Middle East Institute

CAR BOMBS AS WEAPONS OF WAR

ISIS'S DEVELOPMENT OF SVBIEDS, 2014-19

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SUMMARY

The suicide vehicle-borne improvised explosive device (SVBIED) has been one of ISIS's most powerful and versatile weapons. The group consistently adapted the SVBIED design based on operational environment and other factors, with modifications in armor, payload organization, color, and detonation technology. Advanced SVBIED designs have been distributed between many ISIS provinces, not only within Iraq and Syria, but also globally to provinces in Nigeria and the Philippines. ISIS's research and development of SVBIED technology presents a continued threat, even after the collapse of the territorial caliphate, due to the group's ability to export its designs and enable nascent ISIS provinces to launch powerful attacks on unsuspecting communities globally.

INTRODUCTION

The suicide car bomb, more accurately referred to as the suicide vehicle-borne improvised explosive device (SVBIED), is an extremely powerful and versatile weapon — and one that played a central role in ISIS's rise to power. The group's use of a fleet of SVBIEDs was key to its rapid territorial expansion in Syria and Iraq in 2013-14. They served as powerful force multipliers, giving the numerically inferior insurgents the ability to deliver tons of explosives to designated targets. SVBIEDs were used tactically to punch holes in static defenses, allowing for follow-up ground attacks that would regularly overrun larger enemy positions. Additionally, they also had a psychological effect, demoralizing their targets while buoying the spirits of fellow ISIS fighters to continue fighting.

Now, more than four years later, ISIS's territorial caliphate has been destroyed, as the U.S.-backed Syrian Democratic Forces (SDF) prized free the group's hold on the last few villages in the Hajin pocket along the Euphrates River in Syria, close to the Iraqi border, in March 2019.

This case study focuses on how ISIS developed an array of different SVBIED designs to suit a variety of operational environments. It will also examine how ISIS has shared information about SVBIED designs across provinces to facilitate their development, as well as how these designs are spreading to its satellite provinces around the world.

HISTORY OF ISIS'S SVBIED USE

THE BEGINNING

While ISIS has become infamous for its widespread use of SVBIEDs, they were first employed by predecessor groups beginning in 2003. Historically speaking, the most well-known and commonly used type is the covert SVBIED. This consists of a vehicle with an unmodified exterior that's been fitted with an interior explosive payload. The vehicle is then driven to and detonated at a specified target by a driver. The unmodified exterior allows the SVBIED to blend in with civilian traffic on roads and in cities controlled by the opposing force, making it extremely difficult to counter.

Apart from covert SVBIEDs, non-state actors often use parked VBIEDs as well, which look the same as the former but are parked at a location and then detonated remotely or via victim triggers. As parked VBIEDs lack drivers, they basically function as larger masked stationary IEDs. Though parked VBIEDs are easier to employ, the offensive nature of covert SVBIEDs allows them to be much more precise.

The design of covert SVBIEDs is optimal for disadvantaged non-state actors involved in insurgencies, which is why they have been used almost exclusively up until recently. This was also the case for ISIS: The covert design was optimal for the early stages of its insurgency,

CHRONOLOGY

2014

June	Militants declare ISIS as a worldwide caliphate
July	ISIS overruns the city of Mosul

2015

May	ISIS overruns the city of Ramadi

2016

August	Turkey launches Euphrates Shield mission to secure the Turkey-Syria border
October	Battle of Mosul begins, Iraqi forces reach the outskirts of east Mosul

2017

February	Fighting begins on Mosul's western outskirts
June	SDF begins offensive to retake city of Raqqa
July-Dec.	Syrian loyalist forces recapture nearly all of the central and eastern Syrian desert from ISIS control

2018

January	Fighting escalates in the Hajin pocket

2019

March	US announces end of ISIS's territorial caliphate

when the group was largely engaged in guerrilla warfare, conducting hit-and-run attacks in hostile territory before disappearing.

However, as ISIS gradually gained strength and began seizing territory in Syria and Iraq in 2013 and 2014, the landscape started to change and it encountered a problem. Capturing and actively controlling land meant that clearly demarcated frontlines separated ISIS territory from that of its adversaries. Additionally, this expansion resulted in ISIS seizing large quantities of military armored vehicles, artillery pieces, as well as other types of weaponry and ammunition. For example, when it overran the city of Mosul in July 2014, it seized an estimated 2300 HMMWVs (or Humvees).[1]

TERRITORIAL CONQUEST AND INNOVATION

With increased military strength, the parity of arms began shifting in ISIS's favor as it fielded this newly acquired equipment in battle. The group was now waging more conventional warfare in these areas, as opposed to its traditional hit-and-run guerrilla tactics. This new environment negated the advantage of stealth offered by the use of covert SVBIEDs, and subsequently forced ISIS to rethink the way it employed SVBIEDs offensively on the battlefield. In turn, this resulted in the emergence of the up-armored SVBIED.

The core tenet of SVBIED manufacturing and usage has always been to maximize the chances of the vehicle being able to reach its intended target. With covert SVBIEDs, this is done by masking them as civilian vehicles to avoid detection. With up-armored SVBIEDs, ISIS began welding steel plates as a form of improvised armor to the front of the vehicles in order to shield them, their drivers, and their payloads from incoming fire up until the intended point of detonation.

