Libya - The Toxic and Explosive Legacy of Modern Conflict

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Agenda

• Current situation in Libya
• Explosive hazards
  – Improvised Explosive Devices (IEDs)
  – Mines
  – Unexploded ordnance (UXO)
  – Abandoned explosive ordnance (AXO)
  – Unsecured ammunition storage sites
• Toxic hazards
  – Liquid propelled missiles
  – Bulk liquid propellant storage
• Libyan urgent operational needs
• Candidate areas for support
• Forces aligned to the Libyan National Army (LNA) commenced an assault on Tripoli in April 2019.
• Heavy fighting has been largely focused on the area to the south of Tripoli.
• Armed UAVs have been used by both sides.
• The LNA has made use of UAVs to strike targets of forces aligned to the Government of National Accord (GNA).

Top: Wing Loong 2 UAV armed with Blue Arrow 7 missiles over Tripoli
Bottom: Blue Arrow 7 laser guided air-to-ground missile
• Following the GNA capture of the LNA main operating base at Gharyan in June 2019, substantial quantities of weapons were recovered, including FGM-148 Javelin ATGW and GP6 155mm laser guided artillery projectiles.

• Some Gharyan munitions have probably been looted and acquired by groups of unknown affiliation.
• Sophisticated and highly capable anti-aircraft systems have been introduced into Libya.
• These systems, used in conjunction with electronic warfare to disrupt aircraft navigation and communication systems, pose a threat to civil aircraft.

Top: Pantsir S1 self propelled gun and missile system in Libya
Bottom: Korkut 35mm self propelled anti-aircraft gun
Extensive use has been made of high net explosive content air delivered ordnance.

Air attack on Tajoura Detention Centre on 2 July 2019 resulted in the deaths of over 50 detained migrants.

Attack was made using a precision guided aircraft bomb, probably a Mk 82/BLU-111 sized weapon, possibly with a JDAM guidance system package.
• Effects of a Blue Arrow 7 missile at the Tripoli Military Academy on 4 January 2020.
• Over 30 people were killed and many more were injured by the use of a laser guided missile launched from a UAV.
Current Situation in Libya (8)

- UN Secretary General’s remarks to the Berlin Conference:
  - One year ago, Libyans – with the support of the international community – were taking hopeful steps to move the country forward through a political solution.
  - Since then, the conflict around Tripoli has killed and injured thousands, including hundreds of civilians.
  - Libya has been dragged into an ever deeper and destructive conflict with a growing number of external actors also involved. Such a conflict could lead to a humanitarian nightmare and leave the country vulnerable to permanent division.
  - We urge the Libyan parties to engage in good faith dialogue on political, economic and military issues in a Libyan-led and Libyan-owned inclusive process.
The Libyan people are suffering greatly as a result of the continuing conflict.

Explosive weapons in populated areas are having devastating consequences.
Libya – Explosive Hazards (1)

- Improvised Explosive Devices (IEDs)
- Mines
- Explosive Remnants of War (ERW)
  - Unexploded Ordnance (UXO)
  - Abandoned Explosive Ordnance (AXO)
- Unsecured ammunition storage areas
• The presence in Libya of considerable quantities of munitions and other ERW, much of it unguarded, and not under the control of the Libyan Government, poses a significant hazard.

• Of great concern is the use of IEDs by extremist groups, attracted by the ready availability of the high explosives contained within military munitions.
• ISIL and Al Qaeda remain active in Libya but at reduced levels of capability compared to when ISIL held Sirte and was active in Derna.

• The April 2019 outbreak of fighting around Tripoli has allowed Da’esh/ISIL in particular to regroup and carry out attacks in south/central Libya.
• Substantial quantities of ‘legacy’ VOIEDs are still present in formerly contested areas, such as Sirte.

• Most VOIEDs are based on simple switches and, invariably, use items of military ordnance as the main charge.

• When buried in rubble, they represent an enduring hazard to clearance operations.
Pull wire attached to a door

Crush wire across a track (note IED markers!)
• RCIEDs have been widely encountered across all areas of Libya.

• RCIED initiation systems include:
  – Keyless entry systems
  – Mobile phones
  – Motorcycle alarm systems
  – Industrial switching systems
  – Personal mobile radios

Examples of radio control IEDs recovered in Libya (Tripoli and Benghazi)
Libya IED Update (5) Suicide PBIED

- Da’esh/ISIL retains the capability to mount complex attacks in the major cities, including Tripoli, using suicide IEDs (Person Borne IED and Vehicle Borne IED).
- Intent seems to be both attack government institutions and create uncertainty regarding security in Libya.
• All VBIEDs make use of readily available military ordnance for main charge.

