HOW TO GET INSENSITIVE MUNITIONS BENEFITS ACCORDING TO HAZARD CLASSIFICATION

Written by IMEMG's Expert Working Groups on :

- Hazard Assessment & Classification

- Cost Benefits Analysis

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www.imemg.org

Context

- IMEMG is the European Organisation assembling leading armament groups working with IM technologies.
- It aims at expressing the viewpoint of the armament industry with regards to relevant transnational regulations and requirements.
- This paper is the result of common work carried out by the Hazard Assessment & Classification EWG and the Cost & Benefit Analysis EWG.

Introduction

- Today's qualified IM products in the inventory are very often handled and stored in the same manner as conventional ordnance with no advantage brought by insensitiveness.
- In an attempt to solve this issue, a proposition for harmonisation of HD 1.6 criteria with STANAG 4439 requirements has been proposed. *Does it really profitable for IM development?*
- In few countries, the explosives manufacturing industry can benefit from the use of safer explosive compositions in every day operations. *Does Best Practices share possible for realistic IM Hazard Assessment?*
- Benefits that may be achieved by the development of specific regulations for IM can be illustrated by the use of CBA applied throughout the life cycle. *Does dedicated CBA tools have the potential to help quantify the cost savings provided by IM?*
- *This IMEMG's presentation offers industrial experts point-of-view to IM community.*

Proposed Amendments to UN HD 1.6 Criteria

- Real IM according to STANAG 4439 can't be classified in UN HD1.6 due to use of no-EIDS,
- NATO SSD1.2.3 cannot be introduced directly to UN regulations,
- UN Orange Book influence increasing through GHS & CLP implementation,

↳ *Proposition for harmonisation of HD1.6 criteria with STANAG 4439 requirements has been proposed by Munitions Safety National Experts :*

- *Significant step forward, IM would pass UN HD1.6 !!!*
- *HD1.6 are stricter than SSD 1.2.3 !*
- *Then, caution to new criteria, they can be inappropriate*

Proposed Amendments to UN HD 1.6 Criteria

- Proposition has been brought to the UN Expert Committee (June 2010):
  - ☺ Strict EIDS criteria only consider the main charge (and become EIS),
  - ☺ Booster compositions have to meet a reduced set of EIDS criteria,
  - ☺ Fuse compositions have to be placed behind two safety barriers,
  - ↳*Real and justified improvement taking into account to risk analysis*
  - 😐 Introduction of AOP39 Response descriptors,
  - 😐 Move from Type IV to Type V response to Bullet Impact,
  - ☹ Introduction of Fragment Impact (18.6g @ 2530m/s) with Type V response,
  - ↳*Does last criteria representative, realistic, achievable and coherent? (i.e. for rocket motors or large munitions)*
  - ↳*SSD 1.2.3 doesn't consider the fragment impact!*

Proposed Amendments to UN HD 1.6 Criteria

- Does Fragment Impact (18.6g @ 2530m/s) representative and realistic?
  - 18.6g fragment correspond to large bombs MKxx but fragments velocity doesn't overpass 1800m/s,
  - 2530m/s fragment are generated by air-to-air missile but fragments mass doesn't overpass 4g,
  - None in-service gun is able to deliver such projectiles,
  - ↳Only EFP or IED are able to generate such attacks with significant surrounding effects in same time,
  - ↳STANAG 4496 offers two fragment velocities (2530m/s and 1830m/s), is it necessary to fix the maximum speed for UN Orange Book ?
  - ↳Why stricter criteria for transport than for storage ?

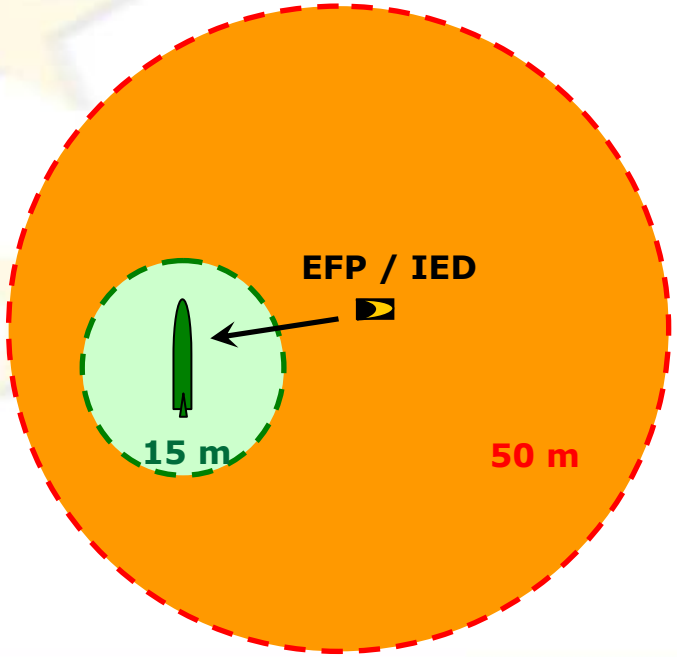
Proposed Amendments to UN HD 1.6 Criteria

- Does Fragment Impact Type V response achievable and coherent?

