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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Context

- IMEMG is the European Organisation assembling leading armament groups working with Insensitive Munitions 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.

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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 amendment for harmonisation of HD 1.6 criteria with STANAG 4439 requirements has been approved recently. *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.*

Amendment to UN HD 1.6 Criteria

- Real Insensitive Munitions 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*

  >>> it has been approved by UN Committee of Experts on 10 December 2010 :

  - *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*

United Nations ST/SG/AC.10/38/Add.2

Secretariat

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Committee of Experts on the Transport of Dangerous Goods and on the Globally Harmonized System of Classification and Labelling of Chemicals

Report of the Committee of Experts on the Transport of Dangerous Goods and on the Globally Harmonized System of Classification and Labelling of Chemicals on its fifth session

Held in Geneva on 10 December 2010

Addendum

Annex II

Amendments to the fifth revised edition of the Recommendations on the Transport of Dangerous Goods, Manual of Tests and Criteria (ST/SG/AC.10/11/Rev.5)

Amendment to UN HD 1.6 Criteria

- Main facts which must be analysed:
  - ☺ 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!*

Amendment to UN HD 1.6 Criteria

- Does Fragment Impact (18.6g @ 2530m/s) representative and realistic?
  - 18.6g fragment correspond to large MKs bombs 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 ?

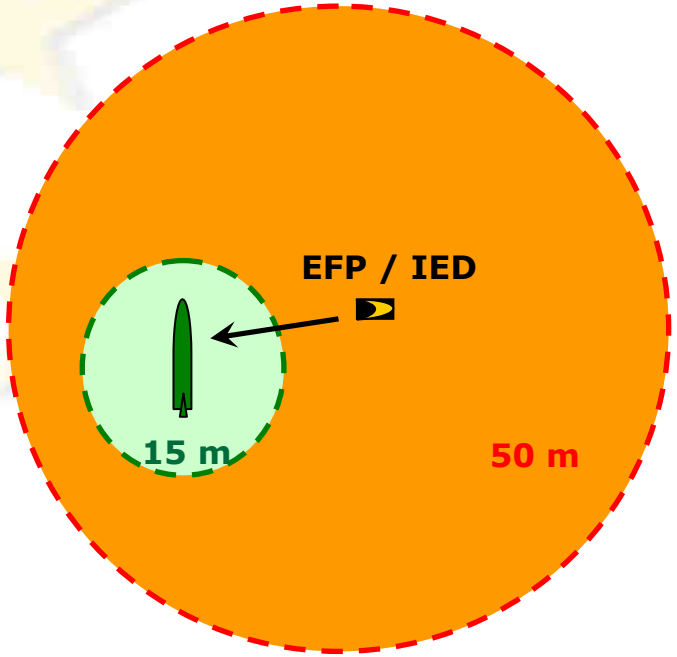
Amendment to UN HD 1.6 Criteria

- 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?

Amendment to UN HD 1.6 Criteria

- Remind on Type V response definition:

– … "no item travels beyond 15m with energy higher than 20 Joules 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