Though unrefined at the beginning, the eventual standardized up-armored SVBIED would come to feature improvised armor plating concentrated at the front of the vehicle, with metal plates focused on shielding the engine block, windshield, and tires. The plate covering the engine block typically had slats cut out of it in order to prevent overheating, and the driver's viewing port usually consisted of a rectangular hole either covered with protective glass or coupled with a smaller metal plate that could be slid into place to form a more narrow rectangle when the vehicle came under fire.

ISIS up-armored SVBIED used against Syrian loayalists in Homs Province. *(ISIS video release, September 2016)*

Later iterations of up-armored SVBIEDs featured sloped and slat armor. Sloped armor, steel plates welded to the front of the vehicle at an angle, increase the effective thickness of the armor facing frontal

impacts.[2] For example, 100mm thick armor sloped at 45 degrees becomes 141mm of effective armor. The angled armor plating also helps to deflect incoming rifle and machine gun fire of varying calibers, instead of absorbing the force head on.

Slat or cage armor generally takes the form of a metal grid or bars, and is typically fitted over the improvised armor plating with some spacing. If an anti-tank munition is fired at the vehicle, slat armor is designed to catch and crush the warhead, rendering it inoperable. If the warhead detonates, slat armor can provide a slightly increased standoff distance between the explosion and the vehicle, reducing the munition's ability to penetrate.[3]

It's important to note, also, that while ISIS began using up-armored SVBIEDs in areas where they actively controlled territory, the group simultaneously continued to use covert SVBIEDs in other areas to wage guerrilla warfare. This further demonstrates the importance of situational factors for groups like ISIS in determining when and where to use different types of SVBIEDs.

Though up-armored SVBIEDs seemed like a new phenomenon to many, it's not the case. While the majority of SVBIEDs used by insurgents during the Iraq war were covert, they would in rare cases also employ some with steel plates welded to the interior of the vehicles' windshields.[4] For example, there's video footage from as early as 2007 showing Islamic State of Iraq, ISIS's predecessor, using SVBIEDs based on heavy trucks that had been fitted with interior windshield armor.[5]

Seeing as ISIS often operates at a numerical disadvantage, the use of up-armored SVBIEDs in combat functions was a powerful force multiplier that enabled a smaller attacking force to overrun larger enemy contingents. The primary military application of up-armored SVBIEDs has been its ability to initiate battles by softening static enemy defenses before a ground assault.

An ISIS up-armored SVBIED with slat/cage armor used on the outskirts of eastern Mosul. *(ISIS video release, October 2016)*

As ISIS rose to prominence, they seized large numbers of military armored vehicles. While most were employed in their intended roles, some were diverted for use as SVBIEDs. The most common vehicles converted to SVBIEDs were armored personnel carriers like the Soviet-made BMP-1 and the US-made M113 or HMMWV. These vehicles have built-in armor far thicker than any civilian vehicle and are often tracked, which provides great off-road capabilities. They also typically include large storage spaces for payloads. Main battle tanks, however, were rarely used as SVBIEDs since they are much more useful assets when employed as intended.

An ISIS military armored SVBIED in Salahuddin Province. *(ISIS video release, November 2015)*

Beyond the use of up-armored SVBIEDs based on pick-up trucks, heavy trucks, and military armored vehicles, ISIS began designing and employing more complex, target-specific SVBIED designs aimed at particularly fortified targets. Heavy construction equipment like front-end loaders and bulldozers had already been used offensively, as their ability to remove earth berms and punch through roadblocks proved essential to clearing a path for follow-up attacks by up-armored SVBIEDs. Soon, ISIS went one step further and began using up-armored front-end loaders and bulldozers as SVBIEDs themselves.

When ISIS overran the Iraqi army positions in Ramadi in May 2015 and captured the city, they used upwards of 30 up-armored SVBIEDs.[6] In multiple instances, the up-armored SVBIEDs were preceded by up-armored front-end loaders and bulldozers that removed concrete blast barriers to clear the way for the SVBIEDs. In one such case, an up-armored SVBIED based on a front-end loader barreled through two layers of concrete blast barriers before detonating next to an Iraqi army position. An SVBIED followed afterwards and its detonation caused the entire eight-story building, where the Iraqi forces were based, to collapse. This was a clear demonstration of the role that heavy construction equipment could play when employed as up-armored SVBIEDs, especially when attacking fortified targets.

In the same vein, ISIS soon introduced a two-man SVBIED design. In this setup, the driver was accompanied by a rooftop gunner tasked with providing suppressing fire until the vehicle reached its intended detonation point. Typically reserved for tougher-than-average targets, two-man SVBIEDs have seen comparatively little use. They aren't restricted to a single vehicle type and a large variety of vehicles have been used as two-man SVBIEDs, ranging from SUVs and military armored vehicles to heavy trucks and front-end loaders.

An ISIS two-man up-armored SVBIED in Anbar Province. *(ISIS video release, April 2016)*

Both heavy construction equipment and two-man SVBIEDs are innovations aimed at increasing the success rate of SVBIED operations targeting hardened enemy positions. These target-specific SVBIED designs were only the first in a series of innovations, all spurred by changes to battlefield settings or enemy tactics.