↳ EFP / IED able to propel specified fragment generate significant surrounding effects : blast overpressures & primary fragments,

↳ i.e. 1kg explosive charge with 2mm thick case outcomes injuries up to 50m,

↳ Type V response is mandatory : none dangerous effects beyond 15m!



- Maximum response for Sympathetic Reaction or Shaped Charge Jet is Type III

↳ Why Type V response is mandatory for Fragment Impact?

↳ Why Type III response in not allowed?

Proposed Amendments to UN HD 1.6 Criteria

- Remind on Type V response definition:

– … "no item travels beyond 15m with energy higher than 20J based on the distance/ mass relationship used for HC" …

– Steel barrel filled with water subjected to fuel fire test has exhibited a response consistent with :

  ↳Type IV reaction failing to be IM or HD 1.6 article,

  ↳HC 1.2 according to UN Orange Book (Test 6c).

Steel barrel movie

IM Benefits during Manufacturing Processes

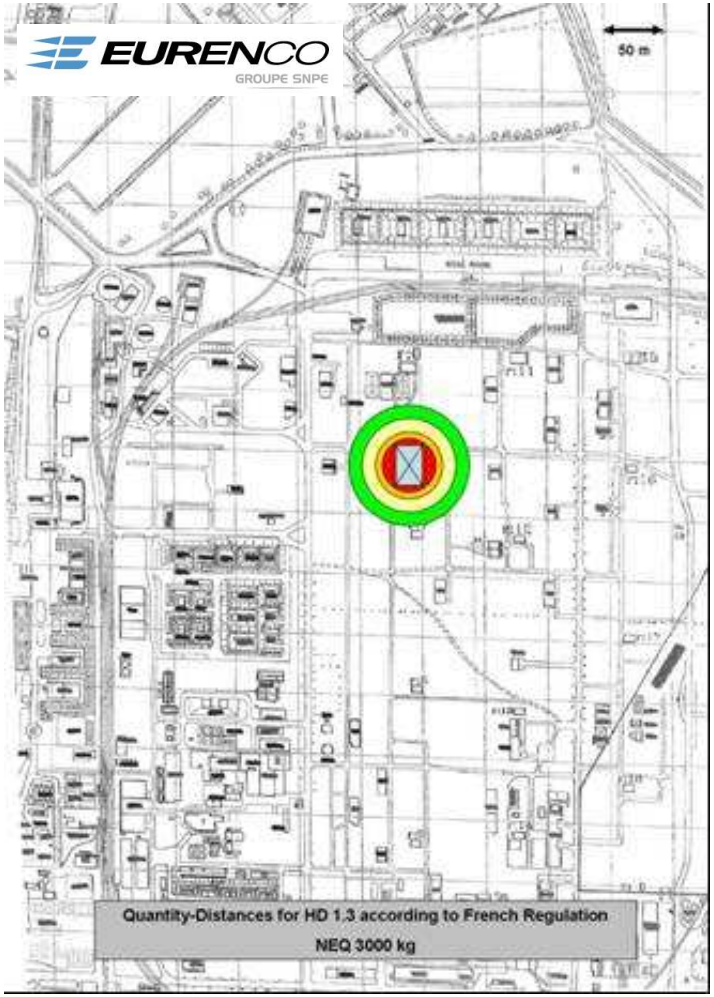
- However, even with existing regulation, explosives manufacturing industry can benefit from the use of safer explosive compositions in every day operations.
- Reduction of regulation constraints can be achieved through the reduction/elimination of accidental detonation risks.

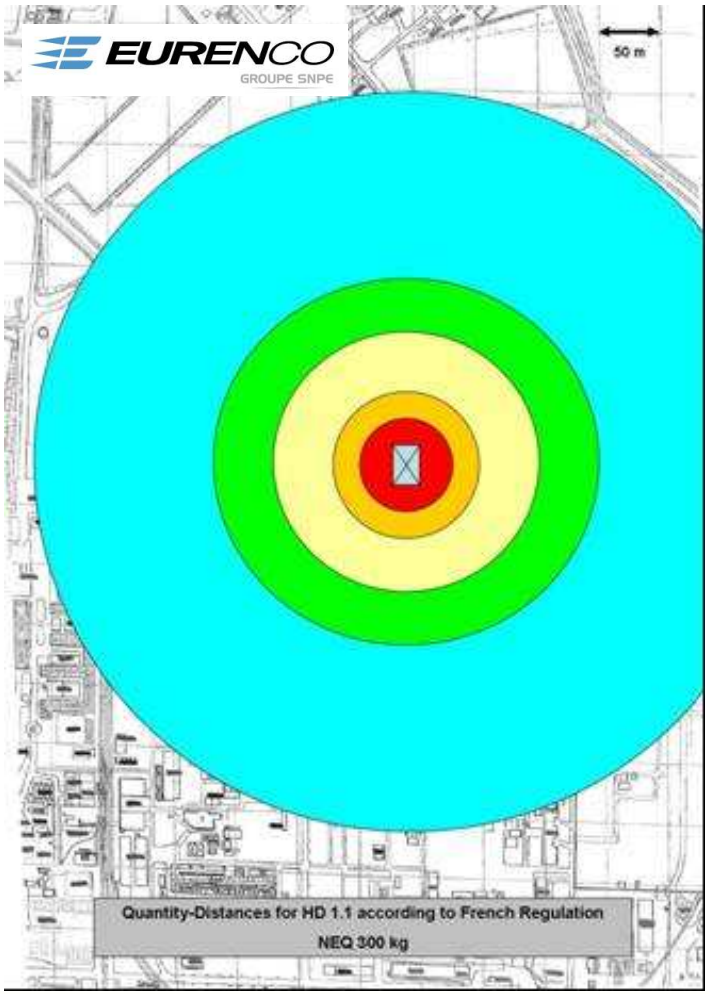
➥ Thus the accidental event effects are limited to thermal flux.

