

High Explosives Charges for Insensitive Artillery and Mortar Ammunitions

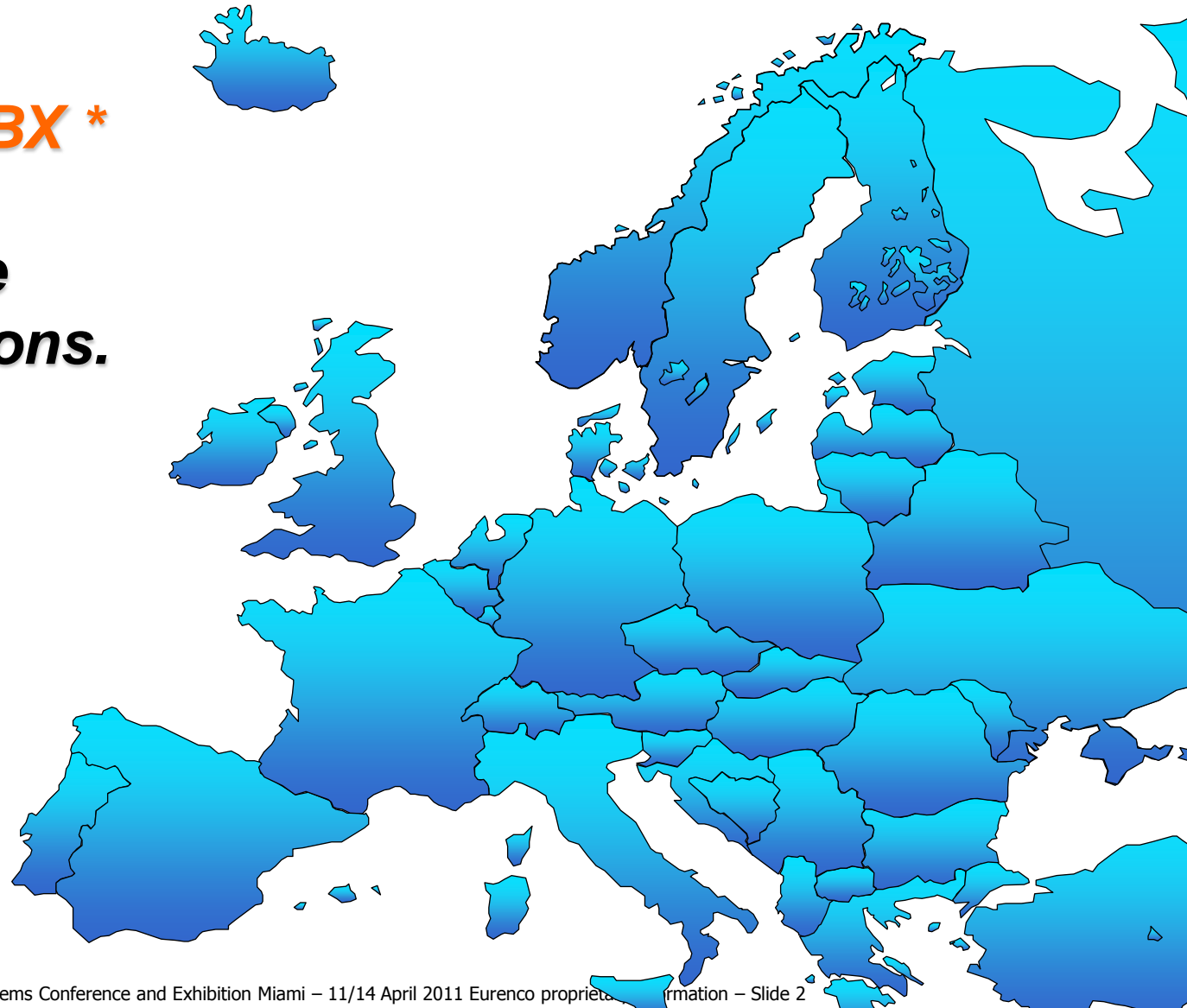
***46th Annual Gun & Missile Systems
Conference and Exhibition
Miami – 29 Aug / 01 Sept 2011***

[Unique Know-How, Multifaceted Range]



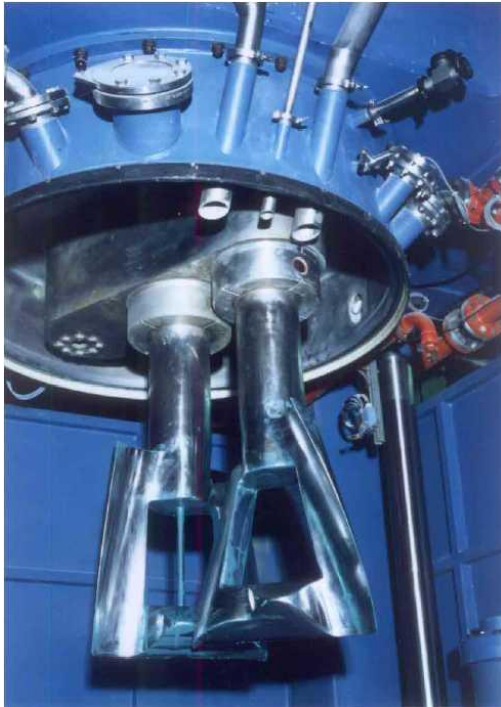


***In Europe, Cast PBX *
is the Most Used
Explosive to make
Insensitive Munitions.***



* **Cast PBX: Cast Plastic Bonded explosive**

- Binder = HTPB (synthetic rubber)
- Energetic Filler = RDX, HMX, NTO...





