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New Safety Requirements For Munitions Fuzing System Solutions

54th Annual Fuze Conference

"The Fuzing Evolution – Smaller, Smarter and Safer"

Kansas City, MO - May 11-13, 2010

Max Perrin
JUNGHANS Microtec

Outline

- Safety Issues
- Conventional Requirements
- New Safety Requirements – Trends
- Fuze Safety - Technical Solutions
  - Before safe-separation phase
  - After safe-separation phase
  - Post-conflict phase
- Fuze Technologies

Company Presentation

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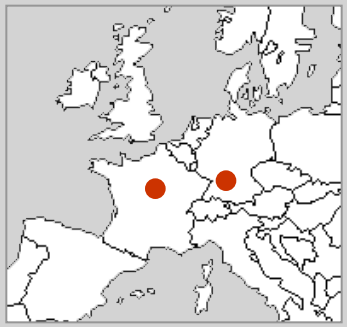
- **A global leader in the field of ammunition fuzes and S&A devices**
- **Full range of products**
- **Key competences in**
  - Fuzing technologies
  - Micro-technologies
  - Ammunition electronics



A Diehl and Thales Company

Munitions – Safety issues

- The Fuze is the key element to guarantee safety and protection to the crew throughout the logistical and tactical cycles
- Modern warfare means new safety requirements for munitions
- This leads to new challenges for the fuze designer, who will have to implement new safety concepts and technical solutions

… while

- Keeping and enhancing the fuze reliability
- Dealing with munition constraints as small size and low cost

Safety: Conventional Requirements

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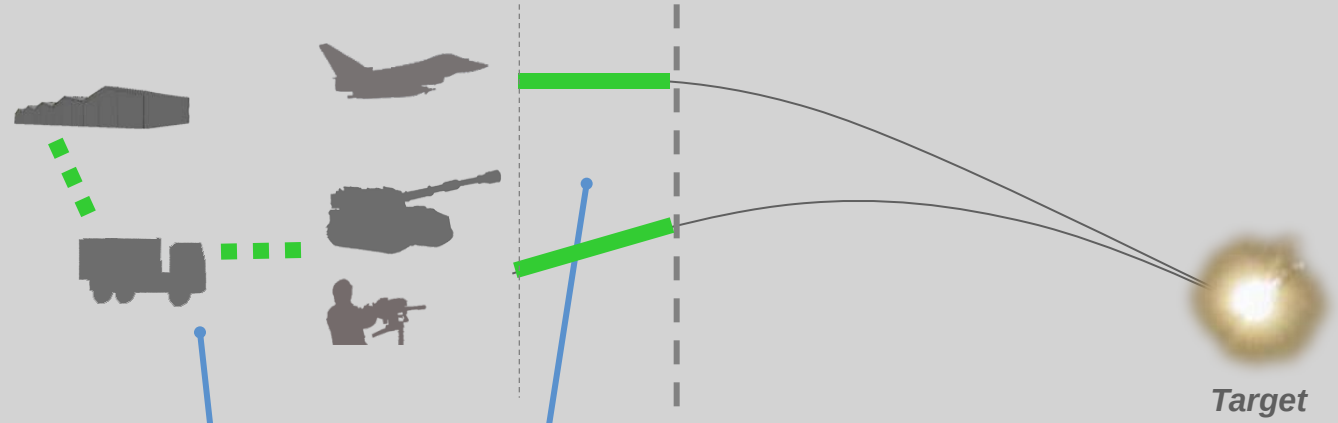