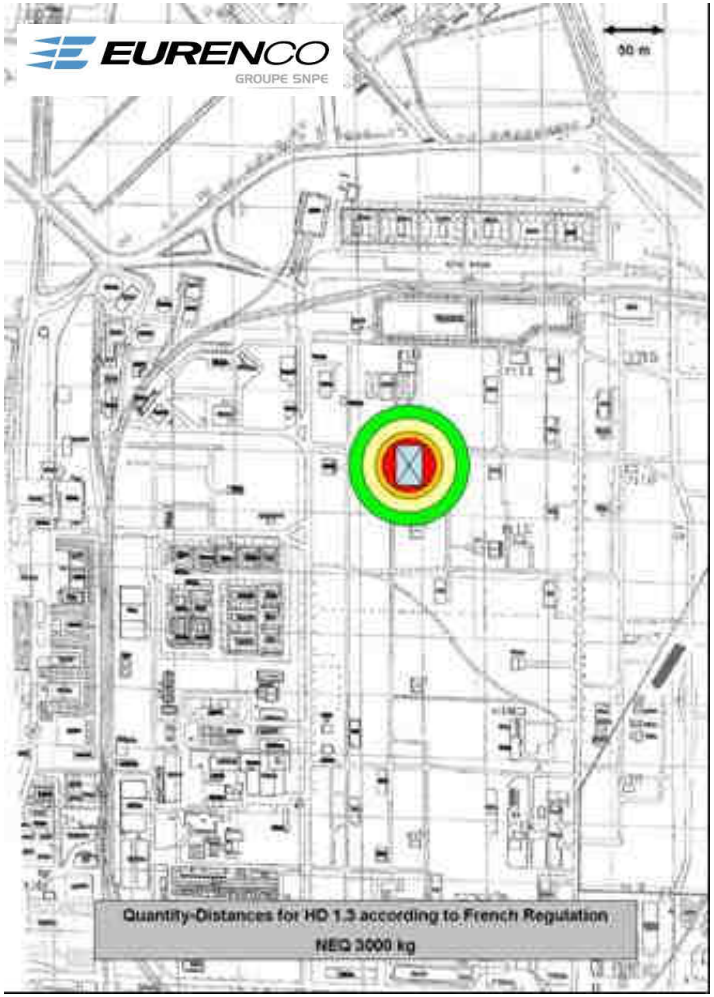
- However, even with existing regulation, explosives manufacturing industry can benefit from the use of safer explosive compositions in every day operations.
- Reduction of regulation constraints can be achieved through the reduction/elimination of accidental detonation risks.

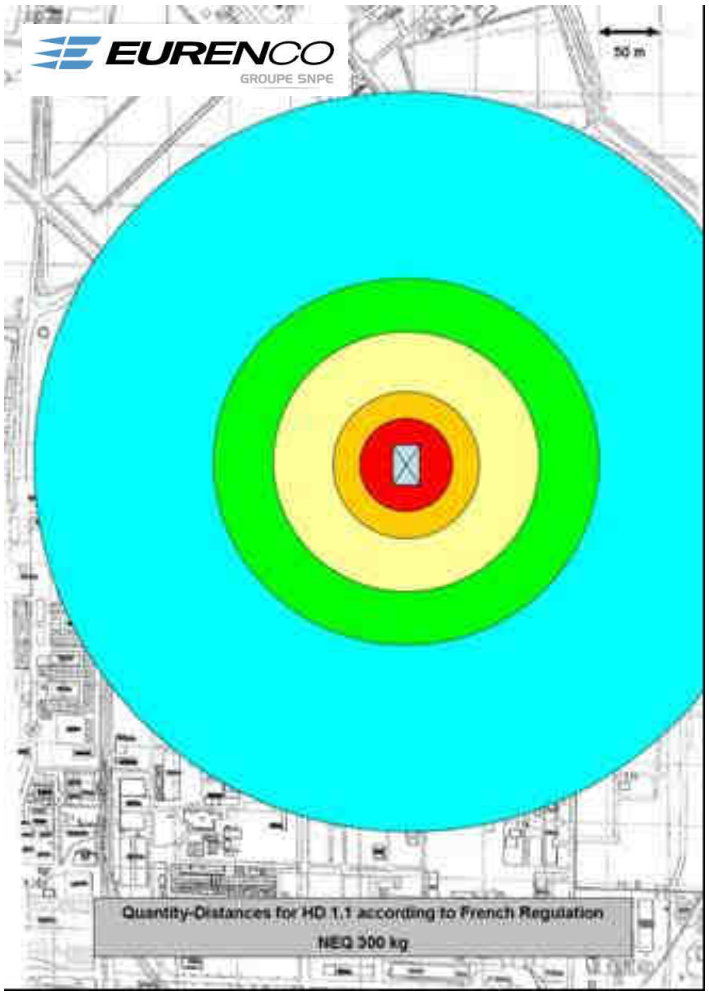
↳ Thus the accidental event effects are limited to thermal flux.

↳ 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.