• The quality of the explosive engineering employed in Da’esh/ISIL IEDs (VBIEDs) has diminished recently.

• This may be due to attrition of experienced bomb makers.

• Most suicide VBIEDs have multiple means of initiation including backup radio control.
• **World War 2.** Mines were laid in very large numbers by German, Italian and British forces operating in Libya during World War 2. In May 2003 it was estimated that between 1.5 and 3 million anti-personnel (AP) mines still remained in Libya from World War 2.

• **Libya-Egypt War of 1977.** Two million mines were reported to have been laid during the period of the Libya-Egypt war of 1977.

• **Libya-Chad War 1978-1987.** Landmines were employed extensively in southern Libya and the area of the Aouzou Strip in Chad during the periods of conflict between Chad and Libya from 1978-1987.

• **Libya Revolution of 2011 and Onwards.** Protective perimeter minefields were laid at a number of ammunition storage areas by former regime forces in 2011. In 2014 it was also established that mines were employed in the vicinity of Tripoli International Airport. Mines employed during and since the revolution tend to have been scattered and definitive minefield records were not made.
The Libyan UXO problem is massive and diverse and getting worse by the day.
Abandoned Explosive Ordnance

- Conventional ammunition, of virtually every type, is scattered across Libya (this example near an ASA south of Tripoli).
- Abandoned explosive ordnance poses a significant IED proliferation risk and fuels conflict, nationally and regionally.\textsuperscript{22}
The conflict witnessed the loss of national control over military materiel and a complete redistribution of weapons ownership in the country. The distribution of weapons to civilians, the appropriation of the contents of depots by individuals and brigades, coupled with additional military materiel that entered Libya from elsewhere, resulted in the uncontrolled circulation of very large quantities of arms and ammunition during the conflict.

• Libya has the world’s largest uncontrolled stocks
• In 2012, estimated to be in excess of 200,000 tonnes
• Continued conflict has impacted public infrastructure, including government facilities, schools, universities and hospitals
• Due to the current conflict, the ERW threat is worsening everyday, including Improvised IEDs and is exacerbated by the legacy mine fields and UXO left behind from previous conflicts since the 1940s
Toxic Legacy of War in Libya (1)

- Wide variety of liquid fueled missile types were procured by the former Libyan regime
- All liquid fuels in Libya are toxic and hypergolic
- Missiles may be encountered at ammunition storage areas and missile sites across Libya
- Most missiles which were fueled and made ready during the 2011 conflict have been emptied
- Most significant hazard is now posed by bulk fuel and oxidizer stocks which are stored at a number of sites across Libya
• Liquid propellants pose a significant hazard and a risk to health and, should they be released into the atmosphere, exposure to propellant vapour will cause harmful lasting effects to the local population and on the environment.

• Exposure to liquid propellants must be avoided. Leaking or venting containers must be dealt with in a timely, safe and controlled manner. Recognising the hazards associated liquid propellants will reduce effects and minimise the impact on both the health of individuals and damage to the environment.
Liquid propellants are designed to burn, in controlled conditions, in a rocket motor.

Liquid propellants normally come in two forms:

- **Fuels.** Which as the name suggests provides the source of fuel.
- **Oxidizers.** The source of oxygen for the burning reaction.
Liquid Propellants – Use (2)

- Most liquid propellants are hypergolic i.e. they burn spontaneously, and almost immediately, when mixed together.
- If liquid propellants leak and mix accidentally then they inevitably cause a fire.
- Liquid propellant fires, due to the presence of strong oxidizers, are extremely difficult (almost impossible) to extinguish.
The former Libyan regime acquired missiles from a wide variety of sources and a number of strategic air defence and surface-to-surface systems employ rocket motors which use liquid propellants.

