EDF-2021-GROUND-R: Precision Strike Capabilities

Proposals are invited against the following topic:

EDF-2021-GROUND-R-IW: Improved warheads.

Budget

The Union is considering a contribution of up to EUR 10 000 000 to support proposals addressing the abovementioned topic and its associated specific challenge, scope, targeted activities and functional requirements.

Up to one action may be funded under this call.

Defeating improved protection systems of main combat platforms, hardened targets and reinforced (critical) infrastructures remains a focal challenge for military operations. Enhanced effects on targets, like blast, perforation, penetration, shock, bubble effects or electromagnetic pulse, are required to defeat such advanced protection systems. In this way, the development of new types of warheads with higher performance is required. Activities should cover the research on an enhanced penetration performance.

Specific challenge

In recent years, new threats have emerged on the battlefield. Among these threats are next generation main battle tanks. These systems apply active protection systems (APS) that render conventional anti-tank weapons ineffective. However, warheads with a standoff capability, which can be initiated outside the range of an APS, might destroy such targets. In addition, explosive reactive armour (ERA) and passive armour were improved during the last years. In this respect, enhanced shaped charge technologies are required.

In recent years, there has also been a steady increase in urban warfare. Thus, battlefield engagements are not limited against main battle tanks or fighting vehicles, but increasingly against infrastructure. Often, these infrastructures apply high-performance concrete, which makes engagements more challenging. Consequently, it necessary to obtain small calibre penetrator warheads for battlefield weapon systems that can be effectively employed against infrastructure. In this respect, new penetrator technologies are required.

Scope

The scope of the research action should be:

- Research on technology of explosives - development of a technology of production of explosives charges with high homogeneity (uniform density distribution in the entire volume of the charge), geometric accuracy and high detonation parameters;
- Research on technology of liners of shaped charges and explosively formed projectiles (EFPs);
- Development of a technology of production of precise liners made of conventional materials (copper, Armco iron) with high structural homogeneity, chemical purity, etc.;
- Development of a technology of production of precise liners made of new materials, e.g. manufactured with the use of additive techniques; with a programmed texture

affecting the projectile formation process in such a way that the final shape of the projectile improves its stabilization on the flight path; slow stretching shaped charges allowing to keep its integrity as long as possible;
- Optimization of the shapes of the liners;
- Development of a technology of manufacturing of the warhead shells providing high strength, accuracy and repeatability of assembly, maximizing the penetration capability of the warheads and minimizing the weight of the entire system; e.g. by using a steel-composite shells with circumferential reinforcements made of carbon or glass fibres in a polymer matrix;
- Development of new methods of explosive initiation, ensuring additional acceleration and appropriate shape of the detonation wave, axisymmetric deformation of the liner and, as a result, maximization of its penetration capability;
- Development of multi-liner warheads (one explosive charge form and accelerate several projectiles). Such solutions will enable defeating armoured vehicles, but also can be used to destroy various types of infrastructure during military operations in urban areas (small calibre/low mass of explosive limit the negative side effects of detonation of the EFP, e.g. damage of buildings);
- Development of initial concepts of new warhead carriers as well as selection of existing ones and definition of new warhead applications related to their structures (grenades, mines, drones, etc.);
- Definition of numerical models of the warhead/target systems and performing computer simulations in order to initially evaluate the penetration capability of newly developed warheads;
- Performing experimental tests determining the functioning of the developed warhead systems.

Furthermore, the proposal must address penetrator warheads that can be effectively employed against infrastructure. Moreover, the proposal can address other technologies that offer added value in the context of next generation battlefield targets.

Targeted activities

The proposals must cover the following activities as referred in article 10.3 of the EDF Regulation, not excluding downstream eligible research activities if deemed useful to reach the objectives:

- Activities aiming to create, underpin and improve knowledge, products and technologies, including disruptive technologies, which can achieve significant effects in the area of defence;
- Activities aiming to increase interoperability and resilience, including secured production and exchange of data, to master critical defence technologies, to strengthen the security of supply or to enable the effective exploitation of results for defence products and technologies;
- Studies, such as feasibility studies to explore the feasibility of new or improved technologies, products, processes, services and solutions.
- The design of a defence product, tangible or intangible component or technology as well as the definition of the technical specifications on which such design has been developed which may include partial tests for risk reduction in an industrial or representative environment.

Activity 1. Generating knowledge - Compiling background information

- Task 1: Collecting data on parameters, characteristics, functioning and efficiency of currently used protection systems of heavy-armoured vehicles and infrastructure facilities (passive, reactive and active protection systems and their combinations);
- Task 2: Identifying of weak points of currently used protection systems of heavy-armoured vehicles and infrastructure facilities (passive, reactive and active protection systems and their combinations);
- Task 3: Defining potential strategies and methods of defeating protection systems of heavy-armoured vehicles and infrastructure facilities (passive, reactive and active protection systems and their combinations), that will take into account indicated weak points of their design and definition of the basic parameters of the developed combat system: type of the warhead used; number and type of shaped charges/EFP's/other charges (single, tandem, triple); type of the warhead carrier (grenade, mine, drone, etc.);
- Task 4: Determining methods of increasing of the warheads effectiveness and defining design assumptions that will allow to implement the strategies of defeating protection systems for heavy-armoured vehicles and infrastructure objects defined in the previous tasks (passive, reactive and active protection systems and their combination);
- Task 5: Identify state-of-the-art charge designs and manufacturing technologies of sub-components such as high explosive charges, shape charge liners, initiation systems and warhead casings.