Target

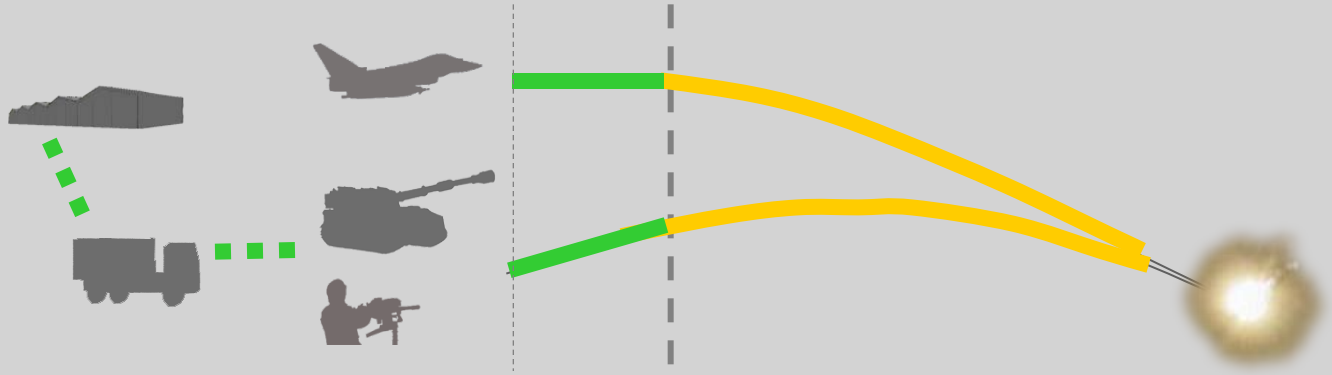
Storage, Transportation & Handling Safety

Firing / Launching Safety

Prior to Safe Separation phase

Then …

Safety: New Requirements



Storage, Transportation & Handling Safety

Firing / Launching Safety

Enhanced safety

IM

Two Safety Criteria

Modern weapon severe environment

Prior to Safe Separation Phase

Safety: New Requirements

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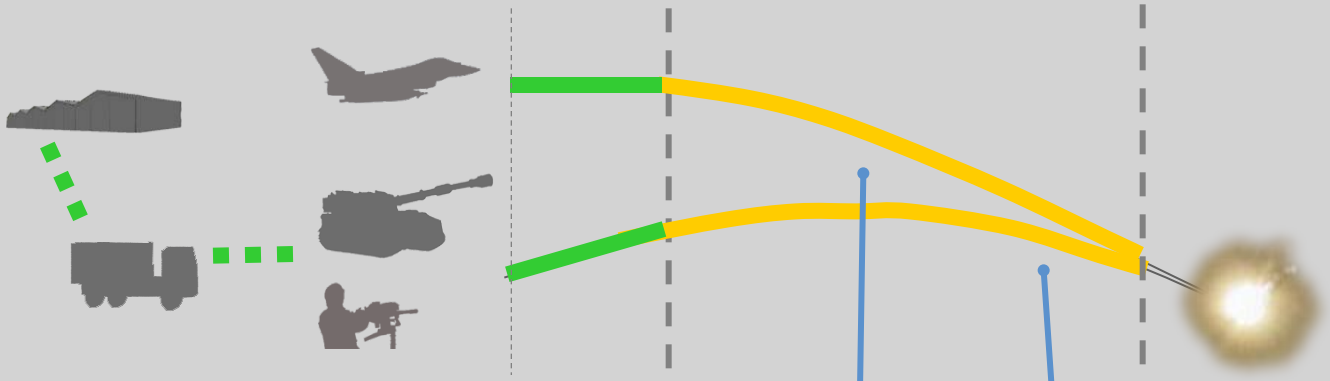

