



# Blast Overpressure Tool

## Informational Briefing to IESSE

23 January 2026

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# Agenda

- Introduction
- DoW Requirements for Managing Brain Health Risks from Blast Overpressure
- Blast Overpressure (BOP) Tool
- Discussion







## Mission

Responsively and responsibly create, develop, acquire and deliver medical capabilities for the warfighter.

## Vision

Lead the advancement of military medicine.



# Public Law 115-91: A Longitudinal Medical Study On Blast Pressure Exposure Of Members Of The Armed Forces



## Longitudinal medical study goal:

Will improve the DoW's understanding of the impact of blast pressure exposure from weapon systems on Service member brain health and better inform policy for risk mitigation, unit readiness, and health care decisions.

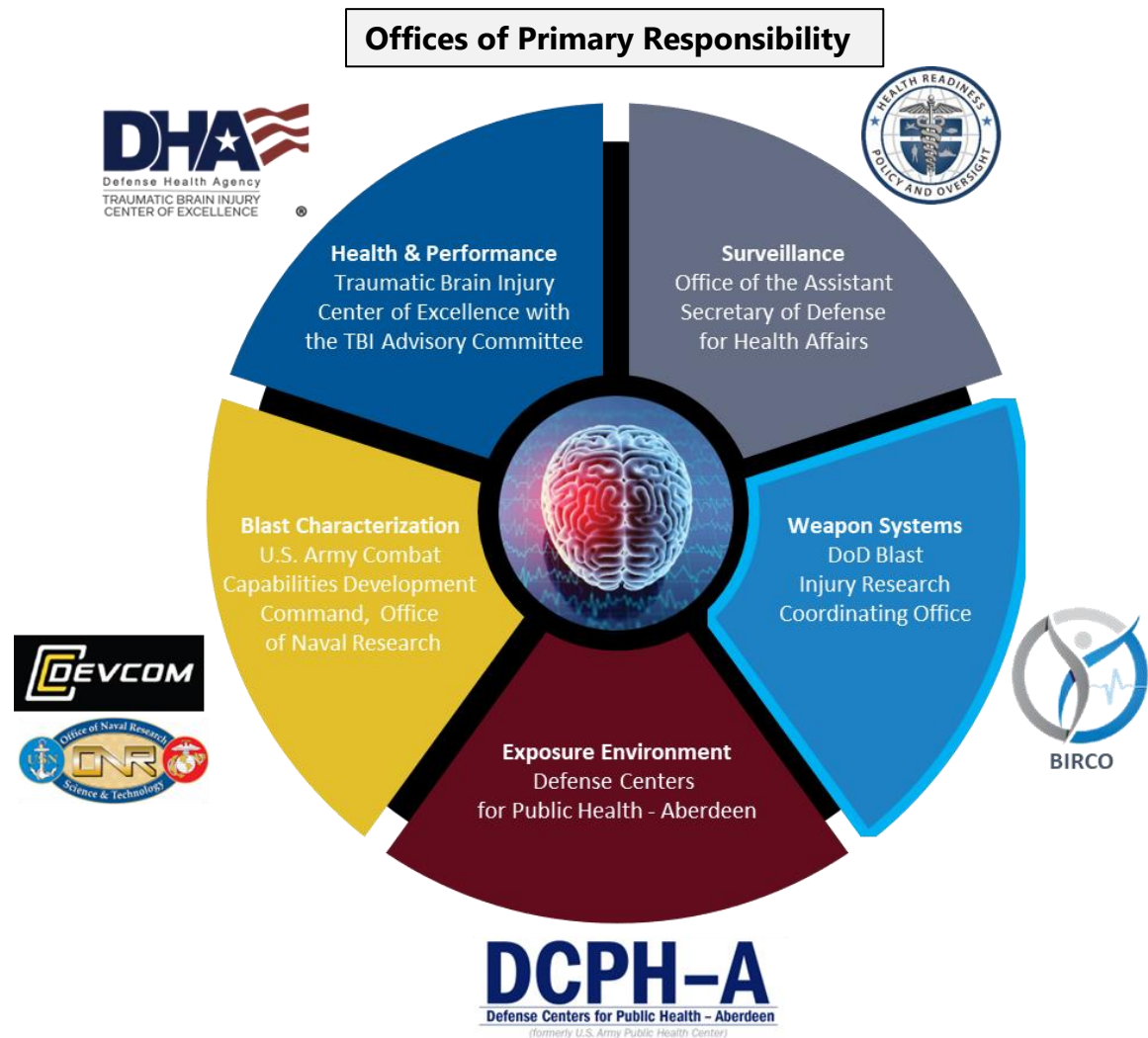
## INCORPORATED SECTIONS OF THE NDAA IN THE STUDY

**Section 734** of the 2018 NDAA requires the Secretary of Defense to conduct a **longitudinal medical study on blast pressure exposure** of members of the Armed Forces.

**Section 253** of the 2019 NDAA further mandates the Secretary of Defense **review the guidance on blast pressure exposure during training** to include Service members who train with **high overpressure weapon systems**.

**Sections 717 and 742** of 2020 NDAA mandate **inclusion of blast exposure history in medical records** of Service members and direct **modification of requirements for the longitudinal medical study** on blast pressure exposure of members of the Armed Forces and collection of exposure information.

# Five Lines of Inquiry (LOIs) Established



## LOI 2 Weapon Systems objectives

- Coordinate, collate, and analyze information on blast pressure resulting from heavy weapons and blast events
- Inform strategies to account for emerging research on the effects of blast pressure exposure on health and performance

## Why is this important

This effort will improve training safety protocols and will incorporate technology and predictive analytics for early intervention to reduce cognitive impact of blast exposure on Service members



# DoW Requirements for Managing Brain Health Risks from Blast Overpressure



- DoW issued **"Interim Guidance for Managing Brain Health Risk from Blast Overpressure (2022),"** known as the **"4 psi guidance memo"**
- DoW replaced this memorandum with the "Department of Defense Requirements for Managing Brain Health Risks from Blast Overpressure" on 8 August 2024
  - Identified specific actions to reduce risk but is not meant to preclude or restrict commanders from conducting mission-essential weapons training
  - Intended to raise awareness of BOP risk
- In December 2024 the DoW issued implementation guidance with required critical risk management actions including, "To the maximum extent practicable, integrate BOP exposure mitigation measures during live fire events, including Joint Mission Essential Task List proficiency, while not compromising training."

# BOP Mitigation Strategies

- Implement procedures and standards for training and operations that incorporate BOP risk management to minimize the risk of brain injury, including at a minimum:
  - Stand-off distances for personnel involved in training (e.g., instructors, range safety officers). Modifications may be made in situations where increasing stand-off distance inadvertently introduces a safety risk (e.g., recruit training activities).
  - Stand-off distances for non-training audiences that maximize distance from the weapons system to the greatest extent possible.
  - Personal protective equipment for firers, trainers, and other personnel at an increased risk of BOP exposure.
- Minimize the number of personnel in the vicinity of BOP generating events (i.e., personnel who are not directly involved training)
- Integrate simulations into training strategies to reduce BOP exposure, when appropriate, and not expend excess rounds once training standards are achieved.