➥ Best Practices share would be profitable for IM community and to achieve realistic IM Hazard Assessment.

IM Benefits during Manufacturing Processes

EURENCO's Sorgues Plant example: Mortar, Artillery, tank IM Shell Workshop





"For 10 times less of Net Quantity Explosives, Quantity-Distances are 6 times larger for detonation risk"

This classification has allowed the workshop to be constructed whilst maintaining the required quantity distance arcs.

In addition it has achieved significant savings in the capital expenditure required for the construction of the new installation.

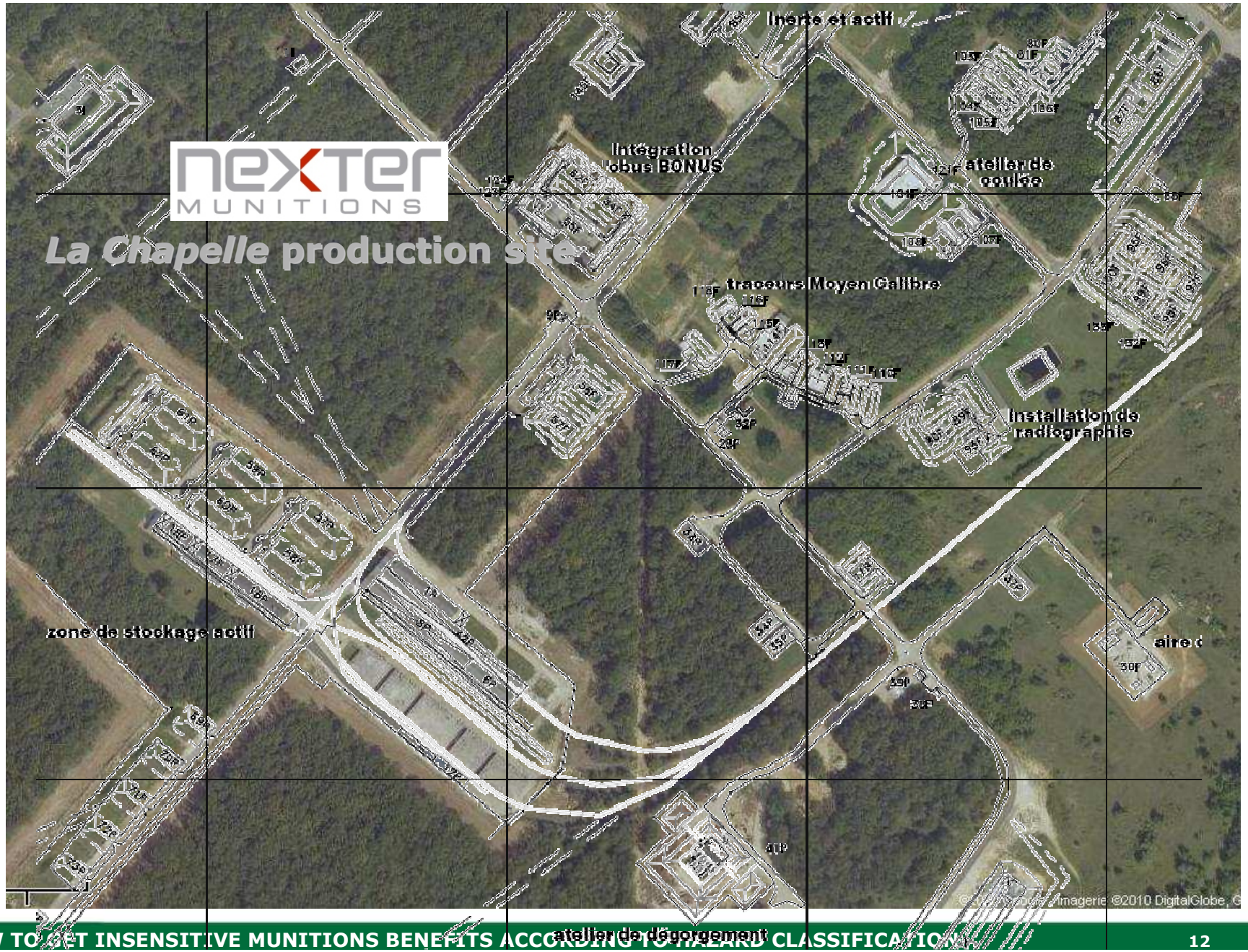
IM Benefits during Manufacturing Processes

NEXTER's La Chapelle Plant example: Industrial fluxes for the manufacturing process for 155mm HE artillery shells.