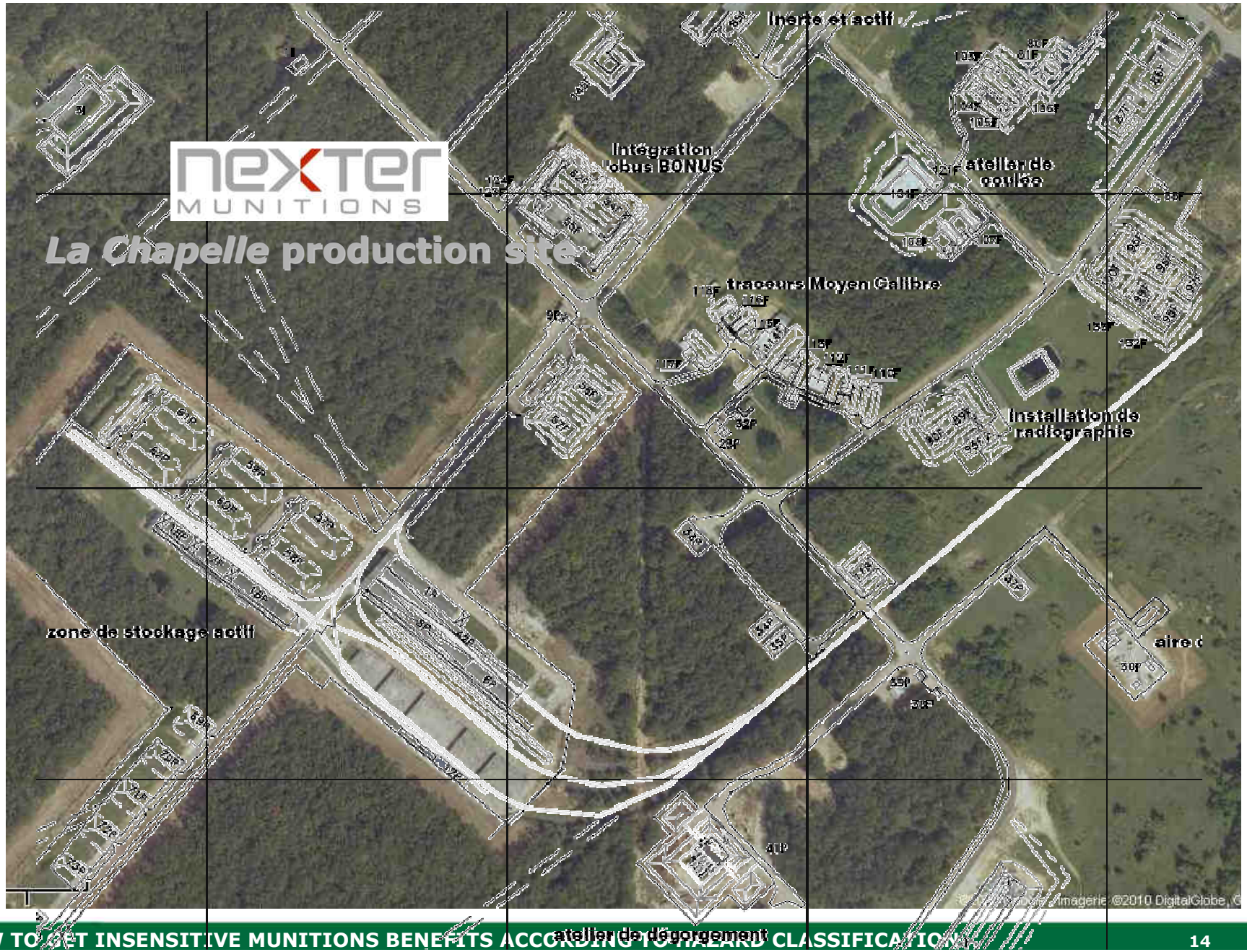
In addition it has achieved significant savings in the capital expenditure required for the construction of the new installation.