Sweden: **Nammo** Karlskoga

Norway: **Nammo** Raufoss

UK: BAE Systems GCS

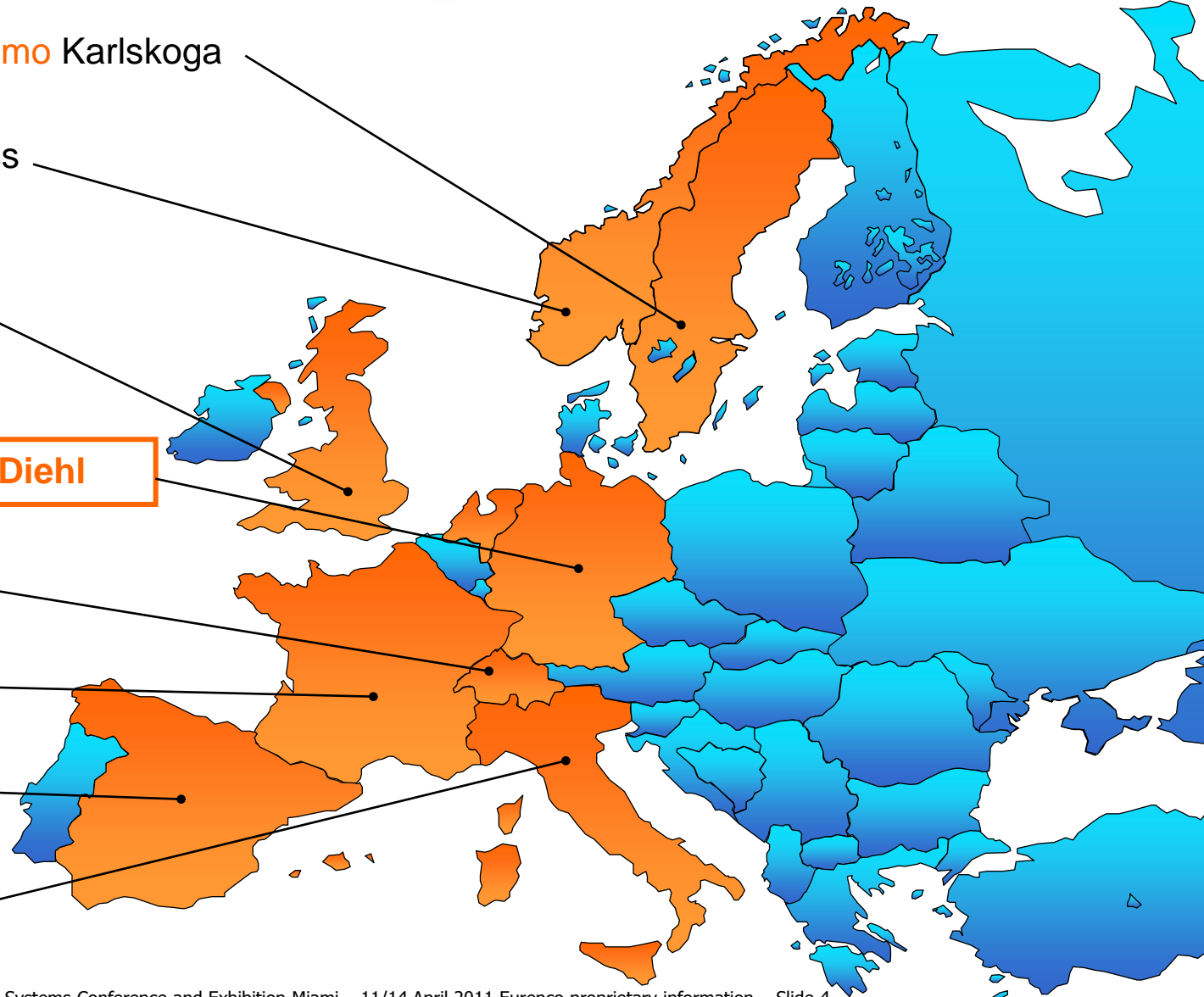
Germany: Rheinmetall, TDW, Diehl

Switzerland: **SBDS**

France: Eurenco

Spain: **Expal**

Italy: OTO, SEI, Simmel

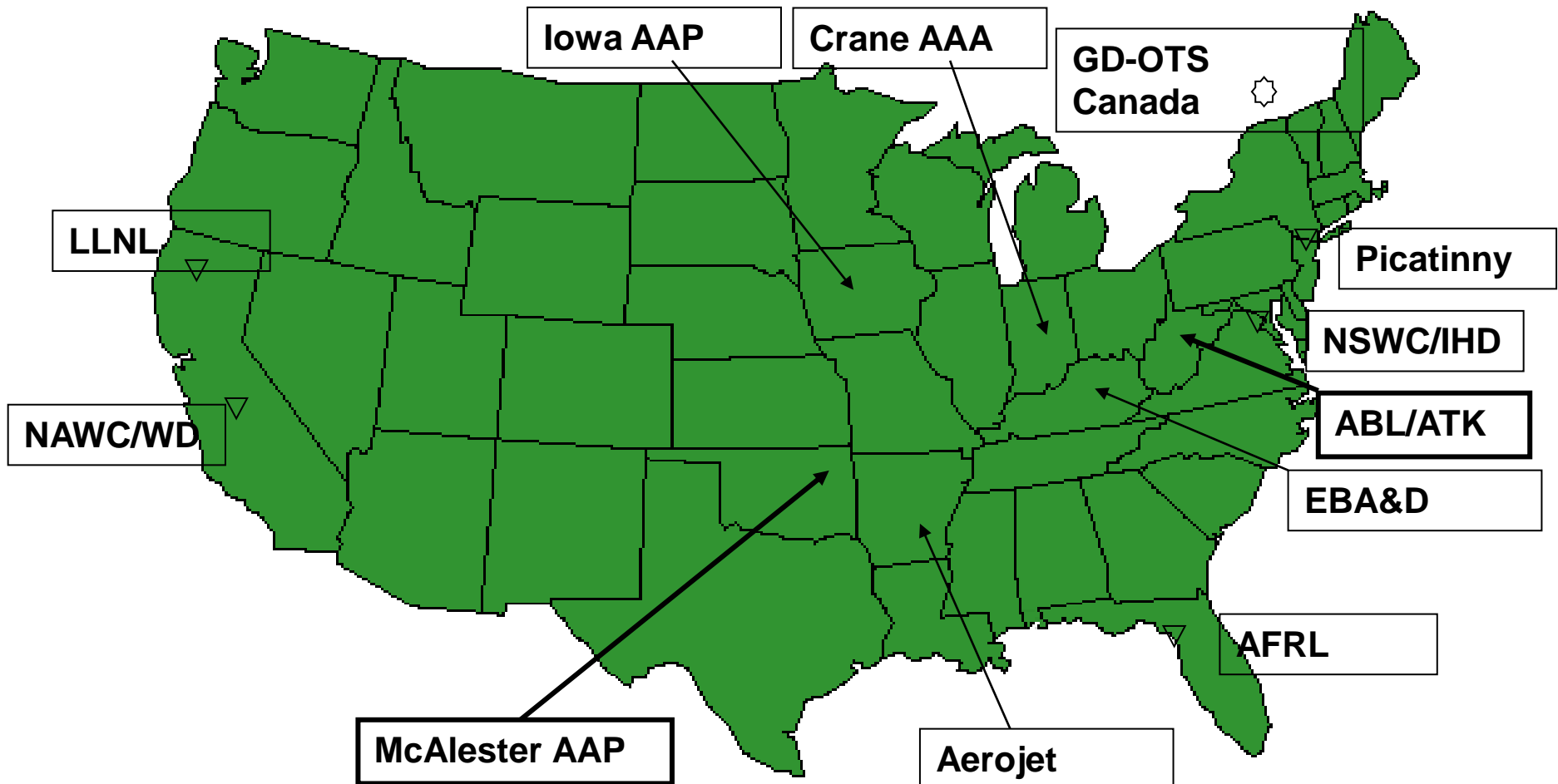


***European Countries using cast PBX in Insensitive
60mm to 155mm Caliber Ammunitions***

- **UK** **81mm, 105mm, 155mm...**
- **GERMANY** **120mm, 155mm**
- **NETHERLANDS** **81mm, 155mm**
- **FRANCE** **76mm, 81mm, 120mm**
- **ITALY** **76mm, 127mm**
- **SWITZERLAND** **60mm, 120mm**