Storage, Transportation & Handling Safety

Firing / Launching Safety

Overhead / overflight safety

Enhanced safety

IM

Two Safety Criteria

Modern weapon severe environment

Mission Abort

Reduce Collateral Damage / Friendly Fires

Prior to Safe Separation Phase

Flight or Active Phase

Safety: New Requirements

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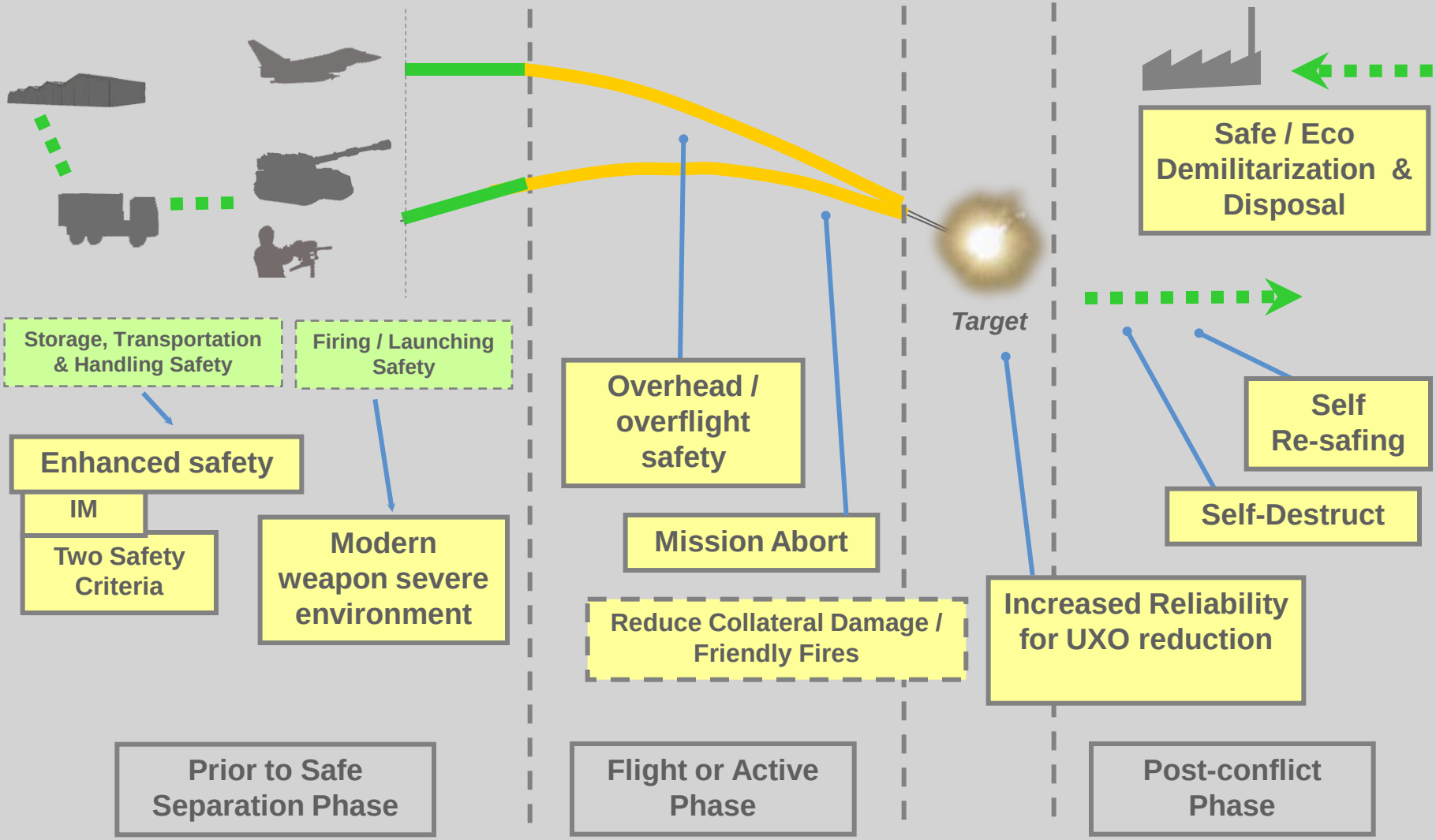

Safety Requirements: Standards and Trends

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- Still usual safety related standards, with continuous improvements, + issue with new technologies
  - e.g STANAG 4187, STANAG 4170, STANAG 4368

- New International agreements and protocols, which lead to obligations or recommendations
  - Mainly related to post-conflict hazards: e.g CCW / CCM UN Protocol
  - Not strictly regulatory but require consideration for any country armies and industry (political issue)
  - Sometimes extended by some governements to other related products

- Media and public opinion pressure
  - Beyond strict regulation
  - Environmentally friendly policy
  - NGO pressure
  - Relevance: sometimes questionnable ?

