</u> is developing a plug-and-play software platform that gives commercial, off-the-shelf (COTS) drones the ability to navigate autonomously in GPS-denied environments. The drones can be tasked with 3D mapping, identifying signs of life or tracking targets of interest through buildings and cluttered, outdoor spaces. The platform also provides real-time 3D imaging and intelligent support to field agents and remote operating centers. This solution is currently funded by DHS S&T.

Technology Solution	Description
SPECOPS Group Inc. **X3FINDER**	Specops Group Incorporated developed the remotely operated X3FINDER, which detects and pinpoints signs of life such as heartbeat and respiration in real time through walls, voids, thresholds and in debris fields (up to 18 inches cumulatively or 300 feet in open areas). X3FINDER is a self-contained, portable and ruggedized apparatus with a 24-hour standby time and can perform up to 12 hours of continuous scans. SpecOps also deployed its miniature, handheld, short range life detection system, Cyclops 20/20. Cyclops 20/20 can see through up to eight inches of concrete or 50 feet in open areas. The device can be gun, robot or drone mounted and can be deployed for up to four hours of continuous use. Each of these technologies requires minimal training. This solution was previously funded by DHS S&T.
TRX Systems **NEON**	TRX Systems' NEON application delivers mission-critical 3D mapping, location and tracking of sensors and personnel operating in GPS-denied environments both indoors and out. NEON also provides cloud-based playback and after-action review capabilities as well as easy integration with third party applications. DHS S&T funded the development of an earlier TRX indoor location solution.

DHS S&T also hosted a series of additional demonstrations that did not involve any operational experimentation by end users. The purpose of the demonstrations was to allow the responder community to improve their situational awareness and locate victims in need of rescue. Both One Engineering (HALO) unmanned aircraft system (UAS) and Airgility exhibited capabilities to support search and rescue efforts.

In addition to UAS technologies, responders were able to observe a tool that aids in location of victims at an incident. X3FINDER allows responders to detect heartbeat and respiration through walls to locate trapped victims. The first demonstration on day one was with the Nebraska Task Force 1. The demonstrations on day two were with Canada Task Force 2 and Canada Task Force 1 at the rubble pile and a collapsed building respectively. Each time, X3FINDER was operating at the same time as the canines were searching the building site for victims. Each hit by a canine was also found by the technology. X3FINDER was also able to locate each victim before the canines.

Figure 27. Technology Demonstration at MUTC during Shaken Fury

Two other technologies were of particular interest to those that visited the DHS S&T tent and were subsequently used in impromptu field exercises with a few of the US&R teams. MOSAIC by Gates Defense Systems participated in a nighttime field operations exercise with the Vancouver Heavy Urban Search and Rescue (HUSAR team: Canada Task Force 1) that was highly successful. This is an example of a British technology that was used by a Canadian HUSAR team at an American-facilitated event.

Plum Case proved to be an essential technology at the MUTC site. The cases were essential in supplying Wi-Fi signal access to many of the vendors in the tent that allowed them to perform demonstrations. Plum Cases were also used to provide signal to field demonstrations for the UAS and Gates Defense vendors. Additionally, the Plum Cases were used by several of the US&R teams to provide Wi-Fi signal for communications on the remote MUTC site. This technology was a significant enabler for some teams during the exercise.

Figure 28. Plum Cases used onsite at MUTC

Outcomes

During the exercise, the project team members collected data via interviews with agency personnel, US&R participants and industry prior to, during and after the exercise and through direct observation. The tables below summarize the key findings from the MUTC US&R activities:

Information Sharing

The Shaken Fury exercise provided DHS S&T and CUSEC the opportunity to demonstrate technology solutions that enhance states' capacity to share information and maintain situational awareness.

Relationship Building

Through interviews, both vendors and US&R teams gave very positive feedback about the experience with DHS S&T's showcase approach at MUTC and are eager to continue their relationships with DHS S&T both outside of the exercise context as well as at future planned events.

The vendors expressed appreciation of the opportunity to develop relationships with US&R personnel that came through the DHS S&T technology showcase as well as in the field during exercise demonstrations. They found these interactions to be valuable in both obtaining end-user feedback on the current iterations of their systems and in better understanding user requirements.

The vendors expressed appreciation of the opportunity to network with each other in the tent during down time. Several of the vendors reported discussions about potential collaboration efforts in the future.

First responders were excited about the opportunity to both see the functionality of the new technology as well as speak with developers about how it could address their needs. Several US&R teams scheduled in house demonstrations of the technology as a result of presentations in the tent and in the field during exercise.

"The future technology to do our job better was here. We could see it; we could test it; we could play with it. They can go back and make it better for us and hopefully get it to us in the next few years." – Evan Schumann, Program Manager, Ohio Task Force 1.

Multi-Level Coordination

No findings related to multi-level coordination for this initiative.

Operational Support

Three technologies in particular – UAS, X3FINDER and Plum Cases – were in high demand for live demonstrations at the exercise.

Through one the vendors, DHS S&T was able to provide free wireless network services to US&R teams in the field.

In some instances, vendors were able to work together to solve operational problems during the exercise. For example, the Ascent Solar power team worked with SpecOps to build portable solar powering solutions for FINDER.

The US&R teams were expecting more new hands-on technologies, such as drones, search cameras and echo systems. Some of the technologies provided software solutions that the teams were not able to use operationally and therefore could not assess the efficacy or viability of the solutions.

Technology Advancement and Adoption

US&R teams, exercise staff and VIPs had the opportunity to both ask questions and provide feedback on the technologies through interactions at the tech showcase tent as well as in the field during exercise operations.

There was a mix of technologies on display, some experimental, others were limited to display only. Participants stated that available demo units for some of the items would have been good to see in the field.

Each vendor described the opportunity to display and/or demonstrate products to the first responders as valuable. The vendors felt that they benefited from interacting with the US&R team members and received valuable input/observations from those interactions. Feedback regarding the range and types of incidents these responders face and how the technologies might be able to support their mission was described as hugely valuable for the technology developers.

The UAS technology developers felt that they learned perhaps as much or more from the failures as from the successful demonstrations, as those failures will inform the incremental technology advancement plans going forward.

Integration into Governance and Process

It was suggested that in the future, prior to the exercise, that DHS S&T contact the appropriate FEMA US&R subgroup so that a representative of the subgroup can attend the exercise or event. This would have a threefold benefit: 1) ensure a subject matter expert is present to give feedback; 2) provide the means to get the potential solutions into the decision-making process so the technology may be added to the authorized cache list; and 3) help transition DHS-funded and commercial technologies.

Participants

Participants in the FEMA US&R Multi-Task Force exercise included:

Table 9. Shaken Fury MUTC Partners

MUTC Participants	
FEMA Urban Search and Rescue Teams	
California Task Force 5	Indiana Task Force 1
Colorado Task Force 1	Nebraska Task Force 1
Ohio Task Force 1	Tennessee Task Force 1
DHS/FEMA Partners	
FEMA US&R Branch	FEMA International Affairs Division
FEMA Region V	FEMA Region VIII IMAT
FEMA Region VIII MERS	DHS Science & Technology
FEMA US&R Incident Support Team	
Other Federal Partners	
NORAD/USNORTHCOM	U.S. Army Corps of Engineers
U.S. Department of State	U.S. Customs and Border Protection
U.S. Department of Agriculture	U.S. Food and Drug Administration
State Partners	
Civil Air Patrol	Illinois Task Force 1
Indiana Department of Homeland Security	Tennessee Air National Guard
Tennessee Army National Guard	New Jersey AHIMT
Illinois Army National Guard	State of Ohio/ Butler County IMT
International Partners	
Public Safety Canada	Canada Task Force 1 Vancouver
Canada Task Force 2 Calgary	Canada Task Force 3 Toronto
Canada Task Force 4 Manitoba	Canada Task Force 6 Montreal
Australia Emergency Management Agency USAR Task Force 1 Queensland	Australia Emergency Management Agency USAR Task Force 2 New South Wales

NGFR Birmingham Shaken Fury Operational Experimentation

DHS S&T hosted the NGFR - Birmingham Shaken Fury OpEx in August 2019 to promote technology integration and support innovation and adoption of public safety technologies. DHS partnered with agencies and organizations in Birmingham and Jefferson County, Alabama, for these activities. The participating agencies included: Jefferson County Emergency Management Agency (EMA), Birmingham 9-1-1, Birmingham Fire & Rescue Services (FRS), Birmingham Police Department (BPD), Birmingham Public Works (BPW), Birmingham Mayor's Office, Birmingham Information Management Systems (IMS), Birmingham Parks & Rec (BPR), Alabama EMA, Alabama National Guard, University of Alabama at Birmingham (UAB) Emergency Management and the UAB Police Department. As hosts of the World Games 2021, a major international sporting event, Birmingham and its regional partners will leverage the OpEx outcomes to assess how advanced technologies can help prepare them for planned events, like the World Games, and no-notice events like natural disasters.[24]

Operational Experimentation vs. Exercise

The Birmingham Shaken Fury event was an operational experiment, which is different from a full-scale exercise. The scenario and actions resemble that of an exercise in that responders, their apparatus and equipment are used to respond to the scenario and injects. However, the play is slower because the focus is on assessing the operational utility of the technology and getting responder feedback.

DHS S&T launched the NGFR Apex program in 2015 to develop, adopt and integrate cutting-edge capabilities using a standards-based approach to make responders better protected, connected and fully aware.[25] Between 2016 and 2019, DHS S&T held a series of NGFR Integration Demonstrations to incrementally test and evaluate interoperable technologies currently in development. These demonstrations evolved from tabletop integrations to field exercises with partner public safety agencies. These events put emerging technologies into the hands of end users in an operational setting, allowing first responder and federal stakeholders to try them out before buying, giving the developers direct feedback on how to improve their technologies, and allowing DHS S&T to test new solutions and assess their mission impact in a controlled setting.[26] DHS S&T incorporated results and responder feedback from the NGFR Integration Demonstrations into the NGFR Integration

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[24] *Next Generation First Responder – Birmingham Shaken Fury Operational Experimentation* (Washington DC: Department of Homeland Security), 2019-01

[25] For more information on the NGFR Apex program, visit the program website: https://www.dhs.gov/ngfr

[26] Factsheet: Next Generation First Responder – Birmingham Shaken Fury Operational Experimentation: https://www.dhs.gov/sites/default/files/publications/4425_ngfr_birmingham_opex_onepager_201904_updated-508.pdf

Handbook, which outlines a standards-based environment that enables commercially-developed technologies to integrate with existing first responder infrastructure.[27]

The NGFR – Birmingham Shaken Fury OpEx was the final NGFR Integration Demonstration of the program, which concluded in January 2020. The Birmingham OpEx was not one of the primary Shaken Fury exercises, but used a common scenario as the basis for the experiment.

It is important to recognize that individual stakeholders may have different objectives for the same activity. Birmingham's requirements in preparation for the 2021 World Games were different than those of DHS in demonstrating the success of its programs. Activity-level and stakeholder-level objectives for the NGFR Birmingham Shaken Fury OpEx are summarized in Table 10.

NGFR Integration Handbook

DHS S&T published the NGFR Handbook in 2018 to guide industry in developing technologies using open standards, allowing easier system and device integration through a "plug-and-play" standards-based environment. The goal of the Handbook is to make it easier for developers to make interoperable technologies, and easier for public safety organizations to buy new technologies that they know will work with what they already have. The NGFR Integration Handbook identifies standards, interfaces and data flows that would allow public safety organizations to integrate hardware, software and data of different technology solutions, building their own public safety system.

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[27] The NGFR Integration Handbook is available here: https://www.dhs.gov/science-and-technology/ngfr/handbook

Table 10. Birmingham Shaken Fury Objectives

NGFR Birmingham Shaken Fury OpEx Objectives	
DHS S&T Objectives	
Goal 1: Demonstrate success of the NGFR program's research and development through operational test and evaluation	• Evaluate how NGFR technologies improve first responder safety and effectiveness in an operational environment • Demonstrate the successful integration between NGFR-funded technologies, industry solutions and existing first responder systems to exhibit the value of the NGFR Integration Handbook • Improve regional core capabilities in a multi-agency response
Goal 2: Identify pathways for transitioning NGFR-developed products	• Facilitate transition of NGFR-developed technologies, integration approaches and knowledge products • Promote innovation and adoption of public safety technologies to make responders better protected, connected and fully aware
NGFR Apex Program Objectives	
• Collaborating with industry around integration standards and the NGFR Integration Handbook • Coordinating with responders to gather operational feedback on how NGFR technologies improve their mission response • Demonstrating a successful integration approach and identifying improvements at the NGFR – Birmingham Shaken Fury OpEx • Working to close out research and development on key technologies and assist performers to transition technology into operational use	
Stakeholder Objectives	
• Prepare Birmingham and Jefferson County to support public safety activities during the 2021 World Games • Improve coordination, communications and response to all-hazards incidents • Build relationships across cities, jurisdictions, agencies and disciplines to improve unified command and operations to planned and no-notice incidents • Understand public-private response integration, including activation of private-sector resources • Assess local Public Safety Broadband capabilities • Understand resource-sharing mechanisms for disaster response (mutual aid resource planning, tracking and use) • Identify barriers to change in technology, procedures and coordination and develop mitigation approaches • Meet exercise and training requirements for participating agencies as required for grant funding	

There were three primary activities associated the NGFR - Birmingham Shaken Fury OpEx. These activities include: technology identification and development, the EOC information sharing workshop and the operational experiment.

Technology Identification and Development: At the first site visit prior to the OpEx, state and local partners identified capability gaps covering nine areas. The table in Appendix I illustrates those gaps and their alignment with the FEMA Core Capabilities. The table below lists the technology areas that correlate with the identified gaps.

Table 11. Birmingham Shaken Fury OpEx technology areas of interest

Technology Areas
1. Fixed, on-body or handheld sensors (e.g., physiological monitoring, HAZMAT detection, environmental threat detection);   2. Search and rescue sensor deployment tools and systems (e.g., sensors, robotics, unmanned aircraft systems (UAS));   3. Indoor and outdoor responder location tracking systems;   4. Wireless patient physiological monitoring and location tracking systems;   5. Resource tracking and management systems;   6. Mobile and enterprise common operating picture, collaboration or situational awareness platforms (e.g., mapping applications that display responder locations and sensor alerts);   7. Video and image access, management and analytics tools;   8. Deployable communications systems, including those for Land Mobile Radio (LMR), Long-term Evolution (LTE), satellite, mobile ad-hoc network (MANET) and Wi-Fi; and   9. Emergency vehicle traffic signal preemption systems.

DHS released a Request for Information (RFI) to invite industry organizations to bring new technology solutions for responders in the above listed areas. Posted in February 2019, DHS received multiple responses for each of the technology areas. DHS reached agreements with 23 vendors to provide systems and equipment for use during the OpEx. Through a combination of DHS S&T-funded technology, private sector-developed solutions and existing systems, the DHS project team integrated multiple solutions to address the identified capability gaps.
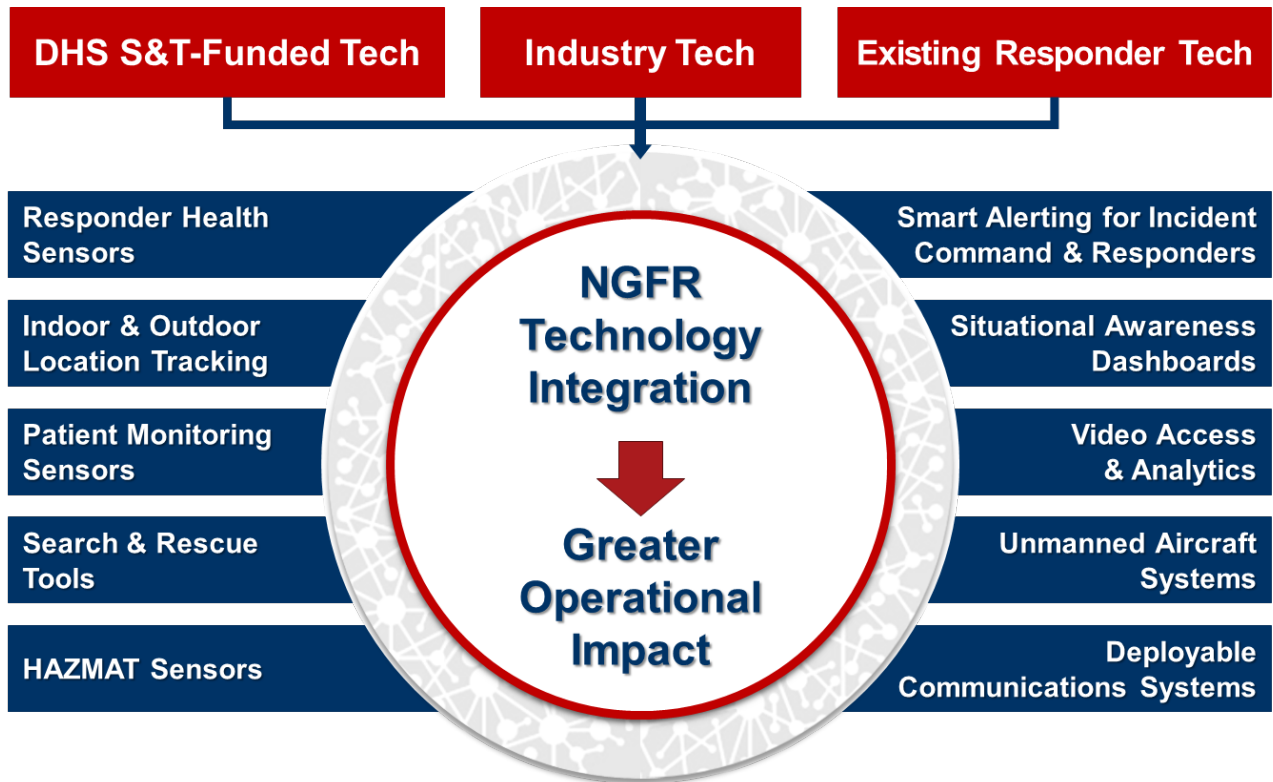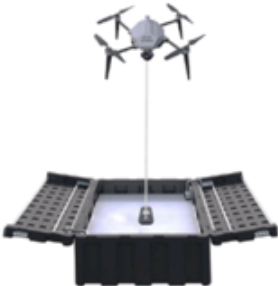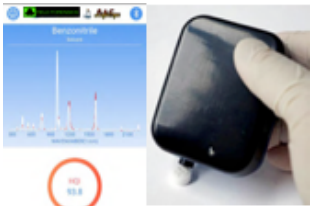
Figure 29. Integration of Solutions at the Birmingham Shaken Fury OpEx

Table 12 below contains brief descriptions of each of the technology solutions assessed during the OpEx.