Cast PBX in USA: A well established Technological and Industrial Base





The Most Implemented Insensitive High Explosive



Aircraft Bombs



Anti Ship Missiles



Cruise Missiles



Artillery



Torpedoes



Air-to Air Missiles



Air Defense Missiles



Mortars



Rockets



Sea Mines



Air-to-Ground Missiles



Tanks



***Major Disasters on High Value Combat Platforms
led to find a Mature and Effective IM Solution***



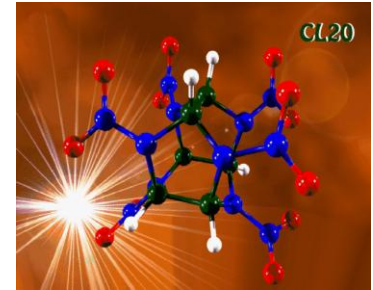
Aircraft Carriers Accidents



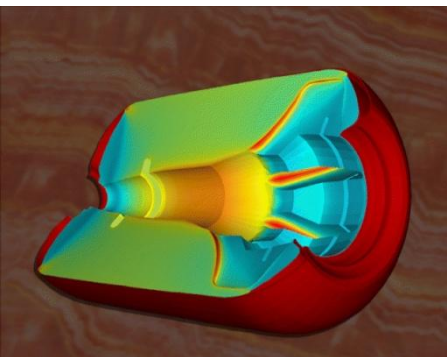
Best Insensitive Explosive for IM Bombs



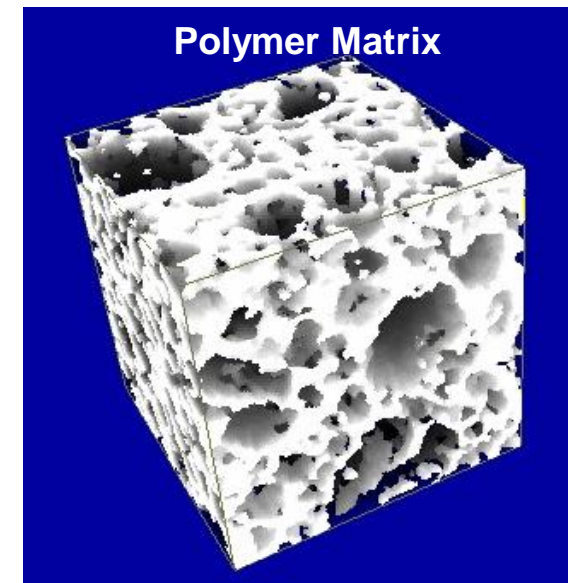
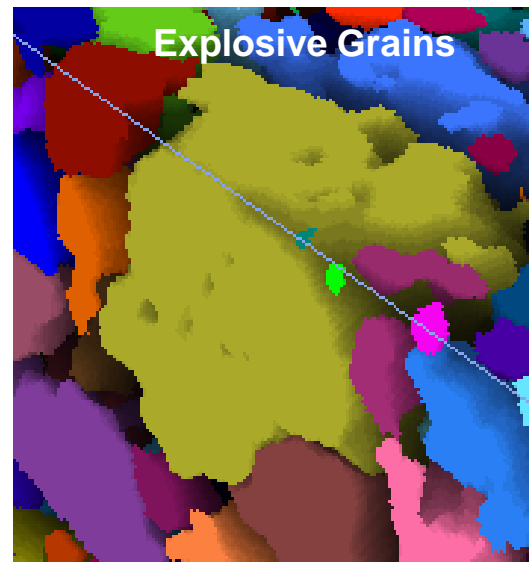
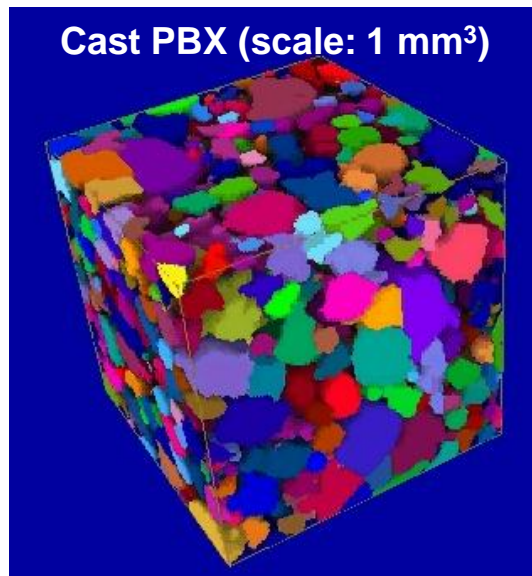
Cast PBX technology is based on a 50 year background shared with Solid Rocket Motor technology.



- **Large Catalogue of Qualified Formulations**
- **Extensive Scientific Knowledge on these formulations (chemical, physical, mechanical properties, ageing...)**
- **Production Processes adapted to various types of applications**



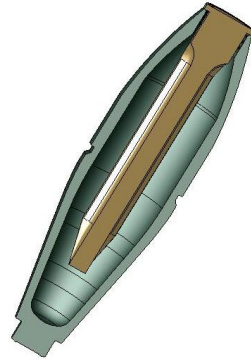
A material with Excellent Intrinsic Properties



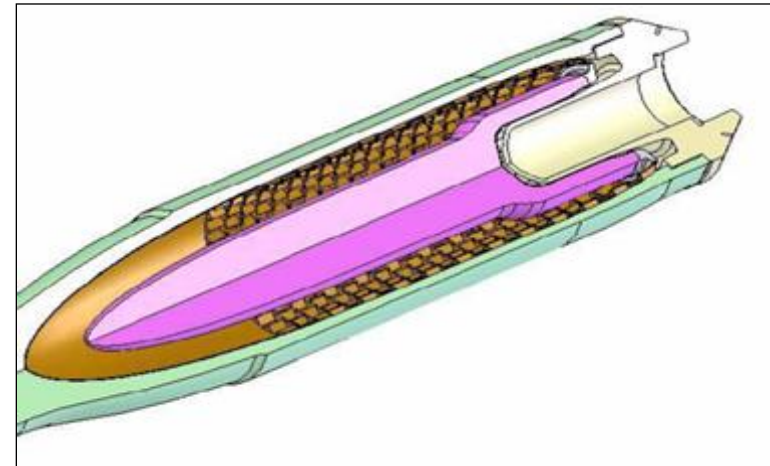
- **Structural Reliability**
(no internal cracks)

- **Homogeneity**
(no micro-voids)

