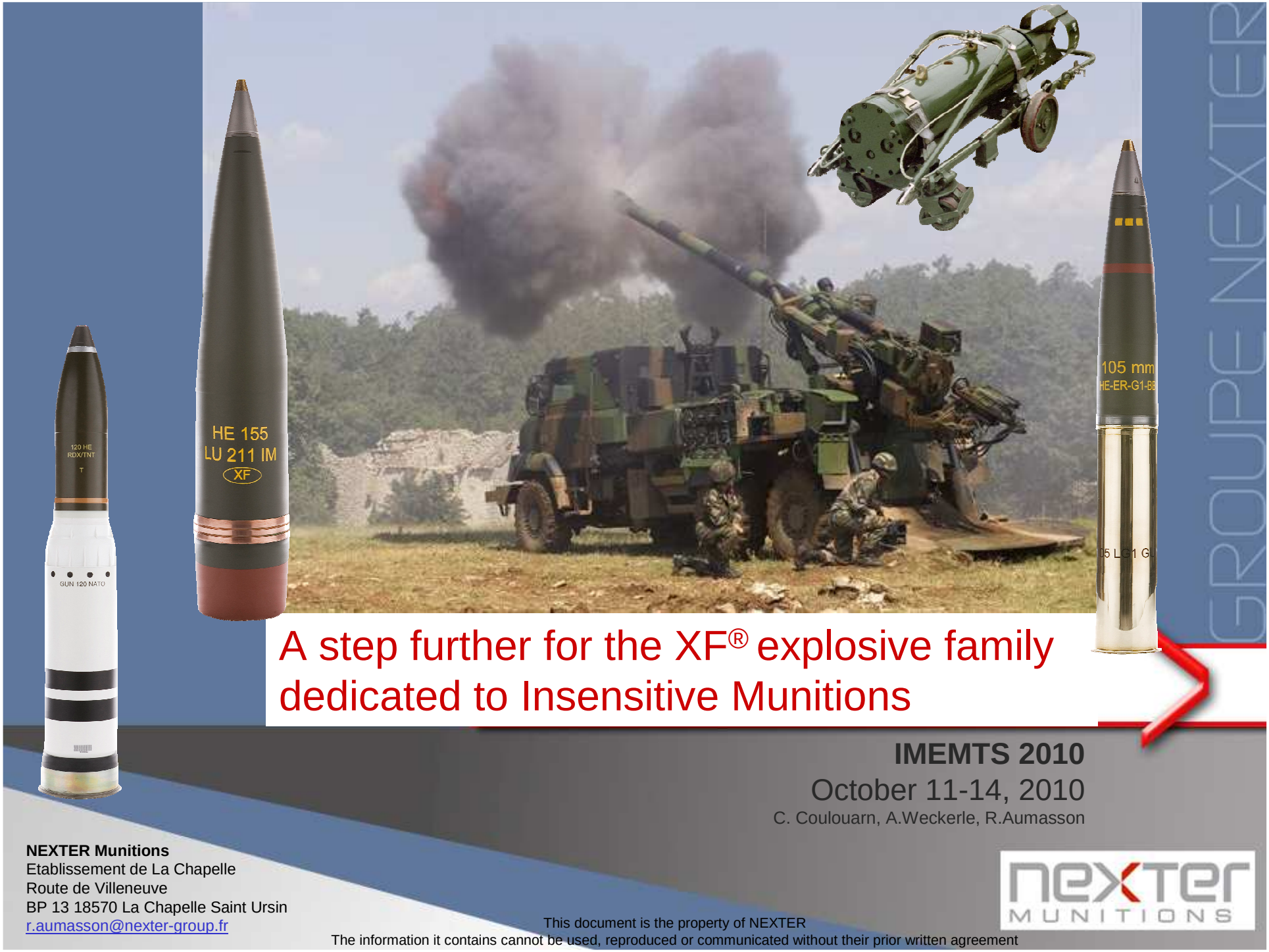

A step further for the XF® explosive family dedicated to Insensitive Munitions

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Extension of the EIDS XF® Family