ISIS rose to prominence in 2013-14, and at its peak, controlled territory in Syria and Iraq larger than the land area of Great Britain.[7] To facilitate management of this huge swathe of land, ISIS divided it into more than a dozen *wilayat* (provinces), each with a centrally appointed *wali* (governor) responsible for administration. Each province also had a series of *diwans* (departments) responsible for managing everything from health care, education, finance, and agriculture to internal security, judicial affairs, and war.[8] *Diwan al-Jund*, the military and defense department, oversaw the manufacturing and use of SVBIEDs in each province. To increase the efficiency of their military operations, some provinces also set up official "suicide battalions" of SVBIEDs that accompanied other ISIS vehicle formations into battle, clearing the way before a final push.[9]

An ISIS up-armored SVBIED in Nineveh Province, made from a front-end loader *(ISIS video release, January 2017)*

A network of different workshops traditionally constructed ISIS's up-armored SVBIEDs, resulting in a lack of design uniformity. However, in September 2015, a series of almost identical up-armored SVBIEDs began to appear in different ISIS provinces across northern Iraq, including Nineveh (home to the city of Mosul), as well as neighboring Salahuddin and Dijlah. These new SVBIEDs were overhauled black pick-up trucks with similar modifications, including frontal slat armor. These vehicles stood out compared to the average up-armored SVBIED. Interestingly, the logo on the side of these SVBIEDs was always blurred out in official ISIS video releases.

An ISIS black SVBIED captured by Liwa Ali al-Akhbar in Salahuddin Province in late 2015. *(Deleted youtube video, Stahlgewhitter Sy)*

However, when the Iraqi Shi'a militia *Liwa Ali al-Akhbar* captured one of these SVBIEDs in Salahuddin Province in late 2015, photos that displayed the logo in full were released. It read "Wilayat Nineveh – Car Bomb – Abu Laith al-Ansari Battalion," indicating that the SVBIED had been manufactured in the Mosul area and later shipped out for use by the ISIS contingent in Salahuddin. The resource-rich city of Mosul and its surroundings had far greater ability to produce high-quality up-armored SVBIEDs in volume than surrounding provinces. As such, Mosul supplemented SVBIED operations in other provinces by supplying additional vehicles. The same was true for the Syrian city of Raqqa, which would later come to supplement SVBIED operations in the northern Aleppo countryside during the Turkish "Euphrates Shield" operation.[10]

The rollout of these black up-armored SVBIEDs coincided with the introduction of an environment-specific SVBIED design. This type was identical to the former, but was painted tan to blend in with the natural surroundings of the areas in which the SVBIED operations were carried out. Northern Iraq contains many open desert plains, which have proven to be difficult environments for offensive SVBIED attacks. The wide plains provide next to no cover for attacking SVBIEDs, rendering them particularly vulnerable to incoming fire. Painting the up-armored SVBIEDs the same color as their surroundings helped them to blend in more with their surroundings.

THE BATTLE OF MOSUL

As the battle of Mosul commenced in mid-October 2016, the use of desert-colored up-armored SVBIEDs continued. The initial fighting took place in and around villages in the Nineveh plains that surround eastern Mosul, where desert-colored SVBIEDs were most useful. Having controlled Mosul and its surroundings since June 2014, ISIS had substantial time to prepare for an attack on the city and manufacture many SVBIEDs for initial defense. ISIS claimed to have conducted 50 SVBIED attacks in the first week of the offensive alone.[11]

DETONATION TECHNOLOGY

At the outset of ISIS's use of SVBIEDs, detonation technology was unrefined and rudimentary. Soon, however, detonation systems in SVBIEDs were improved to prevent a premature detonation by the driver, and the "white box" detonation system became the standard. The box features two sets of safeties and firing switches on separate firing circuits. Each safety must be pressed before the corresponding firing switch is activated, so as to prevent an accidental premature detonation. This also increases the chances of a successful detonation in case either of the firing circuits contains faulty wiring. Some SVBIEDs also include further precautions such as an additional set of safety and firing switches, grenade fuse-based firing switches or suicide belts worn by the drivers.

A SVBIED detonation mechanism employed by ISIS. *(ISIS video release, 2016-2017)*

An ISIS desert-colored up-armored SVBIED used on the outskirts of Mosul. *(SIS video release, November 2016)*

Even after Iraqi forces reached the outskirts of the city in late October, ISIS continued to use desert-colored SVBIEDs until December. However, when the Iraqi forces penetrated the city's outer defenses, all-white up-armored SVBIEDs began to appear, replacing the desert-colored vehicles. This was the first stage of the "camouflaged SVBIED."

While white was the most common color for SVBIEDs in the battle of Mosul, some pick-up truck and SUV-based SVBIEDs also appeared in grey and black. These colored SVBIEDs demonstrate a deliberate effort to blend in with civilian vehicles and deceive Iraqi forces and U.S.-led coalition aircrafts by masking the SVBIEDs' armor and making them appear as unmodified civilian vehicles.[12] The change in color was mostly a product of the change in operational surroundings from open plains to sprawling urban terrain, and was a continuation of the same logic that led to the creation of desert-colored SVBIEDs. In this sense, camouflaged SVBIEDs are essentially hybrid designs that combine the stealth of covert SVBIEDs with the protection offered by up-armored SVBIEDs.