Fuze Safety Requirement and Solutions (Before Safe Separation)

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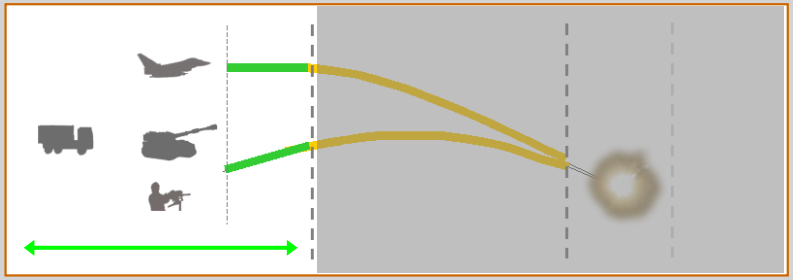
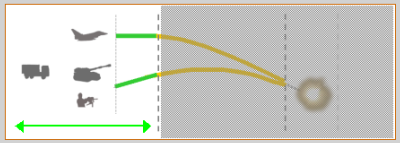


- Main requirements
  - Capability to withstand more and more severe firing/launching environments, e.g with modern howitzer systems or longer carriage time for air-launched munitions
  - IM (Insensitive Munition) capability
  - Full compliance with STANAG 4187 mainly regarding the 2nd safety feature

- Technical solutions
  - More G-hardened fuzing solutions
  - Implementation of 2nd environment sensor : mechanical or electronic
  - IM explosive trains: IM materials, ESAD technology

Fuze Safety Solutions (Before Safe Separation)



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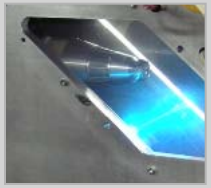
- Hardened design
  - Design able to withstand harsh environment: 52 cal. gun, Flickramming systems
  - Examples:
    - New generation MOFA fuzes
    - New generation PD fuzes

DM84 / L166

FRAPPE

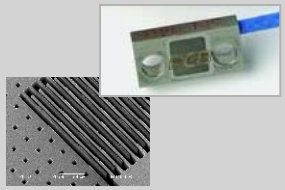
PD 544

- 2nd environment sensors, in particular for non-spinning projectile
  - Mechanical sensor (e.g relative wind detection)
    - New generation of mortar mechanical fuzes
    - Bomb fuzes



DM 93-S

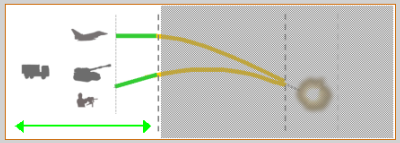
  - Electronic sensors and signal processing
    - Wind sensors
    - Magnetic sensors
    - Pressure sensors
    - Accelerometers
    - MEMS technology



Bomb Fuze Sensor

MFZM

Fuze Safety Solutions (Before Safe Separation)



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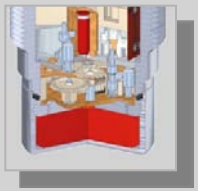
- IM explosive train
  - Use of IM energetics material and appropriate safety design
    - Issue for the fuze designer: Need to keep a high energetic power as the munition material is more difficult to initiate!
  - Specific packaging design
  - Relevance of IM single fuze testing vs complete round ?
    - Depends on the ammunition type



New Generation Artillery Fuzes

Specific Packaging

Infantry Grenade Fuzes

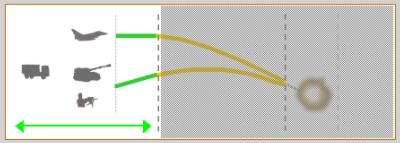
Tank Ammunition Fuze

New Generation Mortar Fuze

Upgraded Version of Mortar Fuze

Air Bomb Fuze and booster

Fuze Safety Solutions (Before Safe Separation)