Avoid unnecessary exposure

Fewer personnel

Increased distances

Shorter durations

Limit number of rounds

Use PPE

Educate others

Service members need information to minimize adverse health effects



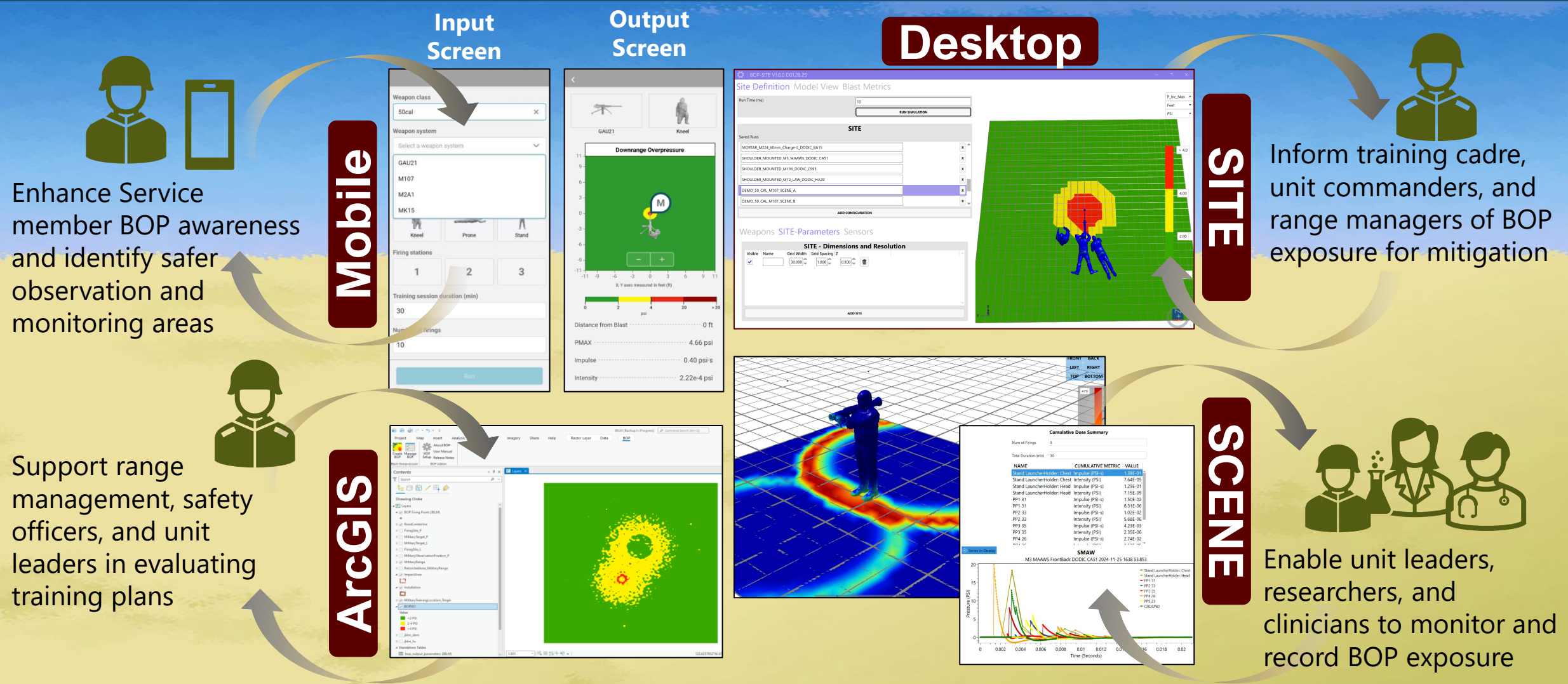


# BOP Tool

- Supports Department of War Requirements for Monitoring Exposure and Managing Brain Health Risks from Blast Overpressure
- Offers capability to **monitor and investigate incidence** of BOP exposure of Service members
- Informs training cadre, unit commanders, and range managers for **mitigating BOP risk** in training
- Identifies **safer areas** to observe and monitor
- Determines **previous and future exposures** including **cumulative** exposures (weapon system, ammunition, and # of firings)
- Provides objective, standardized BOP exposure determinations for unit level blast log records
- Conveys information to minimize adverse health effects



# Blast Overpressure (BOP) Tool for Monitoring and Recording BOP Exposure



- Shows BOP exposure zones in training site around the weapon firing system
- Estimates cumulative BOP exposure during repeated weapon firing
- Validated against benchmark weapon blast overpressure data

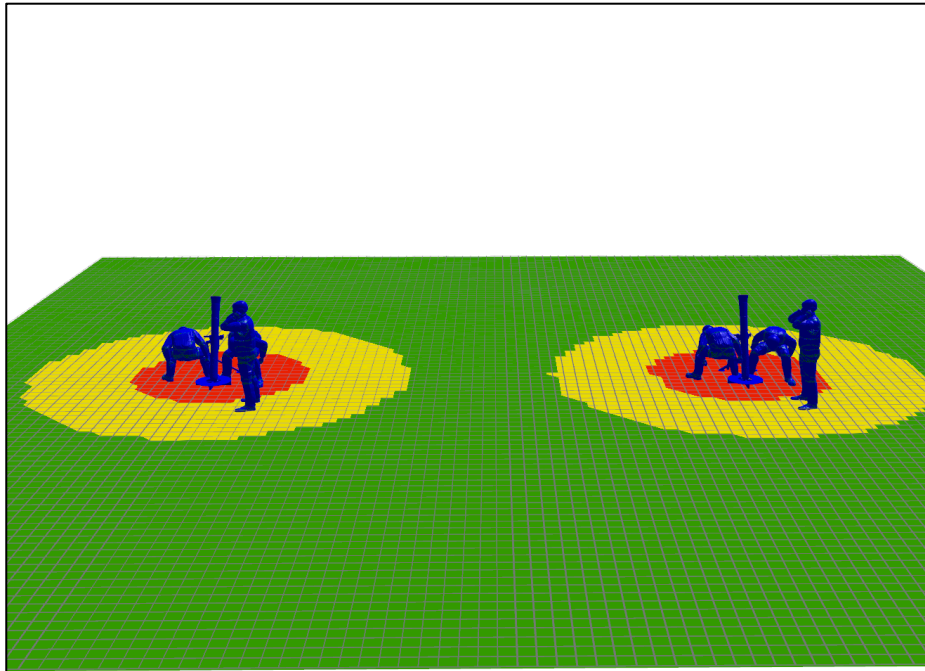


**M120 (Mortar) Firing: Multiple weapon systems**

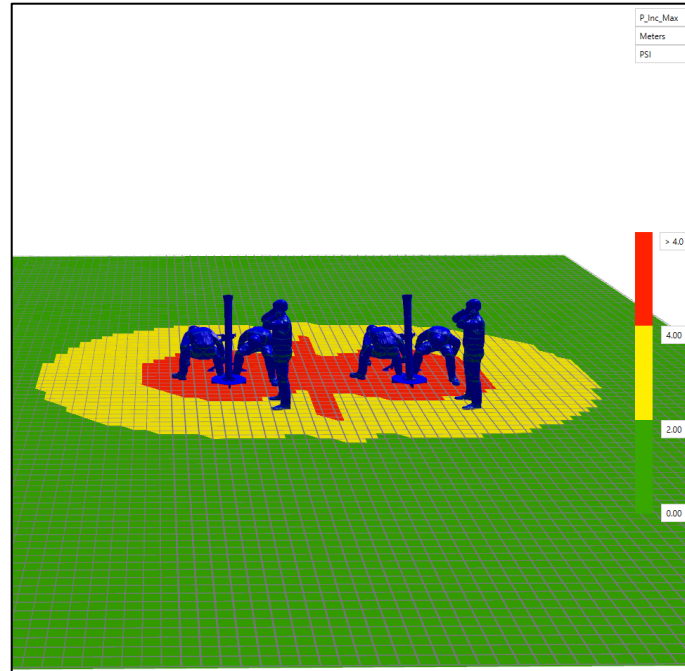
Informs training plans and reinforces safety warnings to prevent unnecessary blast exposures of Warfighters