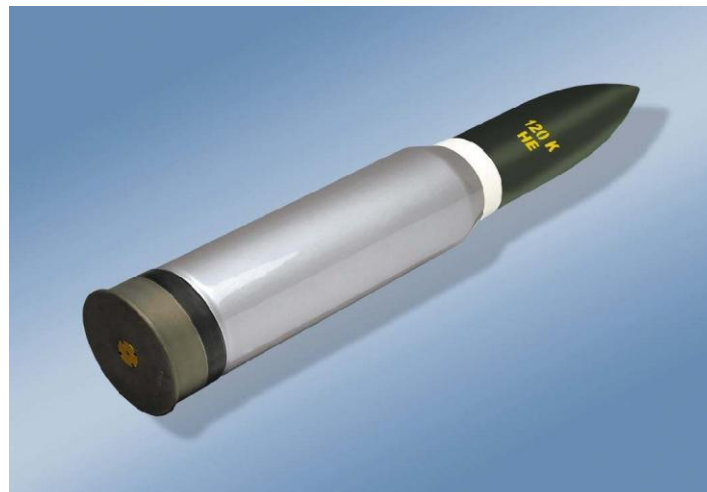
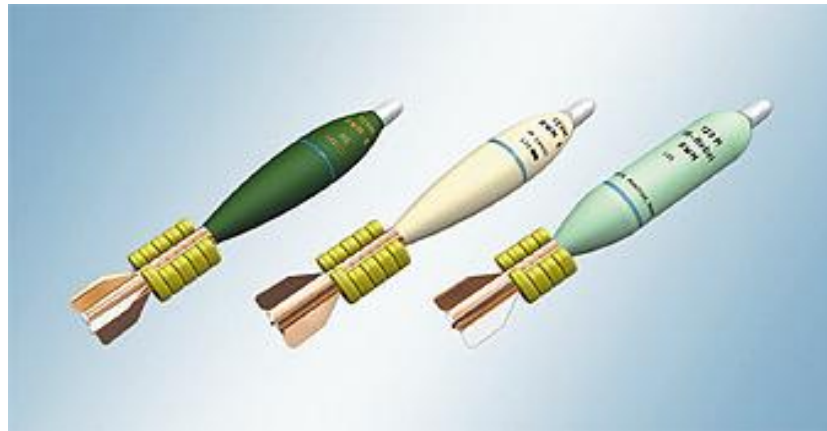
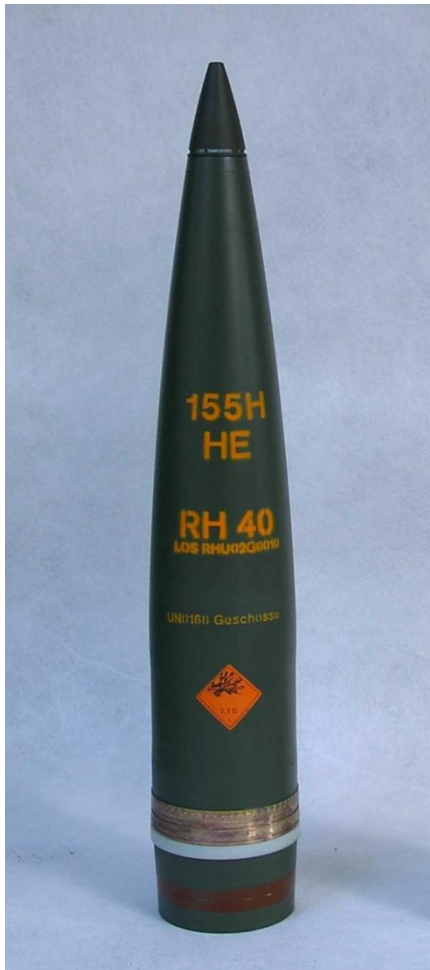
- **Thermal Stability**
(no reverse melting)



- **Affordable product (no high-cost ingredient needed)**
- **Performances comparable to non-IM explosives (Comp-B, TNT/Al...)**
- **Flexibility of design**



How to Produce High Volumes of Cast PBX Shells?



Batch Process is well adapted for Production of Explosive Charges for Bombs, Missile Warheads...



- Step 1: **Mixing** (with cross linking agent)
- Step 2: **Casting** (pot life limited)
- Step 3: **Curing** (several days)

Batch Process is Not Optimized for Production of Shells (60mm, 81mm, 105mm, 120mm, 155mm...)



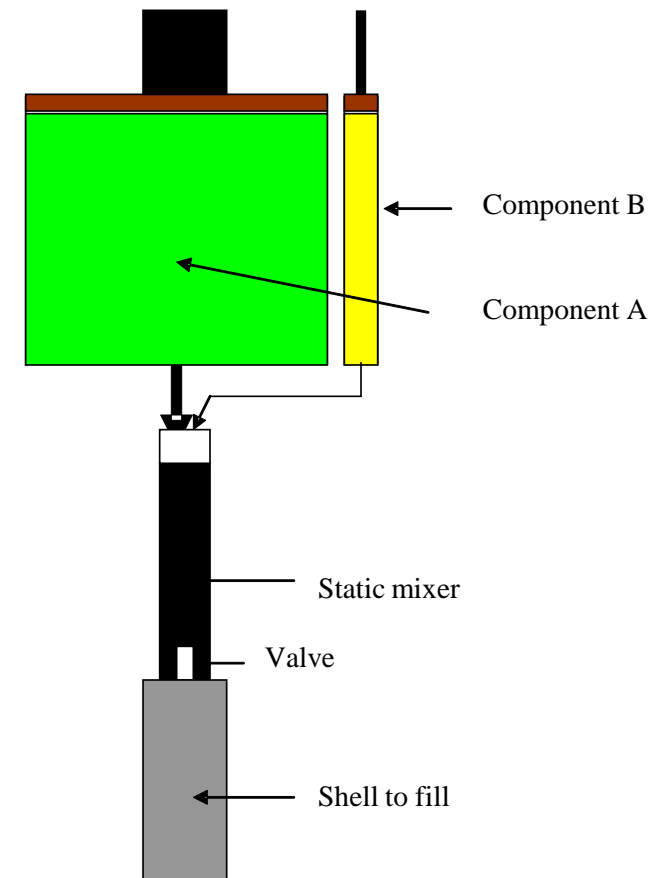
- **Casting time is limited**
(pot life constraint)
- **Curing takes days**
(large oven areas)
- **Large mass of explosive**
in the workshop