Table 12. NGFR Birmingham Shaken Fury OpEx technology solutions

Technology Solution	Description
5VS LLC **TOD (Triage-On-Demand) Biosensor** 	5VS is committed to providing lifesaving triage and medical awareness at a glance and in real-time. TOD is the size of a band-aid, weighs 11 grams and adheres to the chest. Vital signs are captured and relayed reliably and accurately to the Incident Command dashboard. Any critical (red) or non-critical (yellow) change is instantaneously flagged on the first responder's smartphone display and flagged and prioritized on the Incident Command dashboard. Responders and Incident Commanders can tap on any first responder or patient and their real-time vital signs appear with their precise location. TOD captures and relays a single lead ECG, heart rate, respiratory rate and body temperature, detects falls with a high degree of probability and may diagnose traumatic brain injuries. TOD can make responders safer through consistent monitoring, both during and after an incident response, when most firefighter heart attacks occur. TOD can be applied to patients at the incident scene within 60 seconds, helping to identify and prioritize the care of critically injured individuals in a mass casualty incident.
AT&T Corporation **FirstNet Solutions** 	AT&T is working with the First Responder Network Authority (FirstNet) to build, deploy and maintain the first-ever nationwide public safety broadband network for America's first responders. The FirstNet network will help ensure first responders and the public safety community have access to the interoperable communications and technologies they need when they need them.

Technology Solution	Description
BodyWorn **BodyWorn** **AVailWeb** 	*BodyWorn* Generation 2 BodyWorn provides a video camera with automatic recording, Gunshot Detection, Holster trigger, Officer Down reporting and live video streaming based upon a smartphone platform. *AVail Web* Avail Web provides a map-based real-time situational awareness solution for BodyWorn and in-car video, audio and metadata. Features include live video streaming, officer down alerts, video redaction and full chain of custody audit trail reporting. *Vehicle Wireless Router and Video Server* The Rocket IoT is a vehicle-mounted hardened IP-67 cellular, FirstNet, Wi-Fi and Bluetooth access point and video storage server that supports up to four video cameras and unlimited BodyWorn cameras.
Easy Aerial, Inc **SAMS-T (Smart Aerial Monitoring System – Tethered)** 	The SAMS-T allows remote deployment of a tethered unmanned aircraft system (UAS), or drone, with a continuous aerial video monitoring system. It includes an "Alpine Swift Drone" - a customized Falcon drone capable of carrying a variety of payloads. SAMS-T transmits all data directly to the RMS via the tether, allowing for highly secure data transmission. The system can be deployed in either a stationary location, or on an emergency vehicle and easily deployed within seconds. By providing continuous video surveillance for up to 24 hours, first responders will be able to view real time video feeds to make the most informed decisions.

Technology Solution	Description
Federal Emergency Management Agency **Integrated Public Alert and Warning System**	The Integrated Public Alert and Warning System (IPAWS) modernizes the nation's emergency communication capabilities. Based on the Common Alerting Protocol (CAP) and aggregated through FEMA's Open Platform for Emergency Networks, a single emergency notification can be disseminated to many media outlets. This allows Federal, state, local, tribal and territorial alerting authorities the ability to notify and warn their respective communities through multiple communication pathways thereby reaching more of the public. Communication pathways include broadcast to cellphones via the Wireless Emergency Alerts (WEA), radio and television by the Emergency Alert System (EAS), and various integrated IP-based systems such as desktop alerting, signage, siren systems, etc.
Field Forensics, Inc. **HandyRam XS ™**	HandyRam XS™ miniaturizes hand-held Raman spectroscopy to a key-fob/belt-wearable device. It identifies explosives, narcotics, toxic chemicals, precursor compounds and many other organic chemicals quickly (~1 minute) and with minimal sample preparation or handling. Mobile device-based processing allows HAZMAT, bomb squad and drug interdiction teams to rapidly identify chemical substances, ensuring they have time to take appropriate protective measures.
FireHUD, Inc. **BioTrac Platform**	FireHUD's BioTrac Platform provides passive biometric monitoring and accountability for firefighters via arm-worn wearable devices. The data can be viewed in real-time and post-incident by authorized officials to allow for more informed decisions and prevent injuries and deaths due to overexertion. FireHUD provides text alerts in order to prevent overexertion, which is the number one cause of injury in firefighting and responsible for nearly 60% of firefighter line of duty deaths.

Technology Solution	Description
Image Insight, Inc. **GammaPix™**	The patented GammaPix™ technology provides a low-cost, pervasive detector network to monitor for ionizing radiation. It turns any smartphone into a radiation detector for early warning and personal protection without requiring additional equipment. The companion Training Simulator provides Live-Virtual training with realistic source sizes. Data can be viewed over the internet, allowing Incident Commanders to monitor events without disturbing personnel in the field. Use of the GammaPix system provides early warning against radiation emergencies and emergency dosimetry in case of accidental exposure to first responders.
Kratos Defense and Security Solutions, Inc. **Aethon Mk. 1**	Aethon Mk. 1 is a tethered UAS system consisting of a Kratos-built UAS, Kratos's proprietary tether system and a high mobility ATV. The system is capable of lifting payloads up to 20lbs to 500ft AGL on tether and reaches 1 Gbps data speeds over GigE fiber optic inside the tether. This system gives first responders persistent and secure ISR, communications and sensors on a highly mobile and rapidly deployable airborne platform.
Metronome Software, LLC **SENSEI – Sensor Secure Enterprise Infrastructure**	Currently partnered with MobileIron and Kryptowire, SENSEI integrates Enterprise Mobility Management (EMM) and Mobile App Vetting technology to provide a comprehensive system of mobile security for Internet of Things and mobile endpoints. SENSEI ensures that mobile apps are risk analyzed prior to deployment and provides users confidence that their mobile devices are not compromised. Metronome Software was funded by DHS S&T for this project.
MobileIron, Inc. **Unified Endpoint Management**	Provides visibility and information technology controls needed to secure, manage and monitor any corporate- or employee-owned mobile device or desktop that accesses business-critical data. Secures all endpoint devices and their identity and information, providing the assurance that lifesaving operational decisions can be made reliably. MobileIron was funded by DHS S&T for this project.

Technology Solution	Description
Modern Technology Solutions, Inc. **Artificial Intelligence Augmented UAS Search and Rescue** 	MTSI offers a real-time detecting and geo-locating UAS payload solution for object detection at the network edge. The UAS performs operator out-of-the-loop recognition of various object types, geolocates their positions and sends down only the information needed minimizing the need for large network bandwidth. For operators, this means information available directly to situational awareness platforms (such as ATAK) without having to view a UAS video feed.
N5 Sensors, Inc. **Compact Multi-Gas and Particulate Matter Detector** 	N5 provides a compact, low-cost gas and particulate detector leveraging N5's patented chip-scale nanoengineered gas sensor technology. It provides real-time detection of multiple of toxic and fire gases along with particulate matter counts in a wide range of environmental conditions. The sensor technology enables gas detector miniaturization while providing improved resistance to contaminants – enabling awareness of both immediate and long-term chemical threats. N5 Sensors was funded by DHS S&T under the SBIR program for this project.

Technology Solution	Description
NC4 **NC4 E Team** 	An enterprise application that provides real-time collaboration within and between organizations/jurisdictions, NC4 E Team provides situational awareness through tracking events/incidents, enabling all concerned parties to provide simultaneous input. E Team is integrated with NC4 Risk Center, which provides real-time, location-based alerts and notifications. E Team has a complete Resource Management piece which integrates Requesting, Asset Tracking and Vendor Tracking. The ESRI HTML 5 Mapping client enables the consumption of all ESRI services and OGC compliant data. Together this creates a comprehensive common operating picture. E Team also includes an embedded reporting solution based on SAP Crystal Reports Business Intelligence, included dashboards, embedded notification, geolocation of all data, embedded ICS/HICS with one button IAP, working IPAWS Integration and interface, and embedded custom form capability with the ability to create advance workflows.
PAR Government Systems Corporation **Team Connect** **Team Awareness Kit (TAK)** 	Team Connect is an elastic, cloud-based situational awareness server that provides a next-generation, Enterprise-level TAK Server capability. When used with TAK applications, Team Connect provides users with a secure situational awareness solution that provides immediate information of what is happening in their area of operation while gathering additional intelligence from both TAK and non-TAK sources. The Team Beacon feature of Team Connect can also be enabled for use on embedded sensors including those on UAS platforms and robots to share position location information even without the use of TAK applications. TAK is a geospatial mapping engine, originally developed for the Android Operating System, which allows for advanced situational awareness, navigation and data sharing. TAK serves as a common user interface for sharing basic position location information and provides a basis for hosting various user enabling tools that provide an enhanced end-user experience. TAK can function as a standalone situational awareness tool or be incorporated through various tactical and commercial networks.

Technology Solution	Description
Project OWL, LLC **DuckLink** **OWL Incident Management Software** 	Project OWL builds wireless DuckLink Internet of Things devices that are able to communicate with consumer electronics (smartphones) as well as other DuckLinks to form a mobile ad-hoc sensor and communications network. This network can be used to establish communications in locations without it, or to monitor geographies and accumulate data. Project OWL also builds the OWL Incident Management Software. This cloud software system supports DuckLink network operation and offers a simple interface to monitor network activity and communications. This software system may be accessed via web browser. For the OpEx, Project OWL also mounted gas sensors on their DuckLinks and used their LoRa network to pass the sensor readings back to the situational awareness application.
REGAL Decision Systems, Inc. **Pedestrian Flow Simulation Modeling** 	The Pedestrian Flow Simulation Modeling develops a baseline egress model and emergency evacuation model under a threat scenario (earthquake). The developed model reflects Legion Field-specific information such as physical infrastructure and restraints, stadium population, and pedestrian flow routes. The product included video files showing the simulation visualizations to help identify chokepoints and areas of concern, statistical outputs indicating evacuation time requirements and population distribution recommendations, and a written report with graphics providing useful information such as optimal resource placement locations and gathering area requirements. These deliverables help facilitate inter-agency discussions about appropriate coordinated response.
SensorUp, Inc. **SensorThings Cloud** 	SensorUp is an Internet of Things cloud service platform for customers who rely on geospatial in their IoT Implementations. Its Cloud-based API allows customers to rapidly aggregate and coordinate multiple IoT systems, and then transform them into actionable insights. SensorUp provided the sensor integration layer for NGFR that connects the various position, biometric and hazardous materials sensors and enables their data for use in Situational Awareness and Common Operating Picture tools. SensorUp was funded by DHS S&T for this project.

Technology Solution	Description
Silvus Technologies, Inc. **StreamCaster MN-MIMO Mesh Radio** 	StreamCaster radios create a self-forming, self-healing, mobile ad-hoc network (MANET) capable of distributing audio, video and other IP data in an infrastructure-less and RF-harsh environment. Networks built on Silvus radios have been used in environments ranging from subterranean to airborne, desert to dense urban, and at ranges from hundreds of feet to hundreds of miles. Radios can be infrastructure mounted, hand or pack carried, and have been integrated onto more than 100 unmanned systems. Carrying HD video, PTT audio, situational awareness data such as TAK and relaying VHF audio signals, Silvus networks are a powerful blend of robust RF, high throughput, long range and simple operation.
SpectraRep **Datacasting IncidentOne Dashboard** 	Datacasting leverages existing broadcast television signals to deliver encrypted and targetable public safety video, files, alerts and other data to first responders. The IncidentOne Dashboard presents an aggregated view of multiple video systems in one dashboard. Sources can be VMS, cell phone, helicopter, drone, etc. SpectraRep was funded by DHS S&T for this project.
Spectronn **Unified Multi-network Mobile Router and Video Management System** 	The Spectronn mobile router provides (a) high-speed and resilient connectivity by aggregating bandwidth from multiple available backhaul networks (wireless and wired) and transparently offloading connections between networks with session persistence and, (b) advanced video management enabling local storage, local and cloud video streaming, and artificial intelligence-based video analytics. This technology significantly enhances mobile network capacity and coverage for mission critical applications as well as for daily operations while decreasing the information overload on first responders.

Technology Solution	Description
TRX Systems, Inc. **NEON Personnel Tracker and NEON Location Service**	NEON Personnel Tracker delivers 3D mapping and GPS-denied personnel tracking for warfighters, first responders, security and industrial personnel that operate indoors, underground and in areas without GPS. NEON Personnel Tracker uses inertial measurements from the Tracking Unit and any available constraints such as ranges to beacons to compute the user's location. NEON Personnel Tracker is an Android application tightly integrated with the NEON Location Solution where a suite of patented algorithms fuses inertial sensor data, Wi-Fi readings and inferred building data to deliver reliable 3D location. Personnel wearing a NEON Tracking Unit and carrying an Android device running the NEON Location Service can be seamlessly located both indoors and out. TRX Systems, Inc. was previously funded by DHS S&T for indoor tracking solutions.
Tyto Athene, LLC **Acuity® Micro Data Center**	Tyto Athene's Acuity® Micro Data Center for communication and engineering teams focused on the rapid deployment of mission-critical information technology capabilities. Built to deliver essential communication and processing power to emergency or tactical edge locations anywhere in the world, the Acuity solution weighs only 30 pounds, provides 10 servers, enables wireless communication and can easily be carried into any environment.
University of Alabama in Huntsville **sUAS Monitoring and Damage Assessment Mapping**	University of Alabama in Huntsville's Rotorcraft Systems Engineering and Simulation Center can provide near real-time location information of small UAS (sUAS) to show flight paths and data collected at various locations. This solution will also be used to compile geographically accurate mosaics and geospatial data products for damage assessment mapping and comparison to satellite imagery or other sUAS imagery.

A list of functional requirements related to the NGFR - Birmingham Shaken Fury OpEx can be found in Appendix K.

Emergency Operations Center Information Sharing Workshop: On June 6, 2019, DHS facilitated an Information Sharing Workshop with Birmingham, Jefferson County, Alabama Emergency Management Agency (AEMA) and Alabama National Guard partners to identify EEIs and information sharing requirements between the incident scene, local EOC, and state and federal partners. Using the Shaken Fury earthquake scenario, the DHS S&T project team guided

participants through a discussion of each Community Lifeline. The facilitator solicited information on essential data needs, whether the data was currently available, and where the data could be found. For example, during the discussion of Search and Rescue in the Safety and Security Lifeline, participants identified the following as information that would be necessary to support decision-making: capabilities, location and status of regional technical rescue teams; estimates of the number trapped or missing; estimates of game attendance; and the availability of search and rescue equipment.

The EOC information sharing workshop introduced participants to the Community Lifeline concept and helped the community to identify information sharing requirements.

Operational Experiment: The NGFR - Birmingham Shaken Fury OpEx was held August 21-22, 2019. The scenario focused on potential local impacts of the NMSZ earthquake. Positing a stadium collapse as a result of the earthquake, local responders evaluated how DHS-developed and commercial technologies integrated with existing resources and how those integrated

capabilities improve responder safety, enhance operational communications, increase operational coordination and augment situational awareness.

The map of Legion Field in Figure 30 illustrates the location of operational activities and technology solutions during the OpEx. Participants from 12 state and local public safety agencies participated in the two-day event. Three vignettes were used to test and evaluate the technologies. The vignette storyboards from the OpEx are included as Appendix J at the conclusion of this report.

OpEx Scenario

The University of Alabama at Birmingham (UAB) Blazers are playing their home opener game on a Saturday afternoon at Legion Field stadium in downtown Birmingham with more than 25,000 in attendance. The typical tailgating events are taking place in the parking lots outside the stadium. The weather is sunny, with the temperature around 85°F and a light wind out of the WSW at 4 kts.

Two minutes into the 2nd quarter, a 7.7 magnitude earthquake ruptures along the Cottonwood Grove Fault (southwest segment of the New Madrid Seismic Zone, near Memphis, TN). The earthquake causes structural damage throughout the Birmingham area, with the most severe and immediate life threatening and mass casualty incidents at Legion Field Stadium.

About this time, a semi-tanker filled with anhydrous ammonia is traveling east on 8th Avenue. The driver, distracted by the activity at the stadium, the visible damage, the drones, the fire trucks, etc., loses control and runs off the side of the road and crashes onto the grounds of the stadium. The crash causes the tanker to split and release a plume of gas.
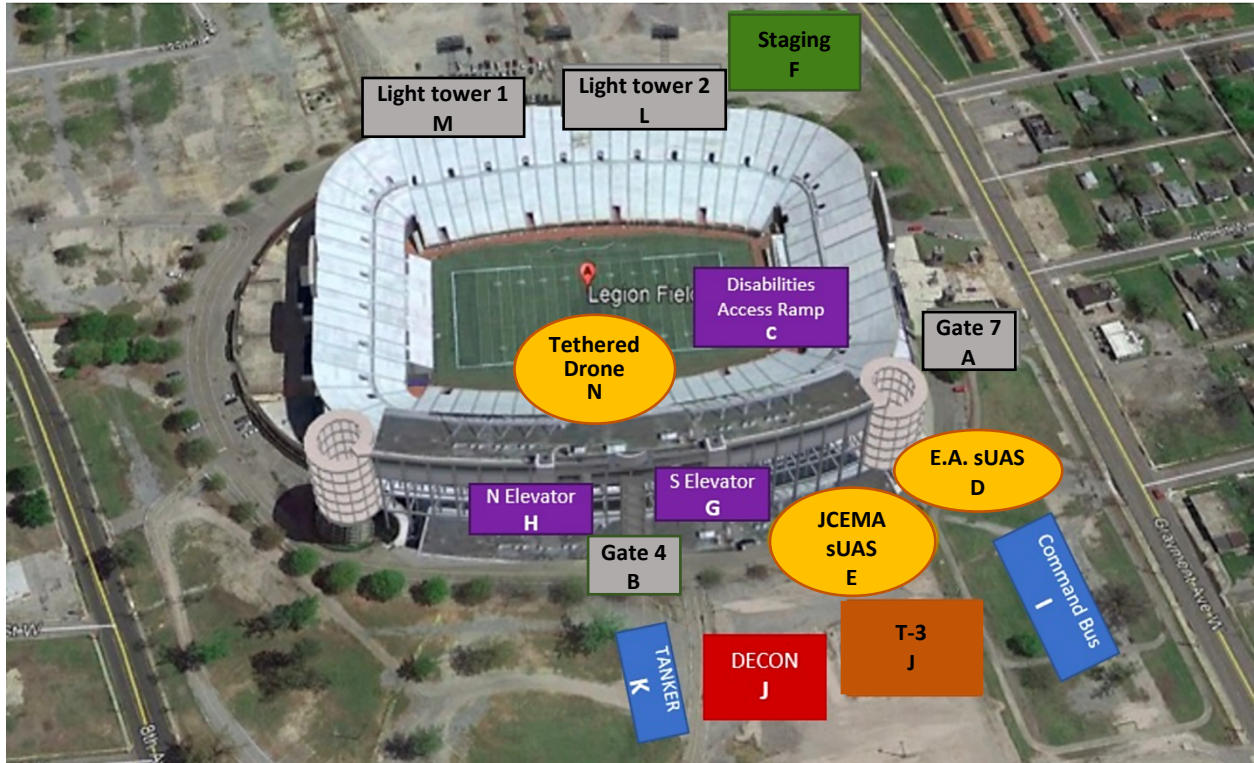
Figure 30. Legion Field stadium locations

Outcomes

The tables below contain the key findings from the NGFR - Birmingham Shaken Fury OpEx.