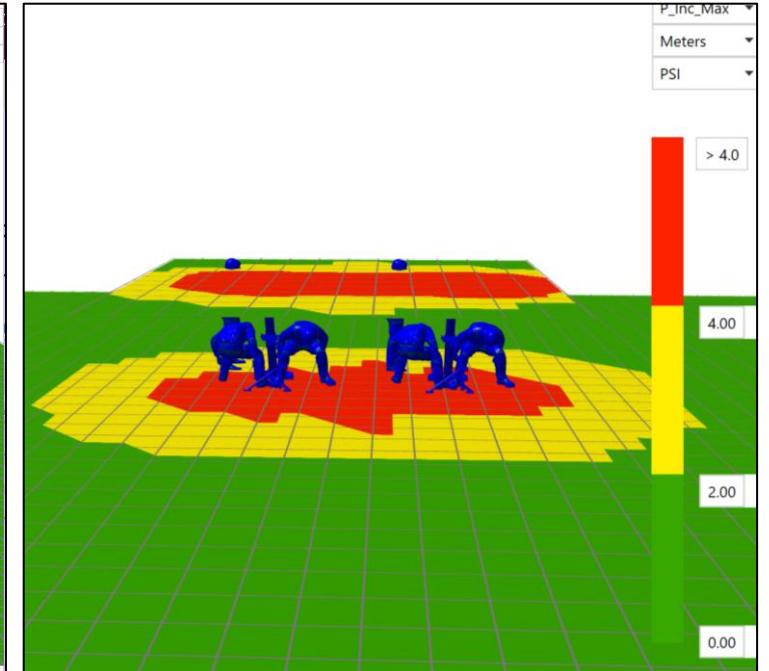
# BOP Tool Site Module Example: M120 Mortars



9m Between M120 Mortars



3m Between M120 Mortars



Predicted Exposure at Multiple Heights

Displays the BOP exposure zones on a training site with single/multiple firing stations

# BOP Tool Scene Module

- Reconstructs BOP scenes of Service members during heavy weapon system training
- Estimates BOP exposure on the different human body regions
- Predicts BOP exposures on Service members (whole body)
- Provides cumulative exposure metrics

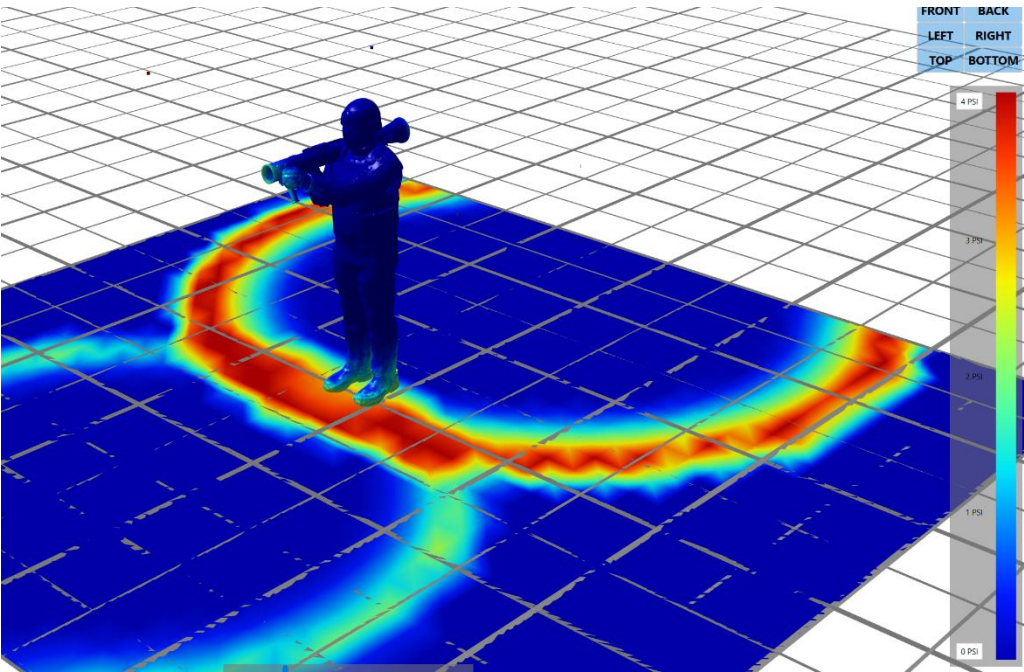


**Shoulder-Launched Multipurpose Assault Weapon (SMAW)**

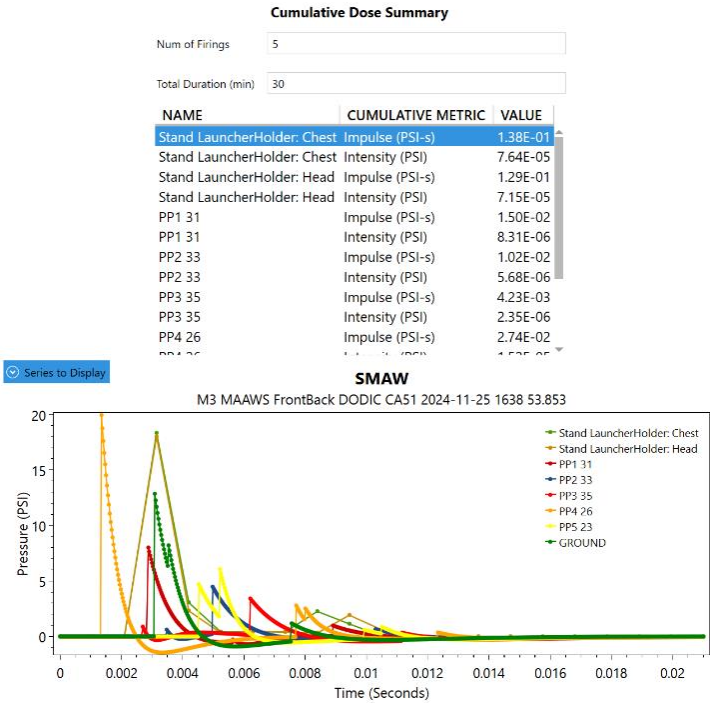
Predicts BOP on the body and provides cumulative exposure for unit log records



