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Sandia National Laboratories

STINGRAY CASE STUDY

Unclassified Unlimited Release

IPO Integrated Partnerships Organizations

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U.S. DEPARTMENT OF ENERGY NNSA National Nuclear Security Administration

BACKGROUND

Improvised explosive devices (IEDs) have injured and killed numerous soldiers and civilians as a consequence of military operations in the Middle East. With gaps in existing technologies, the US military required devices for quickly addressing deadly IEDs without harming military personnel or inflicting severe damage to the environment.

Figure 1: Stingray is a shoe-boxed sized structure that can be positioned next to a suspected IED to disable it.

In response to this need, Sandia developed Stingray, a clear, plastic handheld device to quickly and safely disable threatening IEDs. Stingray is designed to be used in two configurations: a coherent water blade for cutting operations and as a water slug for general device disruption. Prior to disabling an IED, Explosive Ordnance Disposal (EOD) technicians will x-ray the target using tools such as Sandia's X-ray Toolkit (XTK) to determine which function operators should use to dismantle the IED. For example, if the operator knows exactly which wires to cut, they can use the precision water blade. If the operator wants to create a general disruption, they can use the water slug function.[1]

The first function, the precision water blade, formed from the front of the device, is created when the internal explosive detonates; sending a shock wave traveling through the water and accelerating inward into a concave opening. Once the water collides through the opening, it produces a thin blade capable of penetrating the IED before it can explode, resulting in a precise cut. The second function, the water slug, generated from the back of the device, performs a general disruption when attached to an IED, tearing all IED components (e.g. wires, detonators) apart, resulting in a scattered effect.[2] Unlike traditional explosives, Stingray utilizes shaped-charge technology to deliberately manipulate the water to form a specific shape upon detonation. This allows the operator to focus Stingray's energy precisely where needed and accurately disable the IED.[3]

The standard ***Stingray*** device is small, durable, and capable of disabling IEDs in diverse environments including on the roadside; in trunks of vehicles, propane tanks, backpacks; and harsh environments such as wind, dirt, and extreme temperatures.[4] As requested by the Federal Government, Sandia developed smaller- and larger-scale versions of the device. The smaller versions, referred to as ***Tactical Stingray***, have the same effectiveness, but they can fit in the pocket of a soldier's cargo pants. Approximately 3,000 Tactical Stingrays have been deployed to US armed forces overseas.[5] The larger versions, referred to as ***Mantaray*** are approximately three times larger than the standard Stingray and have been deployed

[1] Sandia PIs Juan-Carlos Jakaboski and Robert Todd Miner
[2] https://prod-ng.sandia.gov/techlib-noauth/access-control.cgi/2018/184127m.pdf
[3] http://www.sandia.gov/ims/projects/index.html
[4] https://eimsicn.sandia.gov/navigator/jaxrs/p8/getDocument
[5] https://federallabs.org/successes/success-stories/sandia-bomb-disabling-technology-protects-soldiers

for use in special application missions.[6] Compared to traditional IED disabling technologies, Stingray is beneficial because it is much less likely to detonate an IED while disabling it. [7]

CURRENT ADVANTAGES

- Rugged enough to be deployed by a robot
- Able to disable soft targets
- Can be dropped without breaking
- Can be daisy chained for larger blades and longer cuts[8]
- Scaled down version can be fit in warfighter's pockets for battlefield deployment[9]

RETURN ON INVESTMENT

PROGRAM DEVELOPMENT

In 2006, Sandia engineers working in explosive research development recognized the challenges EOD technicians faced when trying to defuse an IED. The engineers identified one primary challenge: EOD technicians were using inefficient, outdated technologies that inhibited their ability to properly dispose of IEDs. As a result, Steven Todd, one of Sandia's Stingray inventors, formed a team of engineers to develop an improved fluid blade disablement tool for quick disablement of IEDs. Sandia engineers conducted research and development using supercomputer modeling and simulation as well as validation testing using 3D printed models to explore and create a state-of-the-art tool capable of effectively and safely disabling an IED.[10] With funding from the National Nuclear Security Administration (NNSA), Sandia engineers designed, built, and refined Stingray totaling over 50 design iterations and 10 lab prototypes over the course of its development lifecycle.[11,12]