An ISIS all-white up-armored SVBIED used against Iraqi forces in eastern Mosul. *(ISIS video release, January 2017)*

After a while, SVBIED workshops began experimenting with other colors, and soon up-armored SVBIEDs appeared painted dark red, light blue, and even bright yellow. The prevalence of these colors grew once fighting began in western Mosul, with SVBIEDs in bright green, blue, red, and yellow used on a more regular basis. With these new and diverse colors, ISIS aimed to make it more difficult for Iraqi forces to recognize and counter SVBIEDs.[13]

An ISIS stage 2 camouflaged SVBIED used against Iraqi forces in western Mosul. *(ISIS video release, February 2017)*

When the fight for western Mosul began in early 2017, ISIS made the same shift from desert-colored to city-camouflaged SVBIEDs in a repeat of its earlier transition in the east of the city. Fighting in western Mosul, however, also saw the introduction of a new camouflage innovation, known as stage 2 camouflaged SVBIEDS. These looked identical to the stage 1 examples, except that fake windshields, grilles, and wheels painted black were added on top of the existing armor.

This innovation was a dramatic visual improvement on previous camouflaged models, and their introduction was a sign of the lengths to which ISIS was going to improve and refine its SVBIED designs. The black paint added to the windshield, grille, and wheelhouse armor further obscured the presence of frontal armor, giving the camouflaged SVBIED an authentic civilian look at a distance, both from the ground and the sky, again with the aim of increasing the response time by Iraqi forces.[14]

THE BATTLE OF RAQQA

As the battle of Mosul wound down, fighting was ramping up across the border in Syria. After months of preparations, the Kurdish-led SDF began their offensive aimed at retaking Raqqa proper on June 6, 2017. The SVBIED designs used by ISIS during the battle of Raqqa were largely an echo of those employed in its defense of Mosul, including a variety of stage 1 and stage 2 camouflaged SVBIEDs. However, ISIS fighters also introduced a new innovation in this battle.

In early April, the SDF disabled an approaching vehicle near Tabqa city, only to discover that this was a new type of ISIS SVBIED equipped with interior armor. Likely manufactured by the ISIS contingent in Raqqa, the vehicle was a significant improvement on previous designs and was one of the first examples of a stage 3 camouflaged model, although there would be plenty more to follow, especially as fighting progressed into Raqqa city.

The armor kit had been mounted inside the vehicle, leaving next to no sign on the exterior that the vehicle was carrying an explosive payload, nor that it had been up-armored. The wheel armor, interior side door armor, and interior windshield armor were painted black to mimic standard features. To build the unit, ISIS had removed the entire front exterior of the vehicle, mounted metal plates covering the engine block and other vital systems, and re-attached the front section over the plates.

This modification dramatically increased the covert nature of the SVBIED in an explicit continuation of innovation across provinces, from Mosul to Raqqa. It seemed as if the ISIS contingent in Raqqa had picked up where those in Mosul had left off, introducing new innovations to the camouflaged SVBIED designs.

An ISIS stage 3 camouflaged SVBIED used against the SDF east of Tabqa. *(ISIS photo report, April 2017)*

The 12th issue of the English-language ISIS magazine *Rumiyah*, released on Aug. 6, 2017, provided a clue about the Raqqa-Mosul connection. The ISIS military commander of Raqqa addressed the influence of the battle of Mosul on the battle of Raqqa. He stated that "The brothers in Mosul employed new tactics" and their "experiences [in Mosul]

OPERATIONS AND DETONATION SUPPORT

Since many SVBIED drivers are unfamiliar with the area in which they are operating, they require special training and support to successfully reach their target. As drivers prepare to conduct an SVBIED attack, they study either footage recorded with a hobby drone or satellite imagery of the target site to learn the attack route. Additionally, they are sometimes guided to the frontline by local ISIS fighters on motorcycles. More recently, however, ISIS has introduced a new innovation in its support system through the widespread use of hobby quadcopter drones.

An ISIS fighter studies satellite imagery. *(ISIS video release, April 2017)*

During the battle of Mosul, attacking SVBIEDs would almost always be accompanied by an ISIS-operated quadcopter drone that followed them to the target. The fighters operating the drones were in continuous radio contact with the SVBIED drivers, and were thus able to direct them around roadblocks and new threats in real time, often circumventing Iraqi army defenses and striking columns of armored vehicles from directions thought to be secured. This tactic was used both during the battle of Raqqa and sporadically in fighting across the central and eastern Syrian deserts. In a February 2018 ISIS video from the Hajin pocket, an ISIS drone operator could be heard directing an SVBIED driver during attack: "Go in, go in towards the house. Go left, go in, go in, go in. Seek Allah's help and detonate."[15]

An ISIS SVBIED is guided by a local fighter on motorcycle in Hasakah Province. *(ISIS Photo Report, February 2018)*

have been passed on to all the wilayat so they could benefit from them, both militarily and in terms of *iman* (faith)."[16]

Although he didn't specifically mention SVBIEDs, it's likely that information about new designs for ISIS's most important type of weapon was shared by the contingent in Mosul with that in Raqqa. After the recapture of Mosul, Raqqa was the only major city under ISIS control. As such, it is logical that ISIS fighters there would continue innovating new camouflaged SVBIED designs, as Raqqa was the only province with the resources to do this on a large scale. The sharing of SVBIED designs and technology speaks volumes about the extent of inter-provincial cooperation on military innovations across ISIS's territories.

