MSIAC
Munitions Safety Information Analysis Center

MSIAC Workshop

IM Technology Gaps

20 – 24 June 2011
The Hague, The Netherlands

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IM Technology Gaps Workshop

Reducing Munitions Response to Shaped Charge Jets, Fragments and Explosively Formed Projectiles

Dutch Defence Academy
The Hague, The Netherlands
20 to 24 June 2011
Open to MoD and Industry from MSIAC Nations

Workshop Outline

- **Topic**
  - Some munitions currently in use on operations are sensitive to attack by fragmentation warheads, shaped charge weapons and explosively formed projectiles (EFPs).

- **Objective**
  - Identify how to reduce the sensitivity of munitions against these threats
    - Existing munitions in current operations
    - New/upgraded munitions

Aggressions and Munitions Items

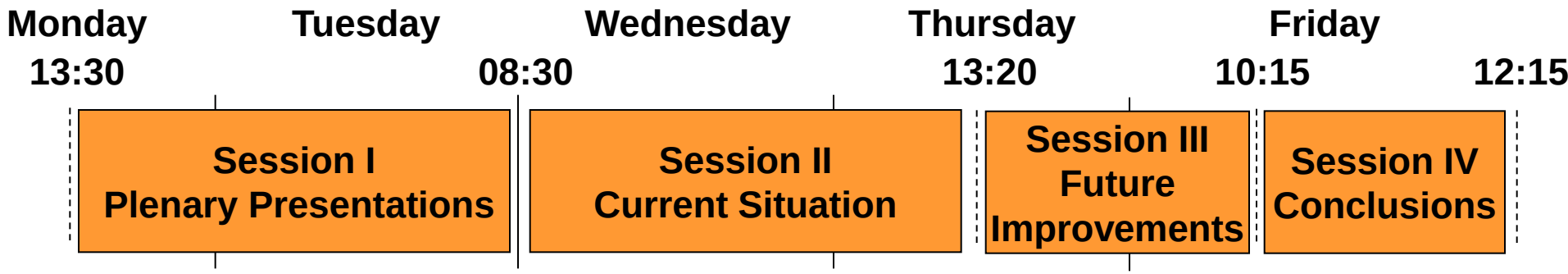
- **Aggressions/threats:**
  - Fragmentation warheads
  - Shaped charges
  - IED EFPs

- **Considered munition items:**
  - Gun propulsion
  - Rocket propulsion
  - Anti-armour warheads
  - Blast fragment and general purpose warheads

Workshop Aims

- **Aims:**
  - State of the Art analysis of available mitigation technologies
  - Identify shortfalls and potential remediation options
  - Identify system level mitigation methods for munitions on operations
  - Assess if IED EFP can be a new challenge for the IM community
  - Increase information sharing and areas for multi-national co-operations

Workshop Structure



- **Session I**

  Presentations on the subjects addressed in the workshop

- **Sessions II and III**

  Working Group discussions

  - Munitions on operations
  - Gun Propellant
  - Rocket Motors
  - Warheads

- **Session IV**

  Workshop wrap-up

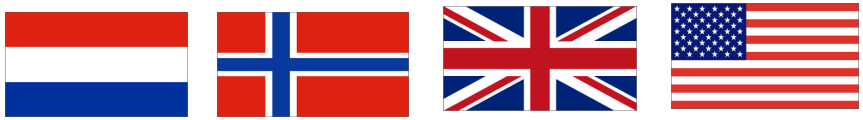
  Presentations of group work and conclusions

Workshop Figures

- 1 very nice facility offered by the Dutch MoD

Instituut Defensie Leergangen (IDL)

- 4 days workshop
- 86 participants from 9 MSIAC nations



- 23 presentations during plenary and working group sessions
- 7 working groups

Working Group Example: Munitions on operations

- **Logistical and tactical scenarios evaluated for munitions on**
  - Land (Afghanistan)
  - Sea (Straits of Hormuz / Arabian Gulf)
  - Air (Libya, Attack Helicopter)

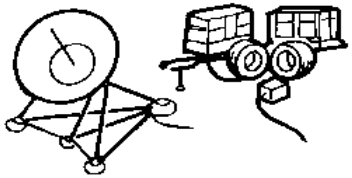
- **Working Group (WG) split in three subgroups to**
  - identify mitigation shortfalls in the different scenarios
  - make recommendations for the future

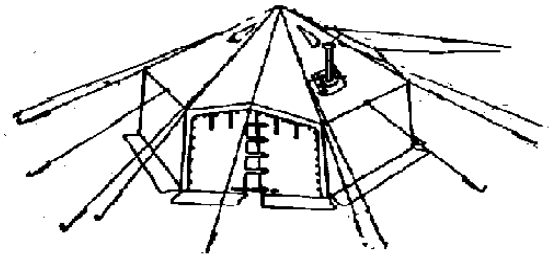
Land Assessment

Afghanistan

Threats Considered

- Fragment Impact (IED)
- Shaped Charge (RPG)
- Explosive Formed Projectile (EFP)





