



The 3<sup>rd</sup> European IM Day  
Amsterdam, 18-19<sup>th</sup> May 2017

SESSION 4

PROGRAMMES / R&T

*Current IM challenges*

Session chair

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CONSTRUISONS **ENSEMBLE**  
LA DÉFENSE DE DEMAIN

# 3<sup>rd</sup> European IM Day

Programmes / R&T  
*Current IM challenges*

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RÉPUBLIQUE FRANÇAISE

MINISTÈRE  
DE LA DÉFENSE

# OUTLINE

- **DGA technical organization**
  - DGA Technical Directorate
  - Safety authorities
  - MURAT
- **Statement since the last IM Day**
- **Example of constraint generated by non-IM acquisition**
- **Conclusion**

# TECHNICAL DIRECTORATE

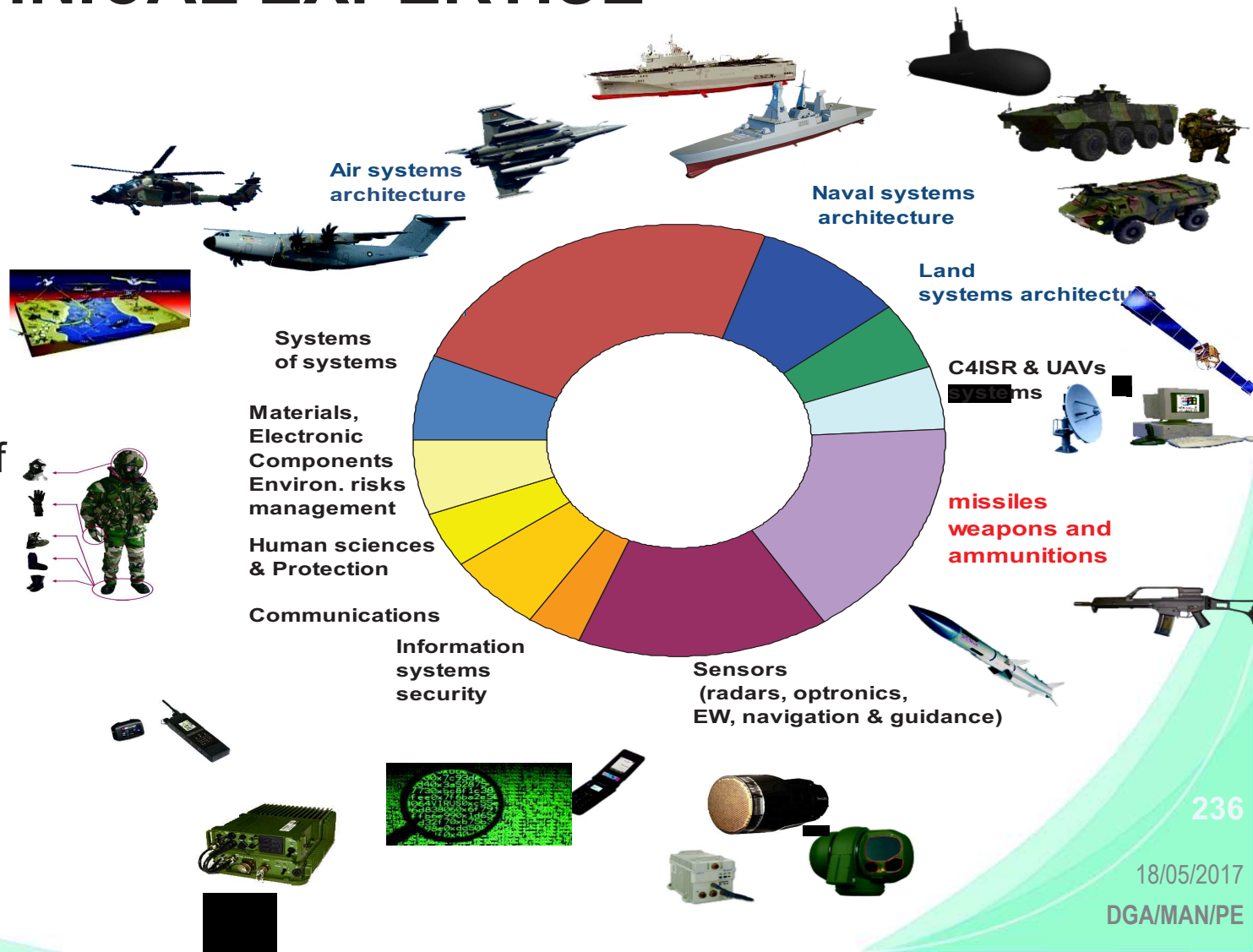
## Activities during programs

- **Provide technical expertise to the Program Teams during every phase**
  - **evaluation and management of programme risks**
- **fully ensuring the compliance, coherence and efficiency of all equipment deliveries**
- **Lead Test & Evaluation in qualification phase**
- **Assess the safety of the systems**