# BOP Tool Scene Module Example: SMAW



Blast Propagation for the SMAW

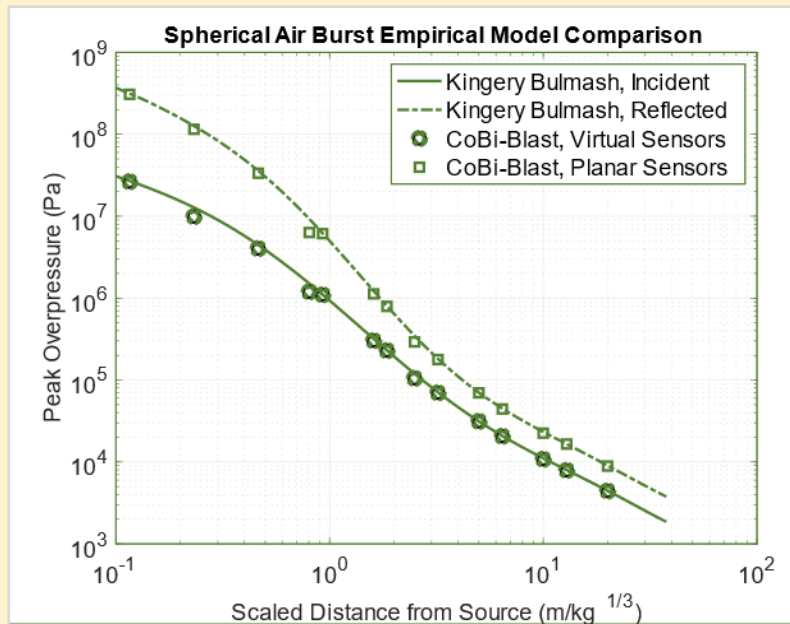


BOP Exposure Metrics

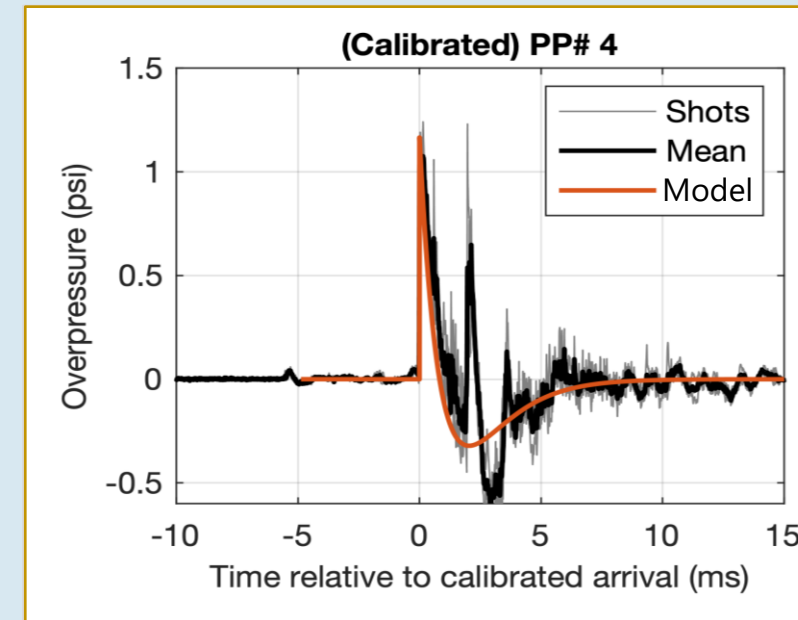
Displays BOP on whole body or regions including cumulative exposure over time

# Independent Assessment and Validation

BOP Tool results are consistent with established literature, existing structural airblast effect tools, and recent research.



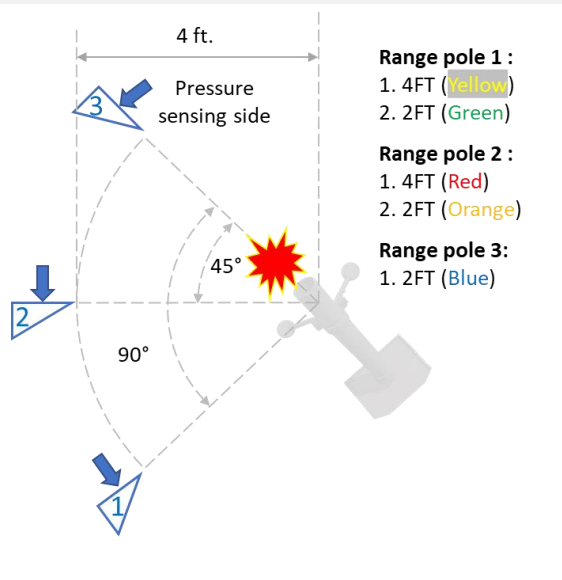
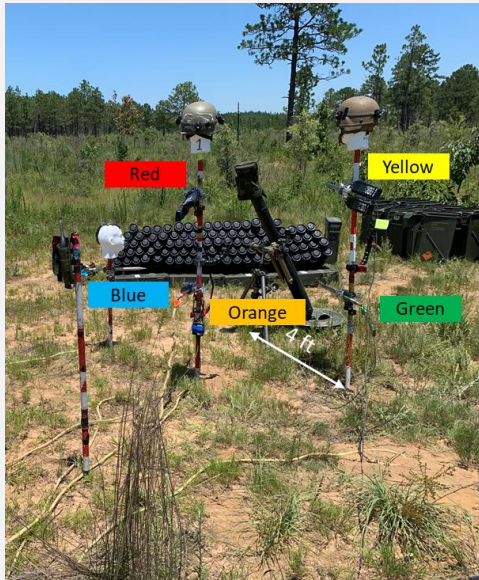
Validated weapon blast overpressure using experimental data from live-fire training.



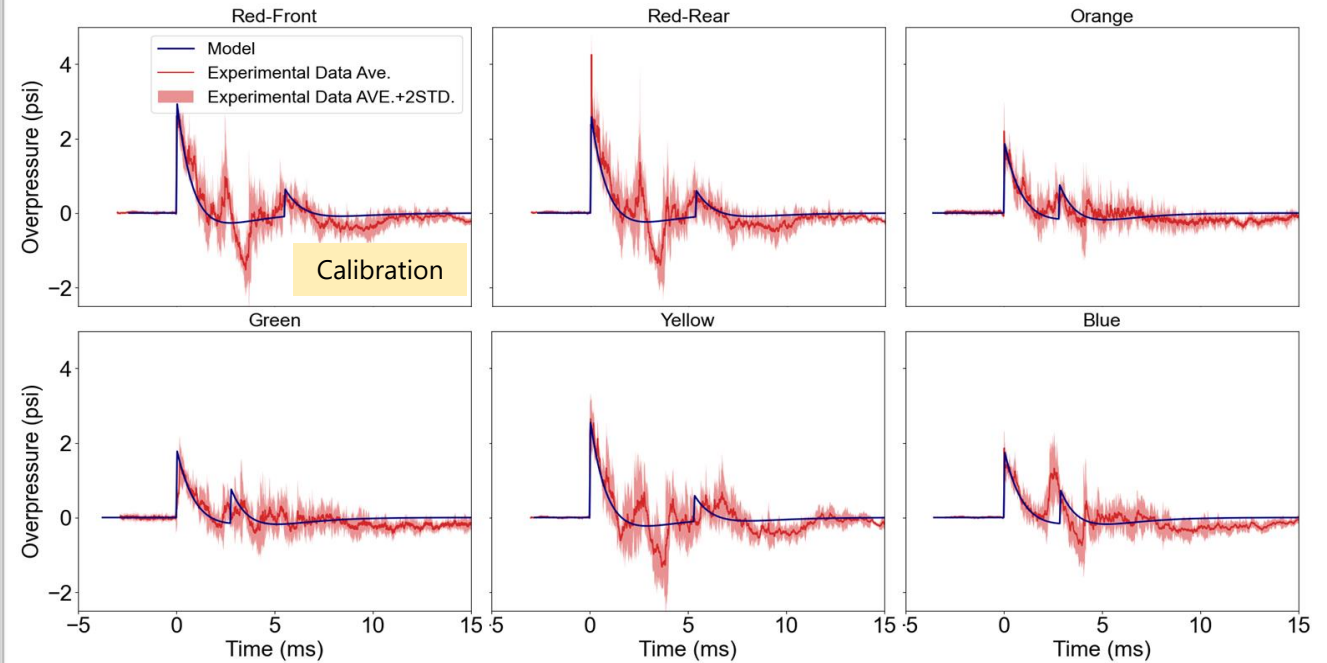
Validated against benchmark weapon blast data



# Example: M120 Mortar System BOP Characterization/Validation



## M120: Weapon Validation Results



- Full Range Training Round (FRTR, DODIC CA09) with 4 charges; 5 pencil probes on 5 stands; 20 shots
- 32 B3 sensors: 4 Service members, 4 on the helmet, 4 on the body