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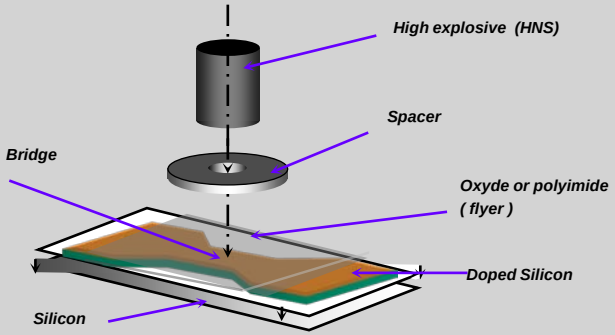
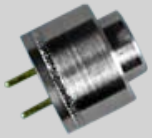
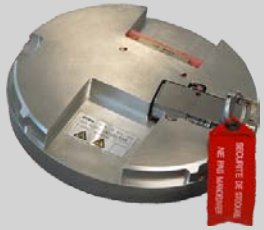
- IM Fuze : Use of ESAD / EFI technology
  - Naturally Insensitive solution, in particular with respect to ECM, ESD and shocks
  - In-Line SAU
  - Electronic control of the arming sequence
  - Testing capability
  - Re-safing capability
  - Today applied on "high-value" fuzes
    - Air-bomb fuze
    - Missile SAU





Slapper Detonator (EFI Exploding Foil Initiator)

FBM21 Bomb Fuze



Missile ESAD

Fuze Safety Requirement and Solutions (After Safe Separation)

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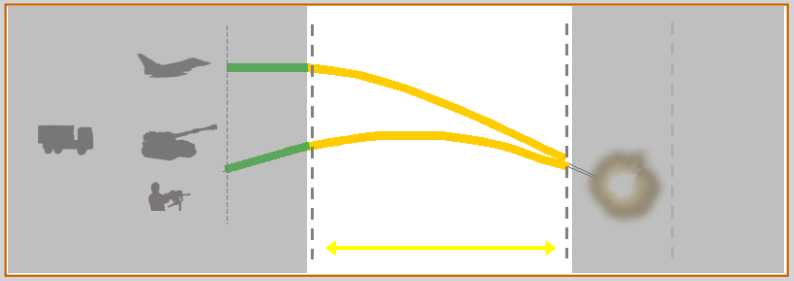
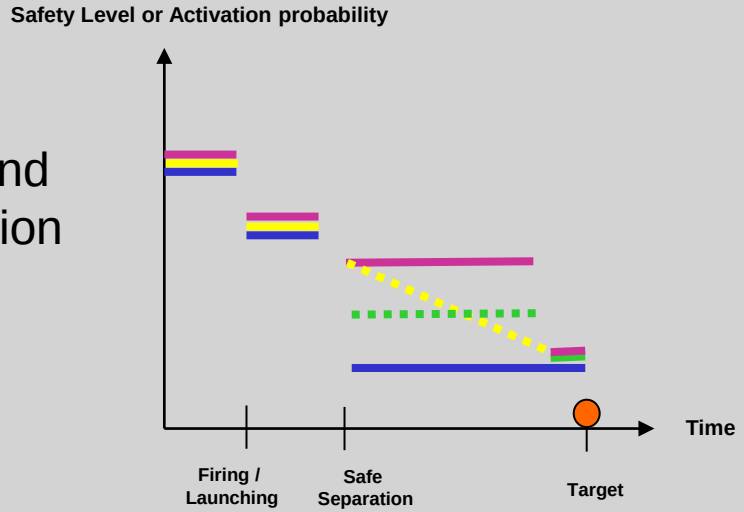
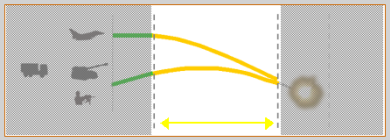


- Main requirements
  - Overhead / overflight safety: no early burst when flying over friendly forces
  - Mission abort: control the fuze or munition status/behaviour during flight when an unexpected event, possibly hazardous, is detected