DOWN THE EUPHRATES RIVER

After the fall of Raqqa, ISIS's territorial losses only continued. Both Syrian loyalist forces and the SDF began near-simultaneous offensives against ISIS-held areas in Syria. Between July and December 2017, Syrian loyalist forces captured nearly all of the central and eastern Syrian desert from ISIS control. This area included the cities of Deir ez-Zor, Mayadin, and al-Bukamal. Concurrently, the SDF managed to take nearly all territory north of the Euphrates River, except for a small strip of villages close to the Iraqi border around Hajin. Throughout fighting in central and eastern Syrian desert and in the deserts north of the Euphrates, ISIS reverted mainly to desert-colored and plain up-armored SVBIEDs.

An ISIS SVBIED used in the Syrian desert north of the Euphrates. *(ISIS photo release, February 2018)*

In this area, ISIS lacked an SVBIED workshop network akin to those in and around Raqqa. Nonetheless, it employed a small number of stage 1 and 3 camouflaged SVBIEDs, the majority of which were used around Deir ez-Zor as Syrian loyalist forces attempted to seize the city. It's highly likely Deir ez-Zor's ISIS contingent received information about camouflaged SVBIEDs and manufactured them in accordance.

THE HAJIN POCKET

After the major territorial losses in late 2017, the remaining ISIS contingent in eastern Syria held only a small strip of land along the northern shores of the Euphrates River opposite al-Bukamal, close to the Iraqi border. After the defeat of ISIS in Raqqa, the group negotiated a deal with the SDF that allowed ISIS forces to leave Raqqa unscathed in a large convoy. These forces travelled safely through swathes of SDF-controlled territory before settling in and around Hajin, the main village in ISIS's remaining strip of land in eastern Syria.[17]

After a short hiatus, fighting escalated in January 2018, as the SDF chipped away at the Hajin pocket. ISIS initially deployed some unrefined stage 1 camouflaged SVBIEDs to slow their advance. The manufacture

of these SVBIEDs in Hajin constitutes a considerable feat for workshops in what is a remote village. It's possible that high-ranking ISIS personnel skilled in SVBIED design and manufacturing escaped Raqqa as part of the convoy mentioned above and were able to assist at the workshops in Hajin. However, the camouflaged SVBIEDs were few in number and ISIS eventually reverted to using a mix of desert-colored and plain up-armored SVBIEDs once again.

The initial clashes around Hajin in mid-January 2018 coincided with the start of a Turkish military incursion into SDF territory around Afrin in northwestern Syria.[18] This incursion prompted the SDF to divert manpower and resources from the campaign in Hajin to support its units in Afrin. Although the SDF continued to make some progress in Hajin as the year progressed, ISIS had fighters estimated in the thousands[19] positioned throughout Hajin, preventing its collapse. After a period of relative calm, ISIS introduced a new SVBIED design in the Hajin pocket in early November 2018.

The new design featured multiple frontal exterior IEDs mounted above the windshield armor and a much more elevated and dispersed rear payload of daisy-chained IEDs. More recent examples included the rear section of the IEDs pointing to the sides, with middle section IEDs mounted at a 45-degree angle facing forward. This directed the explosive energy forward and to sides while maximizing its lethality.

The camouflaged SVBIEDs used by ISIS after the fall of Raqqa – while impressive – were not designed for the sparsely populated desert terrain of the Hajin pocket. The new design addressed this and the constant aerial surveillance in the remaining parts of the Hajin pocket by prioritizing deadliness over stealth. While most heavily used in the Hajin pocket, SVBIEDs with exterior frontal IEDs and this type of complementary payload can be traced back to the battle of Mosul.

An ISIS up-armored SVBIED with exterior frontal IEDs near the Hajin hospital. (*ISIS photo report, December 2018*)

Although ISIS lost the last vestiges of its territorial caliphate in a defeat by the US-backed SDF in March 2019, the group's distribution and proliferation of its SVBIED innovations continues, as discussed further below.

PAYLOAD DESIGNS AND ORGANIZATION

At the outset, the make-up of the explosive payloads used in ISIS's SVBIEDs varied somewhat. In the first two years after its inception, the group utilized an array of different explosives, containers, and designs for its SVBIED payloads, including everything from homemade explosives in plastic barrels or jugs to anti-tank mines, unexploded ordnance, and cylindrical metal IEDs.

ORIGINAL DESIGN

A cluster of daisy-chained cylindrical metal IEDs welded in place in the rear section of the vehicle. The IEDs are typically aimed to the sides. This arrangement is most common in civilian-vehicle SVBIEDs, whether covert or up-armored.

IEDs used in an ISIS SVBIED. (*ISIS video release, August 2017*)

AIMED IEDS

A formation in which IEDs or anti-tank mines are deliberately mounted in specific directions in order to direct explosive energy outwards toward the target, rather than produce a simple explosion. In some versions, explosives are mounted on the doors and windshields on the interior of the SVBIED to direct as much of the explosive energy of the blast forward and to the sides. In other versions, small exterior front-aimed IEDs are mounted to the front of the vehicle and disguised as headlights. This headlight design was often included on tan up-armored SVBIEDs used on the outskirts of eastern Mosul and near Tal Afar.

A vehicle captured by Iraqi forces. (*Iraqi forces, August 2017*)

CRUDE OIL

A payload arrangement that includes crude oil in barrels and jugs. This is employed to increase the primary blast effects upon detonation of the main payload and to ensure that remnants at the blast site are burned, causing further destruction. As with most other payload innovations, this originated in the battle of Mosul. Since then, oil barrels and jugs have been used in SVBIED payloads in Syria as well.

