FRONTLINE PERSPECTIVE

RADIO-CONTROLLED, PASSIVE INFRARED-INITIATED IEDs

Iran's latest technological contributions to the war in Yemen

March 2018

BACKGROUND

Since the start of the current conflict in Yemen, Ansar Allah 'Houthi' forces have employed significant numbers of improvised explosive devices (IEDs) against Arab Coalition forces. Although most are rudimentary in design, the number of comparatively more sophisticated IEDs in Yemen has increased, which speaks to a recent influx of technology.

This report presents comparative findings on explosively formed projectiles (EFPs) documented by Conflict Armament Research (CAR) in Yemen and similar devices documented by CAR field investigation teams elsewhere in the Middle East.

The IEDs recovered in Yemen feature EFPs, which have been camouflaged to resemble natural rocks. These devices are armed by radio control (RC) and initiated using passive infrared (PIR) switches. They can be classed as radio-controlled IEDs (RCIEDs).

Between April 2017 and February 2018, CAR field investigation teams conducted six missions to Yemen to document weapons and IEDs seized from Houthi forces. Multiple strands of information suggest that Iran orchestrated the transfer of technology and materiel to Houthi forces in Yemen to assist in the manufacture of RCIEDs.

synthetic rock-concealed IEDs recovered by Arab Coalition forces, Mokha, Yemen, April 2017.

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DEUTSCHE ZUSAMMENARBEIT

The specific components of the RCIEDs employed by Houthi forces in Yemen are identical to components in an RCIED seized by Bahraini security forces from Iranian-backed militants and documented by CAR in Bahrain. These components are also identical to those interdicted by Yemeni security forces on board the *Jihan 1* cargo vessel, while *en route* from Iran, in 2013.[1]

While of relatively recent occurrence in the Yemen conflict, the use of EFPs emplaced within synthetic rocks has strong precedent elsewhere. Hezbollah has consistently employed similar devices against the Israel Defence Forces (IDF) in Israel and southern Lebanon[2]—including devices documented by CAR. US forces in Iraq recovered numerous caches of comparable EFPs concealed within synthetic rocks—the components of which they later attributed to Iranian supplies to proxy forces.[3]

KEY FINDINGS

- Iran has provided materiel to Houthi forces to assist in the manufacture of RCIEDs.
- EFPs concealed in synthetic rocks and documented by CAR in Yemen closely resemble—in design and construction—devices recovered in Iraq and Lebanon, which parties have previously linked, forensically, to Iran.
- Materiel documented in Yemen by CAR is identical to components previously seized on board the *Jihan 1*. This confirms widespread assertions that the vessel was destined for Houthi forces in Yemen and would suggest that Iranian support to Houthi forces began as early as January 2013.
- Identical construction, and the use of hand-annotated, serialised components, suggest that the electronics kits used in the Yemen RCIEDs were constructed in bulk and potentially in the same workshop.
- Iran uses identical components in a number of improvised weapon systems, which it has clandestinely supplied to groups in Yemen and Bahrain.

Measurements of a PIR used in a synthetic rock-concealed RCIED, Mokha, Yemen, January 2018.

DOCUMENTATION

SYNTHETIC ROCK-CONCEALED IEDS IN YEMEN

Since April 2017, CAR field investigation teams have documented dozens of synthetic rock-concealed IEDs recovered by Arab Coalition forces. Since late 2016, Houthi forces have emplaced these devices along motorways connecting Mokha-Dhubab, Mokha-Ta'iz, and Mokha-Khawkha. Arab Coalition forces recovered the most recently emplaced device in January 2018, which CAR documented in the same month.

Investigations by CAR suggest that there are three variants of the synthetic rock-concealed IED employed by Houthi forces: 1) anti-personnel IEDs containing improvised Claymore mines; 2) IEDs containing a large shaped charge; and 3) RCIEDs containing between one and three EFPs. The third type is the most common and is the subject of this report.

Device

In January 2018, CAR documented and conducted basic exploitation of an RCIED. Arab Coalition forces recovered the device from Houthi forces to the north of Mokha, Yemen. The RCIED contained three 120 mm EFP main charges, detonating cord, and an electronics kit. The latter included an RC antenna and PIR used to arm and initiate the RCIED. All of the components were secured, using expanding foam, within the body of a thin-walled fibreglass resin container. The container had been sculpted and painted to resemble a large rock (Figure 1).

Figure 1
Synthetic rock-concealed RCIED exploited by a CAR field investigation team in Mokha, Yemen, January 2018.