Information Sharing
Participants were impressed with the amount of information from disparate sources that could be integrated into a situational awareness platform. One mentioned that the increase in the level of information that was easily available could significantly change operations.
Live-streamed sUAS and body worn camera video footage allowed unified command staff to have eyes-on situational awareness in and around the stadium, helping them deploy resources.
Jefferson County Emergency Management Agency was impressed by how much real-time operational status information they could access from the EOC through the situational awareness dashboards without having to request a report from the unified command staff.

Relationship Building

Birmingham Police Department believed that there was great collaboration between departments during the OpEx, which will be essential during the World Games 2021 response.

Other participants expressed appreciation that the OpEx allowed participants to "put faces with positions," which will be a good precedent to help prepare for the World Games.

Multi-Level Coordination

The City of Birmingham was pleased with the level of participation from its public safety agencies, allowing state, local and private sector organizations to work together.

The University of Alabama at Birmingham's Emergency Management and Public Safety staff found it very valuable to work more closely with the City's operational responders at all levels, practicing vital coordination.

AEMA and Alabama National Guard provided important state-level insights during the EOC Information Sharing workshop that helped the Jefferson County Emergency Management Agency understand what Community Lifeline information the state would request during an earthquake incident.

Operational Support

The EOC staff felt that they had improved situational awareness using the available technology solutions.

Birmingham Fire and Rescue said that the OpEx opened their eyes to technology that they may use down the road during World Games 2021 response and were particularly enthusiastic about the real-time location tracking and physiological monitoring capabilities.

Participants were pleased with the exposure to new technology, especially the UAS. Based on the outcomes of the OpEx, the Birmingham Police Department is now seeking to establish a UAS team.

Jefferson County Emergency Management Agency were very interested in the evacuation modeling tool and how it could be used to plan egress, staffing and evacuation protocols at the 36 sports venues around Birmingham that will be used during the World Games 2021.

Technology Advancement and Adoption

The technologies singled out as most effective during the OpEx included:
 	
    • Responder geolocation;
    • Physiological monitoring;
    • Radiation monitoring;
    • UAS capabilities; and
    • Stadium evacuation modeling.

Participants expressed surprise at the level of integration, that multiple systems from different vendors were available on a common platform that could be used by everyone.
Participants were impressed with how compact and user-friendly the technology solutions were.
Several of the sensors had issues with triggering correctly in the operational environment, which could indicate either lack of training for the operator to understand how to use the device to get a reading, or it could indicate a technology error.

Integration into Governance and Process
Many of the technologies tested during the OpEx do not easily fit into existing responder Standard Operating Procedures. To fully implement these types of sensors and situational awareness tools, responders would need to adjust these procedures to incorporate the technologies and then re-train personnel.
While operations-level responders wore mostly passive technologies (i.e., location tracking sensors that they do not need to interact with), command-level responders were using complex situational awareness tools that required more training time than was available before and during the OpEx. Full integration of these tools into operations would require significant dedicated training.
Managing a suite of technologies where each responder receives several paired devices requires significant staff support with technical expertise, which is an added operations and maintenance cost in addition to the technology and services costs.
All public safety sUAS programs will need to consider privacy implications of flying over areas where individuals have a reasonable expectation of privacy, which may require more rigorous policy about when sUAS may be used and what can be done with any video or audio recordings (i.e., sharing, storage, review).

Participants

Participants in the Birmingham Shaken Fury OpEx exercise included:

Table 13. Shaken Fury MUTC Partners

OpEx Participants	
Federal Partners	
Department of Homeland Security Science & Technology Directorate	
DHS S&T Next Generation First Responder Apex Program	DHS S&T's National Urban Security Technology Laboratory
Federal Emergency Management Agency	
National Continuity Programs, Integrated Public Alert and Warning Systems Office	Region IV UAS Coordinator
Birmingham-Area Public Safety Partners	
City of Birmingham	
Birmingham Mayor's Office	Birmingham Fire and Rescue Service Department
Birmingham Police Department	Birmingham Parks and Recreation Board
Birmingham Department of Public Works	Birmingham Information Management Services Department
Jefferson County	
Emergency Management Agency (EMA)	
University of Alabama at Birmingham (UAB)	
Emergency Management	Police and Public Safety Department
Birmingham Emergency Communications District	
Birmingham 9-1-1 and Metro Area Radio System	
State of Alabama	
Alabama Emergency Management Agency	Alabama National Guard
Technology Partners	
DHS-Funded Technology Partners	
FEMA Integration Public Alert and Warning System Office	Regal Decision Systems
Metronome Software, LLC.	SensorUp, Inc.
MobileIron, Inc.	SpectraRep
N5 Sensors, Inc.	
Industry Technology Partners	
5VS LLC	NC4 Public Sector, LLC
AT&T Corporation	PAR Government Systems Corporation

BodyWorn	Project OWL
Easy Aerial, Inc.	Silvus Technologies, Inc.
Field Forensics, Inc.	Spectronn
FireHUD, Inc.	TRX Systems, Inc.
Image Insight, Inc.	Tyto Athene, LLC
Kratos Defense and Security Solutions, Inc.	University of Alabama in Huntsville
Modern Technology Solutions, Inc.	

Social Media Integration

The goal of the social media and crowdsourcing effort was to build upon the capabilities tested in the Canada-U.S. Enhanced Resiliency Experiment (CAUSE) Series and New Orleans, Louisiana (NOLA), Flood Apex test.[28,29] The concept was to blend together local needs and activities with FEMA's crowdsourcing unit to address the following capabilities:

- How to leverage crowd sourced information to support official situational awareness;

- Enhanced whole community information sharing practices (social media and other non-traditional sources of information can support traditional information sources and act as an indicator);

- Integrated, real-time field reporting capabilities (the concept of "citizens as a sensor" or crowdsourcing to gain better situational awareness via the public); and

- Test collaboration between local public information officers (PIOs) and FEMA's Social Listening Unit on authoring the FEMA Rumor Control Page.

Use of social media to collect and organize crowdsourced content in the Shaken Fury 2019 exercise aligns with Exercise Objective #1: enhanced whole community information sharing practices. Social media and other non-traditional sources of information can support traditional information sources and act as an indicator to decision-makers about activities that are taking place on the ground.

DHS S&T project team support staff engaged with interested local communities in Illinois, Missouri, and Tennessee, multiple NGOs, as well as the FEMA Crowdsourcing Unit and External Affairs to identify opportunities for communities to act as trusted agents using NORTHCOM's Simulation Deck (SimDeck) to support the use of social media and crowdsourced information during exercise play. FEMA developed products via their digital volunteer network, which were integrated into CUSEC's RISP and shared with CUSEC, states and local agencies. The FEMA Crowdsourcing Unit also placed crowdsourced information into a WebEOC board during Shaken Fury.

In addition, military/civilian information sharing and social media integration were made possible through participation at the National Response Coordination Center (NRCC) in Washington, DC, and the MCC in Nashville, Tennessee.

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[28] The Canada-U.S. Enhanced Resiliency Experiment (CAUSE) is a multi-year series of joint experiments to demonstrate how voice and data communications interoperability greatly enhance regional and cross border operations and resiliency. For additional information:
https://www.dhs.gov/sites/default/files/publications/Canada-US-Enhanced-Resiliency-Experiment-Fact-Sheet-508.pdf
[29]The DHS S&T Flood Apex Program conducted the New Orleans Flood Resilience Experiment in January 2017. During the experiment, participants used the National Information Sharing Consortium (NISC) Member Portal as the central information sharing platform to manage pre-defined Essential Elements of Information (EEIs).

The current state and maturity of social media use by the CUSEC Committee is at or around phase one of the social media maturity model according to the measurement framework outlined in the Virtual Social Media Working Group (VSMWG) report on Operationalizing Social Media.[30]

Activities

Shaken Fury provided an opportunity for the FEMA NRCC Crowdsourcing Unit to test their activation process during the exercise. The Crowdsourcing Unit held daily structured coordination calls involving the digital volunteer groups involved. Digital volunteer groups participating in Shaken Fury included Code for America (CfA), Statistics without Borders (SwB), Crowd Emergency Disaster Response (CEDR), Florida Search and Rescue (FL SAR) and Crowdsource Rescue, FEMA public assistance, and others within FEMA. Unfortunately, communities with whom contract staff worked (Shelby County, Tennessee, and Cape Girardeau, Missouri) prior to Shaken Fury to demonstrate social media reporting and information sharing through the CUSEC RISP were unable to participate in the exercise due to real-world flooding events.

The FEMA Crowdsourcing Unit produced various products that were integrated into a FEMA Crowdsourcing Unit Map Journal (Figure 31).[31] This Story Map (Figure 32) integrated various information products from the RISP so the digital volunteers were able to compare/contrast official and unofficial content.
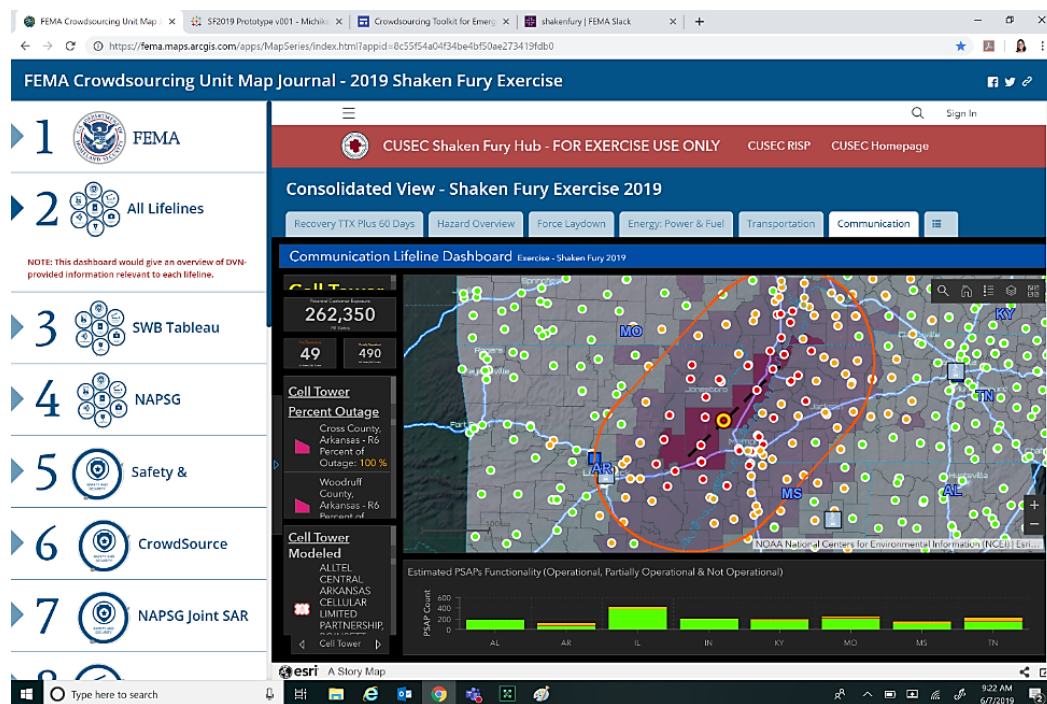
Figure 31. Communication Lifeline Dashboard in the RISP integrated into the Crowdsourcing Story Map

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[30] URL: https://www.dhs.gov/sites/default/files/publications/SMWG_From-Concept-to-Reality-Operationalizing-Social-Media-508.pdf

[31] URL: https://fema.maps.arcgis.com/apps/MapSeries/index.html?appid=8c55f54a04f34be4bf50ae273419fdb0
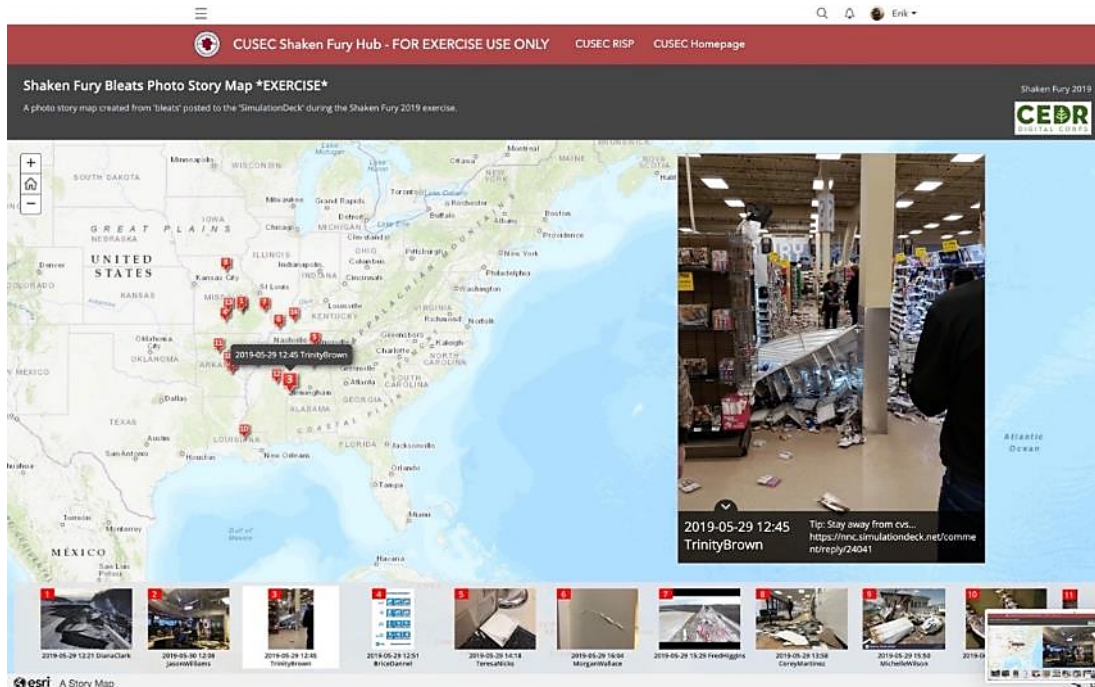
Figure 32. Shaken Fury Bleats Photos Story Map by CEDR

Outcomes

	Information Sharing
	Information from the FEMA Crowdsourcing Unit and the digital volunteer groups was shared bi-directionally with the Shaken Fury Hub Site, allowing viewers to view and incorporate non-traditional information in with traditional information.

	Relationship Building
	During the Shaken Fury exercise, the FEMA Crowdsourcing Unit and CUSEC were able to work together and integrate crowdsource information from partners in the CUSEC RISP.

	Multi-Level Coordination
	The FEMA Crowdsourcing Unit Storymap was available for exercise participants at the federal, regional, state and local levels.

Operational Support
No related operational support findings.

Technology Advancement and Adoption
Collaboration with the Crowdsourcing Unit resulted in an update of the storymap, which was used during Hurricane Dorian.

Integration into Governance and Process
Shaken Fury provided an opportunity for the FEMA NRCC Crowdsourcing Unit to test their activation process and hold daily structured coordination calls involving the digital volunteer groups involved.

Participants

Several communities were recruited by DHS S&T contract staff to act as local trusted agents during Shaken Fury, gathering and sharing actionable information gleaned from social media. The specific participants are detailed in table below.

Participants	
CUSEC	FEMA Crowdsourcing Unit and External Affairs (at FEMA HQ)
Crowd Emergency Disaster Response Digital Corps (CEDR)	Florida Search and Rescue (SAR) and FEMA Region IV
Code for America (CfA)	Statistics without Borders (SwB)

Integrated Findings

DHS S&T support to Shaken Fury 2019 took many forms, from the development of specific technology solutions as part of the CUSEC partnership to the demonstration of dozens of products in Muscatatuck and Birmingham. There are key themes that were repeatedly identified during the development, deployment and assessment phases of these projects. Those include the significant increase in:

- Amount of information that could be shared by community partners during a response;
- Number of new relationships forged during the planning and execution of these projects;
- Amount of collaboration that was possible between new and existing partners;
- Technology solutions available to planning and operational personnel;
- State of technology for information sharing and situational awareness solutions; and
- Ability to integrate new solutions into existing processes and standards.

Each of these findings is discussed in greater detail below.

 Information Sharing Findings

The main focus of the DHS S&T Shaken Fury activities was to develop, demonstrate and assess information sharing capabilities to enhance public safety operations. Participant feedback reflects that S&T was successful in this endeavor. With the RISP dashboards being projected onto very large screens at the KYEM and TEMA EOC sites, hundreds of players were able to use the information provided. The utility of this information prompted the development of additional ad-hoc dashboards during exercise play because agencies were able to appreciate the utility of the information and how it was displayed.

Planning and response personnel from domestic and international US&R task forces, as well as state and local agencies in Birmingham, were able to give direct feedback to enhance future information sharing capabilities. The exposure of the DHS S&T-funded technology solutions and information products augments the ability for S&T to be successful in follow-on and future projects.

General
Over 100 NGB portal users were enrolled into the CUSEC Shaken Fury Sharing Group and the NGB users were successfully able to use content via their JIEE 2.0 platform to support a situational awareness view of operations.
The NORTHCOM COP team based in Colorado Springs, Colorado, worked with project staff to leverage the EEI and general situational awareness content found in the CUSEC RISP Sharing Group.

The integration of the DoD SAR application called Guardian with content from the RISP was not achieved during the exercise.

The Shaken Fury exercise provided DHS S&T and CUSEC the opportunity to demonstrate technology solutions that enhance states' capacity to share information and maintain situational awareness.

Participants were impressed with the amount of information from disparate sources that could be integrated into a situational awareness platform. One mentioned that the increase in the level of information that was easily available could significantly change operations.

Live-streamed sUAS and body worn camera video footage allowed unified command staff to have eyes-on situational awareness in and around the stadium, helping them deploy resources.

Jefferson County Emergency Management Agency was impressed by how much real-time operational status information they could access from the EOC through the situational awareness dashboards without having to request a report from the unified command staff.

Information from the FEMA Crowdsourcing Unit and the digital volunteer groups was shared bi-directionally with the Shaken Fury Hub Site, allowing viewers to view and incorporate non-traditional information in with traditional information.