Industrial Strategic Plan

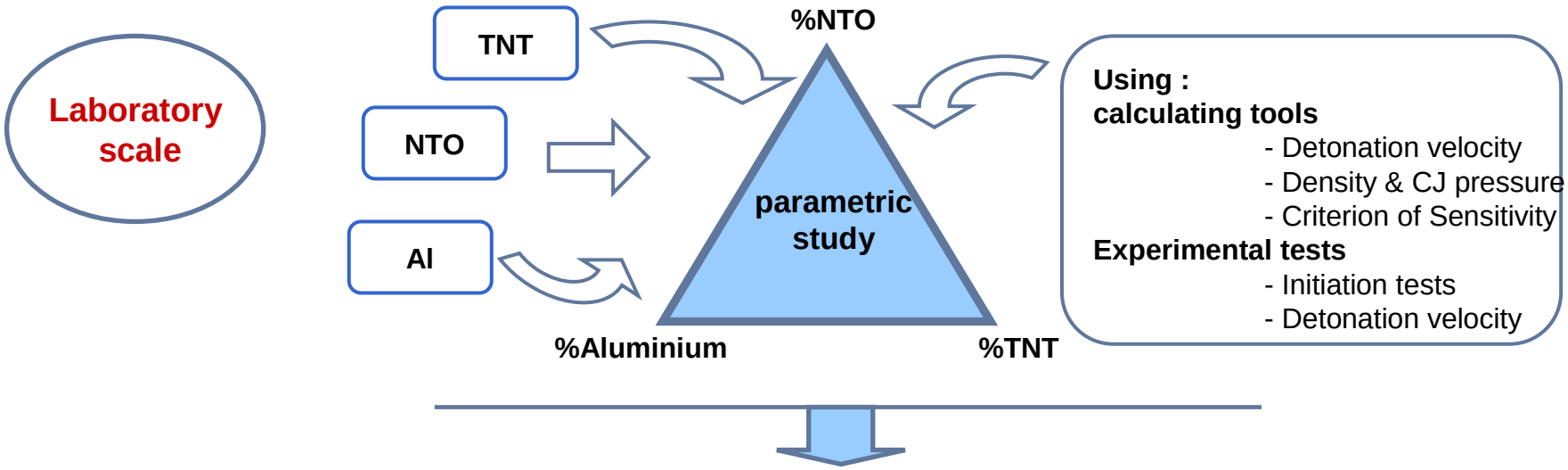
- 155 mm LU211 IM artillery shell is the first French IM Field Artillery ammunition under mass production

- **Aware of the need for the armed forces, NEXTER Munitions is going to tailor new melt-cast EIDS XF® formulations, in order to offer the right response to every customer needs.**
- **NEXTER Munitions has extended its EIDS XF® family from mortar to large explosive charges.**

Global Approach

► NTO/TNT based melt-cast compositions approach

- R&D research : developed and optimized thanks to design of experiments
  - **Optimal conditions require a compromise between NTO/TNT/Aluminium ratio to meet customer's requirements**