Activity 2. Integrating knowledge - Initial warhead designs

- Task 1: Evaluating numerical tools and developing numerical models of the warhead/target systems and performing computer simulations in order to initially evaluate the penetration capability of newly developed warheads;
- Task 2: Warhead design developments integrating previously studied sub-component;
- Task 3: Preparing warheads for experimental tests;
- Task 4: Performing of experimental tests determining the functioning and the penetration capability of developed warheads;

Activity 3. Studies - Warhead optimization and munition applications

- Task 1: Gathering and analysis of the results of experimental tests and numerical simulations determining the functioning and the penetration capability of developed warheads;
- Task 2: Defining the directions of modification and optimization of the developed warheads in order to increase their penetration capability and the effectiveness of defeating protection systems of heavy-armoured vehicles and infrastructure objects (passive, reactive and active protection systems and their combinations);
- Task 3: Developing initial concepts of new warhead carriers as well as selecting existing ones (grenades, mines, drones, etc.).

Activity 4. Design - Weapon system integration and validation

- Task 1: Developing initial concepts of combat systems designs containing developed subsystems: warhead-carrier;
- Task 2: Preparing combat systems variants for experimental pre-tests;

- Task 3: Performing experimental pre-tests determining the functioning of the developed combat systems;
- Task 4: Performing experimental pre-tests imitating the interaction of the developed combat systems with the protection systems of heavy-armoured vehicles and infrastructure facilities (passive, reactive and active protection systems and their combinations).

Functional requirements

Regardless of the chosen strategy of defeating targets equipped with ERA and APS, as well as the type of the warhead carrier, the confirmation of the proper functioning of the developed combat system will be based on the presence of the main armour perforation in the target equipped with ERA and APS. However, defining the precise requirements for the proper functioning of the developed combat system requires knowledge about the structure of the armour system that will be attacked. Collecting this knowledge and, consequently, specifying the requirements for the designed system will be the subject of the actions in this stage of the project.

It should be noted, however, that the functioning of the system, subsystems (warheads, warhead carriers) and individual warhead components should be checked at individual stages of the research. The effectiveness of the newly developed warheads and their components should be compared to the existing solutions. Analysis of the system operation should include:

- At system level, beside determining the presence/ absence of perforation of the main armour of the target, the analysis should include the detectability of the combat system as well as fake warheads/fake carriers by APS radars;
- At the level of the warhead subsystem, their effectiveness should be determined on the basis of the penetration depth of RHA steel plates placed behind the reactive armour cassettes, also as a function of standoff distance;
- At the level of the warhead carrier subsystem, depending on the adopted strategy of defeating target, the analysis should include, among others, the degree of synchronization (of warheads in the case of a tandem grenade; a programmed swarm in the case of using drones as carriers), the degree of detection of the carrier by APS, etc.;
- Properties of the explosives should be analysed in terms of detonation parameters (velocity of detonation wave propagation, detonation pressure, detonation energy), structure homogeneity (uniform density distribution throughout the charge volume), geometric accuracy, etc.;
- Analysis of the liners should include the homogeneity of their structure, shape and integrity of the jet/EFP during the formation process, the penetration capability of the jet/EFP as a function of standoff distance, etc.;
- In case of the shells of the warheads, their strength, accuracy and assembly repeatability should be analysed, allowing to obtain high parameters of jet/EFP while minimizing the weight of the shell;

The activities should include the development of new concepts and demonstrators for technologies like Explosively Formed Projectiles, Multi-Liner Explosively Formed Projectiles or Slow Stretching Shaped Charges. Furthermore, research could be conducted on an enhanced performance of shaped charges by applying new high explosives, new liner materials and geometries.

The activities should include the development of new concepts and demonstrators for geometries, materials, and fusing systems on small calibre penetrator warheads, which can be integrated in weapon systems used by ground forces.

The activities should also include pre-test campaigns with static and dynamic trials against both APS and ERA as well as infrastructure.

The desired technology readiness level (TRL) range is 4-5.

Expected impact

- The outcomes of the aforementioned activities enable EU Member States to engage effectively next generation main battle tanks;
- Recent conflicts have shown that without tandem warhead technologies, land forces would have been ineffective against adversary fighting vehicles with ERA. Since ERA is constantly further developed, both systems have to be addressed. The above mentioned approaches will provide an answer to both APS and ERAs;
- Moreover, EU members will be able to endow their ground forces with the capability to engage effectively infrastructure in the future;
- As multiple recent conflicts have shown, warfare will increasingly take place in urban terrain. Respective weapon systems used in this context have to deliver specific effects and reduce collateral damage;
- These outcomes will strengthen the EU's technological and industrial base and help warhead systems to overcome modern defensive technologies and to penetrate infrastructure with small calibre warheads. Already the availability of such technologies will deter aggressors and thereby contribute to Europe's security.