RISP
The CUSEC RISP Shaken Fury Hub Site was used during the exercise to provide a "front-end" to content shared to the Shaken Fury Group. Participants used the site to access the key information products shared by CUSEC and CUSEC partners. Participants were able to feed information into the RISP and were able to get information from it.
In the lead up to the exercise, there were a total of 162 individuals who requested access to the CUSEC RISP and RISP Shaken Fury sharing groups.
The CUSEC RISP Dashboards were displayed prominently in Tennessee and Kentucky. The dashboards were seen by hundreds of exercise participants during the exercise.
Partners that shared with the RISP during the exercise included CUSEC states, FEMA Regions and headquarters, state and federal ESF partners, private sector, non-profit organizations, and the DoD.
The CUSEC RISP Shaken Fury site was the most visited as this was the main landing page that participants were directed to, with nearly 1,500 page views during the exercise.
Usage of the RISP expanded significantly during Shaken Fury with over 290 total users either using or requesting access to the RISP.
The power outage dashboard was the most visited of the CUSEC information products during the exercise, with 1,149 page views over the course of the exercise.
Participants in the State EOCs used information from the power status dashboard to inform their daily Situation Reports.
Exercise participants stated that the graphical summaries of power outages over time provided a useful way to assess trends in power restoration by state or region.

PDF snapshot reports provided participants with a point-in-time summary of power outages by state.

Conversations with ESFs and participants from other state agencies supporting the exercises in Kentucky and Tennessee revealed they had not previously been aware of the RISP or the availability of Power Outage Status information until Shaken Fury. This is critical to DHS's objective for Shaken Fury to increase awareness and adoption of these systems.

The GasBuddy Dashboard informed emergency managers on regional and state gas station fuel and power status, and the trends in status over time. This information provides emergency managers with a solid evidence base to inform timely decisions regarding resource allocations, such as generator placement to restore power to a station with fuel but no power. Trends in fuel availability provide an indicator on the overall stability of the retail fuel market.

In Kentucky, RISP information products as well as KYEM Task Log, Resource Requests, County Mutual Aid, Water Status, Large Animal Shelters and the CUSEC Shaken Fury Hub Site were prominently displayed in the SEOC during KYEM's exercise play. KYEM incorporated the dashboards from the CUSEC RISP directly into their own products to provide a state and regional view.

CUSEC RISP information products (Power, GasBuddy, Saber) as well as the TEMA ArcGIS MCC Dashboard, ESR & Shelter Map and TNSAVE Dashboard were prominently displayed in the SEOC during the entirety of the Exercise.

EEIs/FEMA Community Lifelines
The exercise provided all participants with a hands-on introduction to the Community Lifeline construct, and how this would be used to help standardize reporting efforts during the response phase of a disaster with the end goal of stabilizing Lifelines.
Seven Tier III FEMA Community Lifelines Dashboards were shared with the CUSEC Shaken Fury Group for all participants to access.
During Shaken Fury, FEMA exercised the use of their Lifeline WebEOC Boards (Tier I, II, IV) as well as the Lifeline-based Information products (Tier III). The exercise demonstrated how the states, FEMA Regions and FEMA Incident Management Assistance Teams could report Lifeline status updates based on the Community Lifeline construct.
The Resource Request (KYEM) and MCC (TEMA) WebEOC Boards were adapted to provide mission status information for these states aligned with Lifelines shared in the RISP Hub.
The Lifeline reporting function was used to export content for Situation Reports.
The TEMA MCC Dashboard and MCC Lifeline report generation tool was used prior to Shaken Fury for a real-word event, during the exercise and then the week following Shaken Fury for a Department of Energy exercise. This demonstrates that the goal of providing a capability that could be immediately used following Shaken Fury was achieved.
KYEM and the Kentucky Division of Water were able to test the water infrastructure reporting capability, and this was used to demonstrate potential capabilities for other ESFs.

KYEM's approach to use Survey123 for coordinating inputs from their State Division of Water represents a repeatable approach that could be applied to other State ESFs.

SEMA developed workflows to report infrastructure status using Esri Maps for Office with Excel demonstrates an easily trainable workflow for users on the same network.

The State ESF Partners in Tennessee that provided inputs to the ESF Lifeline Survey were pleased with the simplicity of the reporting process.

The automated reporting (print to PDF) functionality demonstrated with the MCC Lifeline reporting tool was implemented on a TEMA server to support post-exercise data reporting.

FEMA will continue to drive the Lifeline reporting process forward and is committed to continued partnership with DHS S&T and CUSEC in order to help with coordination and engagement with states for training and roll out of the WebEOC Boards.

FEMA WebEOC Integration

The Shaken Fury exercise provided an opportunity for FEMA to validate new approaches to better automate the way gathering information from states and regions aligned with the Community Lifeline construct and facilitated turning this information into a standard Senior Leadership Brief (SLB) product.

Overall, participants stated that the FEMA WebEOC Integration worked well during the exercise.

Although states had prepared to use the Juvare Exchange solution to connect to FEMA's Lifeline Boards during the exercise, this was not used during the exercise due to a security concern raised prior to the exercise. The concern was related to using Juvare Exchange to connect the FEMA and state systems together without Juvare Exchange meeting FedRAMP requirements.

Building Safety Assessment Application

The CUSEC Building Safety Assessment program represents the most mature implementation of S&T-supported technology demonstrated during Shaken Fury.

During the exercise, the Tennessee Structural Assessment and Visual Evaluation (TNSAVE) coalition tested their activation and field collection processes. Fifteen TNSAVE volunteers across the state provided a total of 51 reports between May 28 - June 7 to test the Collector app and Dashboard.

The ISTF training, Shaken Fury Exercise and real-world deployments of Missouri Safety Assessment and Visual Evaluation (MOSAVE) provided a wide platform to demonstrate the capabilities and value of these Safety Assessment Programs.

Local SAVE coalition teams used the Building Safety Assessment Application to share information regarding critical infrastructure during the exercise. Specifically, it was used to report information such as number of unsafe, restricted use and inspected buildings.

The TEMA Situation Unit Leaders coordinated with FEMA IMAT staff to share content for reporting.

A frequently heard comment throughout the exercise was that the RISP and dashboards give TEMA access to Federal Communications Commission (FCC) data, SABER data (e.g., store statistics), fuel data (through GasBuddy) and power outage data all in one place and in real-time. This aspect appeared to be the most strongly favored by participants.

The TEMA Fixed Nuclear Facilities Specialist explained that dashboards are commonly used at TEMA; however, current dashboards are not equipped for such a large-scale incident, like the new dashboards are. It was also stated that being able to see the status of all other states is key in successful response and recovery.

Relationship Building Findings

Through participation in Shaken Fury activities, DHS S&T was able to build and grow critical relationships that will be advantageous as it moves forward with future technology development projects. Working with end users in CUSEC states to advance the state of the RISP dashboards, working with DoD to identify pathways for future development, and working with US&R teams to better understand capability gaps and needs are all examples of how the relationships established during these activities will enhance the success of S&T in the future.

In addition to the relationships developed by DHS S&T, the Shaken Fury activities allowed for the connection of other groups. Vendors in Muscatatuck and Birmingham were able to work closely with end users to refine their products to better meet operational needs. NGB staff at the US&R exercise were better able to understand how they can share information and support civilian operations. Multiple participants commented on how this experience allowed them to meet and/or work more closely with new and existing partners. This may be one of the most important legacies of the DHS S&T projects.

The TEMA GIS Specialists commented that they learned a lot through the FEMA IMAT teams and from meeting their FEMA counterparts, many of whom they had not met before.

Multiple participants stated that one of the biggest benefits of the exercise was building a relationship with CUSEC, other states and TNSAVE.

Stronger connections were made during the exercise because of the RISP dashboards. Participants noted that the large display of the RISP highlighted that only some EEIs were included in the existing dashboards. This prompted conversations between KYEM and the ESF leads and the development of new dashboards.

The DoD/NGB/DHS Working Group provided DHS S&T with the opportunity to work with stakeholders with whom they had not previously engaged.

Representatives from the U.S. Navy and U.S. Air Force attended the Shaken Fury Exercise as DoD liaisons to the Kentucky Emergency Management Agency, allowing for relationship building.

A planning and integration liaison between NORTHCOM and FEMA suggested that the RISP be utilized in the National Level Exercise that will take place in 2020.

Through interviews, both vendors and US&R teams gave very positive feedback about the experience with DHS S&T's showcase approach at MUTC and are eager to continue their relationships with DHS S&T both outside of the exercise context as well as at future planned events.

The vendors expressed appreciation of the opportunity to develop relationships with US&R personnel that came through the DHS S&T technology showcase as well as in the field during exercise demonstrations. They found these interactions to be valuable in both obtaining end-user feedback on the current iterations of their systems and in better understanding user requirements.

The vendors expressed appreciation of the opportunity to network with each other in the tent during down time. Several of the vendors reported discussions about potential collaboration efforts in the future.

First responders were excited about the opportunity to both see the functionality of the new technology as well as speak with developers about how it could address their needs. Several US&R teams scheduled in house demonstrations of the technology as a result of presentations in the tent and in the field during exercise.

> "The future technology to do our job better was here. We could see it; we could test it; we could play with it. They can go back and make it better for us and hopefully get it to us in the next few years." – Evan Schumann, Program Manager, Ohio Task Force 1.

Birmingham Police Department believed that there was great collaboration between departments during the OpEx, which will be essential during the World Games 2021 response.

Other participants expressed appreciation that the OpEx allowed participants to "put faces with positions," which will be a good precedent to help prepare for the World Games.

During the Shaken Fury exercise, the FEMA Crowdsourcing Unit and CUSEC were able to work together and integrate crowdsource information from partners in the CUSEC RISP.

Multi-Level Coordination Findings

Feedback from stakeholders during many of the Shaken Fury activities indicated that the technologies being demonstrated and assessed improved the ability of agencies and groups to collaborate beyond the technical sharing of data. Not only were staff or groups able to consume information that they had never had access to before, but they were able to communicate with

other organizations to solve problems and make decisions based on that data. For example, EOC staff being able to see the cascading power outages in other states improved situational awareness, allowing them to be more proactive in their decision-making and operational assignments. This included the ability to pre-position supplies and communicate more accurately with other agencies and the public.

Also improved was the ability for agencies to work in coordination with other levels of government. Participants noted that information was not flowing only upwards, but they were getting additional data "downward" from higher levels of government and other partners.

Shaken Fury provided an opportunity to highlight the need for standardization of regional or national level products to support consistent Lifeline reporting processes.
FEMA shared over 195 layers of information in the CUSEC group. Participants stated that being able to see the information that FEMA shared via the RISP was unique because usually information is provided to FEMA with less information flowing from the federal agency.
The emergency service routes shared by TEMA were used by FEMA Region IV for resource planning and allocation decisions.
The EEI and FEMA Community Lifelines Integration provided participants with local and regional summary reports. These automated reports included GasBuddy Fuel Status tracking and Statewide Power Outage Reports, both used during the exercise to share information regarding fuel and power outage status.
During the exercise, FEMA successfully incorporated information shared by states into their own Lifeline-based information products. Because the Lifeline reporting was a new process, the ability to ingest and use this information was an achievement.
The exercise allowed collaboration between the ESFs and Federal IMAT teams, which enabled better coordination within the EOC. As a result, ESFs were interested in exploring additional opportunities to share data to enhance state dashboards, develop new products to assist with Lifeline implementation and align EEIs to Lifelines to enhance reporting.
FEMA WebEOC boards were used by states, FEMA IMAT Teams, FEMA Regions and HQ to report information by FEMA Community Lifelines.
The NGB experienced issues with bandwidth throttling, which impacted their ability to collaborate during exercise play.
DoD included RISP dashboards in daily bridging reports.
The City of Birmingham was pleased with the level of participation from its public safety agencies, allowing state, local and private sector organizations to work together.
The University of Alabama at Birmingham's Emergency Management and Public Safety staff found it very valuable to work more closely with the City's operational responders at all levels, practicing vital coordination.

AEMA and the Alabama National Guard provided important state-level insights during the EOC Information Sharing workshop that helped the Jefferson County Emergency Management Agency understand what Community Lifeline information the state would request during an earthquake incident.

The FEMA Crowdsourcing Unit Storymap was available for exercise participants at the federal, regional, state and local levels.

Operational Support Findings

Of critical importance when assessing the success of a technology development program is the extent to which new solutions produce improvement in capability. In Kentucky and Tennessee, DHS was able to evaluate the success of those efforts to determine the extent to which the RISP, WebEOC Integration, FEMA Community Lifeline reporting and the Building Safety Assessment application met operational needs. Participants in those states were pleased with the operational support provided by the DHS S&T-funded solutions. This was evident not only in the information sharing among ESFs, but also by the inquiries from DoD staff to identify how GasBuddy data, for example, could be used to support their domestic operations.

Participants in Kentucky, Tennessee, Indiana and Alabama commented on how these technologies enhanced their ability to make decisions. The Birmingham public safety agencies commented specifically that many of these technologies would be extremely helpful as they prepare for the World Games 2021 because they provide a substantial increase in their current capability. Furthermore, the City of Birmingham plans to base some World Games planning and investment decisions on the outcomes of the OpEx. The development of additional dashboards during (and after) the Shaken Fury exercise and equipment investment by US&R task forces and state and local response agencies demonstrates the impact of DHS S&T technology development investments.

Tennessee adopted use of the CUSEC RISP dashboards by integrating them into their own state Operations Dashboards to provide information for key EEIs. Exercise participants noted the value of how the information was displayed in the RISP and as a result, ESFs in both states explored ways to better integrate information from their specific agencies into the SEOC dashboards.

The trends of Power Outages and Fuel Status were determined to be essential components of the dashboards.

The TEMA GIS Specialist stated that the two most key decision points in which information was being shared during the exercise were Emergency Medical Services (EMS) routing and sheltering decisions.

A Survey123 form allowed ESFs to report to ESF-5 in a structure that matched the Tier IV WebEOC Lifeline board input form. In addition, alignment of the MCC Dashboard to Lifelines helped ESF-5 to summarize status in the Tier IV FEMA Community Lifeline Board.

The private sector and other partners used the National Business Emergency Operations Center's (NBEOC) situational awareness platform to ask questions and get answers during the exercise.

The TEMA Situation Unit Leaders worked together to collect and organize content from the ESFs, and input this into the FEMA Tier IV Lifeline Board while also developing the daily situation reports.

The TEMA Planning Branch Administrator stated that the RISP has a lot of capabilities that were previously unavailable to TEMA and thought that the RISP information products were useful.

The TEMA GIS Specialist was interested in the RISP functionality to automate the creation of summary PDF reports from GIS content and is interested in adapting some of the RISP scripts for other uses.

The TEMA Situation Unit lead provided a lot of positive feedback about how useful the RISP was to have organized information flows to feed the reporting process.

The GasBuddy Dashboard was seen as an important source of information by several ESFs, including ESF-3 and ESF-12. ESF-12 used the Power Outage and GasBuddy Dashboards during the exercise, giving a positive review about how well it summarized the information with totals and graphs.

The TEMA MCC Board that was modified based on the FEMA Community Lifelines (with the Lifeline tag, ArcGIS Online Dashboard and reporting feature) seemed to be a popular feature among exercise participants, particularly in regard to the dropdown box that was used to select a Lifeline.

The TEMA Planning Branch Administrator stated that the MCC dashboard was one of his favorite things that came out of the exercise. He stated, "The dropdown box for the FEMA Lifelines that connected to the dashboards was a really good addition to help with FEMA reporting as it allowed us to see statuses based on regions and counties, filter by Lifelines, see automated maps and what counties were activated for Lifelines, etc."

TEMA staff thought the MCC Dashboard and summary Lifeline reporting process worked extremely well. Several ESFs had complained that the MCC Board did not have the same ability to filter by Lifeline as the dashboard.

KYEM hotwash participants noted that the availability of the data enhanced their decision-making during the exercise.

Multiple ESF leads at the KY EOC asked about creating additional layers for their own data in the dashboard.

The NGB team shared a Mission View service, containing locations of units involved in active operations, with the CUSEC RISP Sharing Group.

One specific area of interest was the GasBuddy Station Tracking dashboard, which would allow DoD to identify where fuel is availability along transport routes and where fuel POD sites may be necessary. DoD staff requested further information on the RISP dashboards.
DHS and DoD demonstrated information sharing capabilities at the regional level through the CUSEC RISP platform.
First responders felt that each of the products did easily relate to team and organizational needs for deployable capability, supporting standalone functionality.
Three technologies in particular – UAS, X3FINDER and Plum Cases – were in high demand for live demonstrations at the exercise.
Through one the vendors DHS S&T was able to provide free wireless network services to US&R teams in the field.
In some instances, vendors were able to work together to solve operational problems during the exercise. For example, the Ascent Solar power team worked with SpecOps to build portable solar powering solutions for FINDER.
The US&R teams were expecting more new hands-on technologies such as drones, search cameras and echo systems. Some of the technologies provided software solutions that the teams were not able to use operationally and therefore could not assess the efficacy or viability of the solutions.
The EOC staff felt that they had improved situational awareness using the available technology solutions.
Birmingham Fire and Rescue said that the OpEx opened their eyes to technology that they may use down the road during World Games 2021 response and were particularly enthusiastic about the real-time location tracking and physiological monitoring capabilities.
Participants were pleased with the exposure to new technology, especially the UAS. Based on the outcomes of the OpEx, the Birmingham Police Department is now seeking to establish a UAS team.
Jefferson County Emergency Management Agency were very interested in the evacuation modeling tool and how it could be used to plan egress, staffing and evacuation protocols at the 36 sports venues around Birmingham that will be used during the World Games 2021.

Technology Advancement and Adoption Findings

One of the primary missions of DHS S&T is the development of tools, technologies and knowledge products for emergency planners and responders. The end goal is not the development of new technology solutions, but that public safety agencies will adopt these products and that they will help those communities be safer and more resilient. Through participation in Shaken Fury activities, DHS was able to evaluate several of its investments in an operational setting.

In the months prior to Shaken Fury, the DHS S&T project team worked with end users to advance the state of technology by refining existing solutions to better fit stakeholder needs and to deploy new capabilities. The feedback from users in Kentucky and Tennessee was overwhelmingly positive. In Birmingham, the NGFR team was able to further assess the ability of the NGFR handbook construct to integrate disparate systems and provide improved capability for emergency response. In addition, end users commented on the significant improvements in their ability to share information and obtain far greater levels of situational awareness.