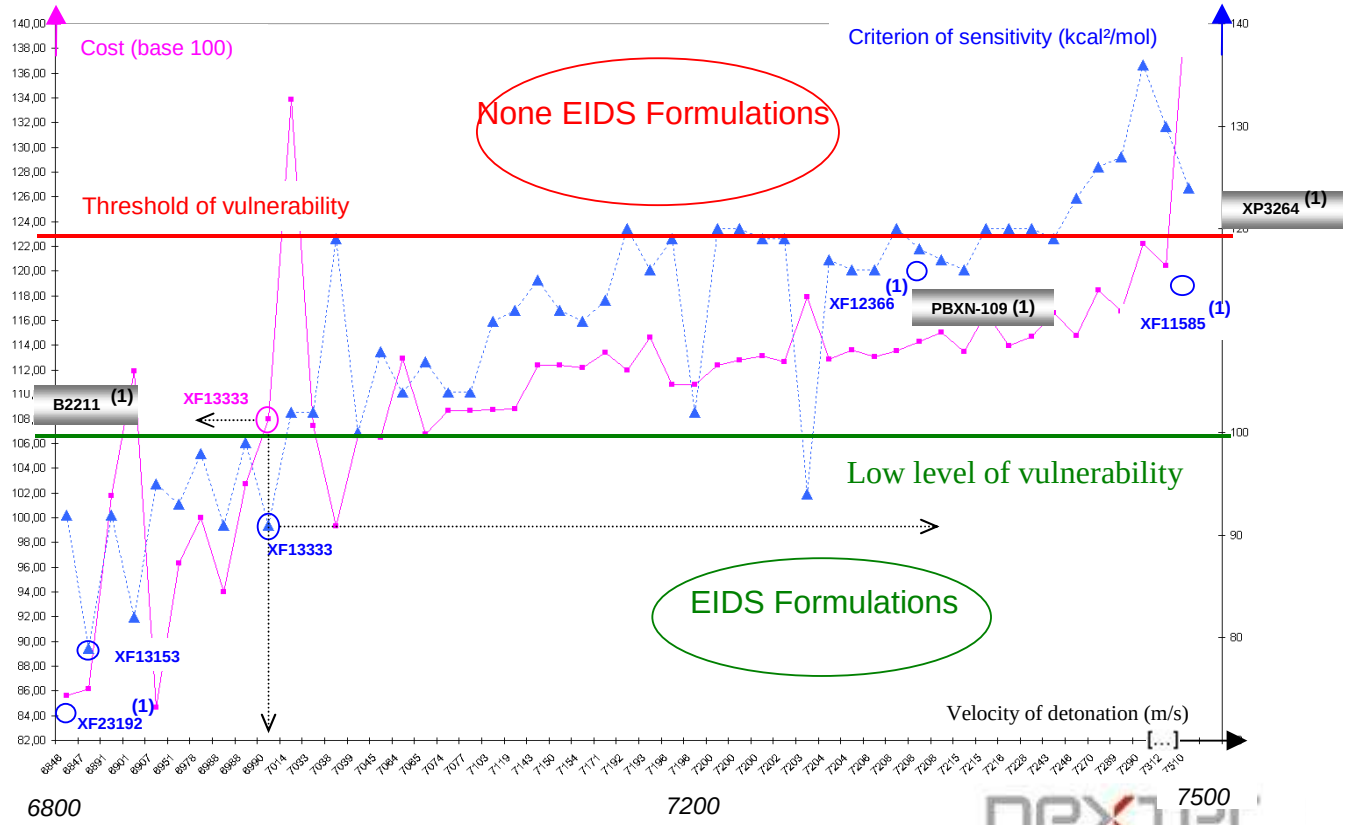
Selection of compositions with expected performances

Safety charaterization, detonation performances evaluation

New Candidates in the EIDS XF® Family

Part 1

- Detonic properties are predictable with a reliable prediction, thanks to calculation tools using :
  - Criterion of Sensitivity calculation based on CHETAH code
  - QUERCY simulation code for the velocity of detonation
  - COMSOL simulation code based on vulnerability aspects