IM Benefits during Manufacturing Processes

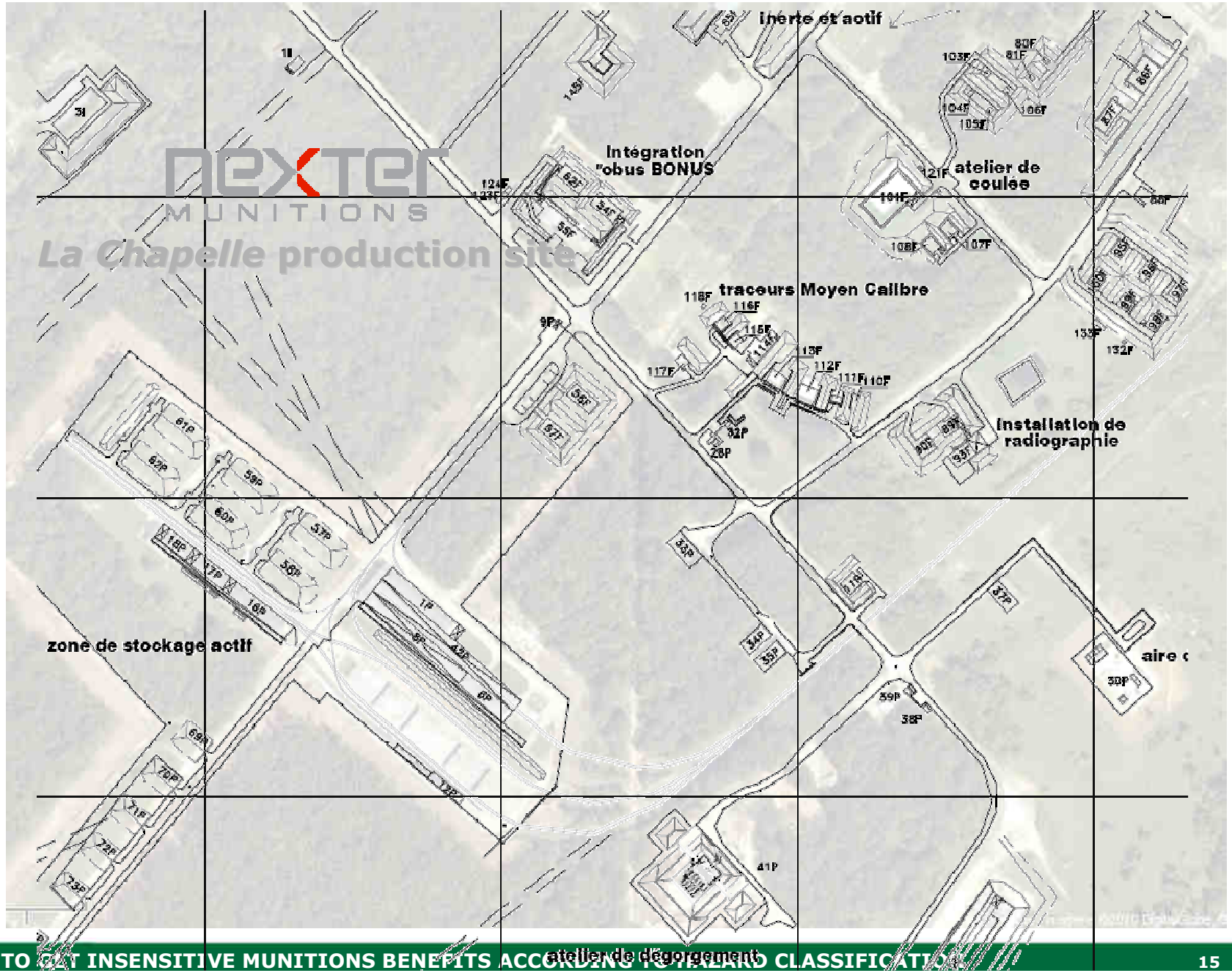
NEXTER's La Chapelle Plant example: Industrial fluxes for the manufacturing process for 155mm HE artillery shells.