- Red-Front sensor is used for calibration, while the other sensors are used for validation
- Experimental data indicate interference by humans and structures

# BOP Tool: Weapon Systems BOP Library

## Shoulder Mounted Assault Weapon Systems

M3 MAAWS



AT4/M136 84 mm



M72 LAW



## Indirect Fire System (Howitzer)

M119 A3



M777 A2 155 mm



M109 A6 155 mm



## Rifles and Machine Guns

M107 Sniper Rifle



M2A1 .50 MG



MK15 Sniper Rifle



GAU-21 MG



## Indirect Fire System (Mortar)

M224 60mm



M1 81mm



M120 120mm



## Breachers

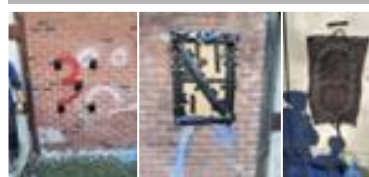
Open Space



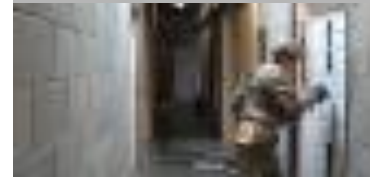
Door



Exterior Wall



Interior Wall





# Potential of the BOP Tool

## Potential Applications of the BOP Tool Capability

### Inform unit of predicted exposures

Blast overpressure is an invisible force. Reinforce safety warnings issued during weapons training by informing Service members about blast exposure hazards

### Inform training plan decisions

Specify plan options (e.g., firing lane positions, positioning of observers) that would prevent unnecessary exposures.

### Inform weapon design

Within the context of real ranges, provide developers with additional information about exposures resulting from their weapon systems.

### Provide exposure data for health and performance studies

Calculate presumptive exposures in cases where measured exposure is not available to researchers.

### Inform range modernization decisions

Provide data to support range design modifications that could prevent unnecessary exposures.

### Inform clinical decisions

Provide information on presumptive exposures in cases where measured exposure is not available to the clinician.

## DoW Community Group

Service members Involved in Weapons Training

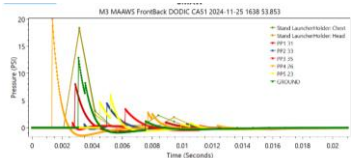
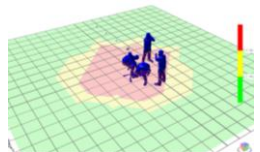
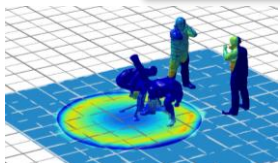
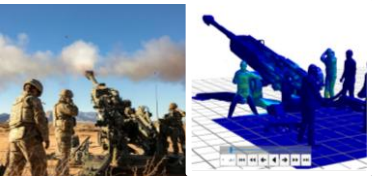
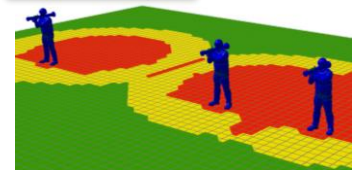
Range Management/Unit Leadership

Research, Development Test and Evaluation (RDT&E)

RDT&E

Range Management

Clinical



# BOP Tool Desktop

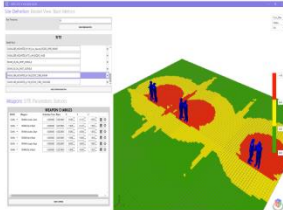
## BOP Tool Site and Scene Modules

Blast Overpressure (BOP) Tool

### Blast Overpressure (BOP)

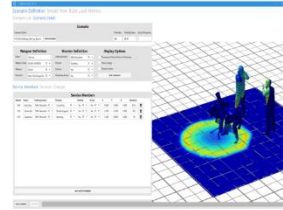
Provides blast overpressure exposure of Service members during firing of weapon systems