Key

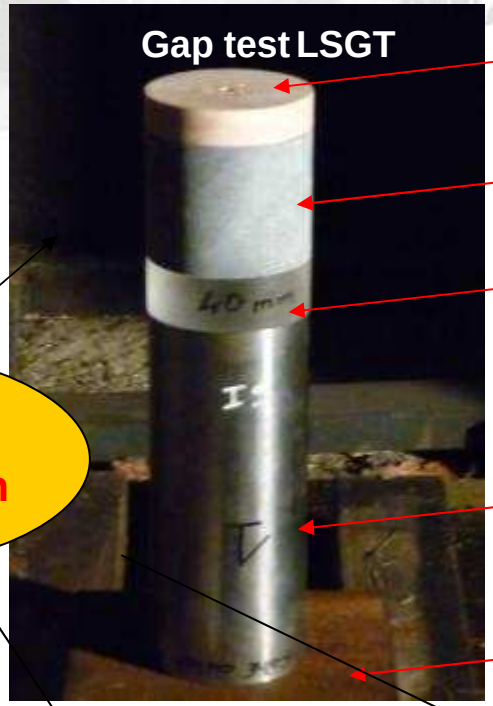
Criteria of Sensitivity

Cost estimation

(1) Formulations without taking into account the cost production

New Candidates in the EIDS XF® Family

Part 1



Igniter M720

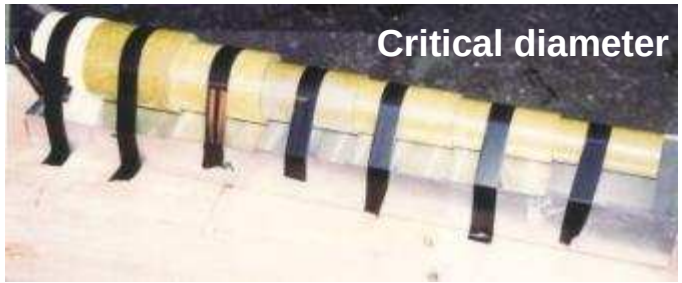
Booster

Barrier PMMA

Confined new XF® formulations

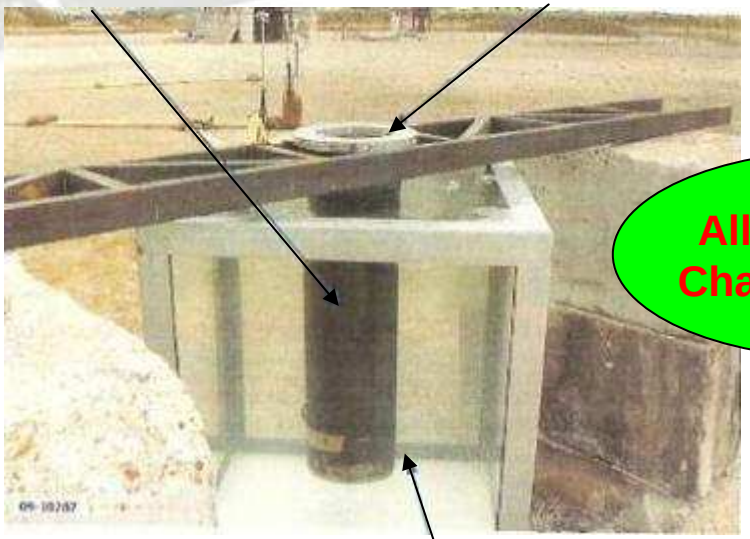
Witness plate

Laboratory Characterization

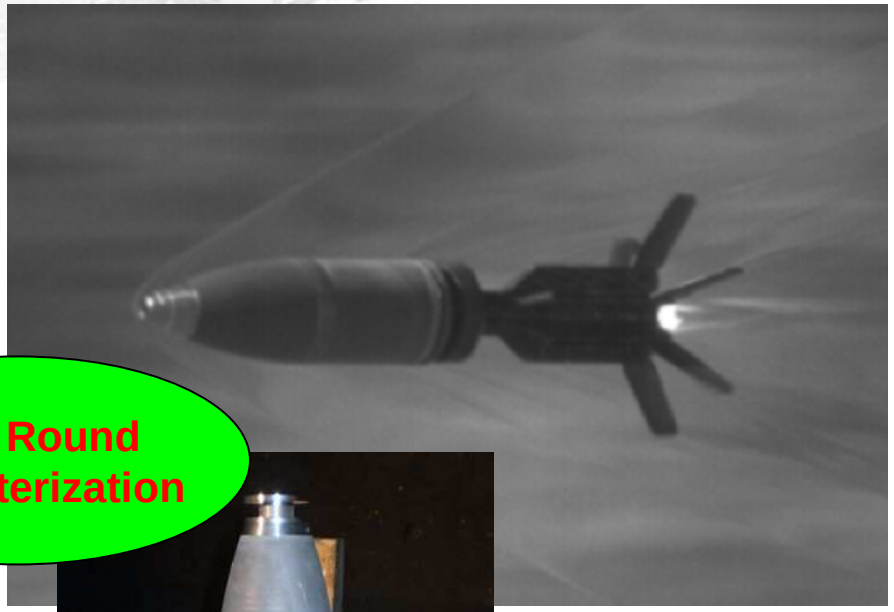


New Candidates in the EIDS XF® Family

Part 1



Explosive Charge Set Up



All Up Round Characterization

120 HE IM Trials

New Candidates in the EIDS XF® Family

Part 1

Formulations recorded from design of experiments

Reference	Composition (weight %)						
	TNT	TNMA	NTO	HMX	RDX	Aluminium	Wax
XF 23192		30	40			20	10
XF 13153	30		40			20	10
XF 13 333	31		48			13.5	7.5
XF 11585	31		21		27	13.5	7.5
XF 12366	31		21	27		13.5	7.5