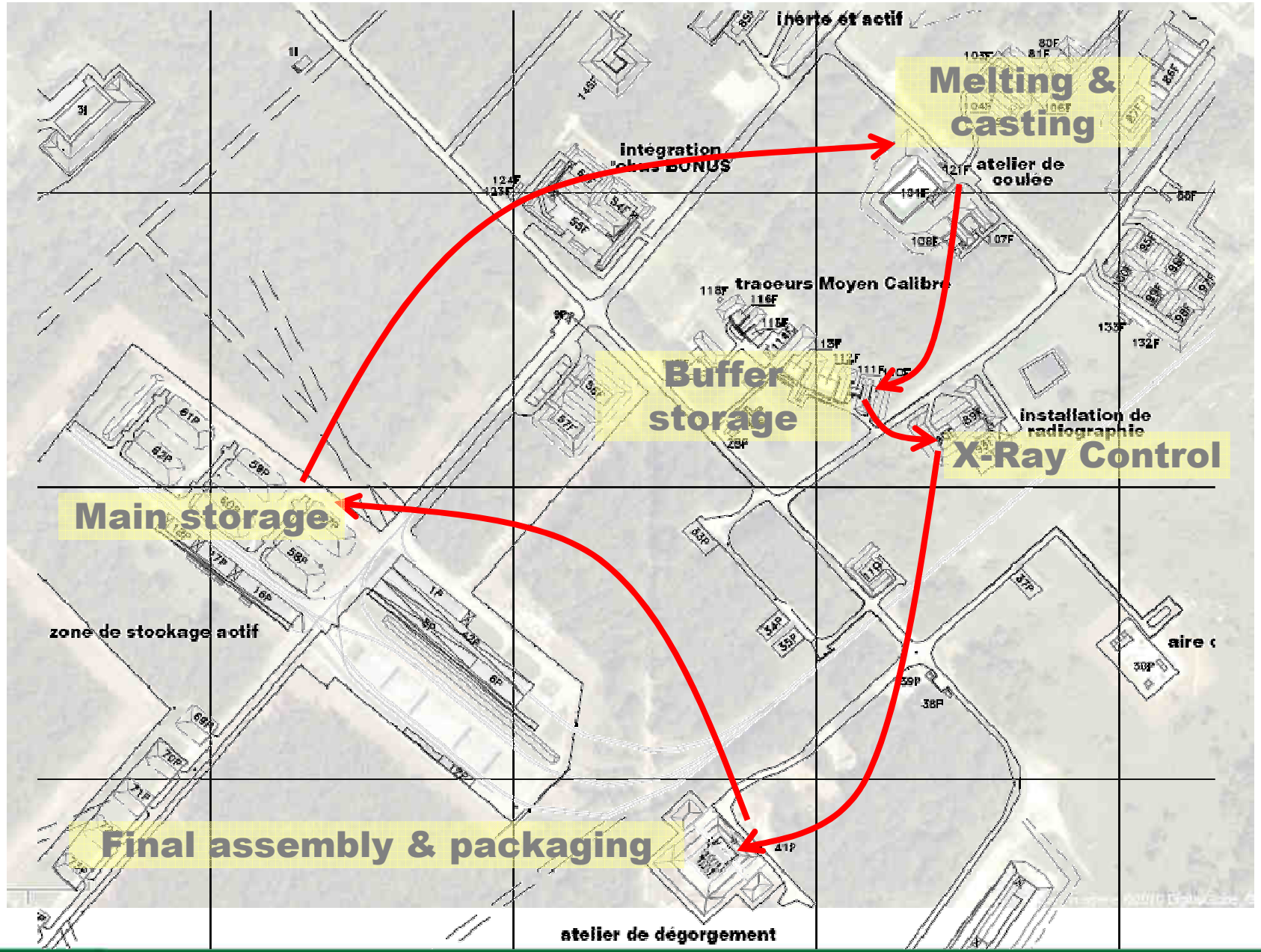
- Conventional HD 1.1 versus IM HD 1.2 unit risk (similar to SSD 1.2.3)