- Conventional HD 1.1 versus IM HD 1.2 unit risk (similar to SSD 1.2.3)

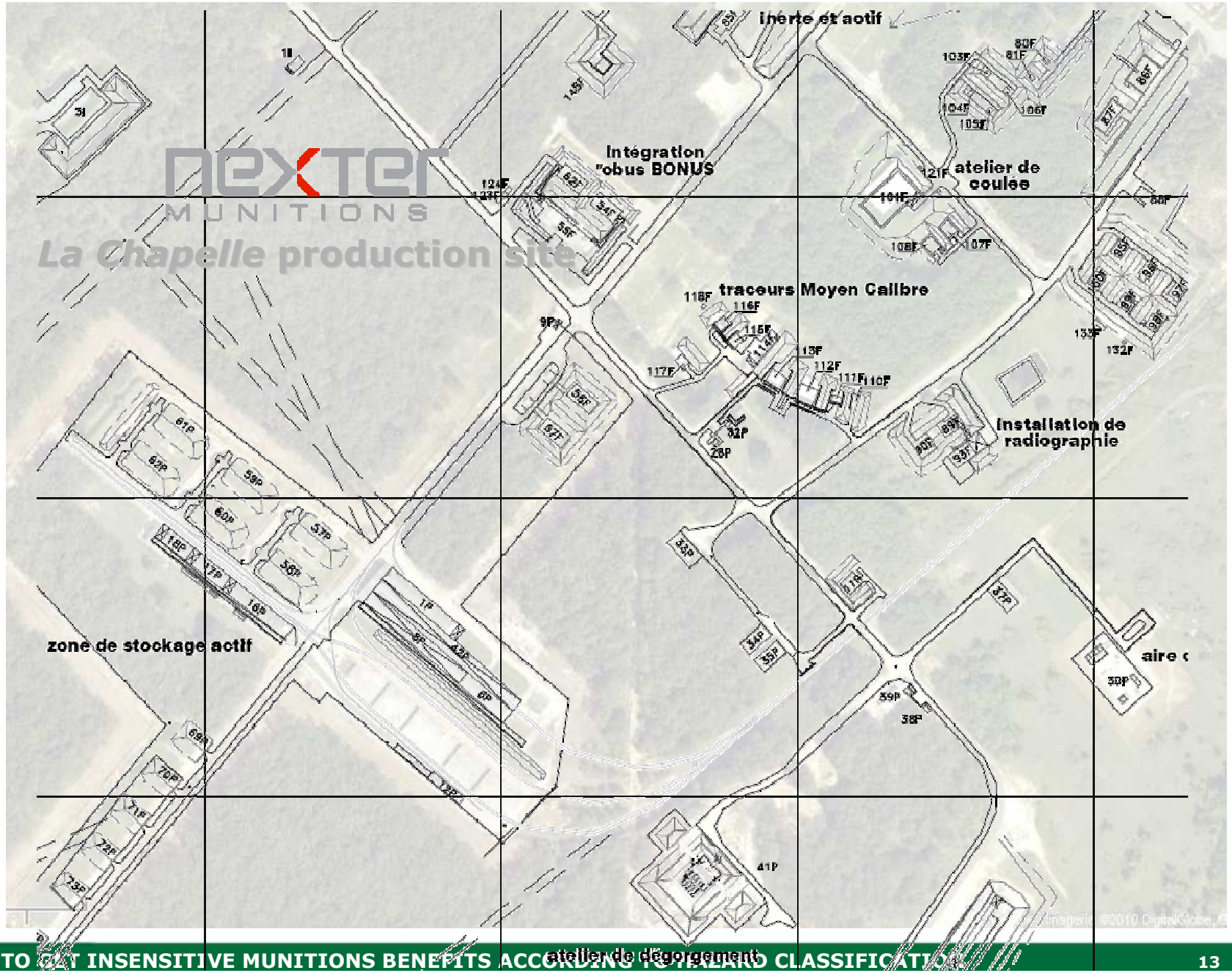
- Concepts:
  - 1.2 unit risk => blast hazard areas reduced (to sole item) and storage capacity increased,
  - In most cases, no longer NEQ storage limitation, the limitation is only due to the internal volume of existing structures,
  - If all products are IM => No more NEQ constraint for internal transportation.