Shows BOP exposure zones around weapon systems




Open SITE Module

Reconstructs and predicts Service member BOP exposure

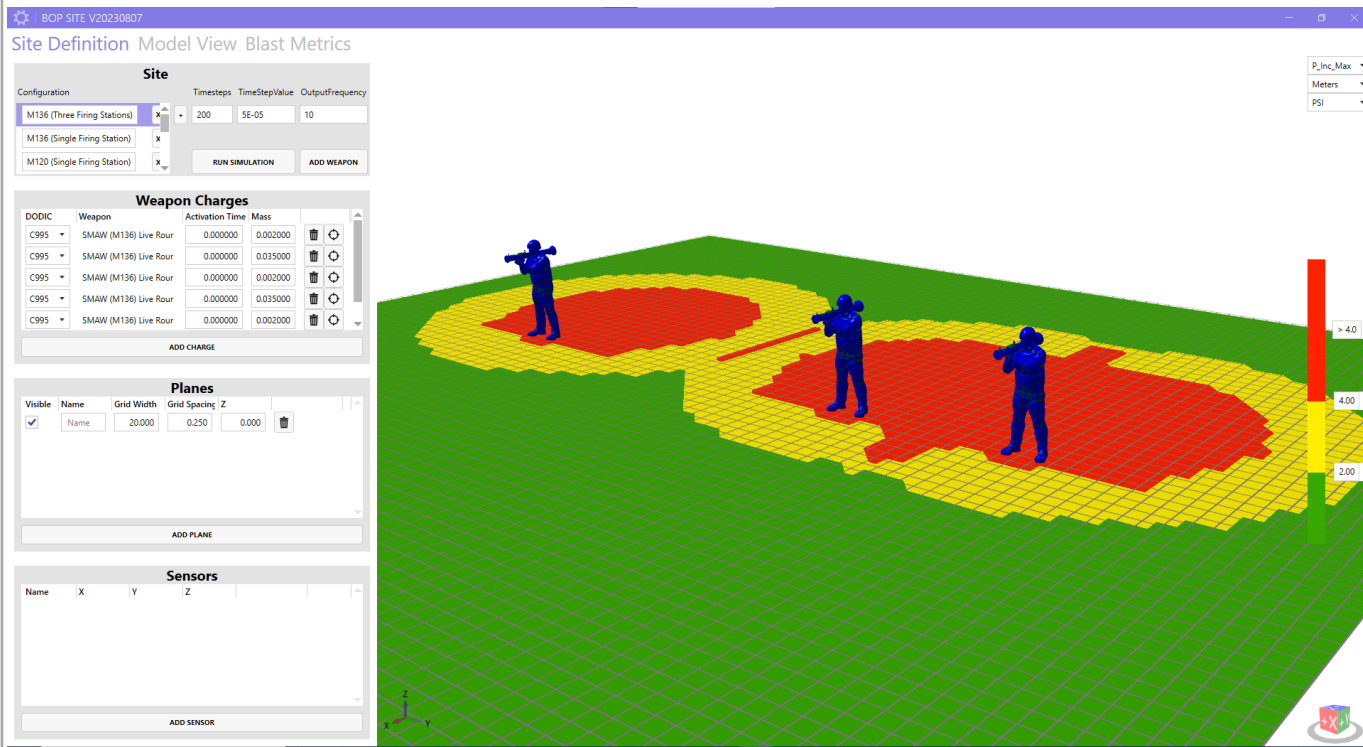


Open SCENE Module

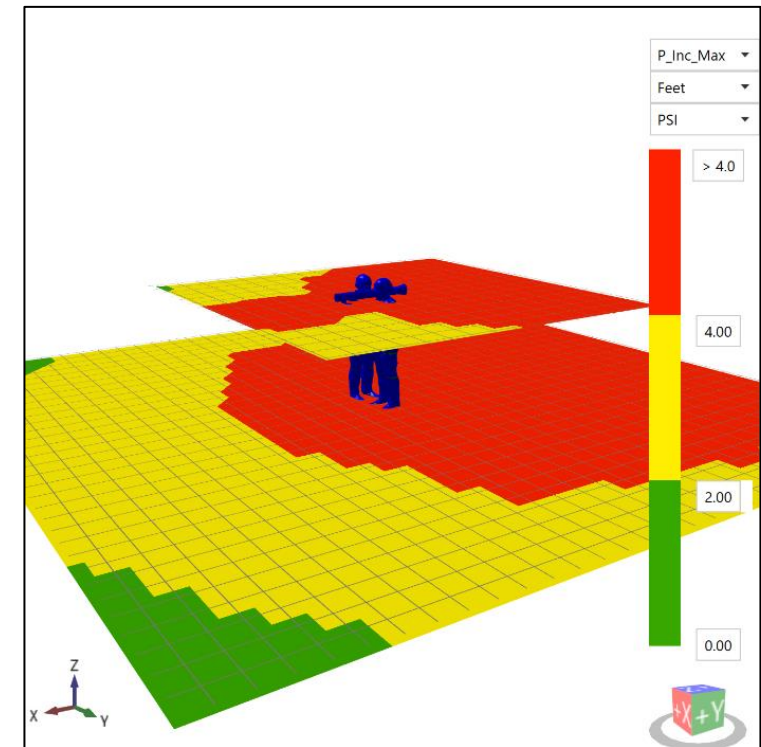


# BOP Tool Desktop

## Site Module



Informing Firing Position Separation



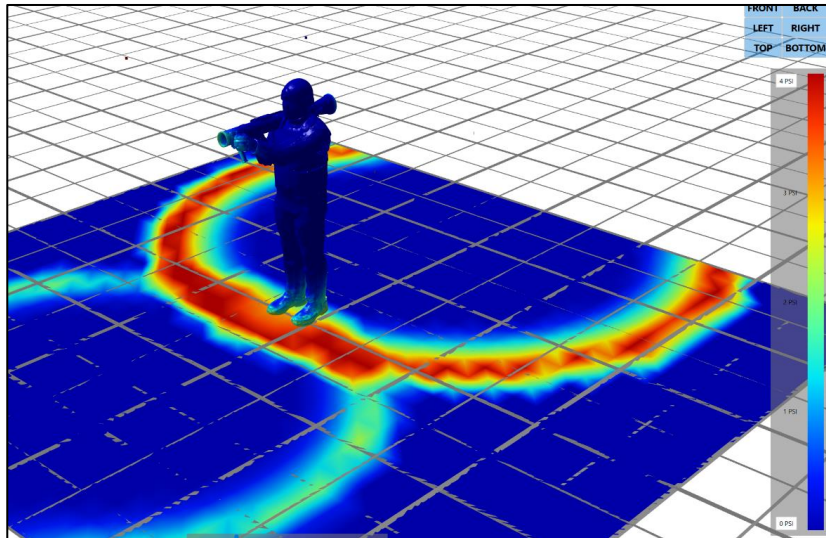
Identifying BOP levels at different heights



# BOP Tool Desktop

## Scene Module

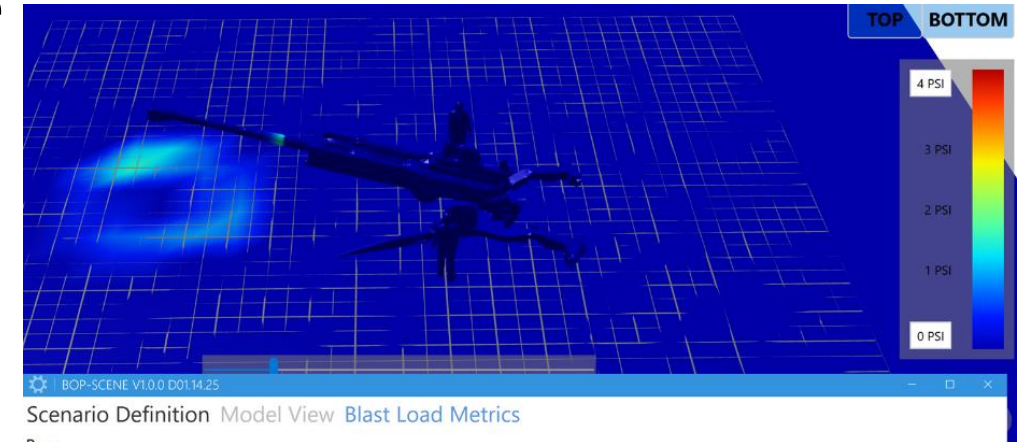
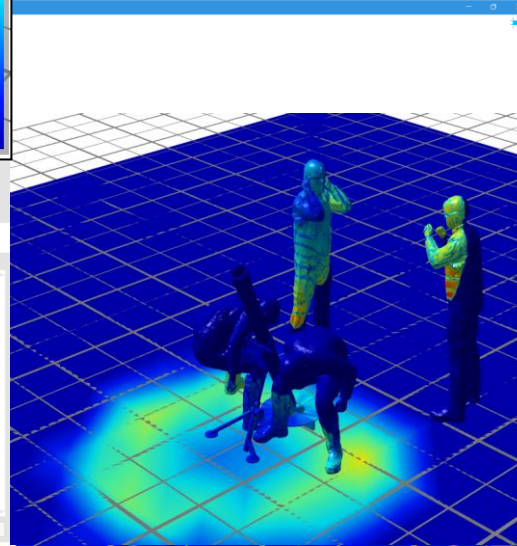
View BOP propagation



Service Members Sensors Charges

Model	Name	Anthropometry	Posture	Headset	Armor	X	Y	Z	Rotation
140	Ass. Gun	50th Percentile	Crouching	Yes	Yes	0.500	-1.000	0.000	210
150	Ammo Br	50th Percentile	Mortar Support	Yes	Yes	-1.000	-1.200	0.000	-90
170	Squad Ld	50th Percentile	Standing	No	Yes	-1.300	0.500	0.000	70

ADD SERVICE MEMBER



Scenario Definition Model View Blast Load Metrics

Runs

Howitzer\_M777\_DODIC\_DA13\_2025-05 CURRENT

### Pressure Summary

Threshold (PSI) 4

NAME	DESCRIPTION
John: Chest	Stand_Shuffle Standing, one foot forward, with arm
John: Head	Stand_Shuffle Standing, one foot forward, with arm
James: Chest	Stand_Shuffle Standing, one foot forward, with arm
John: Head	Stand_Shuffle Standing, one foot forward, with arm
PP1 38	User placed Sensor.

