U.S. Department of Homeland Security
Science and Technology Directorate
Washington, DC

Remote Access Firefighting Assistance Vehicle Operational Field Assessment Report

October 2012

Prepared for:

TechSolutions Program
Department of Homeland Security
Science and Technology Directorate
Washington, DC

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Responder Technologies (R-Tech) Field Assessment Program

Remote Access Firefighting Assistance Vehicle

Operational Field Assessment Report

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EXECUTIVE SUMMARY

In support of the TechSolutions Program within the U.S. Department of Homeland Security (DHS) Science and Technology Directorate (S&T), Science Applications International Corporation (SAIC) conducted an independent and comprehensive operational field assessment of the commercially-available Remote Access Firefighting Assistance Vehicle (RAFAV) which is manufactured by Howe and Howe Technologies. The purpose of the field assessment was to provide an opportunity for firefighters to test and evaluate the effectiveness of the RAFAV during simulated emergency response operations to determine if it would be a valuable tool for the firefighting community.

The RAFAV is a remotely controlled, tracked vehicle to assist firefighting activities. It has the capability to tow charged and uncharged hose lines for water supply to its remotely controlled monitor nozzle. This allows the RAFAV to be used as a portable hydrant for water supply and allows water delivery through the monitor nozzle or two connections for additional handlines.

The field assessment was executed on August 8 - 9, 2012, at a firefighting training facility at the Massachusetts Firefighting Academy in Stow, Massachusetts, with the assistance of Academy personnel and Howe and Howe Technologies. The results of the field assessment are based on the cumulative opinions of the test subjects, which were recorded throughout the assessment.

The results of the field assessment indicate that the RAFAV is highly efficient in providing a remotely-controlled water supply. The overall opinion of the test subjects is that the RAFAV is easy to operate, extremely rugged, durable, and field repairable; the test subjects indicated the firefighting community would benefit from the technology. The test subjects also provided valuable recommendations to enhance the usability of the RAFAV.

The test subjects provided positive comments on the capability and uses of the RAFAV for implementation in many areas of the fire service. Their main concern was that the potential cost of the RAFAV may prevent jurisdictions from being able to obtain the device, but suggested that it could be a regional resource. The RAFAV provides an option to placing firefighters in dangerous and potentially deadly situations during certain fire scene operations.

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1. INTRODUCTION

The TechSolutions Program within the U.S. Department of Homeland Security (DHS) Science and Technology Directorate (S&T) provides valuable information, resources, and technology solutions to address mission capability gaps identified by the emergency response community. DHS S&T personnel learned about the Thermite unmanned firefighting vehicle, commercially available from Howe and Howe Technologies, which may provide firefighters with additional response options in dangerous environments such as collapsed structures or wildfire incidents. Howe and Howe technologies developed a modified remote access firefighting assistance vehicle (RAFAV) using the concepts and technology derived in the development of the existing Thermite platform. TechSolutions and representatives from the Massachusetts Fire Academy conducted a test of this device under simulated operational conditions to determine its performance under typical firefighting response environments.

The National Fire Protection Association (NFPA) publishes *NFPA Standard 1410: Standard on Training for Initial Emergency Scene Operations*, which contains the minimum requirements for evaluating training for initial fire suppression and rescue procedures used by fire department personnel engaged in emergency scene operations. The RAFAV is designed to reduce exposure of firefighting personnel and provide the required water supply and dispersion for safe scene operations.

In support of the TechSolutions Program, Science Applications International Corporation (SAIC) is under contract with DHS S&T (General Services Administration [GSA] Schedule Number GS-23F-0107, Order Number HSHQDC-10-00128) to provide an independent test and evaluation of the RAFAV through an operational field assessment. This report outlines the results of the operational field assessment, which are presented as observations and do not imply success or failure of the technology.