SYNTHETIC ROCK-CONCEALED IEDs IN ISRAEL

In October 2017, CAR obtained images of multiple items, including synthetic rock-concealed IEDs, which the IDF had recovered from Hezbollah forces.[4] The IEDs were similar in design and construction to those employed by Houthi forces in Yemen in three ways: 1) The devices were constructed from a fibreglass resin body; 2) they were filled with expanding foam; and 3) they contained multiple 120 mm EFPs.

The devices recovered from Hezbollah forces also feature a sighting tube, which runs along the top of each charge, and is used for precise alignment during emplacement of the IED (Figure 2). This is not a feature of the RCIEDs recovered in Yemen.

Figure 2
Synthetic rock-concealed IED recovered from Hezbollah forces by the IDF in southern Lebanon, 2006.

The RCIED's three main charges each consist of a 120 mm EFP with a steel body and copper liner (Figure 3). Although the CAR field investigation team was unable to determine the type of explosive contained in the main charge, it appears to be a cast of ground TNT or similar military-grade explosive. Detonating cord runs into the rear of each charge through an aperture, which is sealed with a self-hardening resin. The detonating cord is probably used to ensure the simultaneous detonation of the charges and/or link together additional charge sets for greater effectiveness.

Independent experts, with previous experience in conducting forensic exploitation of EFPs recovered in Afghanistan, Bahrain, Iraq, Israel, Lebanon, Saudi Arabia, and Yemen, analysed images of the EFPs documented by CAR. The experts concluded that the EFP construction indicates that the bomb-maker had a degree of knowledge in constructing devices that resembled, and possibly functioned in a manner similar to, EFPs that have been forensically tied to Iran and Hezbollah.[5]

Figure 3
120 mm EFP extracted from an RCIED in Mokha, Yemen, January 2018.

Transiting the coast of Yemen, January 2018.

RADIO-CONTROLLED IMPROVISED EXPLOSIVE DEVICE EMPLOYED BY HOUTHI REBELS IN YEMEN

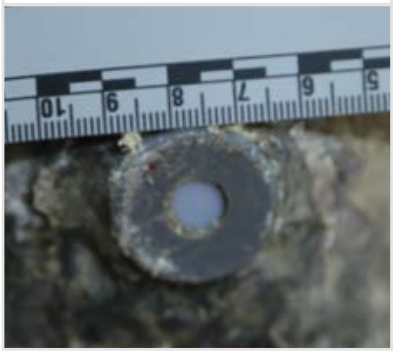
TOP VIEW

FRONT VIEW

BASE VIEW

MAIN CHARGE
3 EFP

SWITCH 2
PIR WINDOW • 26.80 mm • EXTERNAL Ø



POWER SOURCE
8 x 'C' CELL AND 1 x PP3 9v BATTERY CELL

ARMING SWITCH AND LAMP

SWITCH 1
RC RECEIVER

Electronics Kit

CAR extracted an electronics kit from one of the RCIEDs and documented several other electronics kits from RCIEDs, which Arab Coalition forces had previously recovered (Figure 4). The electronics kits generally consist of a power source, an RC receiver, antenna, and an arming switch with electrical lamp.

Figure 4
Electronics kits removed from RCIEDs employed by Houthi forces in Mokha, Yemen, January 2018.

The power source consists of eight 'C' cell batteries and one PP3 9-volt battery, all contained within a plastic covering with an attached board, which bears the inscription 'X565-11.' The power source is connected to an RC receiver, which is contained within a similar plastic covering bearing the same 'X565-11' marking inscribed using a silver paint pen. Between the power source and RC receiver, a moulded unit with two rocker switches forms the safe/arming function for the relevant RC and PIR firing circuits (Figure 5). The RC receiver is connected directly to an antenna and to the PIR sensor with a wire, which runs into the body of the RCIED.

Figure 5
Electronics kit extracted from an RCIED containing the power source (left), RC receiver (right), safe/arming switch (top centre), electrical lamp (bottom centre), and antenna (top right) in Mokha, Yemen, January 2018.

Multiple components are annotated with markings that contain the suffix '11.' In addition to the power source and RC receiver, which bear the marking 'X565-11', the electrical lamp and a microcontroller inside the RC receiver bear the markings 'SA-11' (Figure 6). Hand-annotated serialization on internal and external components indicates that the electronics kits were constructed in bulk and potentially in the same workshop.