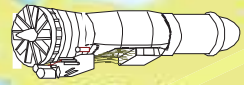
# DGA TECHNICAL EXPERTISE

## 11 domains

- High-profile technical function to manage programmes
- Evaluation and management of programme risks
- Identification and analysis of emerging threats
- Fully ensuring the compliance, coherence and efficiency of all equipment deliveries
- A technical authority



# DGA'S TECHNICAL CENTERS



GESMA  
DGA Techniques navales  
(Brest)



DGA Essais propulseurs  
(Saclay)

DGA Maîtrise de l'information  
(Rennes)

ETAS  
DGA Techniques terrestres  
(Angers)

DGA Techniques hydrodynamiques  
(Val de Reuil)

LRBA (Vernon)

DGA Ingénierie des projets  
(Bagneux)

DGA Maîtrise NRBC  
(Vert le Petit)

DGA Techniques terrestres  
(Bourges)

IM expertise for munitions



DGA Essais de missiles (Saint Médard)

IM tests for munitions

IM tests and expertise for missiles

DGA Essais en vol (Cazaux)

DGA Essais de missiles (Biscarrosse)

DGA Essais en vol  
(Istres)



DGA Techniques aéronautiques  
(Toulouse)

DGA Techniques navales  
(Toulon)

DGA Essais de missiles  
(Toulon + Île du Levant)



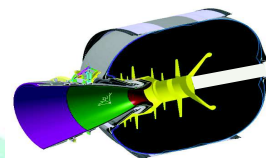
# MAN DOMAIN

## ■ 4 fields

- Missiles Systems (MTS)
- Weapons and ammunitions (ARM)
- Propulsion, Energetic Materials & Pyrotechny (PE)
- Nuclear Safety (SN) 

## ■ Activities for the Air Force, the Navy and the Army

## ■ 800 people



# SAFETY ORGANIZATION



## ■ Process

- **Munition entry into service decided by the chief of Army, Navy or Air Force Staff**
  - after DGA qualification
  - Qualification decided by the DGA IPT leader
  - after pyrotechnic materials homologation by RP MAN

## ■ Different authorities

- **Industry : design authority**
- **Armed Forces : authority for use - risk acceptance authority**
- **IPT leader : qualification authority**

**MAN : safety authority – independant review of the safety case**



# MUNITION SAFETY HOMOLOGATION

- **Munition Safety Homologation ensure**
  - an acceptable pyrotechnic risk level
  - for the whole life cycle
  - for the environments specified by the users
- **safety data package process**
  - Delivery by industry
  - Analysis by **Technical Directorate experts**
  - **An independent analysis** (IPE/SM)
  - **Review** (Safety Authority Commission)
  - **Energetic Homologation** (MAN), eventually with limitations, warning or procedures to reduce the risk
- ➔ **Decision ( to IPT leader) for qualification**



# SAFETY REQUIREMENTS

- Specified in the contract to industry
- Specified according to AOP 15 (in France *S-CAT 619*)
- **3 types of requirements**
  - Statutory requirements,
  - Non statutory requirements
  - Requirements linked to risk acceptance



# NEW FRENCH IM POLICY

## Background

- **MURAT policy part of a compulsory high level acquisition defence document** (Instruction DEF/DGA n°1516, 2010)
  - **Forces Staff involved in the early stages of IM Requirements**
  - **Generate discussions between all concerned actors**
- **win/win deal for**
  - **DGA :**
    - a better understanding of operational needs and constraints
    - A way to collect operational background
  - **Forces :**
    - A better understanding of IM benefits
- **A MURAT (IM) requirements in every program**
  - **Analysis by DGA/DT expert and validation by DGA/IPE through the 'Comité MURAT'**

# NEW FRENCH IM POLICY

## Background

- **Inventory of MURAT database**
- **Database management by DGA**
  - A help for program management (priorities...)
- **MURAT requirements:**
  - Life cycle analysis based on Hazard evaluation
  - According to the “State-of-the-art”
  - Logistic gains
    - ⇒ **Proposed “stabilized” IM signature**

# INTRODUCING NEW IM TECHNOLOGIES ?

- **Less resources → less research program**
  - Research programs are generally focused on the early stage of an ammunition program
  - Only few research programs really focused on IM common research
- **introducing new technologies require :**
  - **sufficient confidence** (i.e. minimum TRL 4-5)
  - **Proposals from the industry** (last research program dedicated to Rocket Motor IM ended in 2013)