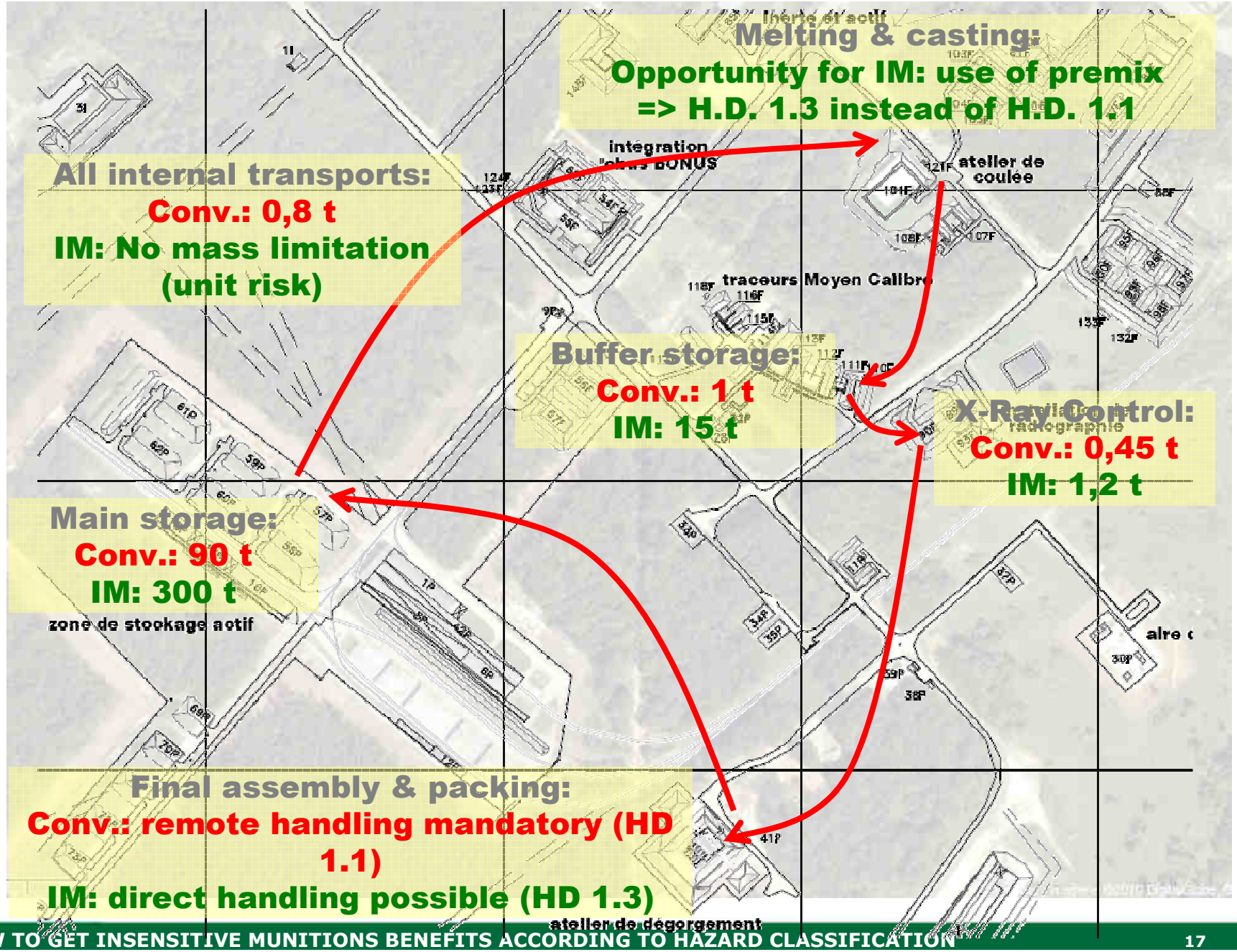
- Concepts:
  - 1.2 unit risk => blast hazard areas reduced (to sole item) and storage capacity increased,
  - In most cases, no longer NEQ storage limitation, the limitation is only due to the internal volume of existing structures,
  - If all products are IM => No more NEQ constraint for internal transportation.