The TEMA Planning Branch Administrator stated that because the RISP and dashboards were customized for TEMA processes through the CUSEC partnership and were already integrated, the technologies were considered already adopted by participants.
The most cited barrier was the staff support needed to sustain any dashboard or any other types of changes. Particularly mentioned were the FEMA WebEOC Boards and the staff that would be required to enter the information into those.
Other barriers to adoption mentioned by participants included: resistance to new technology, resistance to change (e.g., adoption of FEMA Lifelines) and learning curves.
Several of the sites experienced bandwidth issues that impacted their ability to access data. This occurrence has implications for future technology development as potential solutions may need to optimize bandwidth usage.
DoD awareness of the RISP dashboards increased during Shaken Fury exercise play, but the participants at the MCC were not necessarily the correct audience to use RISP data.
NGB use of ArcGIS Online for the JIEE 2.0 system improved and simplified interoperability with state agencies.
US&R teams, exercise staff and VIPs had the opportunity to both ask questions and provide feedback on the technologies through interactions at the showcase tent as well as in the field during exercise operations.
S&T technology was integrated with the national US&R exercise. Participants' feedback not only informs future development of technology, but also results in new/stronger relationships.
There was a mix of technologies on display: some experimental and others were limited to display only. Participants stated that available demonstration units for some of the items would have been good to see in the field.
Each vendor described the opportunity to display and/or demonstrate products to the first responders as valuable. The vendors felt that they benefited from interacting with the US&R team members and received valuable input/observations from those interactions. Feedback regarding the range and types of incidents these responders face and how the technologies might be able to support their mission was described as hugely valuable for the technology developers.
The UAS technology developers felt that they learned perhaps as much or more from the failures as from the successful demonstrations, as those failures will inform the incremental technology advancement plans going forward.

The technologies singled out as most effective during the OpEx included:
- Responder geolocation;
- Physiological monitoring;
- Radiation monitoring;
- UAS capabilities; and
- Stadium evacuation modeling.

Participants expressed surprise at the level of integration that multiple systems from different vendors were available on a common platform that could be used by everyone.

Participants were impressed with how compact and user-friendly the technology solutions were.

Several of the sensors had issues with triggering correctly in the operational environment, which could indicate either lack of training for the operator to understand how to use the device to get a reading, or it could indicate a technology error.

Collaboration with the Crowdsourcing Unit resulted in an update of the storymap, which was used during Hurricane Dorian.

Integration into Governance and Process Findings

It is critical that capabilities and technology solutions developed by DHS S&T can be incorporated into existing plans, processes and standards to the greatest extent possible. The inability to do so is a significant barrier to adoption. Many public safety organizations are resistant to change, and technologies that cause cascading disruptions may be abandoned before their potential benefit is realized. The extent to which the DHS-developed systems such as the RISP are able to be quickly integrated into daily and emergency response operations is a measure of success.

Of the five DHS S&T activities in support of Shaken Fury, the greatest success in integrating technology solutions into governance and process was realized with the Shaken Fury exercise play in Kentucky and Tennessee. Because the DHS S&T project team worked closely with end users in the development and refinement of the RISP dashboards and WebEOC Integration activities, the products were highly integrated with existing capabilities. This was especially evident as personnel from other ESFs requested or built new dashboards after seeing the new capabilities provided.

This collaborative approach to technology development is essential as DHS S&T helps to develop future solutions for emergency planners and operational personnel.

Screenshots and automated reports generated from the RCOP Dashboard series were used in reporting workflows by several different agencies as well as the state emergency management.

Multiple exercise participants agreed that the RISP and the dashboards provided good situational awareness, especially in areas in which they did not have situational awareness

prior (e.g., one participant stated that TEMA usually has to create their own power outage data).
To support integration of Lifelines in state processes, KYEM aligned their ESFs to Lifeline components. KYEM prepared a Lifeline-based dashboard, incorporating a blend of information obtained from within KY as well as regional/national information from the CUSEC RISP.
The TEMA ESF-5 Planning Branch worked with DHS S&T contract staff to modify the TEMA MCC Board to include a Lifeline tag allowing MCC content to be more easily sorted, filtered and reported by Lifeline, and guide the development of an Operation Dashboard for the MCC and PDF report.
The TEMA planning branch manager thought the RISP information products were useful and the "print to PDF" functionality supported the Situation Reporting process.
Many of the ESFs' existing workflows observed during the exercise leveraged spreadsheets or databases that could be integrated with ArcGIS Online in the future to allow easier updating and sharing of information.
CUSEC's Building Safety Assessment Application has been integrated into the operational processes of multiple CUSEC state SAVE coalitions and was demonstrated during Shaken Fury and in a real-world scenario.
Based on TNSAVE play during Shaken Fury, several gaps were identified that point to the need to review state plans concerning Safety Assessment capabilities, as well as to create additional opportunities to train on using these capabilities in exercises.
Based on feedback from TEMA, including the Planning Branch Administrator and other planning staff, the Survey123 ESF report workflow as part of the FEMA WebEOC Integration was an improvement on other reporting workflows tested thus far (WebEOC, email, etc.) and they plan to review the process with ESFs to see what can be improved upon.
The Director of TNSAVE spoke highly of the Building Safety Assessment App stating that it is the "first really good digital application that can assess infrastructure, provide images and related data and put individual data points together into one view scaled for an incident this large." "Prior to this tool, people had to write this information down on a clipboard on paper…this takes time and is less efficient." In addition, it was also stated that this application has the ability to assess large-scale incidents, unlike existing technology.
Following the Jefferson City, Missouri, tornado that struck on May 22, 2019, Missouri's MOSAVE successfully used the Building Safety Assessment App to assess the condition of over 600 buildings in Jefferson City and Cole County. This allowed them to better direct emergency resources and save lives and served as a timely real-world validation of the capability.
Tennessee successfully demonstrated a workflow for entering information into FEMA's Community Lifelines WebEOC boards.

It was suggested that in the future, prior to the exercise, that DHS S&T contact the appropriate FEMA US&R subgroup so that a representative of the subgroup can attend the exercise or event. This would have a threefold benefit: 1) ensure a subject matter expert is present to give feedback; 2) provide the means to get the potential solutions into the decision-making process so the technology may be added to the authorized cache list; and 3) help transition DHS-funded and commercial technologies.

Many of the technologies tested during the OpEx do not easily fit into existing responder Standard Operating Procedures. To fully implement these types of sensors and situational awareness tools, responders would need to adjust these procedures to incorporate the technologies and then re-train personnel.

While operations-level responders wore mostly passive technologies (i.e., location tracking sensors that they did not need to interact with), command-level responders were using complex situational awareness tools that required more training time than was available before and during the OpEx. Full integration of these tools into operations would require significant dedicated training.

Managing a suite of technologies where each responder receives several paired devices requires significant staff support with technical expertise, which is an added operations and maintenance cost in addition to the technology and services costs.

All public safety sUAS programs will need to consider privacy implications of flying over areas where individuals have a reasonable expectation of privacy, which may require more rigorous policy about when sUAS may be used and what can be done with any video or audio recordings (i.e., sharing, storage, review).

Shaken Fury provided an opportunity for the FEMA NRCC Crowdsourcing Unit to test their activation process and hold daily structured coordination calls involving the digital volunteer groups involved.

Appendix A: FEMA Community Lifelines

The figure below illustrates the Community Lifelines construct. Each Lifeline is comprised of multiple components and essential elements of information needed to stabilize the incident.
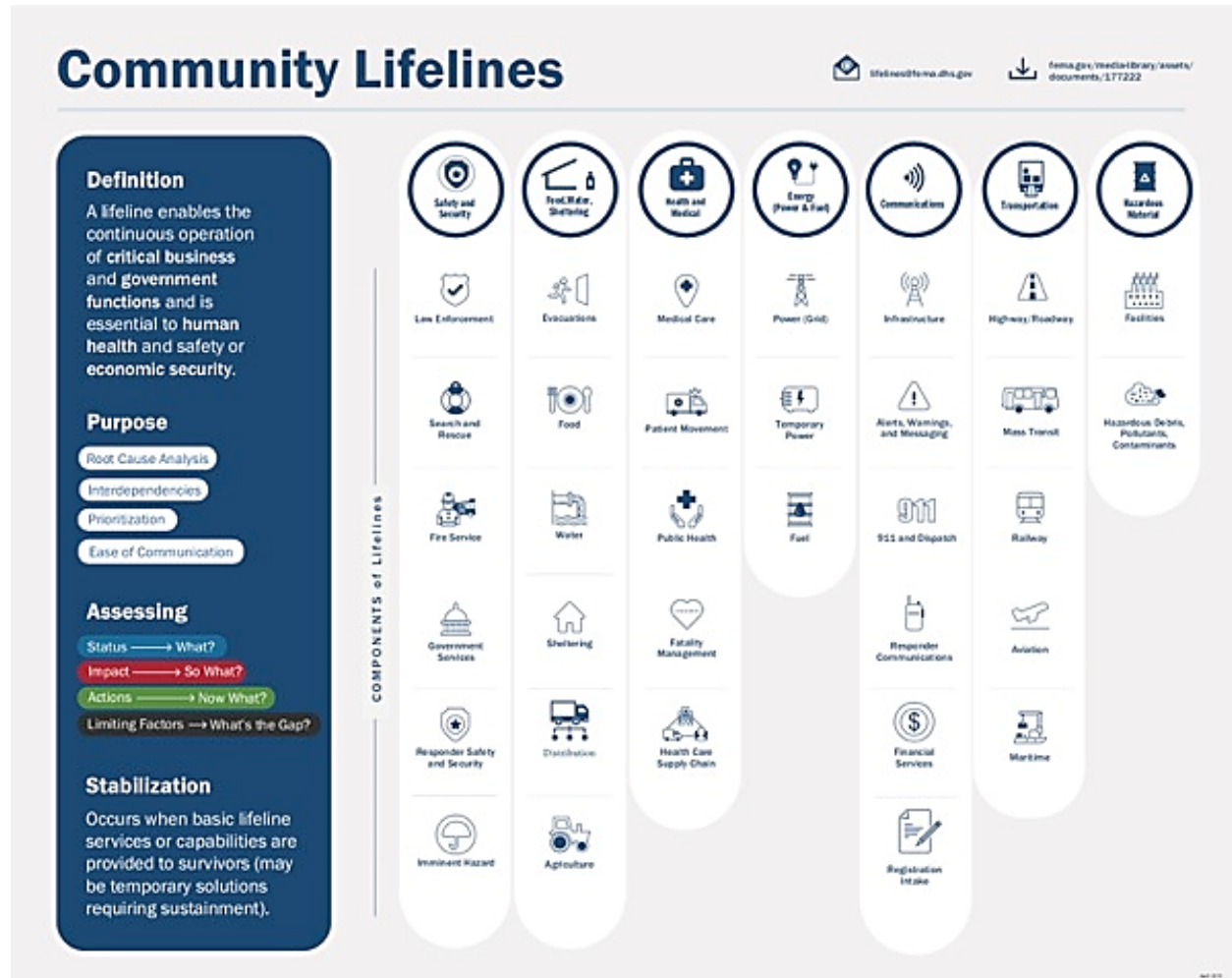
Figure 33. FEMA Lifelines Construct Graphic

Appendix B: CUSEC Prioritized EEIs

CUSEC's efforts to identify and develop EEIs has been led by its Geographic Information Systems (GIS) Technology Working Group since the 2011 National Level Exercise (NLE). Formed in 2008, the Working Group is comprised of GIS and other technology professionals from the CUSEC member state emergency management agencies and other partner organizations. The group has been involved in several major multi-state planning efforts to improve situational awareness and use technology in disaster response and recovery by developing technical approaches to capture and share priority EEIs—originally referred to as Key Primary Indicators (KPIs)—established by the CUSEC Board of Directors. The original list for NLE 11 had seven KPIs. The list expanded to 18 EEIs for the CAPSTONE 2014 exercise, and then was simplified to currently focus on seven priority EEIs that reside in the RISP (see Table 32 below).

NLE 2011	CAPSTONE 2014	Regional COP (2015)
• Power • Shelters • Hospitals • Transportation • Emergency Communications • Fatalities • EOC Status	• Electricity grid • Natural Gas grid • Public Water grid • Road Status • Rail Network • Navigable Waterways • Air Transportation Infrastructure • Area Command Locations • Staging Areas • Points of Distribution JRSOI • Evacuation Orders • Injuries and Fatalities • Shelters • Private Sector Infrastructure • U.S. Geological Survey Data • Communications • Hospital Status	• Power • Shelters • Hospital Status • Transportation • Communications • Water Status • Fuel Status

Figure 34. CUSEC Prioritized EEIs

Appendix C: Injects

The injects below were added into the Master Scenario Events List (MSEL) to prompt states to provide data and review summaries as provided by the technology solutions.

Number	Subject	Description	Timeline
CUSEC-701000-01	Activation of TEMA SA Teams	Based on TEMA request for support, TNSAVE activates and initiates call-down process.	030800S Jun 2019
CUSEC-701002	CUSEC request for additional accounts through ESRI Disaster Recovery Program	CUSEC request for additional accounts through ESRI Disaster Recovery Program in order to support additional requests for access to CUSEC RISP.	291200S May 2019
CUSEC-701002-01	Manage requests for new user accounts in the CUSEC RISP	There is an influx of requests to access information through the CUSEC RISP. There is a mixture of users with existing ArcGIS Online accounts requesting access to the Shaken Fury exercise Group, as well as users without ArcGIS Online accounts needing a temporary account and group access.	030900S Jun 2019
CUSEC-701003	CUSEC providing access to regional power outage data.	Access to power outage data by way of CUSEC RISP. Information provided by DOE/Clearpath.	291400S May 2019
CUSEC-701004	CUSEC providing access to summaries of communications outage data	Access to communications outage data from FCC DIRS by way of CUSEC RISP.	310900S May 2019
CUSEC-701005	CUSEC providing access to commercial fuel status from GasBuddy	Access to fuel/power status from GasBuddy by way of CUSEC RISPl.	310900S May 2019
CUSEC-701006	CUSEC providing access to private sector disruption data from SABER	Access to business disruption data from SABER is accessible from the CUSEC RISP. Information may include details on cause of closure (e.g., Power, Access, Security, Communication) and expected time to return to normal operations.	010900S Jun 2019

Number	Subject	Description	Timeline
CUSEC-701007	TN State Geologists reporting field data on landslides, liquefaction	Field geologists are reporting the location, descriptions and photos of landslides, liquefaction, lateral spreading and other earthquake-related observations. This information is important for emergency managers as it can be used to identify roads/bridges that may be impassable or require inspection, areas underground that may have failed pipes/stormwater drains and potential issues for groundwater supply amount and quality.	030000S Jun 2019
CUSEC-701008	AL State Geologists reporting field data on landslides, liquefaction	Field geologists are reporting the location, descriptions and photos of landslides, liquefaction, lateral spreading and other earthquake-related observations. This information is important for emergency managers as it can be used to identify roads/bridges that may be impassable or require inspection, areas underground that may have failed pipes/stormwater drains and potential issues for groundwater supply amount and quality.	030000S Jun 2019
CUSEC-701009	AR State Geologists reporting field data on landslides, liquefaction	Field geologists are reporting the location, descriptions and photos of landslides, liquefaction, lateral spreading and other earthquake-related observations. This information is important for emergency managers as it can be used to identify roads/bridges that may be impassable or require inspection, areas underground that may have failed pipes/stormwater drains and potential issues for groundwater supply amount and quality.	030000S Jun 2019
CUSEC-701010	MO State Geologists reporting field data on landslides, liquefaction	Field geologists are reporting the location, descriptions and photos of landslides, liquefaction, lateral spreading and other earthquake-related observations. This information is important for emergency managers as it can be used to identify roads/bridges that may be impassable or require inspection, areas underground that may have failed pipes/stormwater drains and potential issues for groundwater supply amount and quality.	030000S Jun 2019

Number	Subject	Description	Timeline
CUSEC-701011	KY State Geologists reporting field data on landslides, liquefaction	Field geologists are reporting the location, descriptions and photos of landslides, liquefaction, lateral spreading and other earthquake-related observations. This information is important for emergency managers as it can be used to identify roads/bridges that may be impassable or require inspection, areas underground that may have failed pipes/stormwater drains and potential issues for groundwater supply amount and quality.	030000S Jun 2019
CUSEC-701012	MS State Geologists reporting field data on landslides, liquefaction	Field geologists are reporting the location, descriptions and photos of landslides, liquefaction, lateral spreading and other earthquake-related observations. This information is important for emergency managers as it can be used to identify roads/bridges that may be impassable or require inspection, areas underground that may have failed pipes/stormwater drains and potential issues for groundwater supply amount and quality.	030000S Jun 2019

Appendix D: Exercise Injects and/or Expected Actions

For each portion of the exercise information sharing lane, DHS S&T project team staff have worked with state exercise planners, military exercise planners and localities to suggest injects and/or expected actions (EA) that will demonstrate use of the technologies that S&T has supported.

CUSEC Regional Information Sharing

Table 14. Injects Related to the CUSEC Regional Information Sharing Portal

'Sub' Objectives	Number	Associated Injects
Engage new and existing partners to develop 'standard' RISP Products and services	C1	*Inject (n/a) – overall objective for shaken fury engagements, no injects required.*
Demonstrate value and Improve awareness of RISP	C2	*Inject (n/a) – overall objective for shaken fury engagements, no injects required.*
States share information with RISP (e.g., Resource Requests, ESR status, Hospital status, etc.)	C3	*Inject (n/a) – would be conducted before exercise.* Expected Action (EA): Prior to exercise, State EMAs share data (including incident/activity logs, resource request boards) with CUSEC RISP. CUSEC monitors that these feeds are active. EA: Safety Assessment teams in TN (TNSAVE) and MO (MOSAVE) activate post NMSZ rupture. TEMA and SEMA share data during incident, including Building Safety Assessments.
States consume information from RISP	C4	Inject (1) CUSEC sends email notification to members of RISP Shaken Fury group alerting them of significant updates in group pertaining to incident-related data sources/dashboards. EA: States access information shared through group.

'Sub' Objectives	Number	Associated Injects
	C5	Inject (2) Email sent to CUSEC, CUSEC member states to provide update on newly added EEIs available on the CUSEC RISP. This will ensure access to services containing data on in Safety Assessments, GasBuddy, FCC DIRS, Private Sector tabs in CUSEC RCOP Dashboard series. (e.g., gas availability via GasBuddy, Communication Status from FCC DIRS, Private Sector Status from SABER). EA: State consume data in their own viewers and/or the CUSEC Dashboard Series. This information will inform state Lifeline reporting through the FEMA WebEOC Lifeline Board.
	C6	Inject (3) Email sent to CUSEC, CUSEC member states to provide update on information on Power status. State observes power outage data hosted by CUSEC RISP, either in RCOP Dashboard series or in their own system. Observes that certain counties have no data reported by utility, but information is available from county EMA. EA: State updates data in CUSEC RISP power outage service (manual override process). This information will inform state Lifeline reporting through the FEMA WebEOC Lifeline Board.
States request accounts through Esri Disaster Recovery Program (DRP)	C7	Inject (4) Influx of requests to access information on state ArcGIS Online for Organizations site. EA: GIS Admin to request additional user accounts.
CUSEC Specific:		
Demonstrate CUSEC's ability to manage users/group access to RISP during event (2) Provide access to CUSEC partners with access to RISP (states, feds, etc.), 'have-nots' that don't have access to ArcGIS Online	C8	Inject (5) Influx of requests to access information on CUSEC RISP. EA: CUSEC request for additional accounts through Esri Disaster Recovery Program. EA: Manage requests for new user accounts in the CUSEC RISP. EA: Manage access request to RISP Exercise Group(s).