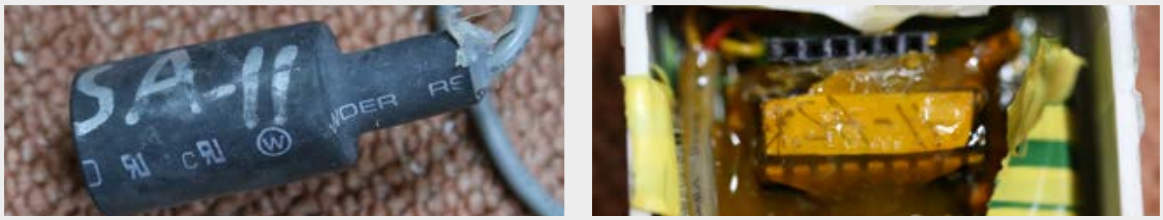


Figure 6
Electrical lamp from the electronics kit (left) and microcontroller inside the RC receiver (right) bearing the marking 'SA-11' in Mokha, Yemen, January 2018.

THE IRANIAN CONNECTION TO RCIEDS IN BAHRAIN AND YEMEN

RCIED COMPONENTS IN BAHRAIN

In June 2017, Bahraini security forces raided the premises of a militant cell, recovering a number of EFPs, Iranian-manufactured ammunition, improvised Claymore mines, and a magnetic RCIED designed for targeted assassinations. The following month, a CAR field investigation team documented the materiel. The team found that the electronic components contained in the magnetic RCIED were identical—in design, construction, and materials employed—to the electronics used in the construction of the RCIEDs recovered in Yemen (Figures 7-9).

Figure 7
Circuit board from an electronics kit recovered from an RCIED employed by Houthi forces in Mokha, Yemen, January 2018 (top left and right) and the circuit board from a magnetic RCIED recovered from a militant cell in Manama, Bahrain, July 2017 (bottom left and right).

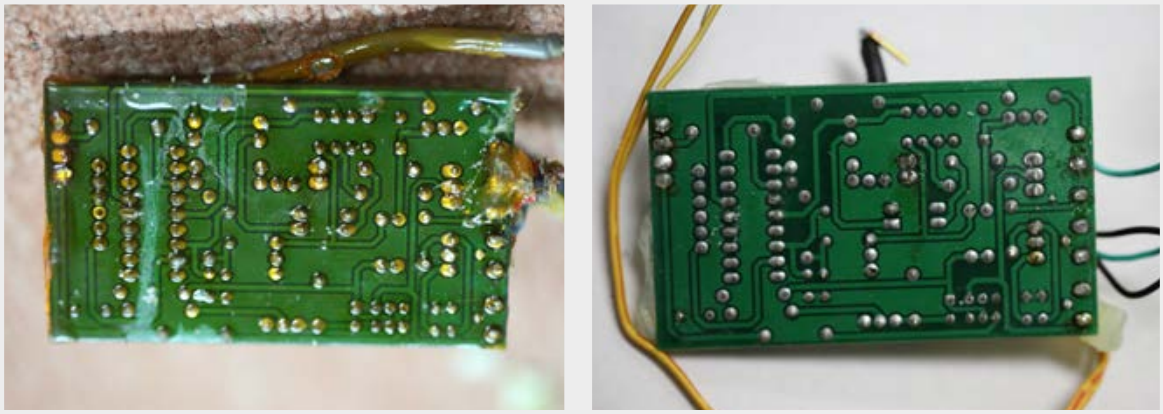


Figure 8
Circuit board from an electronics kit recovered from an RCIED employed by Houthi forces in Mokha, Yemen, January 2018 (left) and the circuit board from a magnetic RCIED recovered from a militant cell in Manama, Bahrain, July 2017 (right).

Figure 9
Power relays on a circuit board in an electronics kit recovered from an RCIED employed by Houthi forces in Mokha, Yemen, January 2018 (top left and right) and power relays on a circuit board from a magnetic RCIED recovered from a militant cell in Manama, Bahrain, July 2017 (bottom left and right).[6]

THE *JIHAN 1* CASE

In January 2013, Yemeni security forces interdicted a cargo vessel, the *Jihan 1,* which was transporting military materiel off the coast of Yemen.[7] On board the *Jihan 1* was a large consignment of Iranian-manufactured ammunition and C-4 explosives, man-portable air defence systems (MANPADS), PIR sensors, and nearly 2,000 electronic components used in the manufacture of RCIEDs. Initial reports claimed that the ship was destined for Al-Shabaab forces in Somalia.[8] However, Yemeni government officials asserted that the contents on the *Jihan 1* were intended for Houthi forces in Yemen.[9] The United Nations Panel of Experts on Iran, which investigated the incident, concluded that Iran was 'at the centre of the *Jihan* operation.'[10]