2. DESCRIPTION OF TECHNOLOGY

The RAFAV is an unmanned, remotely operated, highly maneuverable robot designed as a fire extinguishing platform to pull and maneuver supply hoses (3 inches or greater in diameter) (see figure 2-1). The RAFAV is also designed to transport standard firefighting equipment to alleviate physical burdens on, or potentially reduce the number of, firefighting personnel resources. The RAFAV is designed to fit through industrial doors and to maneuver through stairwells. It is designed with a top speed of 5 miles per hour (MPH) and is commanded by wireless, remote controlled line of sight up to a quarter mile away. The RAFAV provides a small maneuverable platform for fire ground operations, water distribution, and tool and equipment transport. It is equipped with a remotely controlled Elkhart Brass Sidewinder™ nozzle, a 5-inch stortz inlet connector, and two 1-1/2-inch threaded handline connections. Refer to table 2-1 for RAFAV specifications.

Photo provided courtesy of Howe and Howe Technologies

Figure 2-1. RAFAV Model

Table 2-1. RAFAV Specifications

Specification	Measurement[1]
Height	55 inches
Width	35 inches
Length	74 inches
Weight	1,640 pounds
Speed	10 MPH
Start Time	Within 5 seconds
Water Capacity (Distribution)	Up to 500 gpm
Hauling Capacity	1,270 pounds (asphalt)
Remote Control Distance	1/4 mile[2]

Notes:

1 Measurements were provided by Howe and Howe Technologies and have not been verified by SAIC.
2 Line of sight

gpm = gallons per minute
MPH = miles per hour

3. FIELD ASSESSMENT EXECUTION

3.1 Human Subject Research

In accordance with federal regulations, research involving human subjects such as the RAFAV field assessment must be reviewed by an Institutional Review Board (IRB) before the research can begin. The purpose of an IRB review is to ensure, both in advance and by periodic review, that appropriate steps are taken to protect the rights and welfare of humans participating in a research study. To accomplish this purpose, the IRB reviews research protocols and related materials (e.g., informed consent documents) to ensure protection of the rights and welfare of human subjects as outlined in Title 45 of the Code of Federal Regulations (CFR) Part 46. The primary objectives of every IRB protocol review are to assess the ethics of the research and its methods, to promote fully informed and voluntary participation by prospective subjects who are themselves capable of making such choices, and to maximize the safety of subjects once they are enrolled in the project.

SAIC is a parent organization for an IRB, which is registered with the Office for Human Research Protections (OHRP) under the U.S. Department of Health and Human Services (DHHS). An application package was submitted on the RAFAV project to the SAIC IRB, and approval was granted in writing (appendix A) to continue the research based on that application.

3.2 First Responder Participation (Test Subjects)

Three certified firefighters from across the United States and local certified firefighter representatives from the Massachusetts Firefighting Academy volunteered to serve as the user community proxy for the RAFAV at the operational field assessment. The firefighters, herein referred to as test subjects, were solicited based on their experiences in the firefighting community. The test subjects will be assigned to one team.

For the purpose of protecting the privacy and identity of the test subjects during the field assessment, they will be assigned a letter designation (e.g., Test Subject A, Test Subject B, etc.) and their comments and feedback concerning the assessment will be documented in the same manner. Demographic information of the test subjects is included to add validity to the results. See table 3-1 for test subject demographics.

Table 3-1. Test Subject Demographics

Test Subject	Experience	Years
Test Subject A	Fire Service (Fire Chief)	33
	Emergency Medical Services (EMS)	33
	Emergency Management	13
Test Subject B	Fire Service (Assistant Chief)	21
	EMS	20
	Hazardous Materials (HAZMAT) Technician	14
	Law Enforcement	5
Test Subject C	Firefighter (Division Chief)	35
	HAZMAT Technician	32
	Search and Rescue	30
	Emergency Management	15

3.3 Testing Mechanisms and Criteria

Types of Assessment. The main types of testing mechanisms to be used in the operational field assessment of the RAFAV include threshold and objective capabilities, which are described as follows:

Threshold (T) – A threshold is a minimally required capability.

Objective (O) – An objective is a desired capability.

The criteria will be judged by the evaluators into one of the following categories:

- MET – All of the criteria were accomplished.
- PARTIALLY MET – A portion of the criteria was accomplished.
- NOT MET – None of the criteria was accomplished.

3.4 Field Assessment Criteria

The field assessment criteria provide a baseline for determining whether firefighters can engage the RAFAV during high-risk or physically-compromising fire ground operations. The test and evaluation of the vehicle during the field assessment was based on the criteria described below. The evaluators will determine if the criteria are met, partially met, or not met.