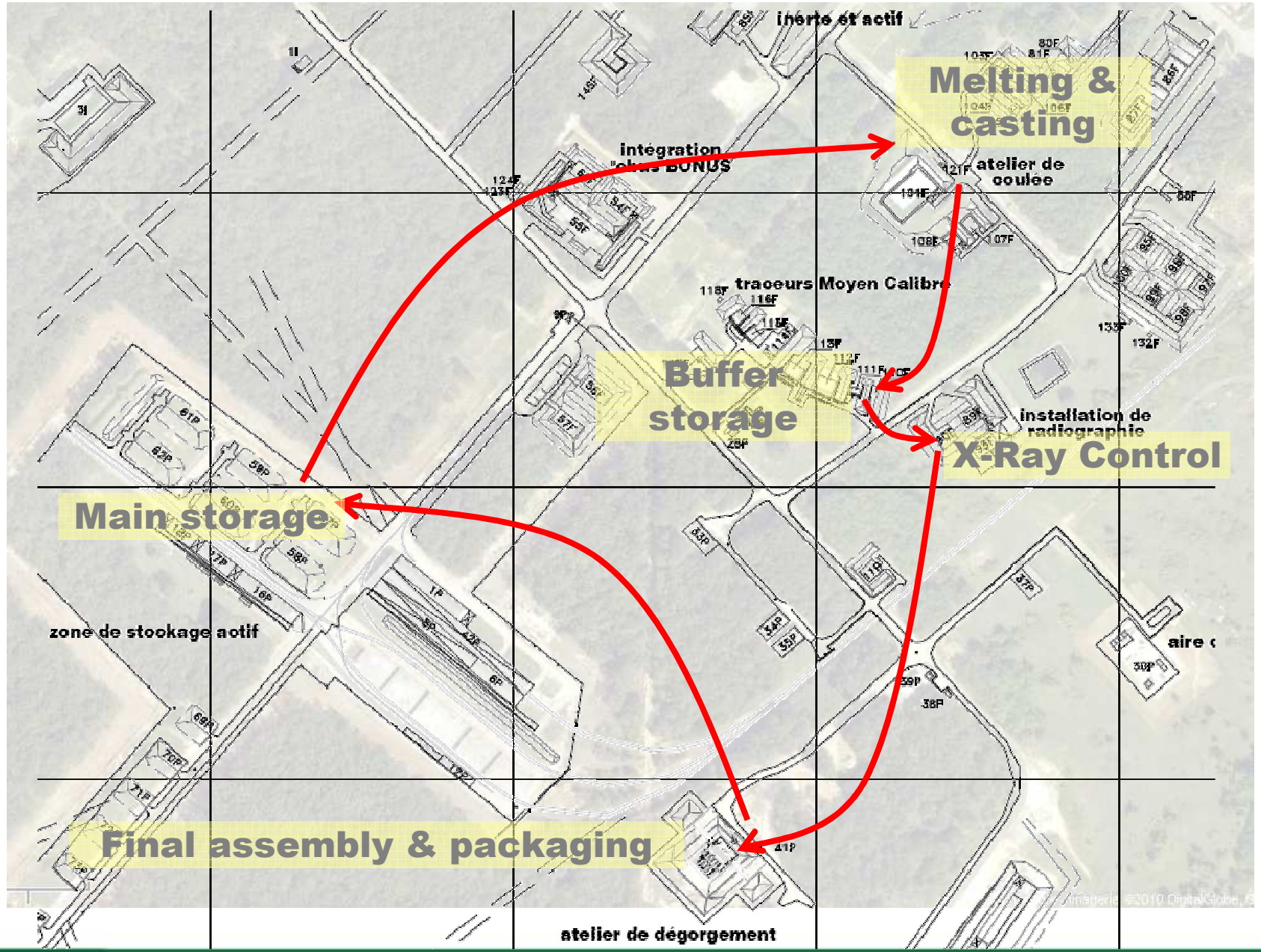
IMEMG MURAT
EUROPEAN MANUFACTURERS GROUP