Table 15. Injects Related to EEIs/Lifelines

'Sub' Objectives	Number	Associated Injects
Establish/document preferred approaches by each state for Lifeline reporting	L1	*Inject (n/a) – would be conducted before exercise, no injects required.*
Coordinate EEI information sharing from states to RISP	L2	*Inject (n/a) – would be conducted before exercise, no injects required.*
Develop State and Regional Lifeline standard reports	L3	EA: State ops staff reference state Lifeline report in preparation for daily Sit reports, FEMA Lifeline reports, etc. *Could be used as attachments for state Lifeline reports on FEMA WebEOC Lifeline Board.*

Table 16. Injects Related to FEMA WebEOC

'Sub' Objectives	Number	Associated Injects
Establish the degree that each state will (1) integrate/use FEMA WebEOC and (2) support resource requests and FEMA Lifeline Boards	W1	*Inject (n/a) – FEMA responsible for any injects under this lane.*

Table 17. Injects Related to the Building Safety Assessment Application

'Sub' Objectives	Number	Associated Injects
Transition Building Safety Assessment Application to states to host and manage	BA1	*Inject (n/a) – conducted before exercise, no injects required.*

'Sub' Objectives	Number	Associated Injects
Test activation/call-down/deployment & data collection process	BA2	Inject (6) After initial assessment of the extent of damage from the Jan. 29 EQ, locals request safety assessment teams deployed to affected area to survey damage to residential/commercial building stock. These surveys are critical in understanding the ability for residents to safely occupy infrastructure, impact on business community, amount of external resources necessary to stabilize the Food/Water/Sheltering Lifeline. EA: The local request prompts the state formally requesting support by the TNSAVE group. TNSAVE activates and deploys, in coordination with TEMA. EA: TEMA coordinates logistical elements, including ensuring law enforcement escorts for SA teams. EA: Activation of SA Teams. EA: SA team lead initiates call-down process. EA: SA Team lead establishes # of available SA Volunteers. The total tally of available volunteers is shared with TEMA.
	BA2	Inject (7) The need for trained volunteers to conduct building safety assessments outstrips availability of local (TNSAVE) resources, requiring mutual aid to bring in additional help outside of Tennessee. EA: Mutual aid request for additional SA teams – logistics transporting team from Missouri. EA: Field report data from safety assessments are gathered using ArcGIS Collector app. EA: Data collected by SA teams shared with state. EA: State share data to RISP. EA: SA data utilized for Response/Recovery.
Coordinate sharing of services back with RISP	BA3	*Inject (n/a)* – overlap with CUSEC Regional Information Sharing Portal / EA for states to share information to RISP.
Support Building Safety Assessment Programs (just in time training, SF MSELs, etc.)	BA4	*Inject (n/a) – would be conducted before exercise, no injects required.*

Military/Civilian Information Sharing

Ardent Sentry, Vigilant Guard and Urban Search and Rescue (US&R) points of collaboration are described below for the DoD/NGB/DHS CIO Working Group. Due to DHS S&T not being formally part of the Vigilant Guard and Ardent Sentry Planning, there were no specific injects created directly to address each 'sub' objective. Instead, the expected actions that demonstrate bi-directional information sharing followed injects already inserted into the JMSEL. In addition, while at the MCC, contract staff simulators prompted players to conduct information sharing expected actions described in Table 18.

Table 18. Associated Activities for Military/Civilian Information Sharing

'Sub' Objectives	Number	Associated Activities
Establish the CUSEC Safety Assessor Program members and Local Communities crowd sourced content as a key data source for DOD mission planners.	DoD1	Example Inject: KY-605262 County Damage Reporting: The Kentucky counties of Ballard, Caldwell, Calloway, Carlisle, Christian, Crittendon, Daviess, Fulton, Graves, Hickman, Livingston, Lyon, Marshall, McCracken and Ohio Counties. Reports of extensive damage to several area roads, homes and public buildings are coming in. Some major roads throughout the region are impassable. Landline phones, cell reception and some radios are not functioning in the most severely affected areas. Downed trees, utility poles and power lines are widespread. EA: Rupture day 2 initial assessments start to come in and DOD mission partners will access the content via the CUSEC RISP and draw up their mission plan or have situational awareness before deploying.
DOD assets share Friendly Force Tracking (FFT) feed to CUSEC's RISP. For Sit Awareness on missions in the Response Phase.	DoD2	Example Inject: Tennessee-608037: TEMA requests TN NG coordinate support to assess airfields to identify a suitable location for establishment of Forward Support Bases (FSBs) and secondary support bases. Airfield Assessment team needs to conduct an airfield assessment of Memphis International Airport, Millington Regional Jetport, McKellar-Sipes Regional Airport and other airports as requested to determine the useable operating runway length and weight limits relating to support, landing and takeoff of cargo aircraft. EA: Rupture day 2 to Rupture day 7 (before time jump) DOD US&R team members share FFT feed with FEMA and State EM.

'Sub' Objectives	Number	Associated Activities
DOD members import FEMA, State and Local missions and also share their Mission Assignment data with FEMA and State Partners in support of Defense Support of Civilian Agencies (DSCA).	DoD3	Example Inject: N-NC/AEROPSPACE-143876 FUOPS activation: Upon awareness of major earthquake, SAR is identified as a possible mission set for DoD response by the J3 who then orders activation of FUOPS to prepare to respond to emergent SAR needs and other DSCA services. EA: Rupture day 3 to day 7 for Incident Action Planning (ICS 215) and RRF mission data is shared and combined with CUSEC SAP data into an operations dashboard.
Bi-Directional sharing of EEIs.	DoD4	Example Inject: Tennessee-608016 Request for Route Recon and Situational Awareness: Develop a request for the Military, Highway Patrol, and the Civil Air Patrol to initiate air recon of Emergency Support Routes. Conduct coordination with the agencies on timeline and available aircraft. EA: R1 –R7 sharing of EEI's and for tactical awareness. Players will work with services and products found in the CUSEC RISP to provide situational awareness capabilities for both Military and Civilian players.
Mission Request Task Content.	DoD5	Example Inject: Mississippi-600101 Debris Removal: Tate Co. EOC reports that Emergency vehicles are having difficulty navigating portions of highway 4 in the aftermath of the earthquake and subsequent fire that swept through the region. The City of Senatobia EOC requests Tate Co. EOC obtain engineer support for debris removal along Highway 4 between North Panola Street and Scott Street. 3 bulldozers, 5 trucks and 3 dump trucks are needed NLT XXX. The POC for this request is XXX. EA: Work with the upward sharing of state and local mission requests via the CUSEC RISP to the DOD community in the Ardent Sentry 19 portal.

Social Media/Crowdsource Integration

For the social media coordination activities, there were no injects for local play since localities planned on using information products generated through SimDeck (e.g., simulated social media content) to respond and execute an expected action. Injects related to social media content are included in Table 19 as examples that may prompt a local response.

Table 19. Associated Activities Related to Social Media/Crowdsource Coordination

'Sub' Objectives	Number	Associated Activities
Document and test coordination between fed, state, local government agencies around rumor control.	SM1	Example Inject: MEDIA-290503 Social Media: Social media tweets from "public" begin…800 to 1000 will be posted during the period of play on this day. EA: Shelby County, Tennessee, and its trusted agents identify a trending, repeated rumor (rumor TBD, but could be multiple topics such as 'FEMA camps' and being eligible for SNAP benefits). Locals package the rumor and report it to FEMA, working with the external affairs team and Crowdsourcing Unit to verify and validate. FEMA creates a Shaken Fury 19 Rumor Control page, then disseminating that back out to regions, CUSEC, states, locals and the public.
Assist in linking up the crowdsourced and social listening reports from FEMA and local partners to the official Senior Level Briefing (SLB).	SM2	Example Inject: Media 290503-03 Social Media: Expect 200 to 500 social media posts from the "replicated" public. EA: Shelby County and other local players will login to SimDeck to report content observed on social media channels that may contribute to situational awareness. The locals' actionable content is incorporated into the FEMA External Affairs and/or Crowdsourcing Unit reports and into an SLB that has unofficial content. This relates to our work with FEMA's WebEOC admin.
Crowdsourcing	SM3	Example Inject: FEMA HQ-000093 Request for a Crowdsourced Shelter Map: Request for map of non-NSS shelter locations based on crowdsourced data. EA: Local players and Federal will leverage crowdsourced content to inform sit awareness and mission planning.

Appendix E: Key Shaken Fury Meetings and Events

Event	Date	Meeting/Event Topics
CUSEC Regional Information Sharing		
Information Sharing Task Force Meeting	Nov 1, 2018	• Task Force kickoff • Purpose, scope and desired outcomes • Approach and timeline • Structure and logistics
Information Sharing Task Force Meeting	Nov 15, 2018	• EEI/Lifeline alignment and reporting processes • Information Sharing Overview – ArcGIS Online
Information Sharing Task Force Meeting	Dec 13, 2018	• Recap of Shaken Fury Planning Meeting • Private Sector Information Sharing and Privacy considerations
Training	Jan-Mar 2019	• Safety Assessment Deployment Training
Information Sharing Task Force Meeting	Feb 14, 2019	• FEMA Lifeline WebEOC Board • State EEI reporting tools
Training	Feb 20, 2019	• Resource Request Lifeline Alignment (KYEM)
SF19 Joint MSEL Synchronization	Mar 12-14, 2019	• Overview of JMSEL tool: JTEMS Lite • Review of the Ground Truth Workbook • Presentation of CUSEC injects for TN SAVE and MO Save play • JMSEL review • Discussion of SF19 time jump and related recovery operations
Training	Mar 15, 2019	• Resource Request Lifeline Alignment (TEMA)
CUSEC Tabletop Exercise	Mar 20, 2019	• Update on FEMA geospatial information products
Information Sharing Task Force Meeting	Mar 28, 2019	• Update on CUSEC geospatial information products
Training	Apr 11, 2019	• CUSEC RISP Overview for FEMA GIS

Event	Date	Meeting/Event Topics
Shaken Fury Final Planning Meeting	Apr 16-17, 2019	• Control structure • Exercise simulation overview • WebEOC Board updates • Synthetic media overview • JMSEL overview
Training	May 2, 2019	• RISP Access and Usage I
Training	May 16, 2019	• Reporting Workflows for Infrastructure Updates
Training	May 23, 2019	• RISP Access and Usage II
Shaken Fury 2019	May 29 – June 7, 2019	• Shaken Fury Exercise Play
Recovery Exercise	June 6-7, 2019	• Discussion of Housing, Infrastructure Systems and Economic Recovery Core Capabilities
KYEM Shaken Fury Hot Wash	June 7, 2019	• Post-exercise review
TEMA Shaken Fury Hot Wash	June 7, 2019	• Post-exercise review
Information Sharing Task Force Meeting	July 9, 2019	• Post-exercise review
DoD/DHS Information Sharing		
Working Group Meeting	Nov 20, 2018	• MOU Update • Shaken Fury approach to information sharing • CUSEC Lifeline Reporting process overview • Concept for Civil/Military information sharing
Working Group Meeting	Dec 11, 2018	• Overview of Shaken Fury Midterm Planning Meeting discussions and documents
Working Group Meeting	Jan 16, 2019	• Review MOU topics • Review Shaken Fury objectives • Discuss JMSEL and exercise ground truth
Working Group Meeting	Jan 23, 2019	• Assess JMSEL contributions • Review information sharing resources
Working Group Meeting	Feb 13, 2019	• Review CUSEC Safety Assessor Program • Review Guardian application for CISR • Review JMSEL
Working Group Meeting	Apr 8, 2019	• Review outcomes of JMSEL meeting • Review CUSEC Tabletop outcomes • NGB/CUSEC Information Sharing Use Case

Event	Date	Meeting/Event Topics
FEMA Urban Search & Rescue Multi-Task Force Exercise		
FEMA US&R Tabletop Exercise		
FEMA US&R Multi-Task Force Exercise	June 1-7, 2019	
NGFR Birmingham OpEx		
Site Visit #1	Nov 2018	• Identification of Birmingham capability needs
Site Visit #2	Feb 11-12, 2019	blank
Integration Test	May 13-16, 2019	• Technology integration testing • Privacy officer meeting
Site Visit #3	June 4-5, 2019	• MSEL walk-through • Mid-term Planning Meeting
EOC Information Sharing Workshop	June 6, 2019	
OpEx Dry Run	Jul 15-18, 2019	
Final Planning Meeting	Aug 9, 2019	
OpEx Event	Aug 21, 2019	• OpEx • Observer Tours
OpEx VIP Event	Aug 22, 2019	• VIP Demonstration • Technology Showcase

Appendix F: State-of-the-World Data for CUSEC Exercise

SHAKEN FURY2019 Response and Recovery Exercise	**CUSEC: Multi-Agency Information Sharing Exercise: State-of-the-World Data** **Exercise Date:** Tuesday, June 4, 2019 **Simulated Date:** Tuesday, February 4, 2019

Weather Forecast:
- *Memphis:* High Temp: 54, Low Temp: 31, Wind: Southerly 10 to 15 miles per hour (mph)
- *Nashville:* High Temp: 52, Low Temp: 28, Wind: Southerly 10 to 15 mph, becoming north 15 to 25 mph late evening
- Weather: Overcast with rain showers

FEMA Lifelines	State-of-the-World
Safety and Security	30+ correctional facilities partially operated or worse 1,200+ daycare centers partially operational or worse 300+ fire stations partially operational or worse
Food, Water, Sheltering	- Over 500 shelters are partially operational or worse - More than 70 wastewater systems partially operational or worse
Health and Medical	- More than 70 hospitals are partially operational or worse - More than 150 nursing facilities are partially operational or worse - There are unconfirmed reports of 420 fatalities/8,348 injuries
Energy (Power and Fuel)	4 major pipelines partially operational or worse - More than 250 electrical substations partially operational or worse - More than 10 power plants are partially operational or worse - Approximately 1,000,000 people without power
Communications	More than 100 cellular towers are partially operational or worse
Transportation	More than 30 main roads are partially operational or worse
Hazardous Material	More than 400 chemical manufacturing facilities are partially operational or worse

CUSEC: Multi-Agency Information Sharing Exercise: State-of-the-World Data

Exercise Date: Wednesday, June 5, 2019
Simulated Date: Wednesday, February 5, 2019

Weather Forecast:
- *Memphis:* High Temp: 46, Low Temp: 24, Wind: Southerly to variable light. Weather: mostly cloudy
- *Nashville:* High Temp: 39, Low Temp: 24, Wind: Northerly then southerly at 5 to 10 mph. Weather: Partly sunny

FEMA Lifelines	State-of-the-World
Safety and Security	40+ correctional facilities partially operated or worse 1,200+ daycare centers partially operational or worse 340+ fire stations partially operational or worse
Food, Water, Sheltering	- Over 300 shelters are partially operational or worse, with 1,600 OPERATIONAL - More than 70 wastewater systems partially operational or worse - Approximately 11,400 people in shelters and 15,000 displaced households
Health and Medical	- More than 70 hospitals are partially operational or worse - More than 150 nursing facilities are partially operational or worse - There are unconfirmed reports of 450 fatalities/9,000 injuries
Energy (Power and Fuel)	- Four major pipelines partially operational or worse - More than 270 electrical substations partially operational or worse - Three power plants are partially operational or worse - Approximately 1,000,000 people without power
Communications	More than 100 cellular towers are partially operational or worse
Transportation	- More than 10 main roads are partially operational or worse - Memphis International Airport now has two ACTIVE runways
Hazardous Material	More than 400 chemical manufacturing facilities are partially operational or worse

CUSEC: Multi-Agency Information Sharing Exercise:
State-of-the-World Data
Exercise Date: Thursday, June 6, 2019
Simulated Date: Thursday, March 30, 2019

Weather Forecast:

- *Memphis:* High Temp: 62, Low Temp: 48, Wind: Northwest at 10 to 15 mph, becoming light and variable. Weather: Scattered clouds.
- *Nashville:* High Temp: 59, Low Temp: 42, Wind: Northerly at 5 to 10 mph. Weather: Mostly cloudy then clear late.

FEMA Lifelines	State-of-the-World
Safety and Security	• Security needs and requirements are beyond local and state capacity. • EPA working with TDEC and remediation companies to deal with spills and infrastructure.
Food, Water, Sheltering	• Most evacuations are complete, some medical and rural evacuations still taking place. • 18 counties without potable water and wastewater treatment plants. • Continuing to establish intermediate and long-term housing. Temporary sheltering is still being used.
Health and Medical	• Accountability of patients is cumbersome. Patients being sent to other states is straining the process. • Sanitation issues developing due to non-functioning waste water plants and refuse piling up. • National shortages of DMORT and forensic specialists. Human remains removal process from debris slowing process.
Energy (Power and Fuel)	• 27 counties still suffer from full or partial power outages. Co-op mutual aids have been stretched thin. • Storage and distribution of gas and diesel is a problem. Propane and Kerosene are in high demand.
Communications	• Many cellular towers are down due to loss of generators. COWs and COLTs in short supply. • Repeater stations being down have affected the state-wide mutual aid network.

FEMA Lifelines	State-of-the-World
Transportation	• Most roads and bridges are either partially operational or better. • Memphis International Airport is operational.
Hazardous Material	• There are several chemical manufacturing facilities that are still inoperable or worse.

Appendix G: Data Gathering Questionnaires

During exercise play in the Kentucky EOC and Tennessee EOC, project team staff held conversations with state EOC staff using the following questionnaires:

General RISP Questions

RISP Membership	Observer Guidance
How many participants have membership in the SF Exercise Group and how many agencies does this number represent? How many participants requested membership/group access prior to exercise vs. during the exercise?	Consider doing a check every day of the exercise to log increase in membership.
Are there any challenges with new users registering and getting access to the system via the CUSEC RISP request form (http://bit.ly/RISP-Request)?	Important both for participants and for CUSEC managing the requests.
Information Sharing	**Observer Guidance**
What information is being shared by the participants (e.g., States, NGB, Private Sector, FEMA, CUSEC, crowdsource groups)?	Document the types of information being shared in the RISP and what format these are shared in.
What information is being used or accessed? (e.g., number of clicks?)	Can capture this through a combination of Google Analytics and AGOL usage statistics following the exercise.