- Solutions
  - Management of the fuze activation and status during flight from safe separation to target vicinity



Fuze Safety Solutions (After Safe Separation)



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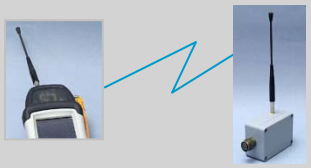
- Overhead Safety
  - Inhibition of fuze operating in flight (electronic)

  or
  - Late arming of the SAU, just before intended function on target

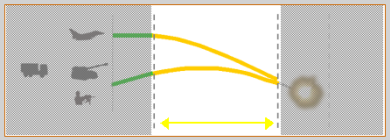
  - Possible use of environmental sensors providing flight condition information

  - Linked to the programming capability , (or remote control) of the fuze :
    - Inhibition or arming time to be set in the fuze control electronics
    - Real-time activity control

  - Supposes safe design and architecture, for hardware but also software, incl. data link protocol



Fuze Safety Solutions (After Safe Separation)



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- Mission abort function:
- New requirement, now necessary with guided munitions (land or airborne) or with course correction fuzes, when:
  - Detection of internal operating fault (built-in test)
  - Guidance problem or target identification issue, internally detected or controlled by the weapon system
  - Main issues: Define the appropriate behaviour? What is the safest action? What is a fail-safe design in that case ?
  - Fuze functions offer various type of “safe” actions
    - De-activation
    - Self-destruction
    - Self-neutralization or Self-sterilization
  - The relevance of the action to achieve depends on the flight phase or on the specific operational configuration

Fuze Safety Requirement and Solutions (Post-conflict Safety)

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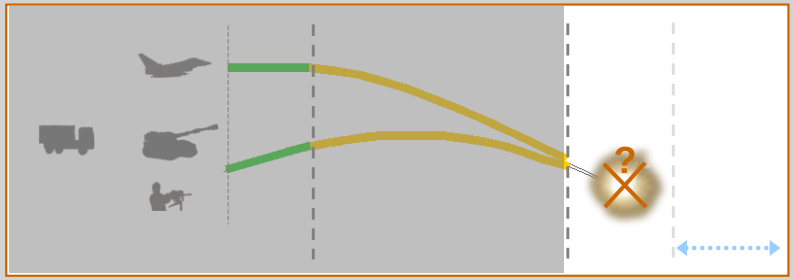
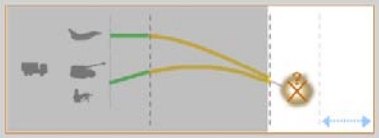


- Main requirements
  - Preventing hazards after the “military” mission is finished:
    - Enable friendly force manoeuvre in the area where munitions have been used (short term)
    - Keep conflict area safe and cleared for any UXO and ERW prior to civilian population returning (medium/long term)
  - + safe disposal and demilitarization of stockpile

- Solutions
  - Best solution: get high reliability of the fuze functions and of the operating on target
  - When difficult to achieve, not because of the fuze function, but due to the target configuration: ➔ safe fuzing backup functions

Fuze Safety Solutions (Post-conflict Safety)



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- UXO reduction: Safe backup functions
  - **Self-destruct function**
  - ➢ Various solutions: pyrotechnical / pyro-mechanical / electronic
    - Infantry grenade fuze
    - Direct fire fuzes
      - Medium caliber
      - Tank ammunition
      - With and without air-burst function
  - **PD backup**
  - **Self Re-safing**
  - … **High reliability fuze**