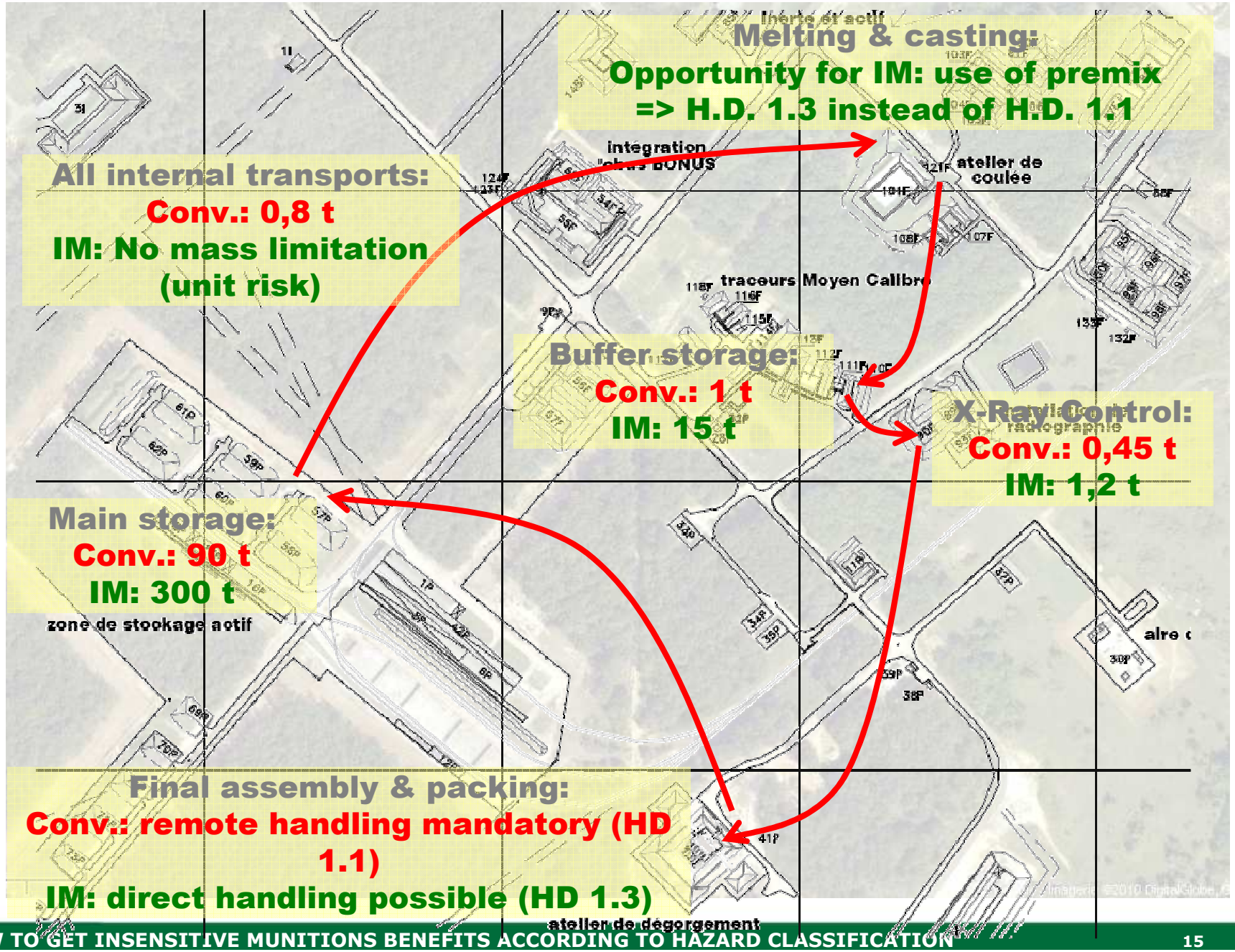


nexter MUNITIONS

La Chapelle production site




inerte et actif
Melting & casting
intégration
atelier de coulée
traceurs Moyen Calibre
Buffer storage
installation de radiographie
X-Ray Control
Main storage
zone de stockage actif
Final assembly & packaging
atelier de dégorgement


Melting & casting:
Opportunity for IM: use of premix
=> H.D. 1.3 instead of H.D. 1.1
All internal transports:
Conv.: 0,8 t
IM: No mass limitation
(unit risk)
Buffer storage:
Conv.: 1 t
IM: 15 t
X-Ray Control:
Conv.: 0,45 t
IM: 1,2 t
Main storage:
Conv.: 90 t
IM: 300 t
Final assembly & packing:
Conv.: remote handling mandatory (HD 1.1)
IM: direct handling possible (HD 1.3)
integration
atelier de coulee
traceurs Moyen Calibre
zone de stockage actif
atelier de dégorgement

Another Way to get IM Benefit ?

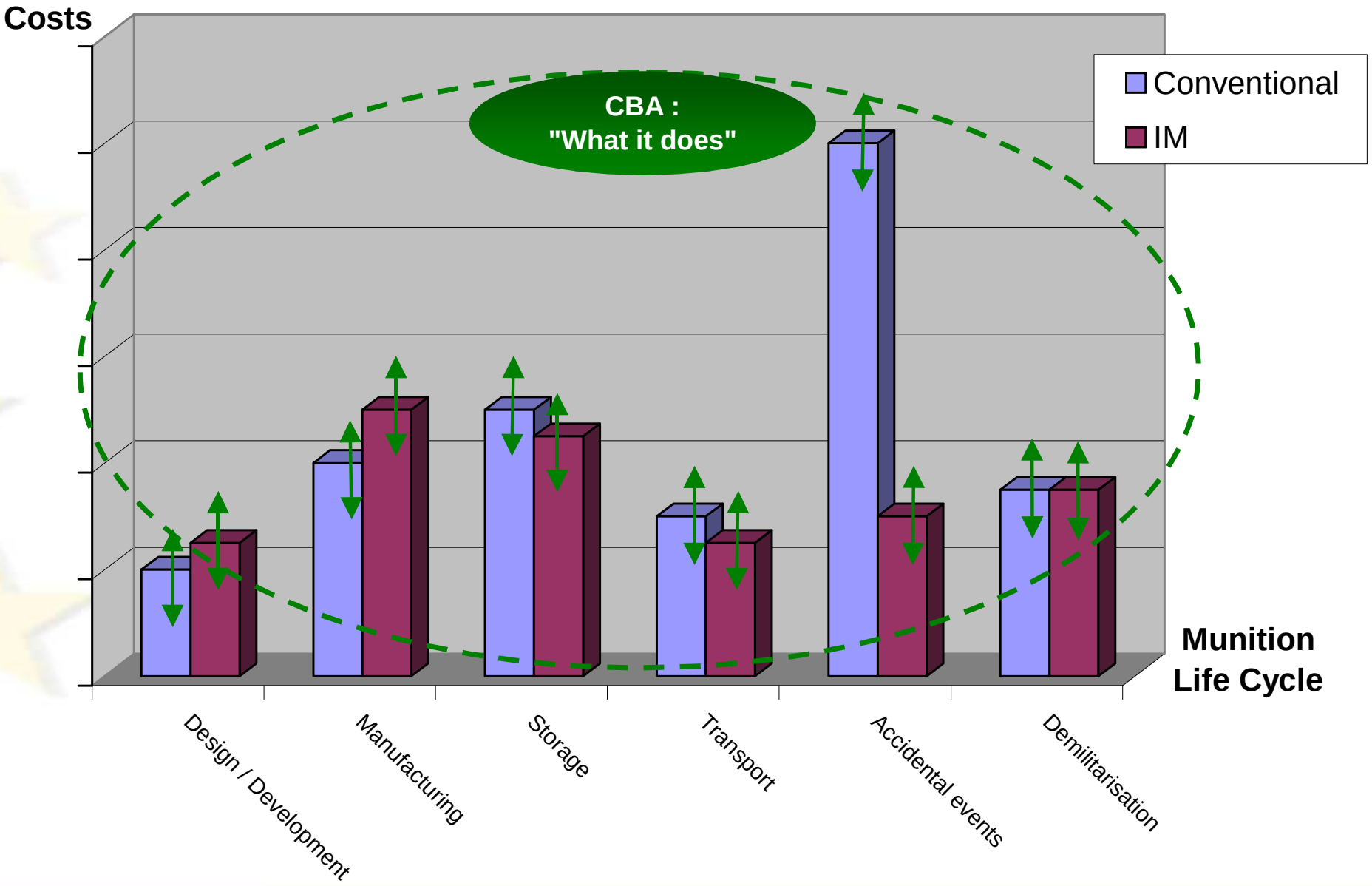
- Cost and Benefit Analysis
  - Industries and users interest
  - To improve their analyses for IM implementation
- Few typical questions raised by Cost and Benefit Analysis (CBA)
  - What for ?
  - Where are we ?
- CBA needs calculations
  - Basic principles
  - What is calculated and how ?
- CBA needs IM level specification