Military personnel were first introduced to Stingray technology at a Sandia training exercise in 2007. As recognition of the technology spread, the US Army, National Guard EOD technicians, and civilian bomb squad officers from the Joint Base Lewis-McChord in Washington successfully demonstrated Stingray at the Raven's Challenge in 2009, which later led to its request for use in the battlefield in 2010.[13] In 2010, Sandia partnered with TEAM Technologies, a local New Mexico business located in Sandia's Science and Technology (S&T) Park, on a commercial patent licensing agreement for the mass production of standard Stingray units for military deployment overseas in Afghanistan and Iraq.

While Sandia was the prime Stingray designer, developer, tester, and evaluator, TEAM Technologies provided the resources necessary to manufacture large quantities of units for quick operational deployment which resulted in the protection of countless US military personnel overseas. Sandia and TEAM Technologies also collaborated on the scalability of manufacturing the smaller- and larger-scale versions of Stingray to ensure system usability, performance, and reduce costs throughout the

[6] Sandia PIs Juan-Carlos Jakaboski and Robert Todd Miner
[7] https://eimsicn.sandia.gov/navigator/jaxrs/p8/getDocument
[8] https://prod-ng.sandia.gov/techlib-noauth/access-control.cgi/2010/105677c.pdf
[9] https://prod-ng.sandia.gov/techlib-noauth/access-control.cgi/2019/194819m.pdf
[10] Sandia PIs Juan-Carlos Jakaboski and Robert Todd Miner
[11] https://prod-ng.sandia.gov/techlib-noauth/access-control.cgi/2010/105677c.pdf
[12] https://federallabs.org/successes/success-stories/sandia-bomb-disabling-technology-protects-soldiers
[13] https://www.alamy.com/stock-photo-active-army-and-national-guard-explosive-ordnance-disposal-technicians-129475115.html

commercialization process. Less than nine months after starting the technology transfer process, TEAM Technologies reached full production capacity. In early July 2010, the first production units totaling 5,000 were delivered to military personnel in Afghanistan and Iraq.[14,15]

In 2010, TIME magazine named Stingray as one of the top inventions in the US and was featured on the Discovery Channel.[16] In 2011, Sandia won the Federal Laboratory Consortium (FLC) Mid-Continent Regional Award for Excellence in Technology Transfer and Stingray was submitted for an R&D 100 award.[17] Sandia does have one granted patent on the technology: US patent number US 8,091,479 *Fluid Blade Disablement Tool*.[18]

LICENSES

Stingray has one licensee: TEAM Technologies, a local New Mexico business located in Sandia's S&T Park. TEAM Technologies collaborated with Sandia to quickly and efficiently manufacture thousands of Stingray units for military deployment overseas.[19]

Partner	Status	Year
TEAM Technologies	Executed	2010-2031

PUBLIC GOOD

The rapid deployment of Stingray has led to countless US military lives saved overseas in Afghanistan and Iraq by allowing EOD technicians to defuse threatening IEDs safely and efficiently. While Stingray was primarily developed for IED disruption/render-safe operations for military EOD technicians and bomb squad units, Stingray can also be used for environmental, emergency response, law enforcement, and demolition applications.[20] For example, emergency response personnel can attach Stingray to a robot such as Sandia's GEMINI-Mine Scout Rescue vehicle for clearing away obstacles in a collapsed mine and support mine rescue missions.[21]

Environment

The US Forest Service worked with Sandia to evaluate Stingray for potential use as a water axe to clear dead trees without emitting sparks, an important advantage in fire-prone forests.[22] To demonstrate Stingray's capabilities, Sandia engineers used the tool to cut a large telephone pole in half. At the time, the US Forest Service was using dynamite to remove forest waste, which could easily ignite and start a fire. This demonstration proved Stingray's ability to safely tear down hazardous materials such as dry brush, wood, and other obstacles without causing additional damage to the environment.[23]