**We are open to new proposals**

# NEW TECHNOLOGIES

## Impact on IM ?

- **Plan to introduce a new technology to improve the performances ?**
  - What are the consequences on IM ?
  - Are they acceptable ?
- **To be discussed and agreed between the contractor and the MoD during the early stage of the program**
- **Examples:**
  - Active mitigation device vs reliability
  - Penetrator warhead vs venting
  - Rocket motor structure vs venting

# OFF THE SHELF ACQUISITION

- Do munitions fulfill the IM requirements ?
- Find a way to reduce the reaction and/or its consequences ?
- Solutions may or may not exist but it always means:
  - Constraints
    - Not buy it ☹️
    - Adapted logistics : reduce the transports and storage
  - Additional costs & delay
- Why ?? Because



# OFF THE SHELF ACQUISITION

## Example : Sympathetic reaction

Forces need a new missile in a short delay :

- Missile to be stored on board a ship
- IM signature – SR test result : **fail** without barrier

↪ A further study had to:

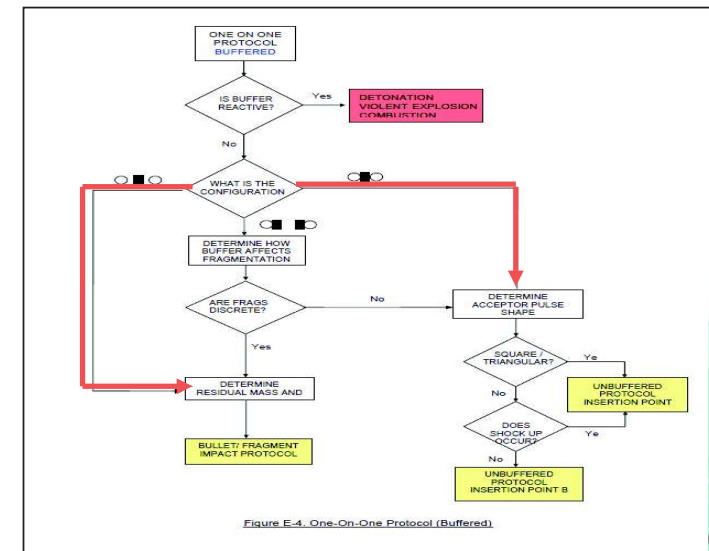
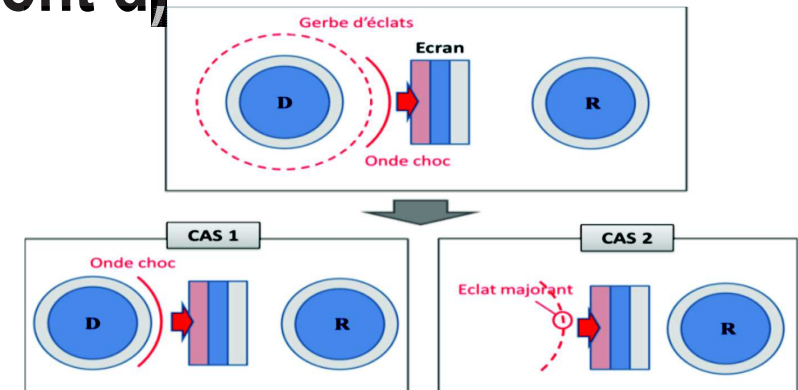
- Design a barrier to prevent the acceptor from detonation
- And barrier should be
  - cost effective,
  - not too heavy,
  - compliant with the container,
  - easy to build and remove ...



# OFF THE SHELF ACQUISITION

## Example : Sympathetic reaction (cont'd)

- Modelling approach:
  - To calculate the effects of donor detonation
  - To compute the acceptor response
- Single donor and single acceptor with buffer
  - Intermediate space rounds (~1D)
  - Both fragments and shock issues
- Modelling tools:
  - Analytical criteria (on inert material)