La Chapelle production site

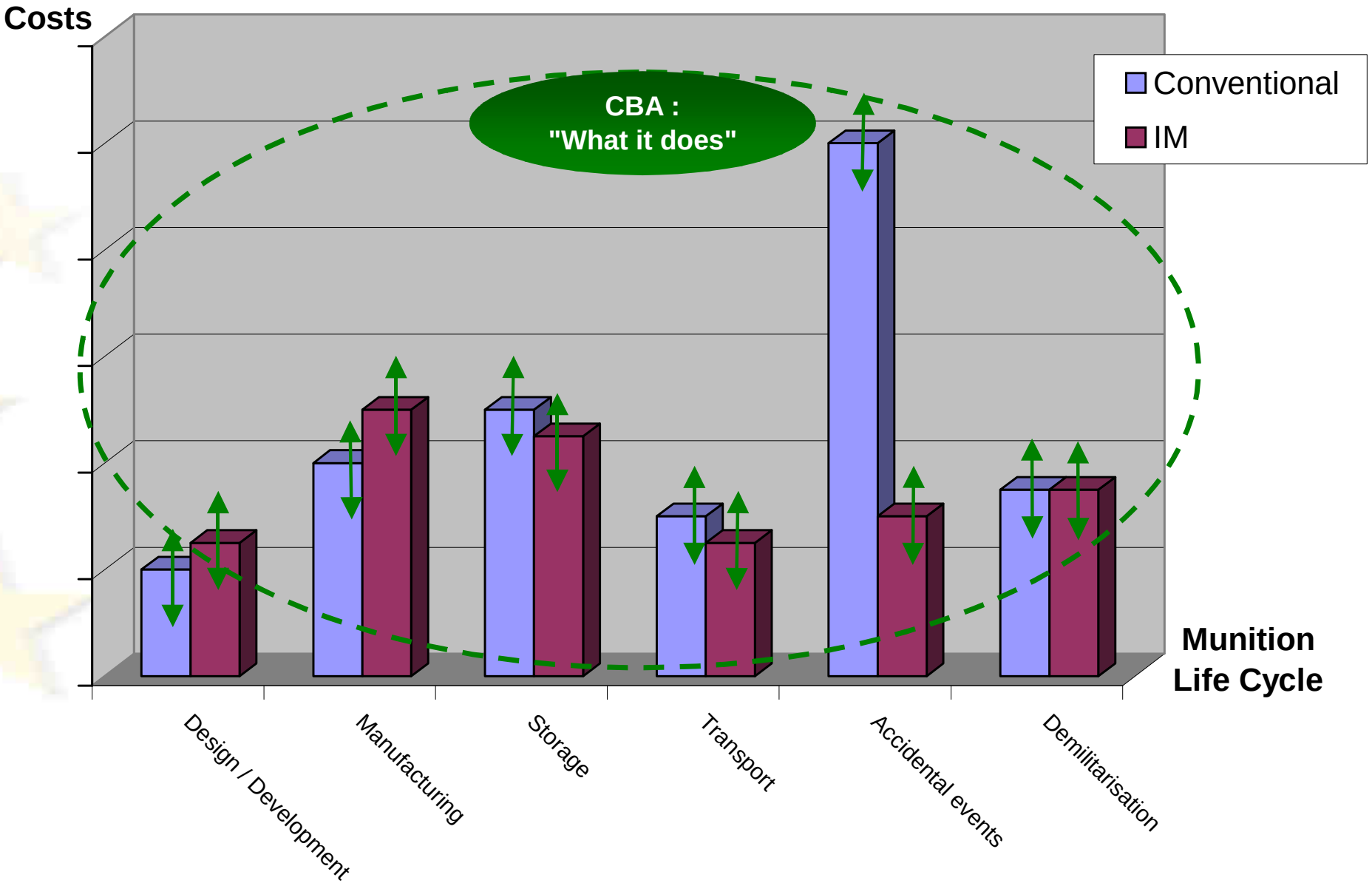



Melting & casting
Buffer storage
X-Ray Control
Main storage
Final assembly & packaging
inerte et actif
intégration
atelier de coulée
traceurs Moyen Calibre
installation de radiographie
zone de stockage actif
atelier de dégorgement


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 coulée
traceurs Moyen Calibre
zone de stockage actif
atelier de dégorgement

Cost and Benefit Analysis

- Industries and users interest to improve their analyses for implementation of IM: Establish the cost of ownership according to a specified IM level
  - Additional costs / Financial savings.
- IM introduction benefits take into account:
  - Improvement of safety & Reduction of accidents costs,
  - Extended/increased platform survivability.
- CBA tools developed and available: CBAM (MSIAC) and ACB (IMEMG):
  - 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 each costs,
    - » comparison of non-IM with IM, IM versus less-IM