THRESHOLDS (T) (Minimum Required Capability)

1. Maneuver through standard doorways and be supported on common floor design construction.

2. Operate in a variety of terrain environments (such as paved, flat, sand, dirt, or wet ground).
3. Tow two charged 3-inch lines 200 feet on a parking lot surface.
4. Tow two 3-inch lines 200 feet and make a 90-degree turn through a doorway.
5. Controlled remotely from a minimum distance of 50 feet.
6. Training for an average operator should not exceed 20 minutes.
7. Move at 5 MPH continuously on flat terrain, have full variability and operational capacity less than 5 MPH.
8. Fully maintained and modified with no more than commonly available equipment to an ordinary fire department motor pool or fabrication shop, to include skill in maintenance and operation.
9. Reliability equivalent to existing firefighting vehicle systems.
10. Provide two secondary water connections capable of supporting a 1-3/4-inch line.
11. Unsupported/unmaintained mission operational time of 2 hours, including time to/from deployment area. This assumes a 90 percent duty cycle.

OBJECTIVES (O) (Desired Capability)

1. Fully functional in open terrain environments.
2. Able to operate in residential construction environments.
3. Tow two charged 3-inch hose lines 400 feet on a parking lot surface.
4. Tow one charged 4-inch line 200 feet on a parking lot surface.
5. Tow two charged 3-inch lines and make two 90-degree turns through doorways.
6. Tow one charged 4-inch line and make one 90-degree turn through a doorway.
7. Climb a flight of commercially-constructed stairs and maneuver the landing while towing two 3-inch uncharged lines.

3.5 Field Assessment Location and Equipment

SAIC conducted an independent operational field assessment of the RAFAV on August 8 - 9, 2012 at the Massachusetts Firefighting Academy. The location provided a safe and

secure environment for the assessment including a burn building (see figure 3-1), a multi-story building (figure 3-2), and several liquid propane (LP) gas props used for live and simulated situational training (figure 3-3).

Figure 3-1. Burn Building at Massachusetts Firefighting Academy

Figure 3-2. Multi-Story Building at Massachusetts Firefighting Academy

Figure 3-3. Gas Props at Massachusetts Firefighting Academy

The equipment used in the field assessment scenarios included actual firefighting hoses common to most fire departments. The test subjects were trained and experienced using all the equipment at the assessment. Only 3- and 4-inch hose was available at the training facility, and the evaluators agreed that the unit could also accept a 5-inch supply line.

3.6 Data Collection

SAIC provided a data collector for recording results and feedback from the test subjects throughout the field assessment. The goal of the data collector was to accurately capture results, stimulate feedback, and assist in accomplishing the field assessment objectives. At the completion of all scenarios, the data collector debriefed the test subjects and recorded results along with any additional feedback the test subjects may have provided on a debrief worksheet. The test subjects were encouraged to provide individual opinions as to the results of the tests during the debriefing sessions. The information collected on the debrief worksheets are incorporated in this report.

3.7 Equipment Familiarization

Prior to the start of the field assessment scenarios, Howe and Howe Technologies provided an in-service on the operation and capability of the RAFAV. Each participant was able to maneuver the device over a variety of surfaces (figure 3-4). The in-service and training time for operators to become minimally proficient controlling the device was less than 5 minutes each. The data collectors recorded all comments provided by the test subjects during the training and familiarization phase of the assessment.

Figure 3-4. Test Subject Equipment Familiarization

3.8 Scenarios

The RAFAV field assessment was performed at an actual firefighting training site using common firefighting equipment. The training site provides a safe location and a controlled environment that is conducive to test subject discussion and interaction during the field assessment.

3.8.1 Scenario 1 –LP Tank Fire/Vapor Dispersion. A line from a propane storage tank has ruptured and ignited creating flame impingement upon the tank. To decrease exposure to personnel, the operator will maneuver the RAFAV, towing two uncharged 3-inch lines a minimum of 400 feet across a paved surface. The lines will be charged and the monitor nozzle will apply water to cool the propane tank as the RAFAV advances toward the tank (figure 3-5). This will simulate extinguishment of a fire impinging upon a propane tank to prevent a Boiling Liquid Expanding Vapor Explosion (BLEVE). The second part of the scenario will involve an LP leak on a rail car conning tower where the RAFAV will approach and use the nozzle to dissipate the heavier-than-air LP (figure 3-6).