### Cumulative Dose Summary

Num of Firings 5

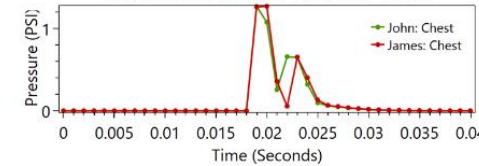
Total Duration (min) 1

NAME	CUMULATIVE METRIC	VALUE
John: Chest	Impulse (PSI-s)	2.28E-02
John: Chest	Intensity (PSI)	3.80E-04
John: Head	Impulse (PSI-s)	1.73E-02
John: Head	Intensity (PSI)	2.88E-04

Series to Display

### Howitzer

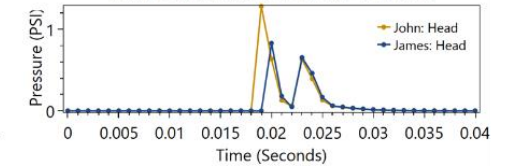
M777 DODIC DA13 2025-09-30 1421 11.942



Series to Display

### Howitzer

M777 DODIC DA13 2025-09-30 1421 11.942



# BOP Tool Mobile Application

## Example Inputs from the Mobile App for Different Weapons

### 50 Cal

Weapon class  
50cal

Weapon system  
Select a weapon system

GAU21  
M107  
M2A1  
MK15

Kneel Prone Stand

Firing stations  
1 2 3

Training session duration (min)  
30

Number of firings  
10

Run

### SMAW

Weapon class  
SMAW

Weapon system  
Select a weapon system

M136-AT4  
M3-MAAWS  
M72-LAW

Kneel Prone Stand

Firing stations  
1 2 3

Training session duration (min)  
30

Number of firings  
10

Run

### Breacher

Weapon class  
Breacher

Weapon system  
Select a weapon system

Door-Water  
Fence  
Interior-Door  
Wall-Fracture  
Wall-GBuster

Kneel Prone Stand

Firing stations  
1 2 3

Training session duration (min)  
30

Number of firings  
10

Run

### Howitzer

Weapon class  
Howitzer

Weapon system  
Select a weapon system

M109  
M119  
M777

Kneel Prone Stand

Firing stations  
1 2 3

Training session duration (min)  
30

Number of firings  
10

Run

### Mortar

Weapon class  
Mortar

Weapon system  
Select a weapon system

120mm  
60mm  
81mm

Kneel Prone Stand

Firing stations  
1 2 3

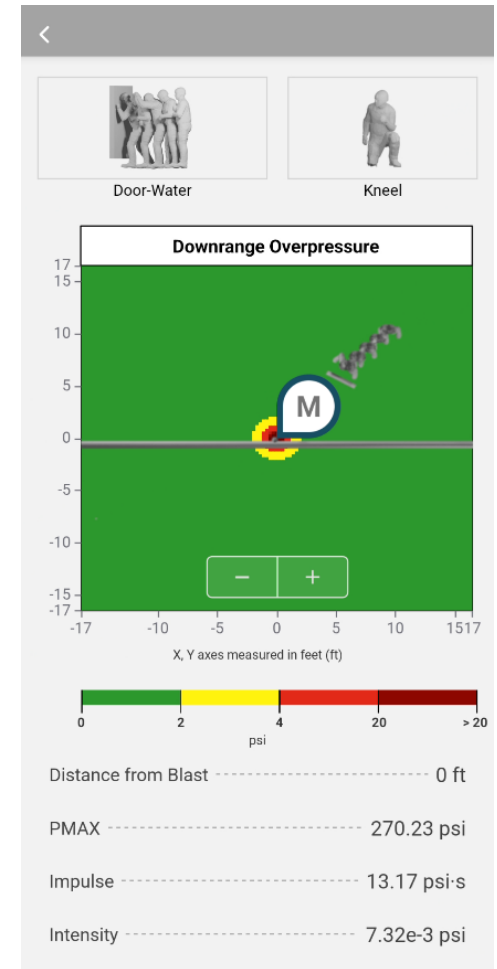
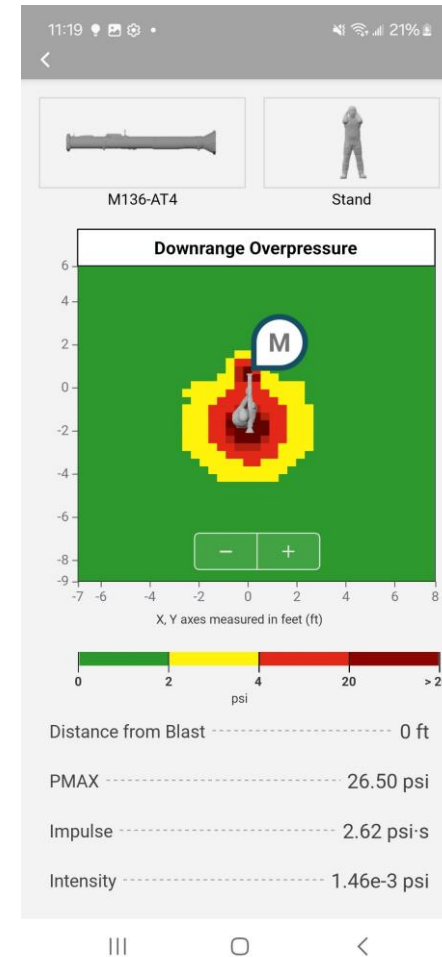
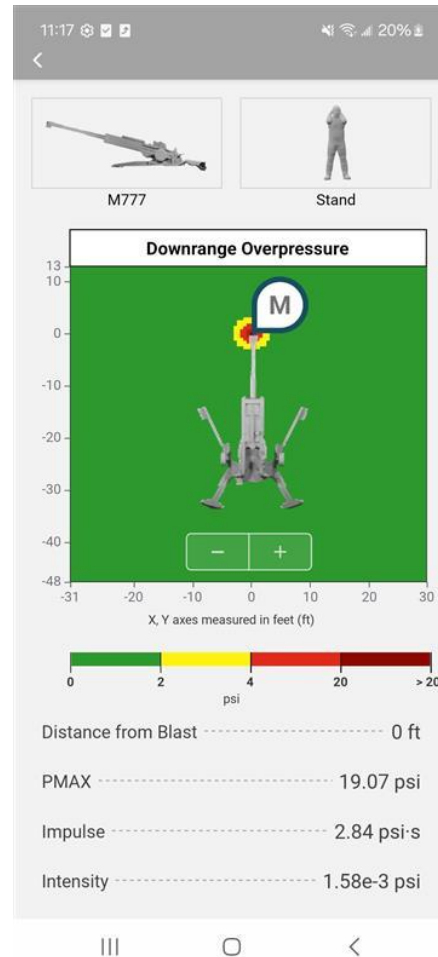
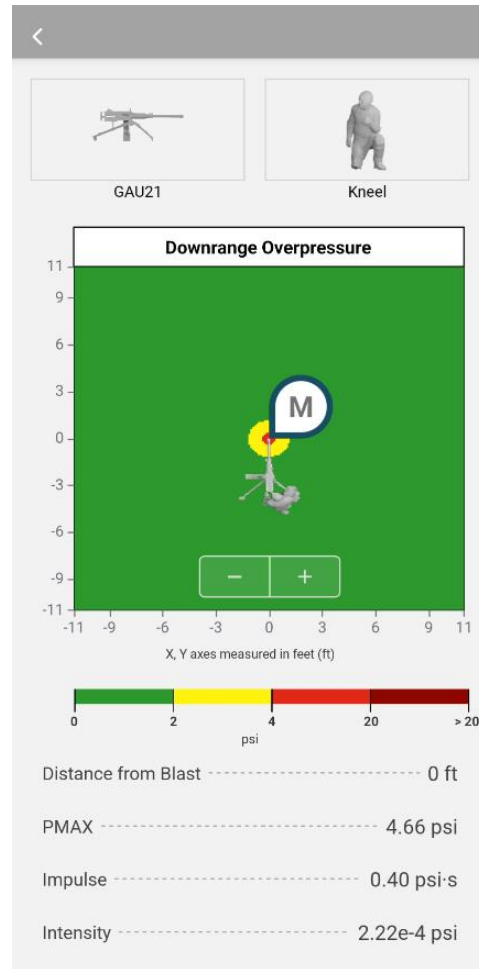
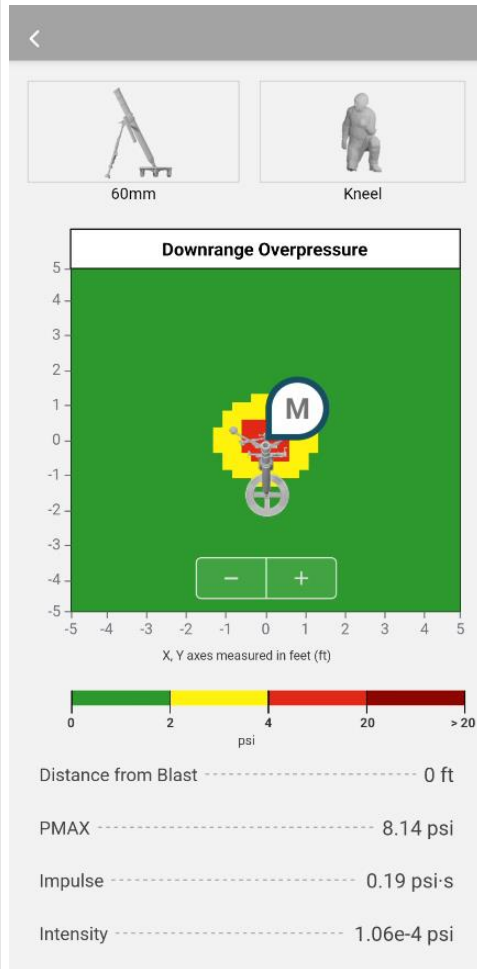
Training session duration (min)  
30