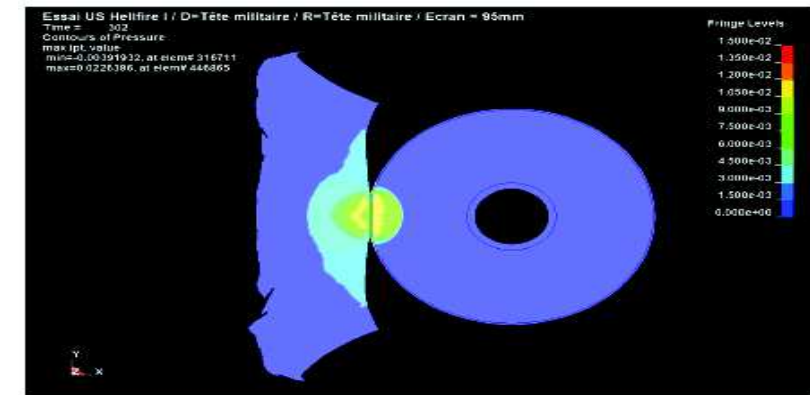
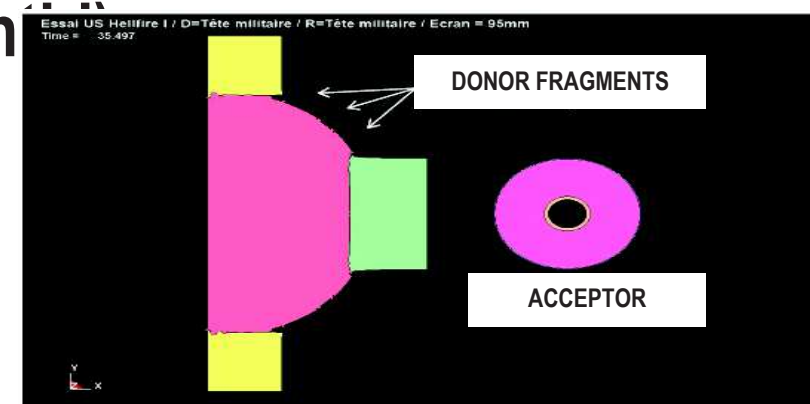


LS-Dyna software (LLNL, USA)

# OFF THE SHELF ACQUISITION

## Example : Sympathetic reaction (con)

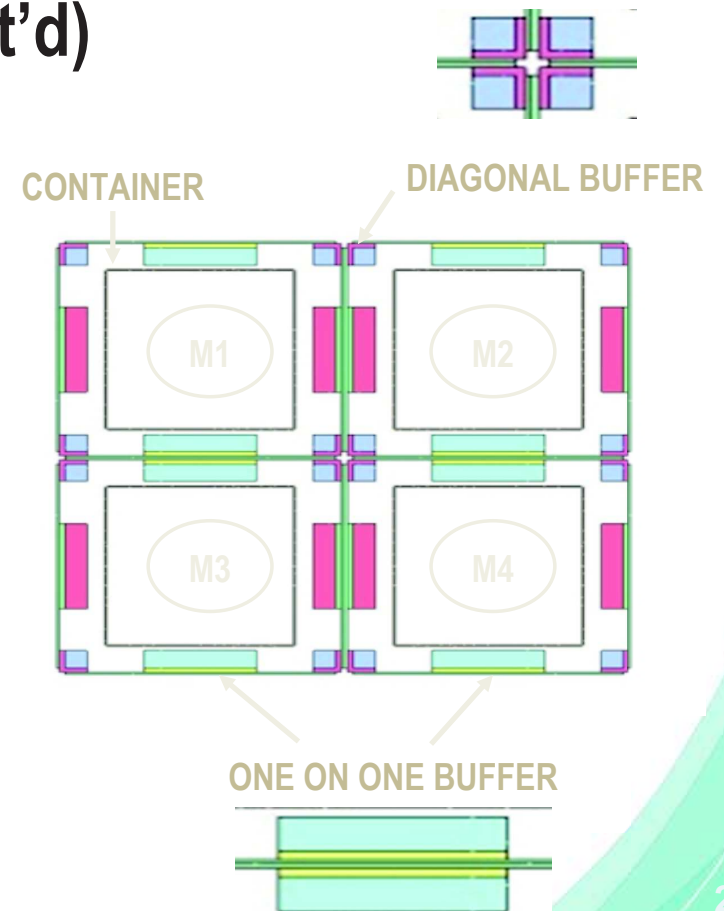
- Acceptor shock response :
  - Depends on the thickness and nature of the buffer
  - Many tested materials : Aluminium, steel, porous concrete, sandwich,...
- Numerical Simulations with LS-Dyna :
  - Validated by, experimental tests on, (conservative SDT criteria on inert material)
  - Made with one-to-one configuration (WH/WH and RM/RM) and extended to the diagonal effect