Reference EIDS XF formulation

Characterization

Reference	Detonics Properties				
	Density	VoD m/s	Pcj kbar	Critical diameter mm	Sensitiveness CS
XF 23192	1.756	6830	204	60	73
XF 13153	1.705	6880	202	<60	76
XF 13 333	1.754	6976	210	<120	100
XF 11585	*1.72*	*>7300*	*>220*	*< 20*	*>110*
XF 12366	1.752	7215	228	< 15	115

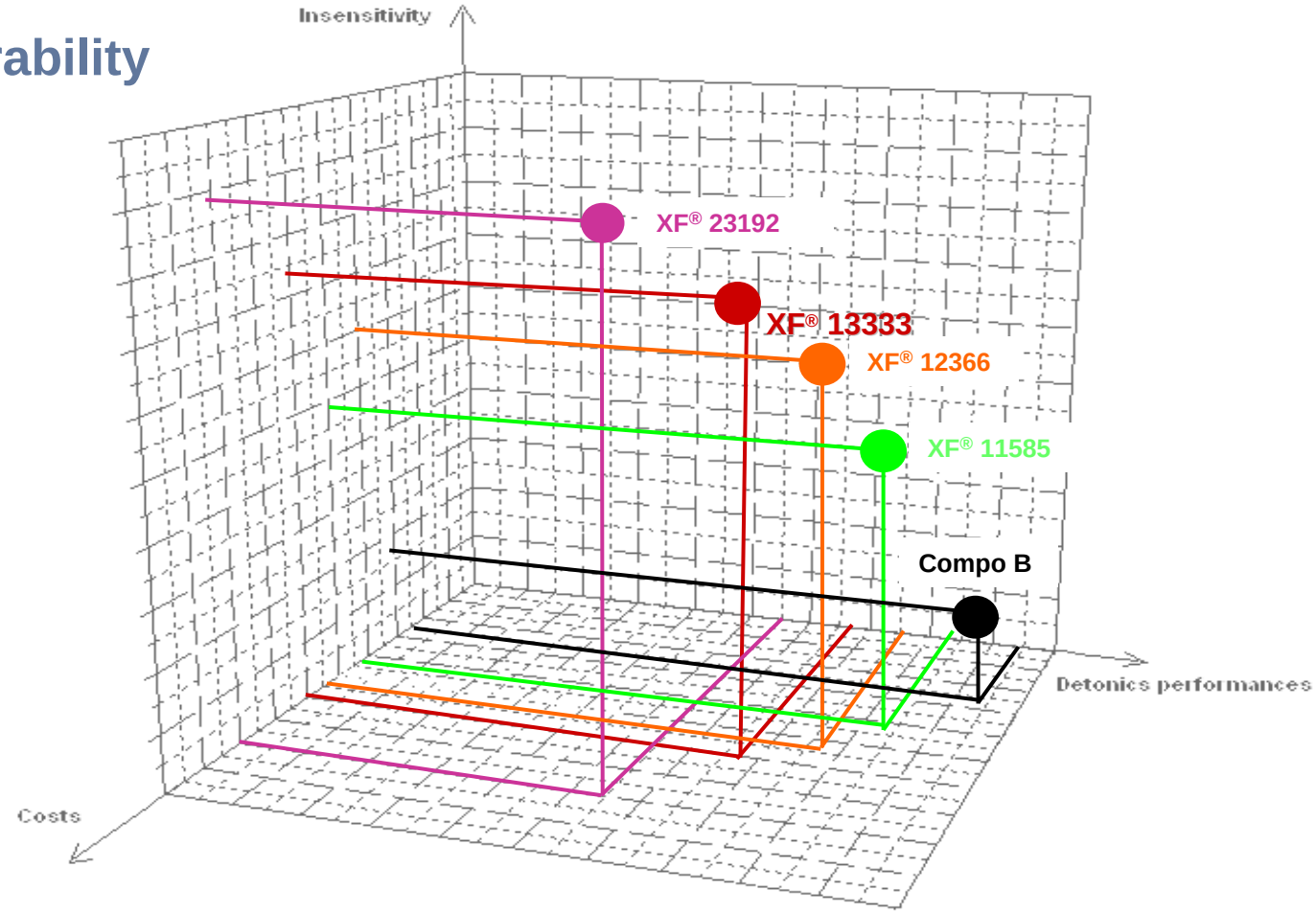
Reference EIDS XF formulation

Estimated Characteristics, Study awarded by the French MOD in progress

New Candidates in the EIDS XF® Family

Part 1

- 3D Positioning of the EIDS XF® candidate formulations in terms of:
  - detonic performances
  - low vulnerability
  - cost



Intermediate Conclusion

- 155 LU211 IM artillery shell has superior IM properties in all test categories with no mitigation devices for the stimuli defined in the STANAG 4439 and in all configurations during the life cycle.
- Mass production is now runing for 4 years at the filling plant of La Chapelle saint Ursin
- In parallel, laboratory studies were conducted with the effective support of the design of experiments.
- The promising recorded results led NEXTER Munitions to promote the EIDS XF® family, ranging the IM applications from mortar up to explosive charges (bombs, depth charge, demolition charge…)
- According to the signifcant interests of different potential users of the melt-cast XF® technology, NEXTER Munitions offers the « ready to use » concept called PREMIX XF®

PREMIX XF® Approach with XF 13333 Formulation

Preparation of the1st mixing

↓

Flakes production

↓

Preparation of the2d mixing (Flakes re-melting)

↓

LU211 IM filling

↓

Non destructive tests

Static and Dynamic trials

Scope of Works

PREMIX XF® Qualification

Part 2

► Laboratory Tests

No change has been recorded with the remelting of flakes using industrial facilities

	Formulation				