An oil barrel connected to an ISIS SVBIED payload in Furat Province. (*ISIS vdeo release, January 2018*)

ROCKETS

A payload arrangement that includes rooftop rocket pods and a firing mechanism containing a safety and five firing switches on separate circuits. These rockets enabled the driver to suppress fire from the SVBIED's target, making the rocket-upgraded SVBIED equally capable of suppressing fire from the target as the two-man SVBIED, while only requiring one operator.

This upgrade was introduced in Western Mosul as Iraqi forces advanced on the remaining ISIS contingent in this part of the city. This innovation, however, saw limited use by ISIS. Only around a dozen examples were ever manufactured, most of which were captured intact by Iraqi forces, rendering their effectiveness questionable.

An ISIS up-armored SVBIED fitted with rooftop rockets. (*ISIS photo report, May 2017*)

GLOBAL SPREAD OF SVBIEDS

Cooperation between ISIS provinces in Syria and Iraq has been central to further developing and implementing SVBIED innovations on the battlefield. This cooperation was particularly clear in the case of Mosul and Raqqa, where ISIS forces in Raqqa employed the exact same SVBIED designs as had been used in the battle of Mosul. However, ISIS has not just shared its designs in Iraq and Syria. In recent months, its SVBIED designs have been used by ISIS provinces in other parts of the world, particularly in Nigeria and the Philippines.

NIGERIA

For more than a decade, the militant Islamist group Boko Haram has been waging an insurgency in northeastern Nigeria.[20] In August 2016, the group split into two factions,[21] one of which became ISIS's official province in the region: Islamic State West Africa Province (ISWAP). By mid-2018, ISWAP attacks had become more frequent and employed increasingly sophisticated tactics. In a video released in early July 2018, ISWAP showcased up-armored SVBIEDs for the first time.

The construction of the SVBIED shown in the video was remarkable. It included movable wheelhouse armor and spaced frontal slat armor, indicating that this SVBIED design originated in the Levant. On Jan. 19, 2019, Nigerian forces disabled another, more refined, ISWAP up-armored SVBIED near the northeastern town of Baga. Some parts of the armor, including the door, appeared to have been transplanted from a seized military armored vehicle. These advanced SVBIED designs suggest that ISWAP militants received detailed technological advice from ISIS mechanics in Syria or Iraq, either in person or online.

An up-armored SVBIED based on a pick-up truck seized by the Nigerian Army near the town of Baga. *(Twitter/@ogundamisi, January 2018)*

THE PHILIPPINES

In the Philippines, Islamist militants of the Abu Sayyaf group have been waging an insurgency for nearly 30 years, since 1991.[22] In late 2014, the group pledged allegiance to ISIS[23] and were subsequently referred to as Islamic State East Asia Province (ISEAP) in official ISIS media. Despite the group's small size, ISEAP surprised many by seizing control of the southern Filipino city of Marawi in mid-2017. This resulted in a five-month-long siege that left the city in ruins.[24]

In late July 2018, an SVBIED detonated at a Philippine military checkpoint on the southern island of Basilan, killing 10. This was ISEAP's first use of a SVBIED. According to official ISIS media, the suicide bomber was a Moroccan fighter.[25] Soon, an image began circulating online, allegedly depicting the IEDs used in the attack.

Picture allegedly showing IEDs that were used as the payload in the July 2018 Basilan SVBIED attack. *(Twitter/@SaladinalDronni)*

The cylindrical metal IEDs shown in the picture appeared similar to those that typically make up SVBIED payloads in Iraq and Syria. Each IED is designed to function independently in a one-off IED attack, but also works as a daisy-chained SVBIED payload. While this design isn't unique to ISIS, it is likely that ISEAP, like ISWAP, somehow received transferred knowledge from ISIS manufacturers in Syria or Iraq.

CONCLUSION

In all of its different forms, the SVBIED has repeatedly proven to be the most potent military asset fielded in battle by ISIS. As a result, the group has dedicated an incredible amount of time and resources to the research, development, manufacture, and use of SVBIEDs since the declaration of the caliphate. This has resulted in a wide array of innovations, all hallmarks of the adaptability of the SVBIED.

Through years of development and field-testing, ISIS has continuously aimed to stay a step ahead of its enemies by developing SVBIED designs tailored for specific threats, targets, and environments. All SVBIED designs and components have aimed to increase the likelihood that the vehicle will reach its intended detonation point.

Innovations and variations on the standard up-armored SVBIED design have all been logical responses to changes in the operational environment and the emergence of new threats that could negatively impact the SVBIEDs' success rate on the battlefield. Reactions have been met with counter-reactions, spurring further SVBIED design innovations.

Numerically speaking, ISIS never came close to the combined manpower of its enemies. SVBIEDs provided one of the few ways it could counter the widespread use of air power by opponents. Simultaneously, SVBIEDs enabled ISIS to project military power on the ground as well. This specific military asset, combined with the massive resources available to ISIS at its peak, allowed for the innovation and introduction of many new models over the years.

Although the group has now lost the last vestiges of its territorial caliphate, its insurgency rages on. Furthermore, the recent spread of SVBIED designs from ISIS in the Levant to growing satellite provinces around the world is a potentially ominous sign of the danger to come. As ISIS in Syria and Iraq has developed and field-tested these different designs, it is likely equipping satellite provinces with comparatively advanced SVBIED designs that could hasten their expansion. This deep knowledge would also facilitate offensive military operations, should ISIS in Syria and Iraq ever resurge and regain territorial control.