In January 2018, CAR compared confidential, unpublished photographs taken of the RCIED components on the *Jihan 1* with the RCIED components documented by CAR in Yemen and determined that the two sets of components were identical. These findings strongly support assertions that similar shipments from Iran successfully made their way to Houthi forces and that the contents of the *Jihan 1* were, as claimed, intended for Houthi forces.[11]

CONSISTENCY OF COMPONENTS USED IN MATERIEL OF IRANIAN ORIGIN

The electronics kits used in the RCIEDs feature heat-shrink wire coverings, which are manufactured by the Chinese company WOER. WOER-brand heat-shrink wire covering is a constant feature of Iranian-origin materiel recovered in Yemen and Bahrain, including RCIEDs, unmanned aerial vehicles (UAVs), and dual-use equipment suspected to be used in the production of rocket propellant (Figures 10-13). Although commercially available, CAR has not documented the use of WOER-branded heat-shrink wire covering in any of its other operational theatres.[12]

Figure 10
WOER heat-shrink wire covering from the electronics kit of an RCIED in Mokha, Yemen, January 2018.

Figure 11
WOER heat-shrink wire covering used in a magnetic RCIED recovered from a militant cell in Manama, Bahrain, July 2017.

Figure 12
WOER heat-shrink wire covering inside a Qasef-1 UAV recovered in Yemen and traced to Iran.[13] Documented by CAR in Abu Dhabi, UAE, February 2017.

Figure 13
WOER heat-shrink wire covering inside an electrical cabinet from a set of dual-use equipment recovered in Yemen and traced to Iran.[14] Documented by CAR in Abu Dhabi, UAE, May 2017.

Measurements of an EFP extracted from a synthetic rock-concealed RCIED, Mokha, Yemen, January 2018.

CONCLUSION

The findings presented in this report build upon CAR's previous reporting of Iran's involvement in the supply of small arms and light weapons and UAVs to Houthi forces in Yemen. Multiple strands of information contained within the report present a broad base of indicators to suggest that, at the very least, Iran has provided Houthi forces with the electronic components necessary for the manufacture of RCIEDs.

Information pointing to Iranian involvement in the supply of IED components can be summarised as follows: 1) RCIEDs containing EFPs emplaced within synthetic rocks in Yemen closely resemble IEDs containing EFPs recovered in Lebanon and Iraq, which forensic experts have linked to Iran; 2) the circuit board design and internal components used in the RC receivers of the RCIEDs recovered in Yemen are identical to those used in a magnetic RCIED seized from an Iranian-backed militant cell in Bahrain; 3) the *Jihan 1* shipment—which a UN Panel of Experts determined to have been orchestrated by Iran—contained electronics kits that are identical to the electronics kits used in RCIEDs by Houthi forces in Yemen; and 4) materiel of Iranian origin recovered in Yemen and Bahrain consistently includes identical components and construction features, including WOER-manufactured heat-shrink wire covering and power relays.

CAR continues its long-term investigations in Yemen, the Arabian Peninsula, and throughout the region more broadly. Its field teams will report any future relevant developments.

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ENDNOTES

1. See Nichols and Charbonneau (2013).
2. See Blanford (2011, p. 128).

   Discussions with Israeli officials, October 2017.
3. Confidential report produced for CAR by an independent group of experts with experience in the forensic exploitation of EFPs. See also USDOD (2008) and Ismay (2013).
4. Confidential source.
5. On 7 September 2017, CAR sent a request for information to Omron but has yet to receive a response.

   On 15 September 2017, Panasonic Electric Works Europe responded promptly to a formal trace request issued by CAR on 7 September 2017. This response confirms that Panasonic Electric Works Europe manufactured the Signal Relay with serial number 20527, the subject of CAR's request, in Japan in 2002. Panasonic Electric Works Europe informed CAR that this type of standard product has been on the market for over 20 years, sold globally in very high quantities, and that the company does not hold records for longer than 10 years. Panasonic holds no further information of transfer of this item.

   On 12 February 2018, Panasonic responded to an informal information request issued by CAR on 8 February 2018. Panasonic confirmed that it produced the two signal relays, subject to CAR's requests, in 2003 and 2004 and therefore the export records no longer exist.
6. Confidential report produced for CAR by an independent group of experts with experience in the forensic exploitation of EFPs.
7. See Nichols and Charbonneau (2013).
8. Ibid.
9. Ibid.
10. See UNSC S/2013/331 (2013. p. 14).
11. See Schmitt and Worth (2012).
12. On 31 January 2018, CAR sent a request for information to WOER in order to trace the chain of custody of single wall heat shrink tubing but has yet to receive a response.
13. See UNSC S/2018/68 (2018. P. 155).
14. See UNSC S/2018/68 (2018. P. 144).

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