Figure 3-5. LP Storage Tank Prop

Figure 3-6. LP Rail Car Prop

3.8.2 Scenario 2 – Wildland Fire. A wildland fire has grown out of control and is being propagated by high winds. The rural fire department requests mutual aid for the RAFAV to be deployed as a portable hydrant. The RAFAV is delivered by trailer to the staging area and the scene personnel are trained on its operation. Firefighters will move RAFAV at 5 MPH over a variety of terrains (flat, gravel, dirt, paved, wet) to the site of the fire (figure 3-7). The RAFAV will tow two uncharged 3-inch lines approximately 300 feet where the lines will be charged. Then, two 13/4-inch hand lines will be attached to the RAFAV and charged to extinguish the fire. Distance from the operator to the RAFAV will be increased to determine maximum range of operation.

Figure 3-7. Wildland Area

3.8.3 Scenario 3 – Exposure Protection. Fire at a large, commercial, multi-story brick structure presents an exposure risk to the building across the alley. To limit collapse exposure to firefighters, the RAFAV will be deployed to navigate obstacles through a portion of the adjacent structure to provide exposure protection to the adjacent building. It will enter the structure (simulated by wood placed in close proximity to the tower), turn 90 degrees, travel a short distance, and then make a second 90-degree turn through another doorway to end in the alley. The RAFAV will do these maneuvers while towing 200 feet of uncharged 5-inch line into the alley. The line will be charged and flow water through the monitor nozzle (all directions and flow patterns) to cool the adjacent exposure (figure 3-8). These maneuvers will be repeated using two charged 3-inch lines.

Figure 3-8. Fire Tower

3.8.4 Scenario 4 – Multi-Story Industrial Facility Fire. A local industrial facility has a fire on the upper floor. There are no standpipes so the RAFAV will tow two uncharged 3-inch hoses up one flight of a commercially-constructed stairs, turning on the landing to deliver the lines to the upper level. For the second phase, the RAFAV will tow one charged 3-inch hose up one flight of a commercially-constructed stairs, turning on the landing to deliver the lines to the upper level (figure 3-9). The remote controlled nozzle will direct water onto a targeted area.

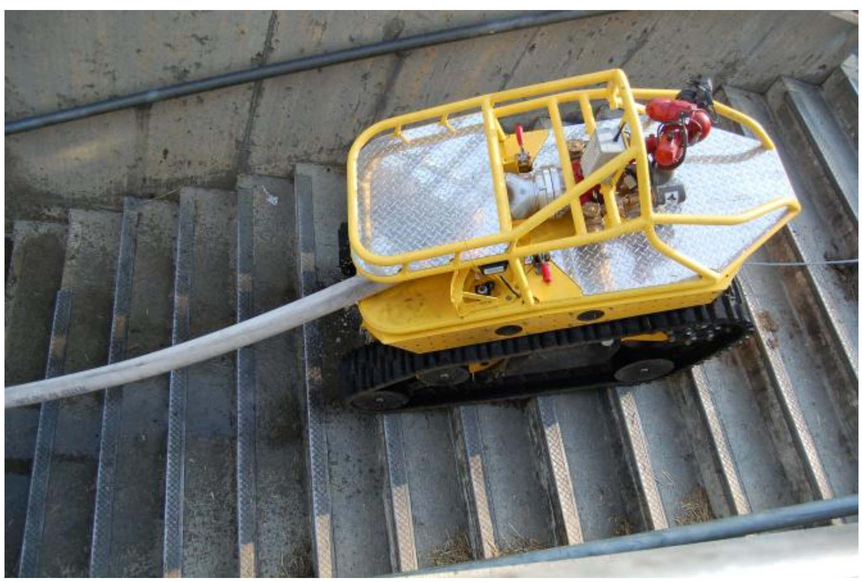

Figure 3-9. Stairwell

3.8.5 Scenario 5 – Culminating Tasks. The tasks for this scenario will be developed by the evaluators during the assessment to address areas not covered in the previous scenarios. The evaluators wanted to assess the stability of the device and then have an opportunity to repair a displaced track (figures 3-10 and 3-11).