APPENDIX: SVBIED GALLERY

VBIED

A vehicle that has been fitted with an interior or exterior explosive payload. These are frequently used by non-state actors to amplify and project military power despite limited traditional military resources. These vehicles, also known simply as "car bombs," are detonated either from inside the vehicle (SVBIED) or remotely when parked (VBIED). As parked VBIEDs lack drivers, they basically function as larger masked stationary IEDs. Though parked VBIEDs are easier to employ, the offensive nature of covert SVBIEDs allows them to be much more precise.

SVBIED

A VBIED that is detonated from inside the vehicle by the driver. SVBIEDs are often used indiscriminately by non-state actors far from active front lines, but their use as weapons of war on the battlefield has been increasing in recent years as well. They have been employed by a variety of non-state actors, with ISIS being their most infamous and prolific user. SVBIEDs act as powerful force multipliers, giving the numerically inferior ISIS insurgents the ability to accurately deliver tons of explosives to designated targets. The group's tactical use of SVBIEDs was designed to punch holes in static defenses, allowing for follow-up ground attacks that would regularly overrun larger enemy positions. There are several different varieties, including covert and up-armored SVBIEDs.

Covert SVBIED

A vehicle with an unmodified exterior that's been fitted with an interior explosive payload and blends in with civilian traffic. It's driven to and detonated at a specified target by a driver. Historically speaking, this is the most well-known and commonly used type of SVBIED. It's an ideal weapon for non-state actors involved in an insurgency, as the unmodified exterior makes them extremely difficult to detect and counter once a bomber departs on a mission. The covert SVBIED was an ideal fit for the early stages of ISIS's insurgency, when the group was focused on carrying out quick hit-and-run attacks in hostile territory and needed a strong weapon that would be unidentifiable as such.

Up-armored SVBIED

A SVBIED with steel plates welded to the front exterior as a form of improvised armor to shield the vehicle, its driver, and its payload from incoming fire until the intended point of detonation. Up-armored SVBIEDs are most often used to initiate battles by softening static enemy defenses before a ground assault. These SVBIEDs serve as as a powerful force multiplier, enabling a smaller attacking force to overrun a larger enemy contingent.

Armor generally is concentrated around the front of the vehicle, with metal plates focused on shielding the engine block, windshield, and tires. The plate covering the engine block typically has slats to prevent overheating. The driver's viewing port usually consists of a rectangular hole either covered with protective glass or coupled with a smaller metal plate that could be slid into place to form a more narrow rectangle when the vehicle came under fire.

In some versions, armor is sloped, with steel plates welded to the front of the vehicle at an angle to increase the effective thickness of the armor facing frontal impacts.[26] For example, 100mm thick armor sloped at 45 degrees becomes 141mm of effective armor. The angled armor plating also helps to deflect incoming rifle and machine gun fire of varying calibers, instead of absorbing the force head on. Armor is slatted in the form of a metal grid or bars that are fitted over the improvised armor plating with some spacing. If an anti-tank ammunition is fired at the vehicle, slat armor is designed to catch and crush the warhead, rendering it inoperable. If the warhead detonates, slat armor provides a slightly increased distance between the explosion and the vehicle, reducing the munition's ability to penetrate.

Military-armored SVBIED

A military vehicle (typically armored personnel carriers like the BMP-1, M113, or HMMWV) that has been fitted with an explosive payload. This variation evolved after ISIS rose to prominence and seized many military armored vehicles. They then employed some of these vehicles as SVBIEDs since they could hold a significantly larger payload than a civilian vehicle and could be used for off-road missions. These vehicles have far thicker armor, larger spaces for payloads, and are often tracked, which make them optimal for off-road missions as compared to other SVBIED variations. Battle tanks are rarely used for this, however, as they are more valuable when employed as originally intended.

Heavy Construction SVBIED

A heavy construction vehicle (mostly front-end loaders and bulldozers) fitted with an explosive payload. This variation evolved out of a need for SVBIEDs that could be used to attack fortified targets. Heavy construction equipment had previously been used in an offensive capacity, as their ability to remove earthen berms and punch through roadblocks and concrete barriers was essential to clearing a path for follow-up attacks by up-armored SVBIEDs. ISIS then went one step further and began using up-armored heavy construction vehicles directly as SVBIEDs.

Two-man SVBIED

An SVBIED operated by two fighters, one driver and one rooftop gunner. The gunner is tasked with providing suppressing fire until the vehicle reaches its intended detonation point. These are typically reserved for tougher-than-average targets like hardened enemy positions and their use is relatively infrequent. Two-man SVBIEDs are not restricted to a single vehicle type, employing everything from SUVs and armored military vehicles to heavy trucks and front-end loaders.

Camouflaged SVBIED

Tan – An up-armored SVBIED painted tan and used primarily in rural areas in Northern Iraq. The wide plains in this area provide next to no cover for attacking SVBIEDs, rendering them particularly vulnerable to incoming fire. The tan color allowed these SVBIEDS to go undetected for longer periods.

Neutral/Colored – An up-armored SVBIED painted any color and used primarily in Mosul to deceive Iraqi forces and U.S-led coalition aircraft by appearing as unmodified civilian vehicles.[27] These were introduced following a change in environment from open plains to sprawling urban terrain.