Number of firings  
10

Run

# BOP Tool Mobile Application

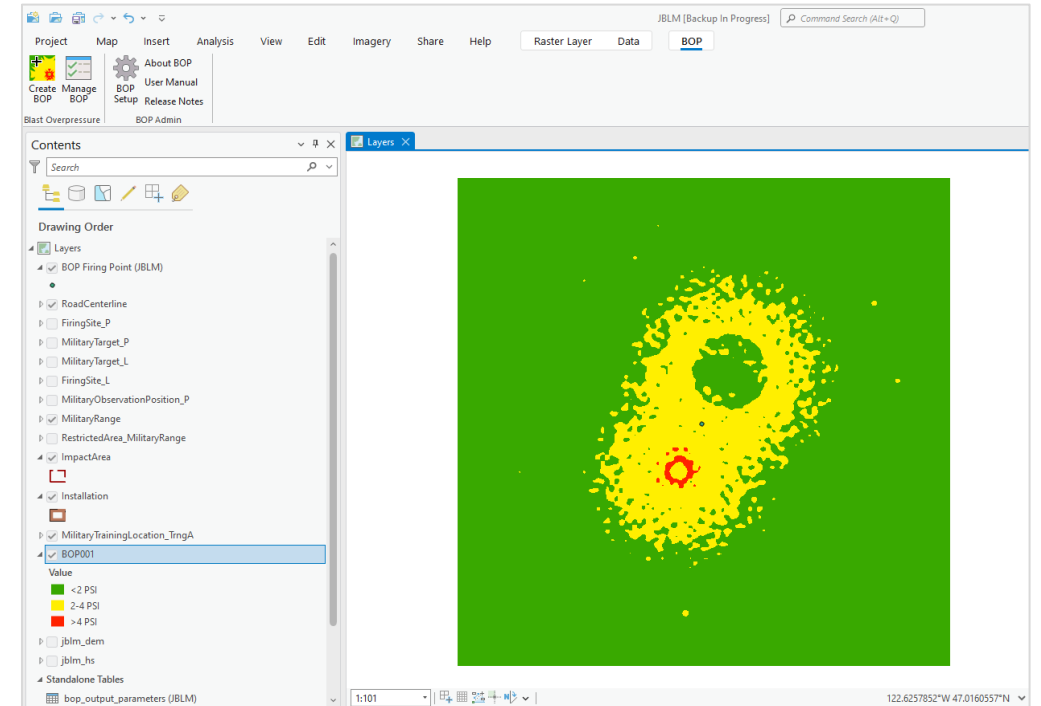
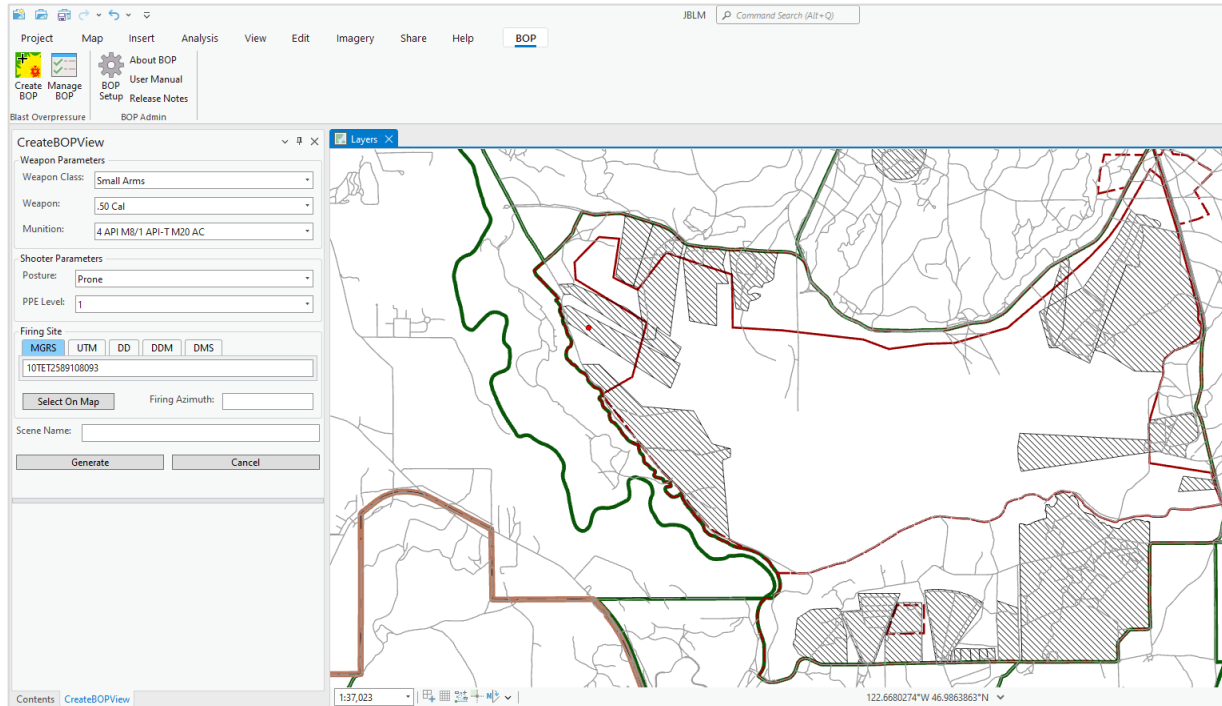
## Example Outputs from the Mobile App for Different Weapons





# BOP Tool ArcGIS

## Range Manager Toolkit Stand Alone BOP Tool



# Next Steps



- Continue engagement with operational community leveraging end user feedback for iterative product refinement
- Finalize educational materials and user manuals
- Formalize transition to advanced development
- Integrate BOP Tool with other DoW modeling tools and range safety applications (e.g., RMTK)
- Integrate BOP Tool function into range safety and operational use
- Review existing blast overpressure recording data from training scenarios for BOP Tool enclosed space modeling

# BOP Tool Team



MITRE





# Thank you!

## Point of Contact

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