The Solution: The Bi-Component Process

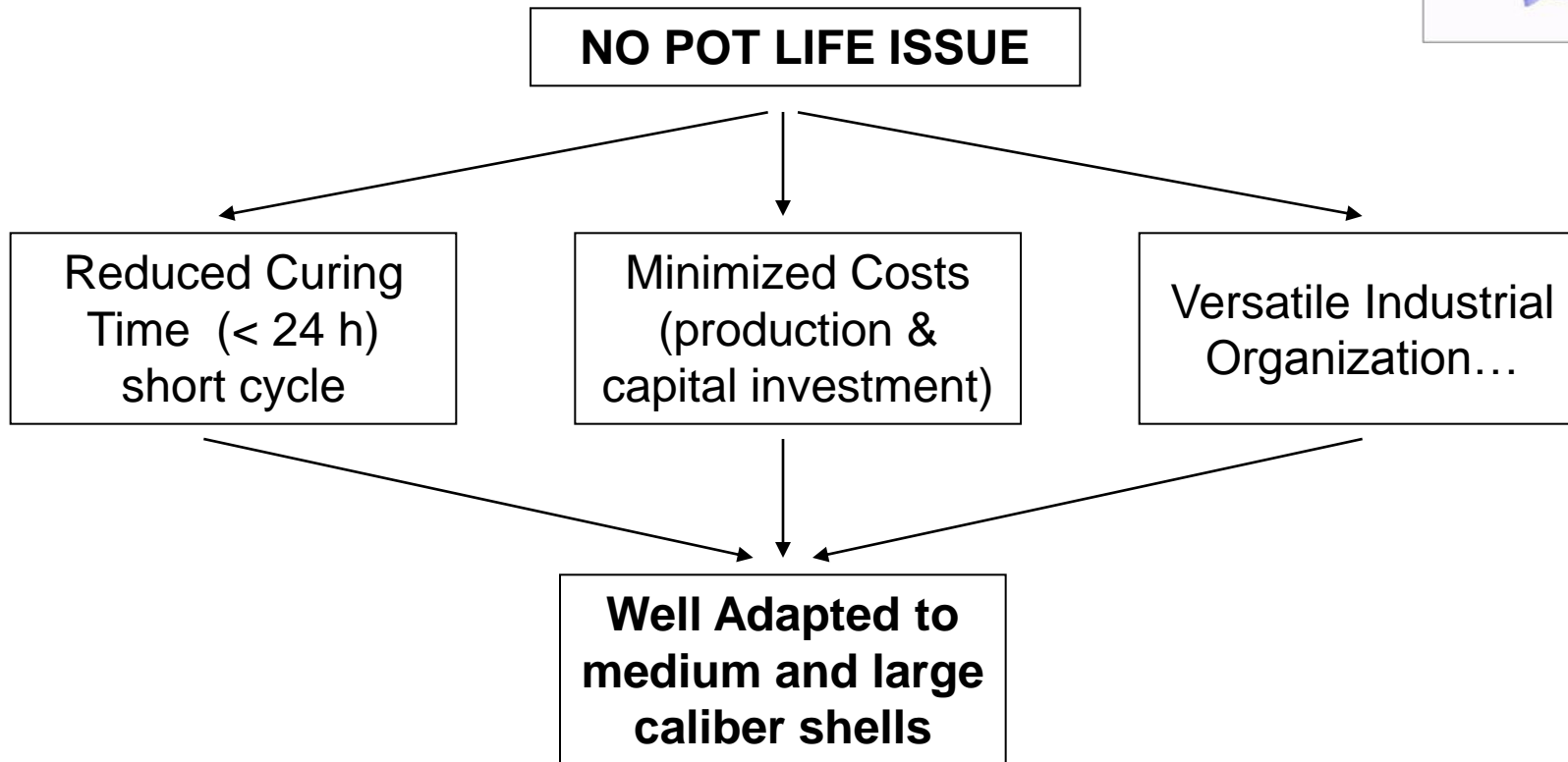
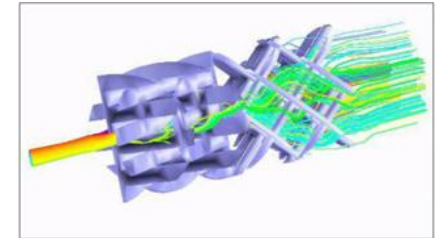
- **Two components:**
 - . Component A: All ingredients, **except curing agent**
 - . Component B: Curing agent
- **Filling « on demand »**
through a static mixer





Advantages of Bi-Component Process:

Static Mixer





**Full scale production line
commissioned in 2006**

"POGS Workshop"

1.3 HD

1,200 m²

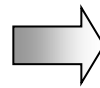
Capacity (items/year)
with one Filling Station