Onsite Questions

General Information Sharing Questions	Observer Guidance
What information is being shared by the participants at the EOC? What systems are being used to share that information?	Include CUSEC RISP but also look beyond, discover what other type of information is being shared during the exercise.
What reporting processes do ESFs follow to report out information in the EOC?	For example, KY Water Division's reporting information on infrastructure status, and TN Department of Environment and Conservation reports out on water infrastructure status.

RISP Accessibility Questions	Observer Guidance
Were you able to access the RISP and the contents? Were there any impediments?	Suggested areas for improvement? Better tagging structure, More complete metadata, improved hub-site search tools?
How easy / hard was it to discover content shared on the RISP?	
Is there a preference to access the information (data services) and/or information products (dashboards, etc.) directly through the RISP, or via the end user's own system (e.g., COP in SEOC)?	

RISP Applicability Questions (what are you using RISP for?)	Observer Guidance
What information is being used or accessed through the RISP?	Power Outage data (CUSEC/DOE) GasBuddy (CUSEC) Private Sector (CUSEC/SABER) Shelter data (FEMA?) Shelter (CEDR crowdsource?) Safety Assessment (during recovery TTX)
Do you use the RISP to gain regional situational awareness?	Want to capture how states are using the data for regional awareness
What information is the state gathering from the RISP to provide a regional overview of information being captured?	Look at transportation, communications, health and medical
Is the information being accessed directly through CUSEC RISP and associated information products, or through some other interface (e.g., COP/UDOP in SEOC)?	Capture photos/screenshots to substantiate
Does the information being accessed from RISP inform EOC decisions/situational awareness?	Subjective question to ask participants at different levels (Ops staff, Logistics, Director level)
Is the information shared through the RISP being included / packaged into other reports?	For example, Daily sitreps, FEMA Lifeline reports, etc.
Is information captured from states incorporated into FEMA's Tier III Lifeline information products?	Discuss with GIS/IT staff

Usability of the RISP	Observer Guidance
Could you describe the value that the content from the RISP provided?	Does it improve overall SA? Simplify ability to discover content? Save time by having ready-to-use information products?
Which of these information products would you like to see active in the future?	For example, GasBuddy, power outages, communication outages, bridge/road status, or other?
How can the existing information products be improved?	Example…
Are there other technology gaps that would improve your operational functions?	Understand any tech gaps that may exist related to information sharing.

While in the EOC, project staff identified those reporting on FEMA's Community Lifelines and their processes. Project staff conducted interviews to understand states' use of EEIs used for Lifeline reporting, FEMA's WebEOC Integration and areas for improvement.

EEIs and Community Lifelines	Observer Guidance
How do you obtain the information required to populate the Lifeline Board?	For example, what partners are providing that information, what processes/systems are involved with gathering that information?
What positions in the SEOC are involved with reporting Lifeline status?	For example, Situation Unit lead, Operations staff, FEMA IMAT
Was information found in the senior level brief helpful for states' situational awareness? Did it lead to any state actions?	

FEMA WebEOC Integration	Observer Guidance
Is the state accessing the FEMA Lifeline Board through the state's own WebEOC instance (through Juvare Exchange) or by logging into the FEMA WebEOC instance?	
Who in the EOC used FEMA's WebEOC Lifeline Board?	For example, Situation Unit lead, Operations staff, FEMA IMAT
How many different people / positions populated information into the board?	
How much time did it take to populate the board?	For example, one hour twice daily
Did the states test the process to concur or dispute the status of Lifelines based on what the Regions or HQ were reporting?	
Were there any redundant processes involved?	For example, did they have to fill out information twice, once for SitReps and once for the Tier IV Board?

FEMA WebEOC Integration	Observer Guidance
Is there an understanding on how the information submitted into the Tier IV board are used to prepare the SLB?	Look for the SLB in the SimDeck.
Was the SLB prepared from the Tier IV board information useful for the State?	

During exercise play at the FEMA Master Control Cell (MCC), project staff observed data sharing between civilian and military entities.

DoD-Civilian Information Sharing	Observer Guidance
Was there an ability to exchange information through the RISP between DoD Players and civilian players in Shaken Fury?	Look for the deliberate act of the sharing of information products between DOD and civilian players. Go to the Shaken Fury Sharing Group in the CUSEC RISP and specifically look for Ardent Sentry users who are sharing content.
Were players able to produce information products comprised of content with DOD and Civilian Content?	Did the NORTHCOM COP use civilian and unclassified content from the Shaken Fury group? Did KYEM staff use DOD information services in their Dashboard?
Were briefings conducted and situation reports made that used content from either domain?	Go to Sim Deck and look for daily sit reps and the Senior Level Briefing to provide samples.

During the Shaken Fury exercise, participants in the NRCC observed the following crowdsource information and documented these information sharing processes.

Crowdsource Information Sharing Questions	Observer Guidance
Was crowd sourced content (e.g., life safety missions, sheltering, etc.) merged with official mission requests to create a blended view of the mission space?	Look for content in either the FEMA GEO Platform or the CUSEC RISP.
Was the FEMA Social Listening and crowd sourced unit able to create products that combined crowd sourced content with authoritative content?	Go to the listening report in SIM DECK.
Was the FEMA team able to collaborate with local officials in authoring the FEMA rumor control page?	Ensure that Shelby County players send field incident reports and observations to the FEMA Crowd Sourcing Unit.
Was the Florida SAR able to coordinate with volunteer groups to create a master mission view of life safety operations in the NMSZ?	Look to the CUSEC RISP Sharing Group and note who is submitting field mission reports or observations.
Did the contributions of Crowd Emergency Disaster Response (CEDR) Digital Corps provide help in resource planning for mass care and sheltering?	CEDR will be sharing a data service to the CUSEC RISP.
Did the CEDR data for Mass Care make it into the Food, Shelter & Water Lifeline?	Look for numbers in situation reports and compare the NSS figures with CEDR.

Appendix H: US&R Technology Demonstration Schedule

The table below provides the schedule that each technology was demonstrated during the FEMA US&R Multi-Task Force Exercise.

Date/Time	Technology	Location	Notes
June 4 1000	SCITI Labs UAS with Canada Task Force 1	High Rescue Trainer (125ldg.. 5048)	• People trapped after earthquake collapse • Local authorities send in K9s • Task forces cannot immediately access upper floors, will have to build climbing structures • Drones sent in to search for victims—four live victims planned, plus several mannequins • One victim trapped at base of elevator shaft, can only access from the roof; drones dropped down first to see if victims are there, give situational awareness • Responders will remove person, do medical interventions inside and on roof
June 4 1100	FINDER with Ohio Task Force 1	Urban Canyon (125ldg.. 5045)	• Urban canyon will consist of several collapsed buildings along a city street • Several trapped victims, K9 rescues, responders will try to enter buildings to treat and remove people • Before responders enter, FINDER will be deployed to scan for heartbeat/respiration
June 2 1430	FINDER with Nebraska Task Force 1	Urban Canyon (125ldg.. 5047)	• Urban canyon will consist of several collapsed buildings along a city street • Several trapped victims, K9 rescues, responders will try to enter buildings to treat and remove people • Before responders enter, FINDER will be deployed to scan for heartbeat/respiration

Date/Time	Technology	Location	Notes
June 5 0900	FINDER with Canada Task Force 2	Rubble Pile (126ldg.. 5245)	• One large rubble pile simulating a large building collapse • FINDER deployed to scan for heartbeat/ respiration • No simulated medical response at this site
June 5 0900	UAS with Canada Task Force 1	Subway (126ldg.. 5115)	• Unified Command believes people are trapped in the tunnel but can't be sure • Task force will cut metal, search subway cars, remove victims (all mannequins) • Some hazmat response, but no sensors on UAS • Smoke machine simulates low visibility • Only way in is through an air shaft; drones dropped in for initial situational awareness, find victims, scan the scene
June 5 1000	FINDER with Canada Task Force 1	Urban Canyon (126ldg.. 5045)	• Urban canyon will consist of several collapsed buildings along a city street • Several trapped victims, K9 rescues, responders will try to enter buildings to treat and remove people • Before responders enter, FINDER will be deployed to scan for heartbeat/respiration
June 5 1100	UAS with Canada Task Force 1	Subway (126ldg.. 5115)	• Unified Command believes people are trapped in the tunnel but can't be sure • Task force will cut metal, search subway cars, remove victims (all mannequins) • Some hazmat response, but no sensors on UAS • Smoke machine simulates low visibility • Only way in is through an air shaft; drones dropped in for initial situational awareness, find victims, scan the scene

Date/Time	Technology	Location	Notes
June 5 1300	UAS with Canada Task Force 2	Subway (127ldg.. 5115)	• Unified Command believes people are trapped in the tunnel but can't be sure • Task force will cut metal, search subway cars, remove victims (all mannequins) • Some hazmat response, but no sensors on UAS • Smoke machine simulates low visibility • Only way in is through an air shaft; drones dropped in for initial situational awareness, find victims, scan the scene

Appendix I: NGFR Birmingham Capability Gaps

The table below provides the capability gaps identified by the Birmingham and Jefferson County public safety agencies at the outset of the OpEx development process.

FEMA Core Capability	Capability Gaps
Operational Communications	• The ability to coordinate dispatch functions from multiple jurisdictions and agencies during response operations • The ability to facilitate the management of communications channels and frequencies among multiple disciplines • The ability to maintain resilient communications systems in urban and rural areas • The ability to maintain interoperable communications across agencies, disciplines, jurisdictions and levels of government
Operational Coordination	• The ability to quickly establish joint command among jurisdictions and agencies
Intelligence & Information Sharing	• The ability to quickly establish joint command among jurisdictions and agencies • The ability to integrate data from multiple sources in real time • The ability to integrate and validate data from social media feeds
Mass Search & Rescue Operations	• The ability to track the status of casualties from incident scene through reunification • The ability to identify casualties on the incident scene
On-Scene Security, Protection & Law Enforcement	• The ability to account for and manage on-duty, off-duty and self-reporting personnel • The ability to coordinate with private, federal and international law enforcement agencies
Situational Assessment	• The ability to understand the characteristics and location of threats and hazards on the incident scene • The ability to obtain and maintain a birds-eye view of the incident scene • The ability to access, integrate, share and display images and video pertinent to the incident scene for the on-scene responder and incident command

FEMA Core Capability	Capability Gaps
Environmental Response/Health and Safety	• The ability to geolocate responders on the incident scene (indoors and outdoors, above and below ground, in three dimensions) • The ability to monitor the physiological signs of emergency responders • The ability to provide appropriate personal protective equipment (i.e., garments, gear, breathing apparatus) for incident type (e.g., weather, comfort, protection)
Logistics & Supply Chain Management	• The ability to integrate resource data from participating agencies for a holistic picture of resources available on scene for incident-specific response • The ability to track resource requests, resource status and resource location • The ability to coordinate public and private resource information • The ability to monitor and manage traffic and transportation systems

Appendix J: NGFR Birmingham Storyboards

The following graphics illustrate the scenarios for the Birmingham Shaken Fury OpEx vignettes.
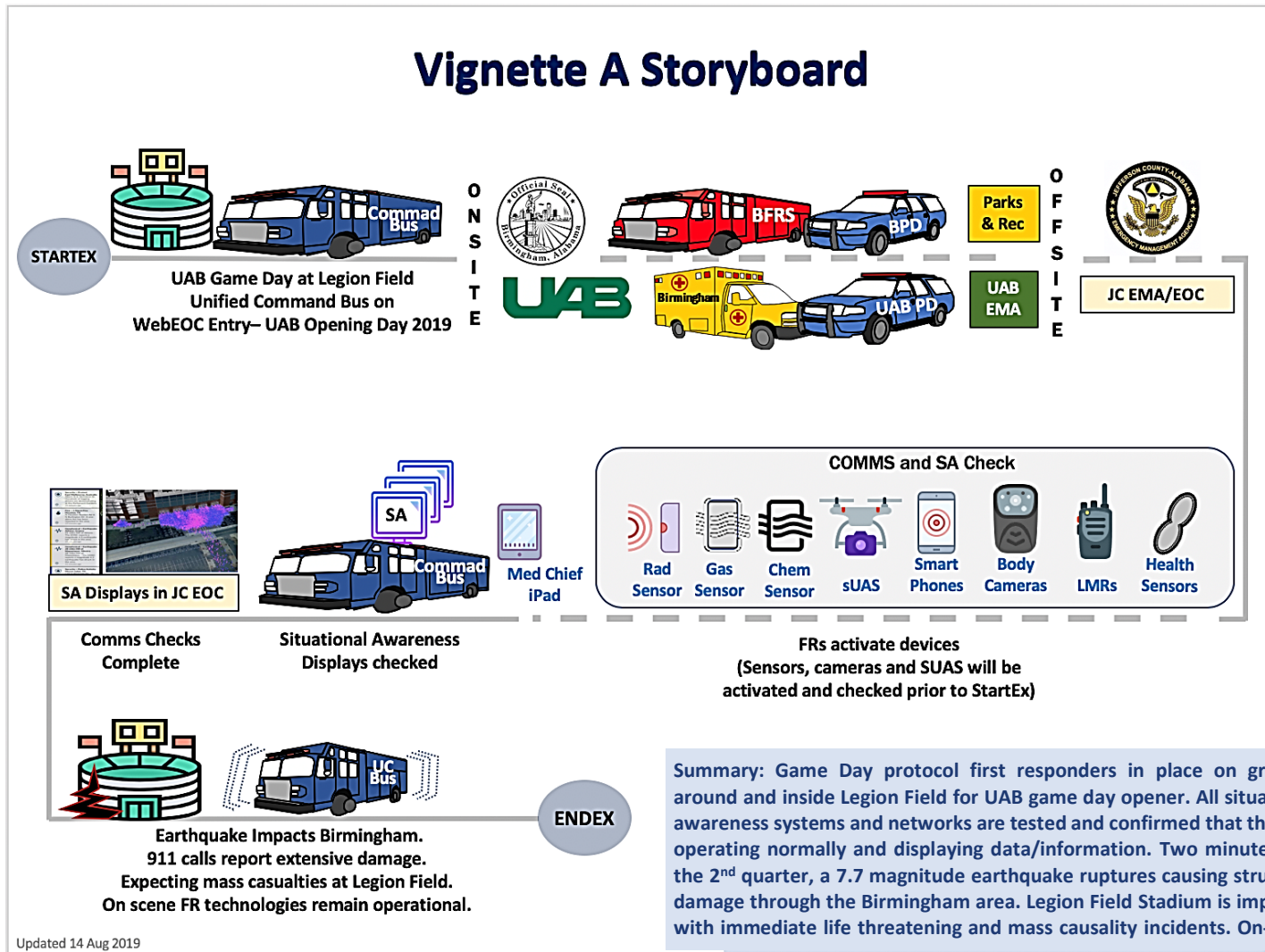
Figure 35. Birmingham Shaken Fury OpEx Vignette A Story Board

Vignette B Storyboard

STARTEX

Post Earthquake
Comms overwhelmed, power outages, stadium collapsed; fatalities, injuries, rescue needed, panic

MCI Protocol. City – County coordinating
JC EMA tracking resources and on-scene BPD and UAB PD

JC EOC

Assessments
Comms Mesh Network

sUASs surveying
damage and sending streaming video

Evacuation Modeling,
PD's Supporting

IPAWS ALERT

Ongoing SAR; tracking, sensors and
video transmitted via mesh network

Evacuation process
supported by Modeling

Heavy Rescue locates trapped
victims, transport to T-3

Injured proceed to T-3 Location.
Physio sensors applied

FF down;
sensors provide location & vitals

FF rescued,
transported to T-3

sUAS's continue searching,
locate additional trapped victims, transmit video

"Odd smell" reported
Determined natural gas; Nearby cleaning fluid

Ops Chief requests Air Boss
Final Flyover – All clear.

ENDEX

Summary: Post-earthquake: Comms overwhelmed and power outages. On-scene sUASs used to locate victims, provide SA & comms mesh networks. MCI declared, additional resources requested. sUAS and camera providing SA. Sensors monitoring responder locations & patient vitals. Comms repeaters transmit sensor and video data from stadium. Firefighters and victims rescued and directed to T-3. Gas/chem sensors alert of potential hazards in stadium.

Updated 14 Aug 2019

Figure 36. Birmingham Shaken Fury OpEx Vignette B Story Board

131

Figure 37. Birmingham Shaken Fury OpEx Vignette C Story Board
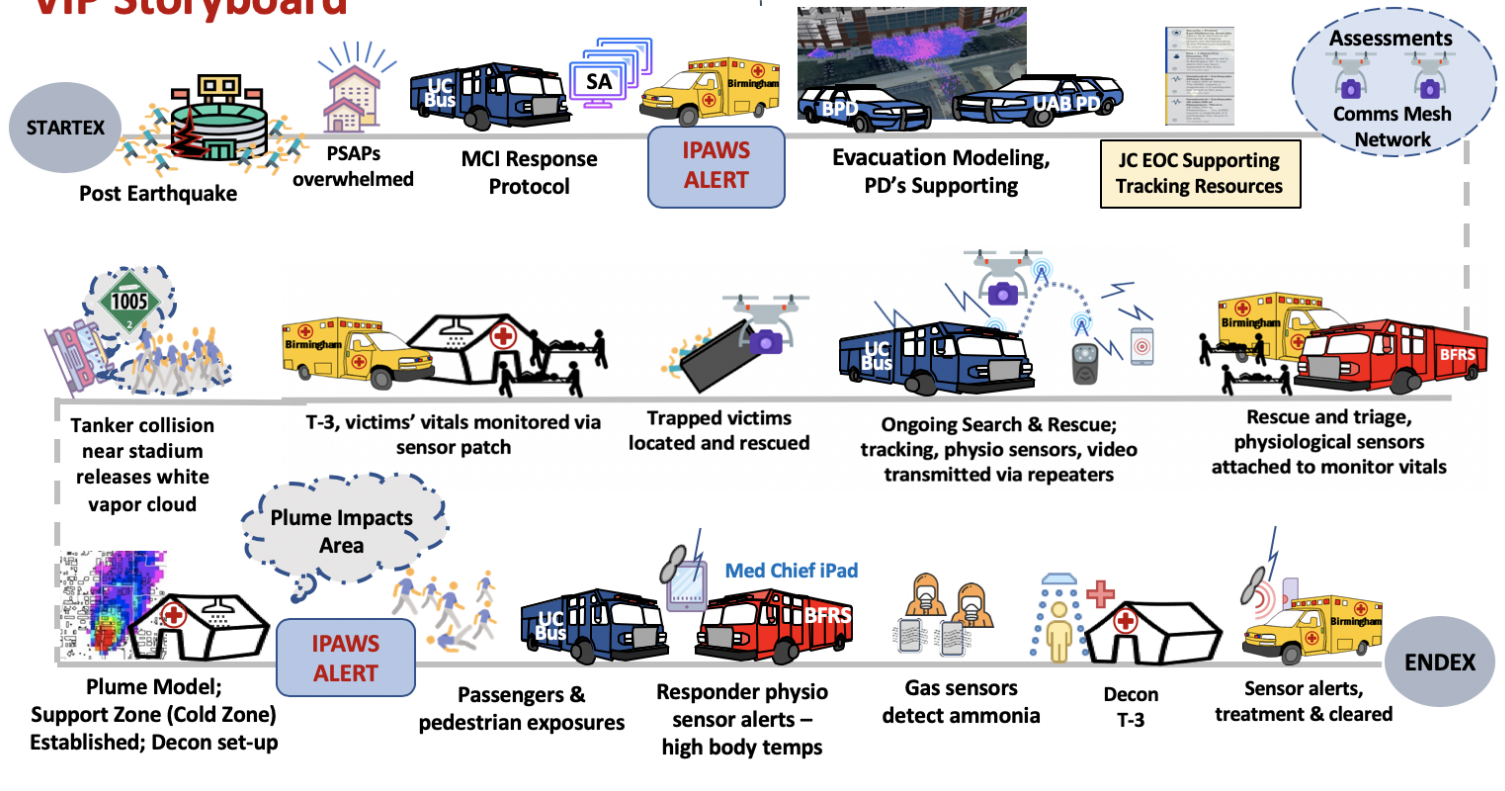
Figure 38. Birmingham Shaken Fury OpEx VIP Vignette Story Board

Appendix K: NGFR Birmingham-Shaken Fury Technology Requirements

The requirements listed below are derived from the NGFR requirements set. The requirements were identified during the OpEx development process. Each requirement was tested throughout the OpEx. The success measures for each requirement are: 1) the NGFR technologies provide the capability or feature described in the requirement language, and 2) performance of the NGFR technologies is sufficient for operational usage.