Figure 3-10. Rough Terrain

Figure 3-11. Track Replacement

4. RESULTS OF THE FIELD ASSESSMENT

4.1 Test Subject Observations

4.1.1 Thresholds (T). A threshold is a minimally required capability.

Maneuver through standard doorways and be supported on common floor design construction. NOT MET. The RAFAV will not fit through the standard 36-inch doorway and was not able to enter any of the doorways in the burn building or training tower (figure 4-1). The consensus of the evaluators was that use in a residential area was limited to the exterior.

Figure 4-1. Unable to Enter Standard Doorway

Operate in a variety of terrain environments (such as paved, flat, sand, dirt, or wet ground). MET. Maneuverability of the RAFAV in all terrains tested was extremely good. It was evaluated on paved, gravel, grass, dirt, and wet terrains. The terrains ranged from flat to rugged to sloped and debris strewn. No area tested presented an impasse for the device. After several unsuccessful attempts by the evaluators, representatives from Howe and Howe Technologies were able to make the RAFAV turn over on its side.

Tow two charged 3-inch lines 200 feet on a parking lot surface. MET. No problems were associated with towing the uncharged lines. It was able to easily tow the uncharged lines in excess of the requirement (figure 4-2).

Figure 4-2. Towing Two Charged 3-Inch Lines

Tow two 3-inch lines 200 feet and make a 90-degree turn through a doorway.
PARTIALLY MET. Since the RAFAV would not enter any of the doorways, it easily towed the lines around the corner of the fire tower (figure 4-3). The only issue was that the couplings would occasionally snag on the concrete corner, but the device was able to force them to pass around the corner.

Figure 4-3. Hose Pulled Around Corner

Controlled remotely from a minimum distance of 50 feet. MET. It can be controlled remotely far beyond the 50-foot requirement. The device was controlled at a line of sight distance of 2,000 feet. The evaluators had the remote control inside the concrete fire tower and were able to control the device. The obstacle was that the operator must be able to see the device because no camera or remote viewing system was incorporated into this testing. Howe and Howe Technologies representatives did acknowledge that a remotely viewed camera system was available.

Training for an average operator should not exceed 20 minutes. MET. Howe and Howe Technologies representatives provided an in-service for the operation of the RAFAV. All three evaluators were able to functionally operate the device in less than 5 minutes of training.

Move at 5 MPH continuously on flat terrain, have full variability and operational capacity less than 5 MPH. MET. Evaluators were able to move the RAFAV in excess of 5 MPH on flat terrain. Full control was achieved at all speeds.

Fully maintained and modified with no more than commonly available equipment to an ordinary fire department motor pool or fabrication shop, to include skill in maintenance and operation. MET. All of the evaluators determined that the RAFAV was easily maintainable with common tools. When the track was deliberately removed by maneuvering by the Howe and Howe Technologies representatives, only two tools were required to return the unit to service.

Reliability equivalent to existing firefighting vehicle systems. MET. The consensus of the evaluators was that the RAFAV is extremely durable and reliable and is equivalent to or exceeds current firefighting systems. There were no mechanical issues during the assessment.

Provide two secondary water connections capable of supporting a 1 3/4-inch line. MET. The RAFAV has two standard connections for 1 3/4-inch handlines (figure 4-4). Two handlines were connected and flowed water along with the monitor nozzle.

Figure 4-4. 1-1/2-Inch Connection

Unsupported/unmaintained mission operational time of 2 hours, including time to/from deployment area. This assumes a 90 percent duty cycle. MET. The evaluators agreed that the RAFAV exceeded this requirement. The Howe and Howe Technologies representatives stated that the unit can operate at full power for 8 hours on the self-contained 5-gallon diesel fuel tank.

4.1.2 Objectives (O) (Desired Capability).

Fully functional in open terrain environments. MET. Overwhelmingly, the evaluators agreed that the RAFAV is fully functional in all the terrains tested, which included paved, gravel, grass, dirt, and wet areas. It also successfully maneuvered hilly and rough terrain without any problems or instability (figure 4-5).