Logistic

- Transport and storage (airfield/camp)

Tactical

- Transport and Storage
  (Forward Operation Base, on mission)

Munitions on operations WG Recommendations

- **Very similar recommendations although the three subgroups met separately:**
  - SHORT TERM:
    - Improve and enforce TTPs (Tactics, Techniques and Procedures), conduct more tests and trials in order to model and assess operational threats and improve C-RAM (Counter-Rocket Artillery and Mortar)
  - MID TERM:
    - Prioritize the stockpile for IM insertion (munitions most commonly used by the warfighter, most vulnerable to attack and improving warfighter operational efficiency)
    - Improve casing/shielding materials used to make them lighter and easier to assemble

Munitions on operations WG Recommendations

- LONG TERM:
  - Continue to seek IM solutions, but also consider “Smart-Pack” for packaged munitions:
    - easy access to retrieve munitions and compatible with a variety of munitions types
    - reduces munitions reaction to stimuli
    - but unpacked munitions remain easy to dispose thus denying the enemy
  - Re-design ammunition stowage compartments in tactical vehicles in order to reduce their vulnerability of attack thus reaction to stimuli

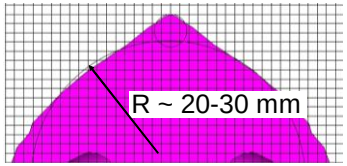
Warhead Technology

System	Design & Mitigation	IM Signature	
		FI	SCJ
Penetrator	Low shock sensitivity and large critical diameter	V	Pass
	PBXN-109 type	V	I
GP bombs	PBXN-109 type	V	I
60 mm mortar	Steel body	III[c]	I
	Composite case (steel balls in a resin)	V*	I
81 mm mortar		III	I
120 mm mortar		IV	I
120 mm Tank HE		IV	I
105 mm shell		V	I
155 mm shell	TNT performance	V	Pass
	Comp B performance	V	I
Fragmenting warhead (missile)	Large diameter warhead	V	I
Fragmenting warhead (missile)	Small diameter warhead	I	I
Shaped Charges / EFPs (Main Charge)		I	I
Sub-Munitions		V	I
Underwater Warheads		I	I

- **Response to FI and SCJI**
  - Pass or near pass for most warheads to FI
  - SCJ considered as a major issue
- **Explosives with large critical diameters considered as the unique current solution to pass SCJ test**
  - But required compromise with performance

IED EFP : a New Challenge for the IM Community?

- **Many types of IED EFP identified**
  - From mono-slug (large diameter and low velocity)



  - To multi-slug high velocity (projectile broken into several elements)

- **Discussion conclusions:**
  - Not enough data available on the response of munitions components
  - Similarities but no demonstrated correlations between
    - Mono slug IED EFP & French heavy fragment (ϕ 40 mm & 1600 m/s)
    - Tip slug from multi slug IED EFP & NATO fragment
  - Requested experimental investigation of munitions response to these aggressions before further discussing the need to consider IED EFP as a new IM threat

STANAG 4526 on Shaped Charge Test

- **Four levels defined in STANAG 4526**

Threat	Representative V^2D ($mm^3/\mu s^2$)
Top Attack Bomblet	200
SCJ with characteristics of 50mm Rockeye	360
Rocket Propelled Grenade	430
Anti-Tank Guided Missile	800

- **V^2D values considered by many participants as very high compared to values measured in their own countries**
  - Values provided during the workshop for
    - RPG7-V is around 140 $mm^3/\mu s^2$
    - Rockeye is between 120 and 165 $mm^3/\mu s^2$
  - Variations could reach a factor of 2 to 3
  - Big differences could partly be explained by the shaped charge impact probe
    - Consumption of the large element at the jet tip

STANAG 4526 on Shaped Charge Test

- **V^2D values considered as not realistic**

  ⇒ **STANAG 4526 Procedure 1 (Standard Test) usually not applied in many MSIAC countries**

- **STANAG 4526 Procedure 2 (Tailored Test) preferred**
  - **Large V^2D variations from one nation to another**
  - **All said to be "compliant with STANAG 4526"**

- **Need expressed by some working groups to amend the STANAG 4526 to**
  - introduce more realistic aggressions / V^2D
  - better define the shaped charge jet characteristics and how to measure them

Conclusions

- **State of the Art drawn on currently available mitigation against fragment and shaped charge jet aggressions**
- **Shortfalls identified and possible ways ahead discussed**
- **IED EFP aggression subject tackled and interest expressed by the participants**
  - But need for experimental studies to get a clearer overview of munitions response to this aggression
- **Shaped charge jet aggression**
  - Questions raised by many participants on the V^2D value levels in the STANAG 4526 and how V^2D should be measured
  - Custodian group to be formed by NATO AC326/SG B
    - Points of contact to participate to this group:
      - **Dr Brian Fuchs and Dr Ernest Baker (US Army ARDEC)**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