- Liquid propellants consist of a fuel and an oxidizer and are extremely toxic, corrosive, and difficult to handle. Liquid propellants require neutralization and treatment before they can be disposed of safely.
Scud Liquid Propellants

- **Main Fuel (825kg – 1022 litres)**
  - 60% coal tar distillate
  - 40% kerosene

- **Main Fuel (alternative)**
  - 825kg Unsymmetrical dimethylhydrazine (UDMH)

- **Oxidizer (2,920kg – 1836 litres)**
  - Inhibited Red Fuming Nitric Acid (IRFNA)

- **Initiator Fuel (30kg – 34 litres)**
  - Mixed amine:
    - 50% triethylamine
    - 50% dimethylaniline
• Libya procured two type of surface to air missile which employ liquid propellants
• S-75 Dvina (SA-2 Guideline) was designed by the Russians and first entered service in 1955
• S-200 Vega (SA-5 Gammon) was designed by the Russians and first entered service in 1966
S-75 Propellants

- **1st Stage Booster**
  - Solid rocket motor

- **2nd Stage Sustain Fuel** –
  - 143kg of TG-02
  - 50% Xyldine
  - 48.5% Triethylamine
  - 1.5% Diethylamine

- **2nd Stage Sustain Oxidizer**
  - 455kg of AK-20 (Melange)
  - 80% Inhibited Red Fuming Nitric Acid (IRFNA)
  - 20% dinitrogen tetroxide

- Turbo pump for sustain motor runs on OT-155 Isonite (isopropyl nitrate)
S-200 (SA-5 Gammon) Propellants

- 1\textsuperscript{st} Stage Booster
  - 4 x solid rocket booster
  - RAM-10K propellant
  - Each containing 580kg solid propellant

- 2\textsuperscript{nd} Stage Sustain Fuel
  - 586kg of TG-02
  - 50% Xylidine
  - 48.5% Triethylamine
  - 1.5% Diethylamine

- 2\textsuperscript{nd} Stage Sustain Oxidizer
  - 1680kg of AK-27 (Melange)
  - 73% Inhibited Red Fuming Nitric Acid (IRFNA)
  - 27% Dinitrogen tetroxide
The P-15 (Termit) missile was first ship-launched cruise missile designed by the Russians and entered service in 1958.

P-15 was installed on the Koni class frigates operated by the Libyan Navy.

The missile employs a solid fuel booster and a liquid propellant sustain motor operates during the cruise phase of missile flight.
P-15 SS-N-1 Styx Propellants

- **1st Stage Booster**
  - Solid rocket booster
  - 226kg solid propellant

- **2nd Stage Sustain Fuel - 216kg of TG-02**
  - 50% Xylidine
  - 48.5% Triethylamine
  - 1.5% Diethylamine

- **2nd Stage Sustain Oxidizer - 635kg of AK-20 (Melange)**
  - 80% Inhibited Red Fuming Nitric Acid (IRFNA)
  - 20% dinitrogen tetroxide
• Liquid propelled missiles are generally stored unfuelled (empty)
• There are a number of sites in Libya where bulk liquid propellants are stored
Libya - Propellant Storage (2)

- Known propellant storage facilities are at Gharyan and Tobruk
- For obvious safety reasons, fuels and oxidizers are stored in separate ventilated buildings
Missile Fuels

• The most common liquid propellant fuel encountered in Libya is based on a mixture of Xylidine and Triethylamine and is known as Samin

• The technical grade of fuel used is TG-02 and has the following constituents:
  – 50% Xylidine
  – 48.5% Triethylamine
  – 1.5% Diethylamine

• In some countries this is known as a mixed amine fuel or Tonka fuel
• The most common oxidizer encountered in Libya is inhibited red fuming nitric acid (IRFNA)
• IRFNA is most often used mixed with other nitrogen oxides and for this reason is known as mélange (from the French word meaning ‘mixed’)
• The exact chemical make up of the mélange compositions which may be encountered vary from missile to missile, but IRFNA is always the major constituent of the mixture

• AK-20 (used in the S-75 and P15 missiles) consists of:
  – 80% IRFNA
  – 20% Dinitrogen tetroxide

• AK-27 (used in the S-200 missile) consists of:
  – 73% IRFNA
  – 27% Dinitrogen tetroxide
Liquid Propellant Hazards

• All liquid propellants associated with Libyan liquid propelled missiles are extremely toxic and have long-term negative impacts on quality of life if exposed to humans
• Some liquid propellants (especially Xylidine) are suspected human carcinogens
• Unprotected exposure to liquid propellants, of all types, should be avoided
• Safe disposal of liquid propellants is a high priority for the Libyan people living in close proximity to storage sites
Libyan Urgent Operational Needs

• IED capability development
  – IEDD training
  – IEDD equipment
  – IED forensics and scene management

• EOD capability development
  – Single & multi item demolitions
  – Expedient EOD techniques for air-delivered ordnance
  – Expedient methods for the clearance of bomb-damaged ammunition storage areas
IEDD Capability Development

• IEDD training and equipment has been delivered in Libya on a project supported by the USA, Germany and the UK

• The magnitude of the IED problem is such that significant effort will be needed to enhance Libyan capabilities

• Existing EOD/IEDD units have sustained very significant casualties
Effective IED scene management, evidence preservation and recovery is a pre-requisite of effective counter-IED operations.