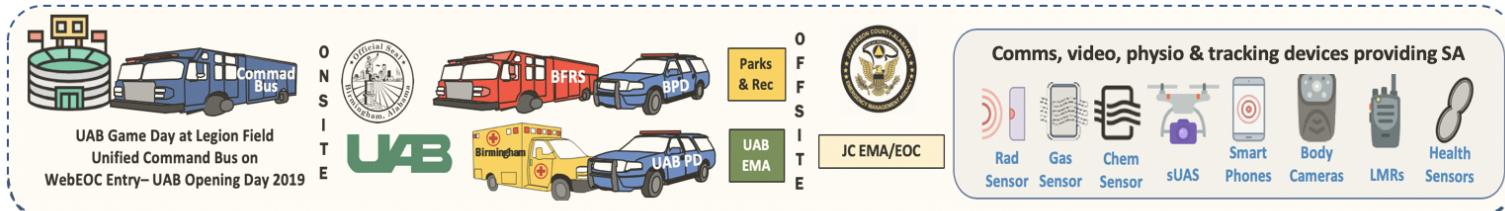| Ref.	Vig.	ID	Name	Description
1	ABC	1	Physiological Sensors	NGFR shall provide physiological monitoring of responders during incident response
2	ABC	1.1	Physiological Sensors/Body Temperature	NGFR sensors shall measure responder body temperature
3	ABC	1.1.1	Physiological Sensors/Body Temperature/Scale	NGFR sensors shall provide body temperature in degrees Fahrenheit
4	BC	1.1.2	Physiological Sensors/Body Temperature/Parameters/Responder	NGFR sensors shall provide alert to responder when responder core body temperature is above or below agency-set thresholds
5	BC	1.1.3	Physiological Sensors/Body Temperature/Parameters/Command	NGFR sensors shall provide alert to command when responder core body temperature is above or below agency-set thresholds
6	ABC	1.2	Physiological Sensors/Heart Rate	NGFR sensors shall measure responder heart rate/pulse
7	ABC	1.2.1	Physiological Sensors/Heart Rate/Scale	NGFR sensors shall measure responder heart rate in beats per minute
8	ABC	1.4	Physiological Sensors/Blood Pressure	NGFR sensors shall measure responder blood pressure
9	ABC	1.4.1	Physiological Sensors/Blood Pressure/Scale	NGFR sensors shall measure responder blood pressure in systolic / diastolic mmHg
10	ABC	1.5	Physiological Sensors/Respiration Rate	NGFR sensors shall measure responder respiration rate
11	BC	1.9.8	Physiological Sensors/Ruggedized/Decontaminability	NGFR wearable physiological sensors shall be able to be decontaminated by first responder agencies
12	ABC	1.10	Physiological Sensors/Physiological Data	NGFR physiological sensors shall encode physiological data
13	ABC	1.10.1	Physiological Sensors/Physiological Data/Transmission	NGFR sensors shall encode and transmit physiological data to **<recipient devices>**
14	ABC	1.10.2	Physiological Sensors/Physiological Data/Timeframe	NGFR physiological sensors shall measure physiological data every **<3>** minutes

Ref.	Vig.	ID	Name	Description
15	ABC	1.10.6	Physiological Sensors/Physiological Data/Notification-IC	NGFR physiological sensor systems shall decode notification data to command
16	ABC	1.10.7	Physiological Sensors/Physiological Data/Notification-Responder	NGFR physiological sensor systems shall decode notification data to responder
17	ABC	1.11	Physiological Sensors/Interfaces	NGFR physiological sensors shall interface with NGFR subsystems or devices
18	BC	2.1	Threat Sensors/Chemical Agent	NGFR sensors shall detect hazardous chemicals
19	C	2.1.16	Threat Sensors/Chemical Agent/Alerts	NGFR sensors shall alert responder and IC when concentration of chemical agents exceeds agency-specific Permissible Exposure Limits (PEL)
20	C	2.3	Threat Sensors/Radiological Particles	NGFR sensors shall detect ionizing radiation
21	C	2.3.4	Threat Sensors/Radiological Particles/Limits	NGFR sensors shall alert when the count of radiological particles exceeds isotope-specific counts per second (cps)
22	ABC	2.10	Threat Sensors/Interfaces	NGFR threat sensors shall interface with NGFR subsystems or devices
23	BC	2.11	Threat Sensors/Threat Data	NGFR sensors shall encode the sensor detection of hazardous agents into a standard data format
24	BC	3.10.1	Threat Sensors/Threat Data/Measurement	NGFR sensors shall measure and encode the concentration of hazardous agents
25	BC	3.10.3	Threat Sensors/Threat Data/Transmission	NGFR sensors shall encode and transmit threat and hazardous condition data to <destination component(s)?> (hub and/or devices)
26	BC	3.10.4	Threat Sensors/Threat Data/Decode and Present	NGFR systems shall decode and present threat location for all responders on a graphical user interface
27	BC	3.10.5	Threat Sensors/Threat Data/Notification	NGFR sensors shall decode and present notification of hazard detection and concentration data
28	BC	3.10.5.1	Threat Sensors/Threat Data/Notification/Timeframe	NGFR sensors shall present notification of hazard detection and concentration data every <1> minute
29	BC	3.10.7	Threat Sensors/Notification/IC	NGFR threat sensors shall present notification of hazard detection and concentration data to Incident Command within <5> seconds of measurement

Ref.	Vig.	ID	Name	Description
30	BC	3.10.8	Threat Sensors/Notification/Responder	NGFR threat sensors shall present notification of hazard detection and concentration data for responder view via visual cues
31		2.12	Threat Sensors/Calibration	NGFR threat sensors shall auto-calibrate where feasible
32	ABC	8.5	Video Communications/Streaming Video	NGFR systems (networks and/or devices) shall be capable of transmitting streaming video
33	ABC	9.2.1	Networks/IAN/Continuous Communications	NGFR communications shall provide continuous connectivity in areas where existing communications networks are typically degraded or attenuated
34	ABC	9.2.2	Networks/IAN/Deployable Technologies	NGFR networks shall include deployable communications technology to expand and/or enhance communications networks at an incident
35	ABC	9.2.3	Networks/IAN/Linked Nodes	NGFR network devices shall have the ability to link, forming a chain of nodes to create or extend a network
36		9.2.4.1	Networks/IAN/Prioritizing Communications	NGFR networks shall have the ability to prioritize communications
37		9.2.4.2	Networks/IAN/Provisioning Access	NGFR networks shall have the ability to provision access
38		9.2.5	Networks/IAN/Control Prioritization	NGFR network shall allow authorized users to elevate or reduce the priority of operations or user transmissions
39	BC	9.2.6	Networks/IAN/Priority Alerts	NGFR systems shall be capable of transmitting emergency alerts with high priority
40	ABC	9.5	Networks/Wide Area Network	NGFR network(s) shall provide connectivity to external networks (Internet) and data
41	ABC	9.4.1	Networks/WAN/Wireless Broadband	NGFR network(s) shall include the ability to transmit over Band Class 14 radio area networks
42	ABC	9.4.3	Networks/WAN/LTE Mission Critical Video	NGFR shall provide access to video application over LTE pilot network (when feasible)
43	BC	10.4	Networked Devices/Preset Text Shortcuts	NGFR communications devices shall have the ability to transmit a pre-defined emergency text message indicating a life-threatening situation

Ref.	Vig.	ID	Name	Description
44	ABC	10.11	Networked Devices/Machine to Machine (IoT)	NGFR systems network enabled connectivity shall provide the ability for communications objects to be differentiated or associated with specific users
45	ABC	10.16	Networked Devices/Unmanned Systems	NGFR systems shall provide connectivity with unmanned vehicles
46	ABC	10.15.4	Unmanned Systems/Hub	Unmanned systems designed to work with NGFR components shall utilize NGFR hub or interface for sensors and imagers
47	BC	10.15.10	Networked Devices/Unmanned Systems/Battery Life	NGFR Unmanned Systems shall be capable of continuous operation for no less than <20> minutes
48	BC	10.15.12	Networked Devices/Unmanned Systems/Transmission	NGFR unmanned systems shall securely send data to recipients continuously in real time
49	ABC	10.15.13	Networked Devices/Unmanned Systems/External Communications	NGFR unmanned systems shall be capable of communicating with other systems
50	B	11.1	Building Plans & Schematics/Building Structure	NGFR systems shall integrate three-dimensional graphic depiction of building rooms and structures
51	B	11.2	Building Plans & Schematics/Building Infrastructure	NGFR systems shall integrate three-dimensional graphic depiction of building infrastructure (e.g., pipes, HVAC)
52	ABC	12	On-Demand Dynamic & Static Data Feeds	NGFR shall provide responders and command access to incident-relevant data
53		12.2	On-Demand Dynamic & Static Data Feeds/UI Representation	NGFR systems shall decode ***user-requested*** data and provide <**appropriate representation**> of data to user interface for responders, command, and dispatch
54		12.4	On-Demand Dynamic & Static Data Feeds/Query	NGFR systems shall provide data in response to a ***user-generated or system-generated query***
55	ABC	13	Mutual Aid Resource Data Integration	NGFR components shall provide access to response and resource data from agencies committed to support operations through mutual aid
56	ABC	13.1	Mutual Aid Resources/Data Ingest	NGFR systems shall obtain and process data about other responder agencies, including available resource data
57	BC	13.2	Mutual Aid Resources/Request Aid	NGFR systems shall inform command of incoming mutual aid resources and anticipated timeline

Ref.	Vig.	ID	Name	Description
58		13.3	Mutual Aid Resources/Prioritization	NGFR systems shall allow command to prioritize resources requested through mutual aid
59	ABC	13.4	Mutual Aid Resources/Incident Management Integration	NGFR systems shall provide the ability to coordinate integrated incident response and management
60	ABC	13.5	Mutual Aid Resources/Incident Management Integration/UI Representation	NGFR systems shall provide command with a user interface containing responder resource data for mutual aid resources
61		14	CCTV & Traffic Camera Data Integration	NGFR components shall provide responders and command with access to open- and closed-source video feeds
62	C	14.1	CCTV & Traffic Cameras/Traffic	NGFR systems shall provide access to video feeds from traffic cameras
63	ABC	14.2	CCTV & Traffic Cameras/Closed Circuit	NGFR systems shall provide access to video feeds from closed-circuit cameras
64	ABC	14.3	CCTV & Traffic Cameras/Public Safety Video	NGFR systems shall provide access to vehicle- and body-mounted camera feeds
65	ABC	16	Blue Force Tracking	NGFR systems shall identify the location of responders on the incident scene tied to latitude, longitude and altitude coordinates
66	ABC	16.1	Blue Force Tracking/Location	NGFR systems shall geolocate responders on the incident scene
67		16.1.1	Blue Force Tracking/Location/Not Defeatable	NGFR tracking systems shall be designed to prevent deactivation by responder during an incident
68	ABC	16.1.2	Blue Force Tracking/Location/Proximity	NGFR tracking systems shall geolocate responders to within **<3>** feet for x, y, and z coordinates
69	ABC	16.1.3	Blue Force Tracking/Location/Confidence Level	NGFR tracking systems shall incorporate a confidence level to indicate the accuracy of location
70	ABC	16.2	Blue Force Tracking/Location Data	NGFR sensors shall securely transmit blue force location data to command
71	ABC	16.2.1	Blue Force Tracking/Location Data/Transmission	NGFR sensors shall securely transmit blue force location data to **<destination hub and/or devices>**
72	BC	16.2.2	Blue Force Tracking/Location Data/Timeframe	NGFR tracking systems shall identify and encode the location of responders on the incident scene every **<3>** minutes

Ref.	Vig.	ID	Name	Description
73	BC	16.2.6	Blue Force Tracking/Location Data/Notification-IC	NGFR tracking systems shall decode blue force location data to Incident Command within <**5**> seconds of when the systems receive the data
74	ABC	16.2.7	Blue Force Tracking/Location Data/Notification-FR	NGFR tracking systems shall decode blue force location data for all responders on a graphical user interface
75	BC	16.2.8	Blue Force Tracking/Location Data/Integrated Hazard Proximity	NGFR tracking systems shall integrate the location of responders with proximity to identified threats and hazards (on a gui)
76	B	16.2.9	Blue Force Tracking/Location Data/Integrated Building Data	NGFR tracking systems shall integrate the location of responders with digital building information (on a gui)
77	ABC	16.2.11	Blue Force Tracking/Location Data/Integrated Responder Data	NGFR tracking systems shall integrate the location of responders with responder-specific data including responder identification and equipment data
78	ABC	16.2.12	Blue Force Tracking/Location Data/Integrated Responder Data/Physiological	NGFR tracking systems shall integrate with responder-specific physiological data (e.g., body temperature, heart rate)
79	BC	17	Multi-Sensor Integration & Analysis	NGFR systems shall integrate data and information to provide a comprehensive picture of hazards on the incident scene
80	ABC	17.1	Multi-Sensor Integration & Analysis/Platform	Integrated NGFR sensors shall be available in multiple platform implementations (i.e., personal, man portable, UAS, UGS)
81	ABC	17.2	Multi-Sensor Integration & Analysis/Hub	Integrated NGFR sensors shall utilize a common hub or interface, allowing interchangeable sensor configuration
82	ABC	17.3	Multi-Sensor Integration & Analysis/Network	NGFR sensors shall have the ability to be networked together
83	BC	17.4	Multi-Sensor Integration & Analysis/Combined Analysis	NGFR sensor outputs and data measurements shall be integrated for a combined assessment of existing hazards
84	ABC	17.5	Multi-Sensor Integration & Analysis/Common Apps Integration	NGFR sensor out-specific physiological puts shall integrate with common electronic situational awareness tools
85	ABC	21	Integration of Internet of Things	NGFR systems shall integrate and automate device communications and data sharing to facilitate response operations
86	ABC	21.1	Integration of Internet of Things/Integration	NGFR systems shall integrate incident data and device data through applications and/or software

Ref.	Vig.	ID	Name	Description
87		21.1.1	Integration of Internet of Things/Integration/Automation	Integration of incident data and device data shall occur ***automatically***
88	ABC	22.2	System Interoperability/Standards	NGFR systems shall use system and interface standards and protocols
89	ABC	22.3	System Interoperability/Open Source	NGFR systems shall use non-proprietary software/open-source code where feasible
90	BC	23	Casualty Management & Decontamination	NGFR systems shall track the status of incident casualties from detection through reunification
91	BC	23.1	Casualty Management & Decon/Triage/Vital Signs Aggregation	NGFR systems shall aggregate patient vital signs to facilitate triage of casualties
92	BC	23.1.1	Casualty Management & Decon/Triage/Body Temperature	NGFR systems shall measure patient body temperature
93	BC	23.1.2	Casualty Management & Decon/Triage/Heart Rate	NGFR systems shall measure patient heart rate
94	BC	23.1.5	Casualty Management & Decon/Triage/Timeframe	NGFR systems shall measure patient vital signs every **<2>** minutes
95	BC	23.1.6	Casualty Management & Decon/Triage/Integration	NGFR systems shall report patient vital signs to electronic situational awareness system
96	BC	23.2	Casualty Management & Decon/Triage/Vital Signs Display	NGFR systems shall display patient vital signs to facilitate triage of casualties
97	BC	23.3	Casualty Management & Decon/Triage/Monitor	NGFR systems shall monitor the medical status of casualties after they are triaged and tagged
98	BC	23.4	Casualty Management & Decon/Triage/Tracking	NGFR systems shall track locations of casualties after they are triaged and tagged
99	BC	23.5	Casualty Management & Decon/Geolocation	NGFR systems shall geolocate casualties on incident scene
101	BC	23.3.1	Casualty Management & Decon/Geolocation/Distance	NGFR systems shall geolocate casualties to within **<1>** foot for x, y, and z coordinates
102	BC	23.3.2	Casualty Management & Decon/Geolocation/Display	NGFR systems shall display the location of casualties on GIS-enabled maps or display
103	BC	23.3.3	Casualty Management & Decon/Geolocation/Confidence Level	NGFR systems shall include a confidence level or margin of error

Ref.	Vig.	ID	Name	Description
104	BC	25	Alerts, Warnings & Notifications	NGFR systems shall support alerts and notifications to the public for safety and situational awareness
105	BC	25.1	Alerts, Warnings & Notifications/Alert	NGFR systems shall provide responder and command with critical safety information to support alerts and warnings
106	BC	25.1.1	Alerts, Warnings & Notifications/Alert/Audible	NGFR sensors shall provide alerts and notifications via audible cues
107	BC	25.1.2	Alerts, Warnings & Notifications/Alert/Visual	NGFR sensors shall provide notification via visual cues
108		25.1.3	Alerts, Warnings & Notifications/Alert/Tactile	NGFR sensors shall provide notification via sense of touch or vibration cues
109	BC	25.3	Alerts, Warnings & Notifications/Threshold Values	NGFR systems shall generate recommended alerts when pre-set or site-specific thresholds have been reached