Figure 4-5. Operating in a Variety of Terrains

Able to operate in residential construction environments. NOT MET. The evaluators all agreed that the RAFAV would generally not be useful inside traditional residential construction. The unit will not pass through the standard residential door opening and the weight could create an issue for residences that had basements or were multi-storied.

Tow two charged 3-inch hose lines 400 feet on a parking lot surface. NOT MET. The unit towed the two charged 3-inch lines across paved surface for about 300 feet but was not able to tow it any additional distance (figure 4-6). The device would tip to the side while attempting to turn due to the weight and drag of the charged hose lines.

Figure 4-6. Towing Two Charged 3-Inch Lines

Tow one charged 4-inch line 200 feet on a parking lot surface. MET. Towing the 4-inch line 200 feet across the parking lot was not an issue for the RAFAV (figure 4-7).

Figure 4-7. Towing a 4-Inch Charged Supply Line

Tow two charged 3-inch lines and make two 90-degree turns through doorways. MET. The RAFAV was successfully able to tow the two 3-inch charged lines (figure 4-8). The only difficulty was the couplings catching on the corner, but the RAFAV was able to force the hose around the corner. The opening was approximately 6 feet wide.

Figure 4-8. Towing Two Charged 3-Inch Lines Around a Corner

Tow one charged 4-inch line and make one 90-degree turn through a doorway. MET. The RAFAV easily towed the charged 4-inch line and made not only the required one 90-degree turn, but two 90-degree turns and applied water through the remote nozzle (figure 4-9).

Figure 4-9. Towing 4-Inch Supply Line Around a Corner

Climb a flight of commercially-constructed stairs and maneuver the landing while towing two 3-inch uncharged lines. MET. The RAFAV towed the two uncharged 3-inch lines up the stairs successfully (figure 4-10). The only issue was that the unit bounced slightly so the climbing speed was minimal. A winch cable was attached to the front of the device as a safety precaution but did not aid in the climbing process.

Figure 4-10. Towing Two Uncharged 3-Inch Lines While Ascending a Flight of Stairs

4.2 Recommendations for Enhancements

Evaluators suggested many possible enhancements for the RAFAV. One of the most prominent was remote video capability. The addition of enhanced video with a wireless receiver for the

operator would greatly increase the usability of the device and allow the operator additional safety by not requiring line-of-sight operation. They recommended two cameras for operating the device: one fixed looking forward for operator orientation and one pan-tilt-zoom (PTZ) for panoramic viewing. The device could also utilize thermal imagery, night vision, and forward looking infrared (FLIR).

Other enhancements included the modular concept for additional components such as patient litters, monitoring equipment, and additional tool-carrying capability. With the modular concept, additional components could be easily added to the RAFAV for the specific required mission.

4.3 Additional Uses

In addition to the scenarios tested, the evaluators noted several possibilities for use of the RAFAV. One of the evaluators stated that, had it been available, he would have used the device twice within the last six months for operations in large commercial manufacturing fires. In addition, the device would have uses during confined space operations, such as in a subway or tunnel.

The RAFAV also could have benefits for the law enforcement community. Some of the possibilities included: breaching capability; officer down rescue; ballistic paneling for officer protection; delivering items for hostage situations; deploying a variety of tools such as tear gas, light and sound diversionary devices, explosive breaching materials, or remote listening devices.

5. CONCLUSION

The results of the field assessment for the RAFAV indicated that it is a valuable tool for the fire service. The main benefit of the RAFAV is the ability to use it in place of firefighters in hazardous and potentially deadly situations. The RAFAV is an asset for certain applications in the fire service. Additional development and testing will increase desirability for all public safety uses.