Advanced Camouflaged SVBIED

An up-armored SVBIED with false windshields, grilles, and wheels added on top of the existing armor. These additions further obscured the presence of frontal armor, giving the camouflaged SVBIED an authentic civilian look at a distance, both from the ground and the sky.[28]

Interior-Armor SVBIED

An up-armored SVBIED with an armor kit mounted inside the vehicle, leaving next to no sign of armor from the exterior. Wheel and interior side door armor are also painted black to mimic these features on a standard vehicle. The entire front exterior of the vehicle must be removed before metal plates covering the engine block and other vital systems are added and the front exterior of the vehicle is re-attached over the plates. This innovation was first seen in Tabqa, Syria in early April 2017 and was often used in Raqqa.

Exterior-Armed SVBIED

A SVBIED with multiple frontal exterior IEDs mounted above the windshield armor and an elevated and dispersed rear payload of daisy-chained IEDs, which are often entirely exposed. In some versions, the rear section of IEDs are directed toward the sides and while the other IEDs are mounted at a 45-degree angle facing forward. This IED formation maximizes lethality by directing explosive energy both forward and to sides. These SVBIEDs were used primarily in the Hanjin pocket, which was nearly always under aerial surveillance, rendering attempts at camouflage impractical. As such, this SVBIED prioritizes deadliness over stealth.

Additional Images

ENDNOTES

1. Ian Johnston, "The rise of Isis: Terror group now controls an area the size of Britain, expert claims," *The Independent*, September 3, 2014.
2. Kenton Fulmer, "Islamic State development & employment of SVBIEDs," *Armament Research Services*, January 20, 2016.
3. Ibid.
4. Michael R. Gordon & General Bernard E. Trainor, *The Endgame: The Inside Story Of The Struggle For Iraq, From George W. Bush to Barack Obama* (London: Atlantic Books, 2015).
5. "Islamic State of Iraq – A Snapshot of SVBIED Design & Use (2007-2012)," Hugo Kaaman, January 11, 2019.
6. The Soufan Group, "The Devastating Islamic State Suicide Strategy," *TSG IntelBrief* (May 2015).
7. Ian Johnston, "The rise of Isis: Terror group now controls an area the size of Britain, expert claims," *The Independent*, September 3, 2014.
8. Ghaith Abdul-Ahad, "The bureaucracy of evil: how Islamic State ran a city," *The Guardian*, January 29, 2018.
9. "The Islamic State going DIY, Inside a DIY offensive," Oryx Blog, 2016.
10. "The History and Adaptability of the Islamic State Car Bomb," Hugo Kaaman, February 14, 2017.
11. Hugo Kaaman, JTIC, "Islamic State SVBIED development & innovation in the battle of Mosul" *Jane's Terrorism Case Study*, (2017).
12. Ibid.
13. Ibid.
14. Ibid.
15. "Inside the Caliphate #7," The Islamic State, February 7, 2018.
16. "It will be a fire that burns the cross and its people in Raqqa," *Rumiyah* 12, August 6, 2017.
17. Jasim (@JasimSyria), "Large parts of the #ISIS convoy that left #Raqqa ended up in #Hajin and #Gharanij, more then 200 km away. Satellite images from 3 December." Tweet, February 14, 2018.
18. "Turkey targets Kurdish forces in Afrin: The short, medium, and long story," *BBC News*, January 22, 2018.
19. Falih Hassan and Rod Nordland, "Battered ISIS Keeps Grip On Last Piece Of Territory For Over a Year," *The New York Times*, December 9, 2018.
20. "Who are Nigeria's Boko Haram Islamist Group?" *BBC News*, November 24, 2016.
21. Ibid.
22. Felipe Villamor, "Philippine bombing kills 10, Showing Insurgents Remain a Problem," *The New York Times*, July 30, 2018.
23. "Philippines unrest: Who are the Abu Sayyaf group?" *BBC News*, June 14, 2016.
24. "Who are Nigeria's Boko Haram Islamist Group?" *BBC News*, November 24, 2016.
25. Thomas Joscelyn, "Islamic State claims foreign fighter bombed military checkpoint in the Philippines," *Long War Journal*, July 31, 2018.
26. Kenton Fulmer, "Islamic State development & employment of SVBIEDs," *Armament Research Services* January 20, 2016.
27. Hugo Kaaman, JTIC, "Islamic State SVBIED development & innovation in the battle of Mosul" *Jane's Terrorism Case Study*, (2017).
28. Ibid.

Cover Photo: Firefighters extinguish a fire after ISIS terrorists' car-bomb attack against Ahrar ash-Sham Headquarters in Aleppo, Syria on January 25, 2016. ***(Ibrahim Ebu Leys/Anadolu Agency/Getty Images)***

Photo 2: An Iraqi policeman looks at damaged cars as he inspects the site of a suicide bomb attack, claimed by ISIS, at a checkpoint leading to the Husseiniyah area, northeast of the capital Baghdad on July 13, 2016. ***(AHMAD AL-RUBAYE/AFP/Getty Images)***

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Hugo Kaaman is an independent open-source researcher, with a heavy focus on the use of Suicide Vehicle-Borne Improvised Explosive Devices (SVBIEDs) by armed non-state actors – specifically ISIS. For the past few years he has researched and written in-depth about the evolving nature of the group's use of SVBIEDs, and how it's transformed and adapted through a series of innovations.

Hugo was a speaker at the 2019 Security and Counter Terrorism Expo, and has researched and written for publications such as Jane's Military & Security Assessments Intelligence Centre.

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