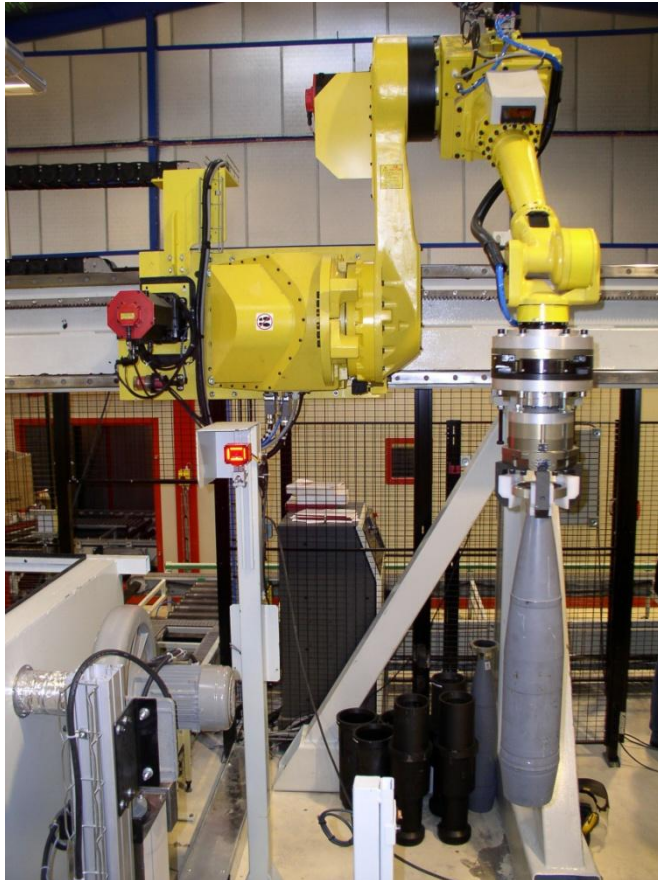
155 mm: 50,000

120 mm: 100,000

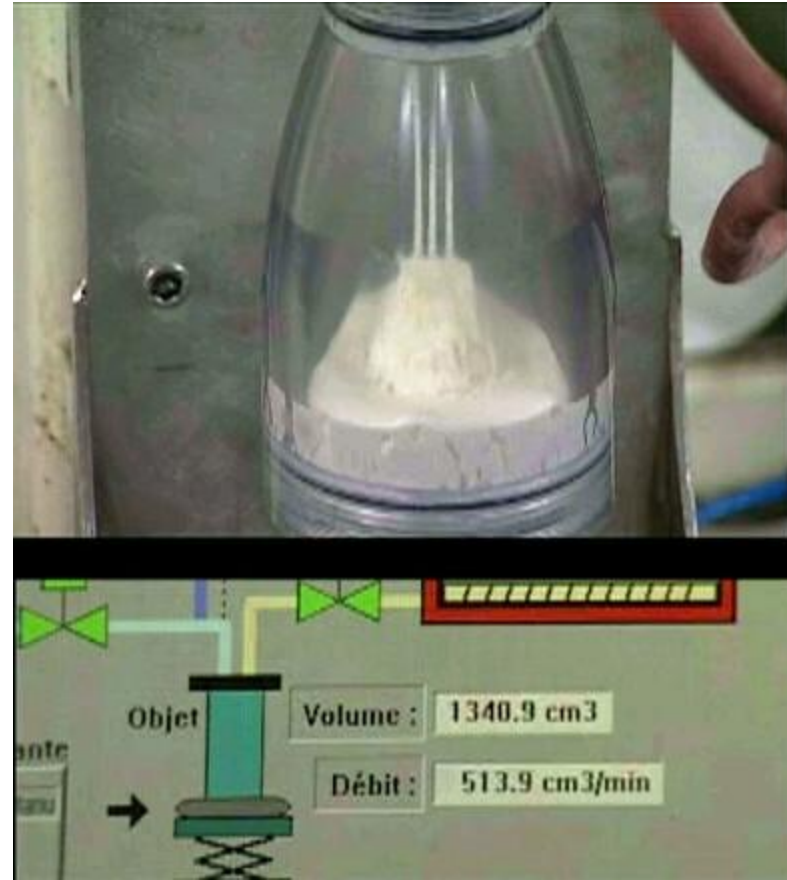


"All-in-One" Workshop (Empty Shells Get In Packed Filled Shells Go Out)