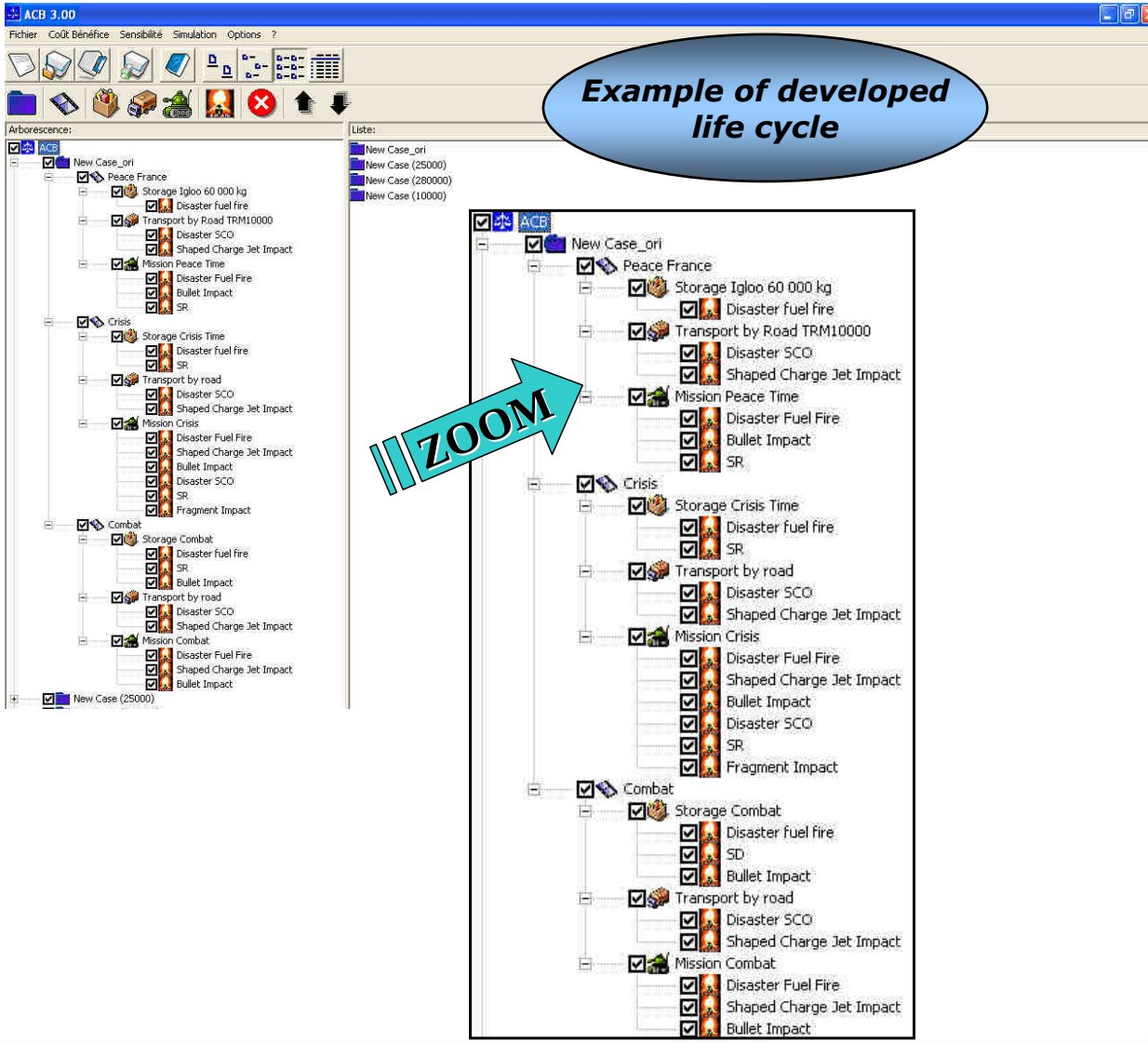

Costs
CBA :
"What it does"
Conventional
IM
Munition
Life Cycle
Design / Development
Manufacturing
Storage
Transport
Accidental events
Demilitarisation

Cost and Benefit Analysis

- CB: Cost Benefit

$$CB = DRP + DPP - DAC$$

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



Conclusions

- Amendment 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.*

Conclusions

- 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.*

- 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.*