C&B ANALYSIS: WHAT FOR ? (1/2)

- CBA: to figure out the benefit acquired from IM

- Evaluate different technical solutions that are
  - Available
  - Feasible/achievable

  => What is the most cost effective way to introduce IM ?


Costs
CBA :
"What it does"
Conventional
IM
Munition
Life Cycle
Design / Development
Manufacturing
Storage
Transport
Accidental events
Demilitarisation

C&B ANALYSIS: WHAT FOR ? (2/2)

- Establish the cost of ownership according to a specified IM level :
  - Additional costs
  - Financial savings
- IM insertion benefits considered
  - Reduction of the risks,
  - Extended/increased platform survivability,
  - Improve of safety.
- So, What for ?
  - Make the relation between IM introduction and costs
  - Study the influence of costs' splitting / the important sources of costs introducing IM

Cost and Benefit Analysis

C&B ANALYSIS: WHERE ARE WE ? (1/4)

- Recent interests:
  - UK (IMIP): Operational costs ?
  - France: IM signature Determination (IMEMTS 2006)
  - 1st European IM Day event (IMEMG 2009): costs consideration in the presentations
- CBA tools developed and available:
  - 2 main tools : CBAM (MSIAC) and ACB (IMEMG)
  - Based on NIMIC methodology (F. Möller)
- Generally, the models are capable of:
  - calculating the costs over a life cycle
  - establishing cost difference regarding the specified life profile of a product
  - give an explanation of the costs
  - help identifying the contribution of costs
  - compare non-IM with IM, IM versus less-IM

C&B ANALYSIS: WHERE ARE WE ? (2/4)

- ACB tool (IMEMG): Data entries? What goes in ?
  - A common and idealised life cycle for the products
  - A projected cost of ownership for each product
    - » Examples: number of munitions, disposal costs, …
  - Important amount of data needed
- Modelling part and main outputs from ACB:
  - Statistical relations between the outputs:
    - » Identification of the most significant data in the analysis
    - » Data which are important to refine
  - Monte-Carlo simulations