[14] https://prod-ng.sandia.gov/techlib-noauth/access-control.cgi/2011/112847p.pdf
[15] Sandia PI Steven Todd
[16] Sandia PI Steven Todd
[17] https://prod-ng.sandia.gov/techlib-noauth/access-control.cgi/2018/184127m.pdf
[18] https://analytics.patsnap.com/search/result?_type=query&q=12%2F486%2C888#/tablelist/1?sort=desc&size=100
[19] https://info-ng.sandia.gov/ESP/output.php3
[20] https://eimsicn.sandia.gov/navigator/jaxrs/p8/getDocument
[21] Sandia PI Steven Todd
[22] https://federallabs.org/successes/success-stories/sandia-bomb-disabling-technology-protects-soldiers
[23] Sandia PI Steven Todd

Law Enforcement

The Transportation Security Administration (TSA), New Jersey State Police, and other US law enforcement entities use Stingray for a variety of applications including for use at officer training events for Bomb Appraisal Officers and civilian bomb squad units.[24] Stingray is also used as an advanced technology training device for geographically dispersed emergency response technicians. To date, Stingray has been used in over 500 law enforcement training events and demonstrations.[25]

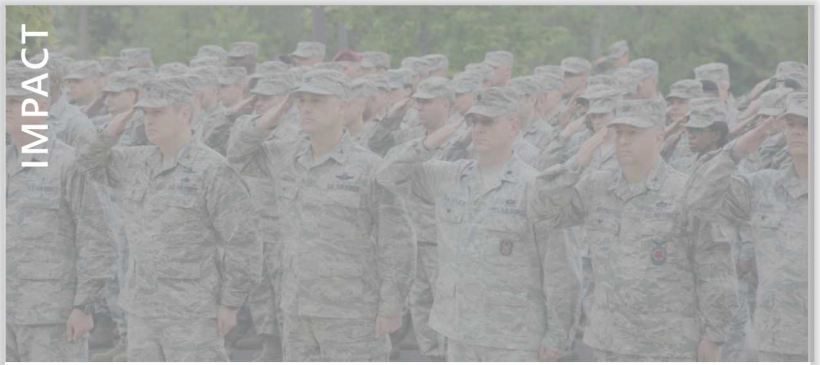
As a result of successful implementation throughout the US and US military abroad, foreign EOD personnel in Australia's special operations forces and law enforcement in Germany are exploring ways to incorporate Stingray into various applications including IED disablement.[26]

[24] http://www.sandia.gov/ims/projects/index.html
[25] Sandia PI Keith Frakes
[26] Sandia PI Steven Todd

STINGRAY

- Improvised explosive devices (IEDs) have injured and killed numerous soldiers and civilians as a consequence of military operations in the Middle East.
- With gaps in existing technologies, the US military required devices for quickly addressing IEDs without harming military personnel or inflicting severe damage to the environment.
- In response to this need, Sandia developed Stingray, a clear, plastic handheld device for effectively and safely disabling IEDs with funding from NNSA.

- Stingray is one tool equipped with two functions: a precision water blade for making precise cuts and a water slug for a general disruption leaving a scattered effect.
- Less than nine months after the start of the technology transfer process, Stingray was deployed for operational use to US military personnel in Afghanistan and Iraq.
- As requested by the US Government, Sandia developed three versions of the tool: standard Stingray, Tactical Stingray (smaller), and Mantaray (larger) for application-specific tasks.



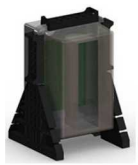
Protects US military personnel and interests abroad

5,000+ units deployed overseas

500+ law enforcement training events

Supports local New Mexico economy through TEAM Technologies partnership

2006
Sandia begins research and development of Stingray with NNSA funding



National Nuclear Security Administration

2007
US Military personnel first introduced to Stingray technology at Sandia training exercise

2009
Active US Army and National Guard EOD technicians with civilian bomb squads conduct a live demonstration of Stingray during the Raven's Challenge

2010
Sandia licenses Stingray to TEAM Technologies

TEAM TECHNOLOGIES INCORPORATED

2010

TIME Magazine names Stingray as one of top inventions

2011
Sandia wins FLC Mic Continent Regional Award for Excellence in Technology Transfer

FLC
Federal Laboratory Consortium for Technology Transfer