

**SNPE Energetic Materials (SME)
Research & Technology Department (DRT)
Le Bouchet Research Centre (CRB)**

9 rue Lavoisier
91710 VERT LE PETIT
FRANCE

Point of contact

Name	M. Yves GUENGANT
Phone	+ 33 1 64 99 15 19
Fax	+ 33 1 64 99 15 95
E-mail	y.guengant@snpe.com
Website	www.materiaux-energetiques.com



General information

SME produces all energetic materials for French MOD and for other customers (directly or through subsidiaries). CRB, European pole of excellence, is the research centre which is devoted to SME R&D studies. CRB mission is to design new propellants, explosives and powders. This is done using advanced processes and supporting customer's munitions developments. Its laboratories are devoted to new molecule synthesis, energetic material formulations, extensive characterizations (chemical & thermal analysis, mechanical properties, ageing assessment, ballistics & detonics performances ...), safety and vulnerability assessment. For each area, some original methodologies and advanced numerical simulations allow to model various behaviours of energetic materials in munitions environment. CRB staff is 200 people including half of Doctors and Engineers-Scientists. SME is certified ISO 9001 V2000, and its safety laboratory is accredited COFRAC for many tests. Safety & Vulnerability team can perform tests from UN Orange Book, CEN, AFNOR, DEFSTAN, MIL-STD, STANAG, Doctrine MURAT, etc. Nevertheless, the achievement of a reduce number of tests cannot guarantee the response levels for all configurations along the whole life cycle of munitions. So, through methodologies using characterizations and numerical simulations, IMness level of munitions submitted to vulnerability trials can be predicted with high confidence. SME is able to produce IM signature or MURAT labelling reports.

Facilities

Vulnerability trials are performed in various facilities up to full scale weapons with many measurement equipments:

- about twenty firing chambers up to 5 kilograms in detonation,
- proving ground up to 5 tons in detonation or 60 tons in combustion,
- chronometry & velocity pins, VISAR, accelerometers ..., more than a hundred recording channels,
- optical fibres detectors, gas analyser,
- pressure gauges, blast overpressure transducers, thrust meters,
- temperature sensors, various heat flux meters, more than a hundred recording channels,
- camera up to 4,000,000 f/s, video and Infrared camera up to 32,000 f/s, X-ray flash equipments ...

Environment trials (climatic chambers, vibrations & shocks devices ...) can be conducted on large items.

Experience

SME customers are French or foreign companies and various authorities. SME provides a complete service for weapon design including energetic material choice, architecture advices and IM or MURAT reports.

Vulnerability trials have already been performed on all weapons types:

- general purpose bombs, penetrators, torpedoes, missiles including solid propellant motors, warheads and sub-munitions, shape charges, decoy flares, artillery shells, gun propellant cartridges ...,
- new mitigation concepts have been developed, for example, a new concept preventing sympathetic detonation for closely-packed systems.

Fast Cookoff

- Fuel fire for all munitions sizes according to standards, all measurements as required;
- Gas torches used for specific studies;
- Numerical simulations through FDS (fire parameters), ABAQUS (time-to-reaction) & LS-DYNA (reaction violence level).



Slow Cookoff

- For all munitions sizes according to standards, all measurements as required;
- Various heating rates following THA,
- Item video motion along whole test;
- Numerical simulations through ABAQUS (time-to-reaction) & LS-DYNA (reaction violence level).



Bullet/Fragment Impact

- For all munitions sizes according to all standards, all measurements as required;
- 0.5" three shots is available;
- 0.5", 20mm & 90 mm guns (bullets and fragments);
- fragments explosive launcher;
- LS-DYNA Numerical simulations.



Sympathetic Detonation

- For all munitions sizes according to all standards, all measurements as required;
- various numbers of items and arrangements according to THA;
- projected item track through IR high speed camera;
- LS-DYNA Numerical simulations.



Shaped Charge Jet Impact

- For all munitions sizes according to standards, all measurements as required;
- various shaped charge calibres;
- various stand-off and configurations;
- LS-DYNA Numerical simulations.



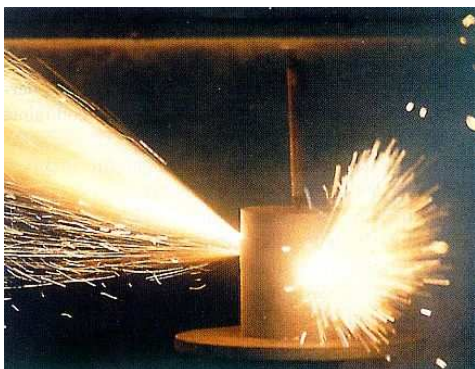
Drop test / Spigot intrusion

- For all munitions sizes according to standards, all measurements as required;
- various height drops and impact angles;
- various steel slabs and spigot models;
- LS-DYNA Numerical simulations.



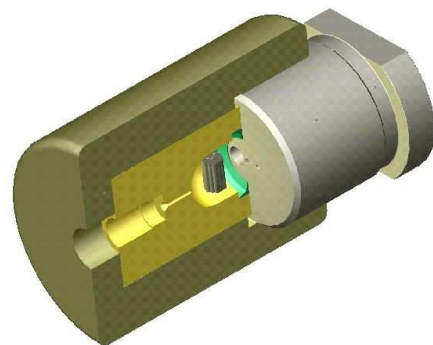
ES / EM / Lightning

- For all munitions sizes according to STANAGs, all measurements as required;
- technical approach focused on energetic materials;
- Numerical simulations through CAREM & ABAQUS.



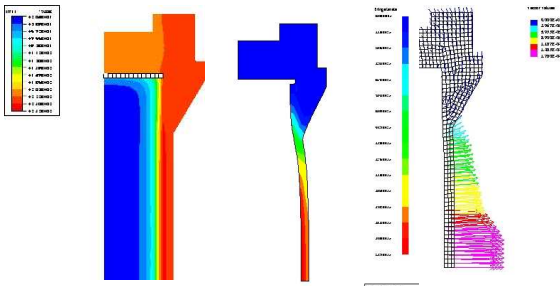
Small Scale Tests/EIDS/Homologation

- Many characterisation tests to obtain data for expert analysis and numerical simulations (> 100 SME Standards);
- All tests to classify in Division Risk (DR), especially in DR 1.6 Extremely Insensitive Detonating Substance (EIDS);
- All tests to homologate energetic materials according to standards.



Predictive Methodologies

- For each vulnerability threat, an adapted methodology has been developed to predict weapon reaction through small scale tests and numerical simulations;
- These analysis allow to increase confidence in rare full scale test and to cover all configurations according to THA along life cycle;
- A well known example concerns Friability test, which is very useful for Bullet Impact response prediction.
- Unconfined Thermoignition test and thermally damaged sample combustion in high pressure closed vessel allow to predict time-to-reaction and violence level to Slow Cookoff Test through ABAQUS and LS-DYNA



Trials support services

- Provided service according to customer needs :
 - completion of simple tests,
 - vulnerability assessment on existing definition,
 - advices for energetic material choice and weapon architecture for IMness improving,
 - design of mitigation devices to reach IMness requirements,
 - prediction of munitions response level without full scale test,
 - prediction weapon behaviour submitted to specific threat according to THA, ...
 - writing of IM or MURAT reports to demonstrate achievement of requirements,
- Environment trials can also be conducted on large weapons (ESM) :
 - climatic chambers,
 - vibration and shock devices,



Cost

Cost is dependant upon type of weapon and services required by the customer. Please contact us with your needs and quote will be provided. We are ready to solve yours problems.