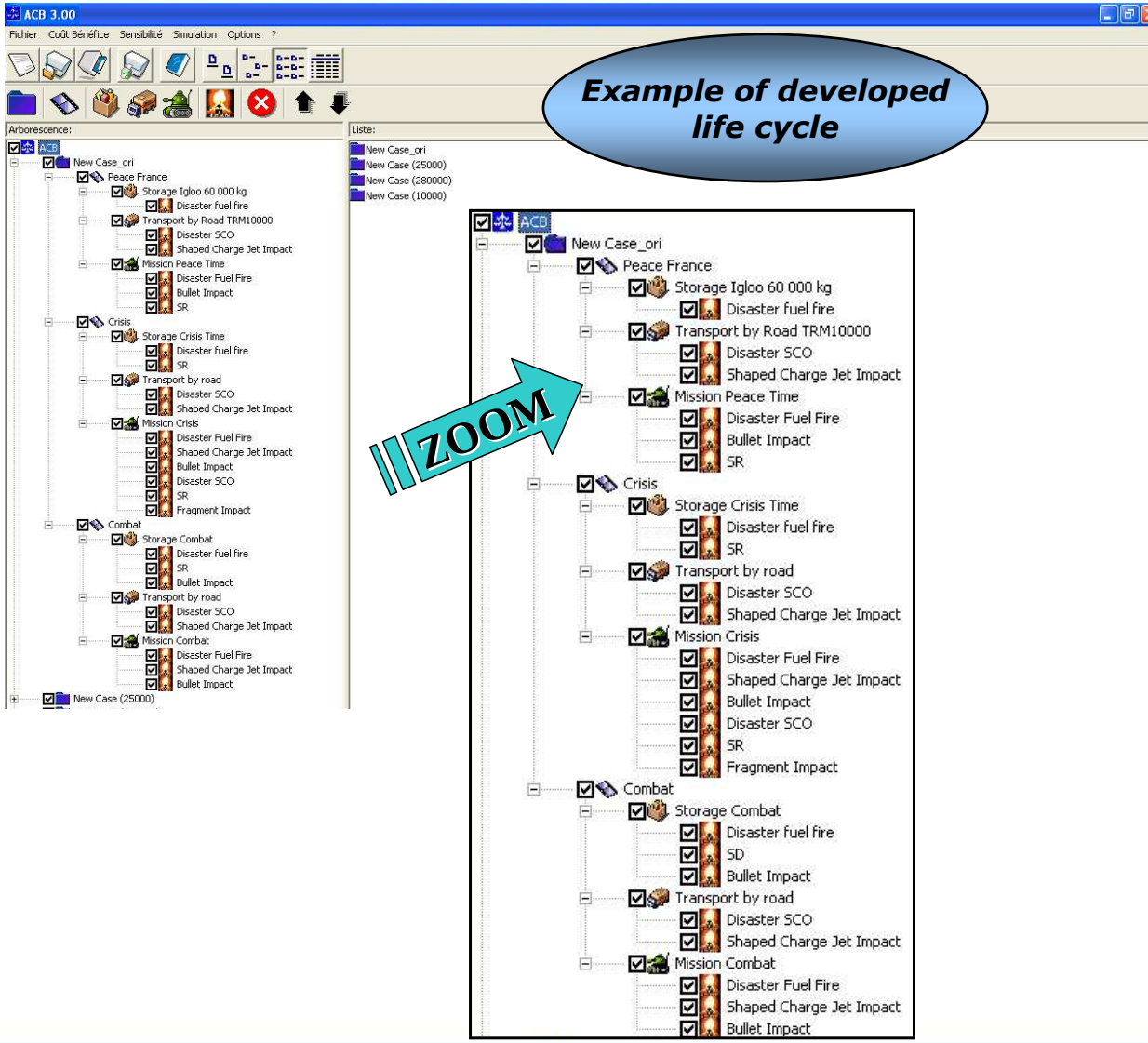
Cost and Benefit Analysis

C&B ANALYSIS: WHERE ARE WE ? (3/4)

- CB: Cost Benefit

$$CB = RP + PP - DAC$$

- Costs Contributors
  - RP: Regulatory profits (storage and transport),
  - PP: Potentiel Profits (damages in case of accident),
  - DAC: Difference in Acquisition Costs
- Case Description
  - Sequence
    - » Peace, Crisis, Combat
  - Elementary Situation
    - » Storage, Transport, Operational phase
  - Threat



Cost and Benefit Analysis

C&B ANALYSIS: WHERE ARE WE ? (4/4)

- Examples: 155 mm artillery shell and missile cases discussed
- Previous cases (non-IM => IM) studied without storage SSD 1.2.3 advantages taken into account
  - No change of the different hypotheses (accidental events)
  - Modification at only one node: introduction of a reduction cost of storage
  - Missile and 155 mm artillery shell studied
    - » Additional benefits can be found !
- Conclusions
  - Additional benefits cannot be at the same level between Missile / 155 because
    - » costs build-up are different
    - » inventories are not the same

  but they exist
  - Additional benefits found during peacetime storage
  - Most important potential earnings expected during operational phases of the life cycle

Conclusions

- Proposition for harmonisation of HD 1.6 with STANAG 4439 brings real improvement by limiting the EIDS criteria (becoming EIS) to the main charge. *This is a significant step forward!*
- Nevertheless, unrealistic criteria have been introduced with the Fragment Impact (18.6g @ 2530 m/s), and with Type V reaction requirement. This is not consistent when compared with the Sympathetic Reaction where a Type III reaction is required or with SSD1.2.3. *It is feared this criteria eliminates many real IM from UN HD1.6.*
- Some possibilities exist to achieve IM's costs reduction resulting from the reduction of regulatory constraints through the elimination of accidental detonation risks; the accidental effects are limited to low order burning events as defined through QRA. *Examples given in this presentation should be disseminated for best practice sharing.*

Conclusions

- Benefits that may be achieved by the development of specific regulations for IM can be illustrated through CBA applied throughout the life cycle from cradle to grave. *A better understanding of IM safety improvements when preparing future regulations will be profitable to all.*
- Another tool that could help in assessing and specifying an IM signature: to find a compromise between costs and IM introduction

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