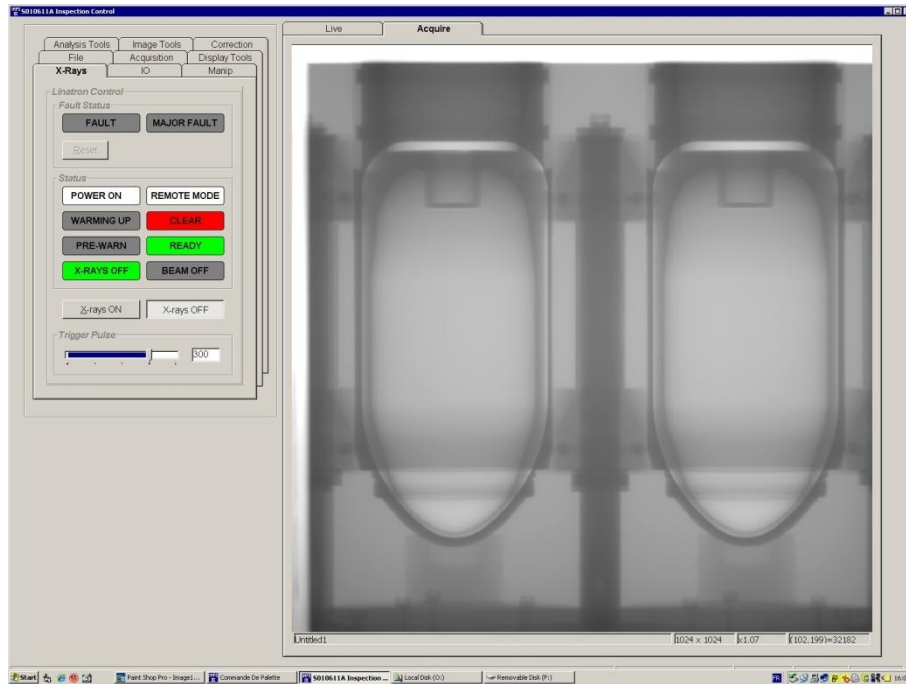
**AUTOMATED
HANDLING**



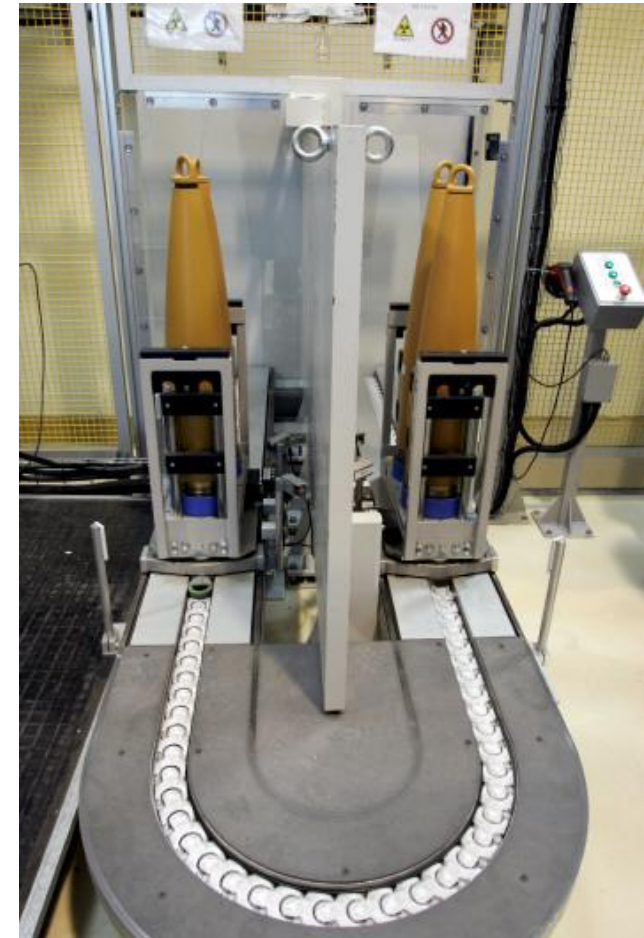
**AUTOMATED
CASTING**



LINEAR CURING OVEN



IN-LINE DIGITAL X-RAYS





Some Applications



76mm n°1	Artillery	Qualified, Production 2011
76mm n°2	Artillery	Development
127mm (5")	Artillery	Production 2011



155mm n°1
155mm n°2

Artillery
Artillery

Qualified, Production 2011
Production 2006-2007 (Combat Proven)



155mm Artillery (RWM RH30-40)



Fast Cook Off



Type V



Type V

IM SIGNATURE

	FCO	SCO	BI	FI	SR	SCJ
Comp-B	I	I	I	I	I	I
RH26	V	IV/V	V	-	-	-

Source : RWM and MSIAC

I = Detonation II = Partial Detonation III = Explosion IV = Deflagration V = Burn

155mm Artillery (New EURENCO Formulations B2268 & B2267)



B2267 (RDX/NTO) : Type III



Shaped Charge
dia. 68mm



B2268
(RDX/
NTO/AL)
: Type V



B2268 Shot

Comp-B

B2268
/B2267

IM SIGNATURE

	FCO	SCO	BI	FI	SR	SCJ
Comp-B	I	I	I	I	I	I
B2268 /B2267	V*	V*	V*	V*	IV/III*	V/III

* Prediction ; Source : EURENCO

Tank Ammunitions

120mm n°1

120mm n°2

105mm

Tank HE

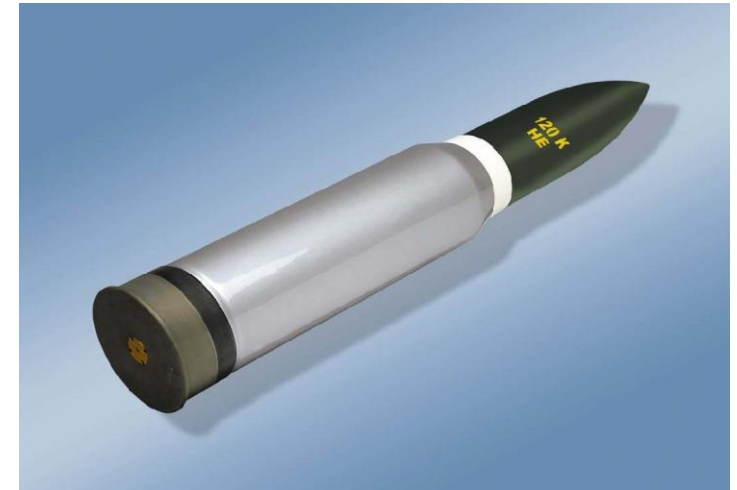
Tank HE

Tank HE

Production 2010/2011

Development

Development



Mortar Ammunitions

120mm n°1
120mm n°2
120mm n°3
81mm n°1
81mm n°2

Mortar
Mortar
Mortar
Mortar
Mortar

Qualified
Qualified
Development
Development
Production 2009/2010



As a reminder: **120mm HE Mortar Ammunition (M934A2)**

- Prime Co. : GD-OTS CANADA
- Customer: US ARMY
- Development: 2001/05 ; TC 2006
- High Blast / Frag (ref. Comp-B)
- Meets IM Requirements
- Licenses for HBU88-B and BC Process





120mm HE Mortar Ammunition M934A2 (US ARMY Type Classified with EURENCO HBU88B)



Comp-B

HBU88B

IM SIGNATURE

	FCO	SCO	BI	FI	SR	SCJ
Comp-B	II	I	I	I	I	I
HBU88B	IV*	IV*	IV*	IV*	IV-Pass	IV-Pass

* Fuze/Adapter Thrown >49 ft ; Source : US ARMY



Conclusion

- **Cast PBX** is the **most used and mature** IM explosive technology available
- **Cast PBX** is affordable and provides same performances as non-IM Explosives
- **Bi-Component** process is the **right economical / technical trade-off** for filling large caliber ammunitions with cast PBX.



The Insensitive Munitions European Manufacturers Group



GOING FROM STRENGTH TO STRENGTH