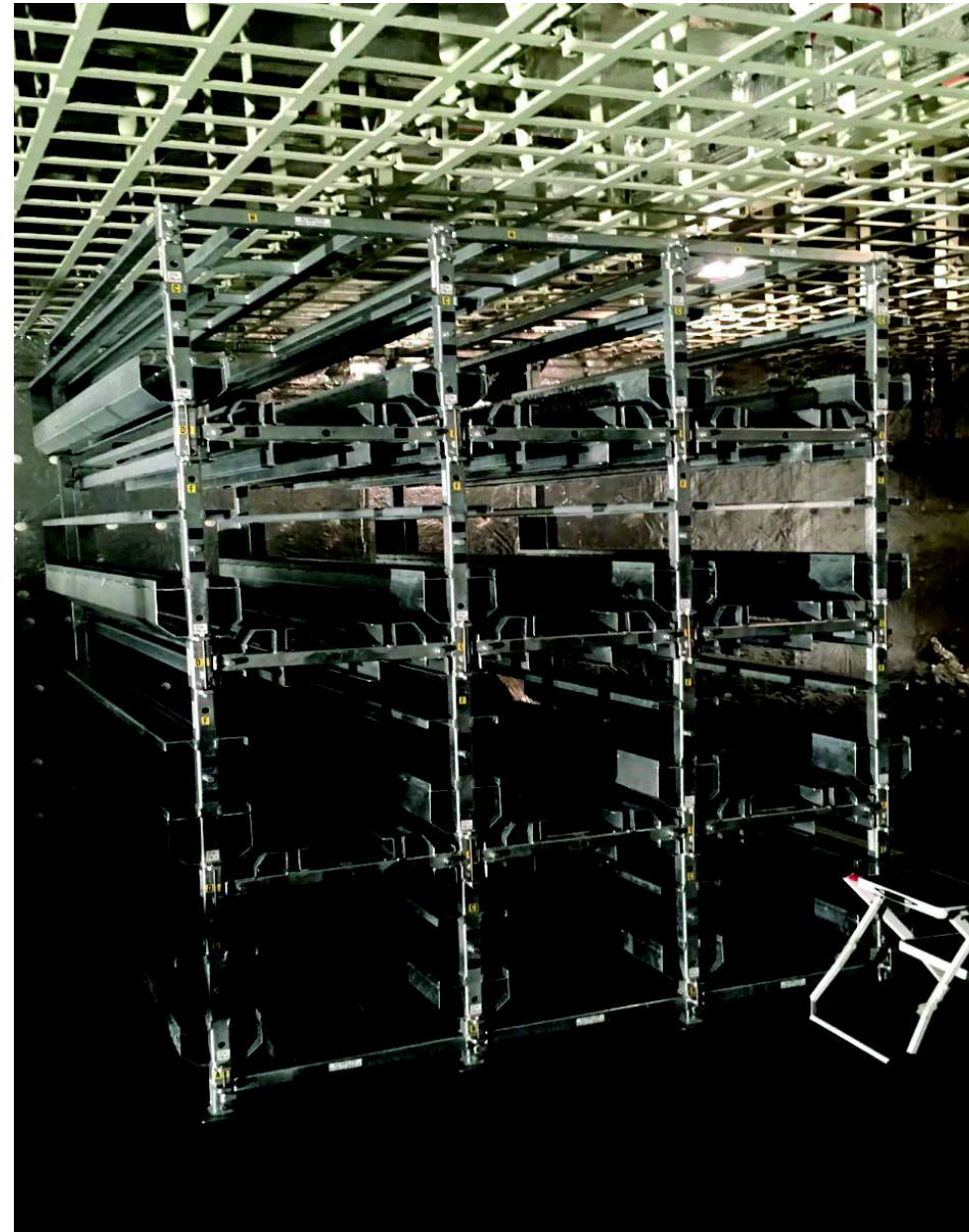
# OFF THE SHELF ACQUISITION

Example : Sympathetic reaction (cont'd)

- Buffer geometry validated by numerical simulations
  - Shock impact
  - Fragment impact (the most severe one)
  - Compliant with diagonal effect
- Buffer sandwich chosen :  
Porous concrete – Armor Steel – Porous concrete



# RESULT



DGA


DE LA DÉFENSE

# CONCLUSION

- **discussions between the different stakeholders should start at the very early stage of the program**
  - **Between Procurement Agency and the Forces to have a common wording of the requirements**
  - **Between Procurement Agency and the contractor to find the better way forward to fulfill:**
    - The performances requirements
    - Without forgetting IM requirements !
- **Sometimes a solution can be found at the end of the program but at higher costs (money, time, operational efficiency..)**

# TO SUM UP

- **Future technologies has to be prepared from now, without forgetting IM techs and specs**
- **Non-IM buyings = costs and constraints**



# INEMG MURAT

EUROPEAN MANUFACTURERS GROUP