Libyan Criminal Investigation Department are extremely professional but need additional equipment and training.

Future focus should be on building Libyan national capabilities.
• The current fighting has hindered the previous focus that the GNA and the LNA had on eliminating the threats posed by groups affiliated to ISIL and AQ.

• Substantial quantities of ordnance have been expended by both sides and a large post-conflict UXO clearance operation will be required. Sadly, some previously cleared areas have been re-contaminated.
Clearance of Ammunition Storage Areas

• ASA Clearance task:
  – 16 heavily damaged ASAs
  – 706 Explosive Store Houses (ESHs) requiring some form of clearance

• Some sites are contaminated with both mines and ejected unexploded ordnance

• Majority of munitions in damaged ASAs will require disposal by Open Burning (OB) or Open Detonation (OD)

• Very little serviceable explosive is available to conduct OD with consequent implications for demolition safety
Candidate Areas for Support

• Missile propellant disposal
• IED forensics and scene management
• EOD capability development
• Explosive harvesting
• Victim assistance
The Gharyan Missile Propellant Disposal project will be delivered in 3 phases:

- **Phase 1**: Site preparatory actions
- **Phase 2**: Neutralization equipment acquisition, installation commissioning and training
- **Phase 3**: Full operation of the Gharyan disposal site until all surplus/redundant missile propellants are safely disposed

Currently, Phase 1 has been supported and funded by the German Government.

Funding for Phase 2 is being sought.
**Phase 1:** funded by the German Government and included:

- Installation of site perimeter security (main gate, fence and security lights)
- Construction of two concrete plinths for installation of fuel and oxidizer neutralization equipment (neutralization equipment to follow in Phase 2)
- Provision of new accommodation for staff (security and administrative buildings)
- Provision of services (power, water and domestic waste water disposal)
- Provision of 350 KVA generator (to power neutralization equipment in Phase 2)

**Phase 1 activities are completed, but further work on the site has stopped.**

**UNMAS Libya is seeking donors to support Phase 2, but further work at Gharyan will not commence until the current conflict stops and the security situation stabilizes.**
Device Scene Incident Management courses, funded by Canada and delivered by Ukroboronservice in Ukraine, was run in April and October 2019 for members of the Libyan Criminal Investigation Department.

- Mixed gender courses, focused on IED forensics and IED scene management.
- Two courses each delivered to 16 students over 3 weeks.
- Aim of the courses was to provide Forensic Police and MOI personnel with the key skills to process IED/explosion scenes.

Libyan Police conducting the analysis of a scene where an explosive device has functioned inside a car.
• Course consisted of a mixture of theory and practical periods and culminated with the full processing of an IED scene.

• Visits to Ukraine Ministry of Interior forensic laboratories took place.

• Students have since put their newly acquired skills into practice in the processing of the Tajoura Detention Centre bombing incident.

• UNMAS is seeking to run further courses in 2020 to help build Libyan Police IED response capabilities.

Libyan Police forensic investigator recovering and sieving evidence from the seat of the explosion of an IED
EOD Capability Development

- The magnitude of the disposal task is huge; therefore, large numbers of teams will be required.
- Training and basic equipment required for:
  - Single item demolition
  - Multi-item demolition
  - Disposal of air-delivered ordnance
- This is a critical enabler for the safe return of IDPs.
Explosive Harvesting

- Libya has large quantities of suitable munitions for harvesting.
- Representatives from UNMAS Libya visited the Golden West Humanitarian Foundation in Cambodia to evaluate the suitability of explosive harvesting techniques for employment in Libya.
- The Golden West system for explosive harvesting and demolition charge manufacture would be ideal as a source of serviceable explosives to support future explosive clearance operations.
Victim Assistance

• The health system has been affected by neglect and has further deteriorated recently due to the relocation of experienced health care professionals. There is an urgent need to enhance the technical capabilities of medical professionals to respond and treat survivors of explosive violence.

• UNMAS is seeking, with an Implementing Partner, to:
  – Capture blast injury and survivor data to understand the specific requirements and support the longer-term development of improved bio-medical engineered devices to reduce impairment for the survivors of explosive violence.
  – Improve the medical and surgical response to the treatment of survivors of explosive violence.