New Safety Requirements
Common Needs – Common Technologies

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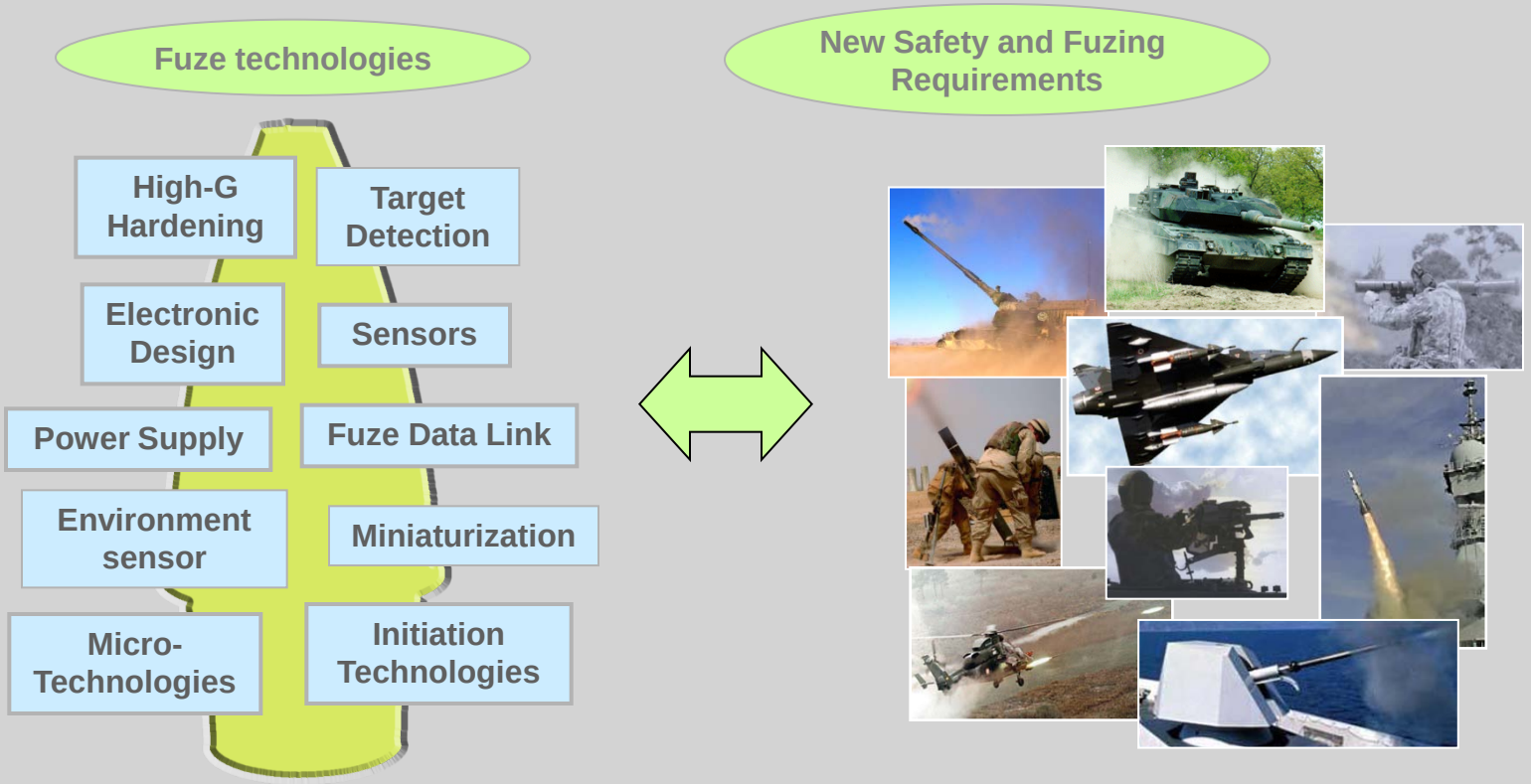
- The new needs and requirements applies to all arms:



Common fuzing technologies and technical solutions can be shared with various applications

Conclusion

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- The fuze designer / producer has a key role in the munitions performances and in particular with respect to the reliability and safety requirements

- Dealing with the new safety requirements, for all arms, suppose the implementation of more complex, but reliable, safety solutions using various technologies,

  … and always: low cost / small size / low power

- Thanks to its technological leadership **JUNGHANS** is able to take up technological challenges to provide the user with
  - Safe, reliable and affordable fuzes
  - For current and next generation fuzing systems

Thank You

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