APPENDIX A – INSTITUTIONAL REVIEW BOARD (IRB) APPROVAL

SAIC

DHHS FWA Number: 00001115
DHHS IRB Number: 00001654
DoD Addendum: DoD N-A3018

CERTIFICATE OF APPROVAL: **INITIAL**

INVESTIGATOR: John O'Neil Project Manager (443) 345-5592	**PROTOCOL IDENTIFIER:** 2012050801	**ADDRESS:** 6210 Guardian Gateway Bldg D – The Gate Aberdeen Proving Ground, MD 21005
PROTOCOL TITLE: Remote Access Firefighting Assistance Vehicle (RAFAV) Operational Field Assessment		
APPROVAL DATE: 06-14-2012	**EXPIRATION DATE:** 06-13-2013	**REVIEW CYCLE (months):** Quarterly (3 months)
RISK LEVEL: Minimal	**REVIEW TYPE:** Expedited	

The SAIC Institutional Review Board (IRB) has approved this initial protocol in accordance with Federal Regulations at 45 CFR 46. Research activities that (1) present no more than minimal risk to human subjects, and (2) involve only procedures listed in one or more of the following categories, may be reviewed by the IRB through the expedited review procedure authorized by 45 CFR 46.110 and 21 CFR 56.110. The activities listed should not be deemed to be of minimal risk simply because they are included on this list. Inclusion on this list merely means that the activity is eligible for review through the expedited review procedure when the specific circumstances of the proposed research involve no more than minimal risk to human subjects.

A copy of the SAIC IRB approved informed consent form has been included with this notification. Copies of the SAIC IRB approved informed consent form must be used when documenting consent of human subjects for participation in this protocol.

Regulations require that this protocol be renewed prior to the above expiration date. If this fails to occur, the SAIC IRB is required to close your protocol. The SAIC IRB will provide a reminder prior to the expiration date, but it is your responsibility to ensure that your request for renewal is received in sufficient time to be reviewed prior to the expiration date.

Changes to your protocol must be submitted to the SAIC IRB for review and approval prior to their implementation. This includes changes to the informed consent form, principal investigator, protocol, etc. You are required to report any unexpected problems or serious adverse events, either physical or mental, to the SAIC IRB that occur during the course of your research. Any unexpected problems must be reported within 5 days and any serious adverse events must be reported within 24 hours.

Our Assurance with the federal government specifies that all signed consent documents be retained for at least 3 years past completion of the research activity.

Please feel free to contact me at 703-676-7175 or by e-mail at john.s.parker@saic.com or Nicholas Owens, Human Protections Administrator, at 703-676-2408 or by e-mail at nicholas.d.owens@saic.com if you have any questions about this approval or about SAIC IRB procedures.

SAIC

Thank you for your concern for human subjects.

Sincerely,

ELECTRONIC SIGNATURE AUTHORIZED BY DR. PARKER

John S. Parker, M.D. Date: 06/14/2012
SAIC IRB Chair

CC: Nicholas Owens, HPA
Gary Waggoner, VP for EH&S

APPENDIX B – ACRONYMS

BLEVE	Boiling Liquid Expanding Vapor Explosion
CFR	Code of Federal Regulations
DHHS	U.S. Department of Health and Human Services
DHS	U.S. Department of Homeland Security
FLIR	forward looking infrared
GSA	General Services Administration
IRB	Institutional Review Board
LP	liquid propane
MPH	miles per hour
NFPA	National Fire Protection Association
OHRP	Office for Human Research Protections
PPE	personal protective equipment
PTZ	pan, tilt, zoom
RAFAV	Remote Access Firefighting Assistance Vehicle
S&T	Science and Technology Directorate
SAIC	Science Applications International Corporation
T&E	test and evaluation

APPENDIX C – RESOURCES

Elkhart Brass, <http://www.elkhartbrass.com/files/aa/downloads/brochures/Sidewinder.pdf>

Howe and Howe Technologies, <http://www.howeandhowe.com/>

Massachusetts Firefighting Academy, <http://www.mass.gov/eopss/agencies/dfs/dfs2/mfa-trng/the-massachusetts-firefighting-academy.html >

Merriam-Webster, <http://www.merriam-webster.com>

National Fire Protection Association (NFPA), <http://www.nfpa.org/>

National Institutes of Health, <http://ohsr.od.nih.gov/guidelines/45cfr46.html>

OSHA, <http://www.osha.gov/>

TechSolutions, <https://www.techsolutions.dhs.gov>

U.S. Department of Health and Human Services, <http://www.hhs.gov>

U.S. Fire Administration, <http://www.usfa.fema.gov/>