	NTO %	TNT %	Wax %	Aluminium %	Density (g/cm³)
XF®13333 (1) reference	48±2	31±2	7.5±2	13.5±2	1.75
XF®PREMIX (2)	46.6 – 49.4	30.2 – 32.8	5.9 – 7.6	12.5 – 13.5	1.75 - 1.76

(1) fusion tank samples (2) shell samples

	XF13333	XF®PREMIX	AFNOR standard
	50% Go results	50% Go results	
Friction Sensitivity	160 N	190 N	NF T 70 503
Impact Sensitivity	48 J	40 J	NF T 70 500

Robustness of the Flake Final Product

Composition sample	Density (g.cm⁻³)	Stress, max (MPa)	Young Modulus (MPa)	Deformation, max (%)
XF13333	1,767	21,1	2060	1,2
XF®PREMIX	1,757	20,4	2009	1,2

PREMIX XF® Qualification

Part 2

- Static Tests

No change has been recorded with the remelting of flakes

Ignition and detonation properties of 155mm LU211 HB IM filled with PREMIX XF® are preserved

+ 63°C

- 46°C

.

Witness Plate Recovery

PREMIX XF® Qualification

Part 2

▶ Dynamic Trials

No change has been recorded with the remelting of Flakes Final Product

155 LU211 IM HB - Safety Trials with 52 cal gun

PREMIX XF® Maturity

Part 2

Safety Confirmation

TEST	Approval
X Ray inspection after filling	yes
XF Formulation (Nose/Middle/base)	yes
Mechanical properties	yes
Impact sensitivity	yes
Friction sensitivity	yes
Ignition behaviour and reliability	yes
Detonation behaviour	yes
Efficiency	yes
Sequential Environmental Safety & Performance	yes
Long term storage (free of exsudation	yes

Conclusion

- On going activities around XF®
  - Mass production of 155 mm LU211 IM filled with EIDS XF ® 13333
  - Evaluation of EIDS XF ® 13333 performances for Air, Land and Navy applications
  - Evaluation of EIDS XF ® 11585 detonics properties and IMness in various mortar and tank ammunition
  - Mastering the ignition IM pyrotechnic train for a large range of applications

Many thanks to the Ana Weckerle and Christophe Coulouarn for their technical expertise.

Thank you for your attention

QUESTIONS ?