EDF-2021-MCBRN-R: Capabilities for CBRN risk assessment, detection, early warning and surveillance

New and improved methods and technologies for the performant detection, identification and monitoring (DIM) of CBRN agents, as well as epidemics, emerging disease and pandemic influenza constitutes an important part of early detection and warning of infectious disease events[1] (biological hazards),chemical and radiological threats. CBRN early warning systems also collect, integrate, and inform military users, as well as relevant users in the health security sectors, about potential CBRN threats, epidemics, emerging diseases and pandemic influenza that can cause public health emergencies that undermine the full security of countries, from both natural or intentional origins.

Proposals must cover the generation of knowledge, methods and technologies leading to improved capacities for sampling, detection, identification, characterisation, monitoring as well as assessment of CBRN threats with a focus on biological agents, but not excluding chemical or radiological threats.

Activities should include but are not limited to innovative, technological improvements in detection technologies, notably regarding the quality of the basic input, i.e. data from sensors, methodologies and tools (or databases) for the identification and characterization of agents in complex bio-samples including sampling procedures, dynamic mapping of threats, vulnerabilities and capacities to respond at geographical levels, mapping of strategic CBRN detection technologies and related production capacities in Europe, agent classification and spread prediction based on artificial intelligence/machine learning, data processing, control measures, effectiveness of control measures and monitoring of their implementation in real-time, and use on mobile and field based platforms (modular, scalable and adaptable).

<u>Proposals are invited against any of the following topic:</u>

EDF-2021-MCBRN-R-CBRNDIM: Detection, identification and monitoring (DIM) of CBRN threats

<u>Budget</u>

The Union is considering a contribution of up to EUR 18 500 000 to support proposals addressing the abovementioned topic and its associated specific challenge, scope, targeted activities and main functional requirements.

Several actions, addressing different solutions, may be funded under this call.

Rapid detection of hazardous agents, detailed identification and monitoring over time and geographical area are an essential part of the CBRN response chain, and the demands vary depending on the specific task. Based on the situational awareness that DIM provides, military commanders can decide how to best proceed throughout their mission (whether the context is

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[1] Decision No 1082/2013/EU of the European Parliament and of the Council of 22 October 2013 on serious cross-border threats to health defines 'epidemiological surveillance' as the systematic collection, recording, analysis, interpretation and dissemination of data and analysis on communicable diseases and related special health issues, OJ L 293, 5.11.2013.

a military conflict or support to civilian society in a crisis situation). It is therefore crucial that the DIM system covers a broad range of CBRN-agents with an output of high reliability.

Performant CBRN DIM is not a single task using one technology or methodology. Existing technologies and their capabilities vary for DIM of biological, chemical, radioactive and nuclear substances. In a simplified manner, the order of technical and functional maturity level between the agent types can be described as B < C < RN.

The general challenges for performant DIM equipment (stand-off, point, integrated and/or personal worn, UxV, mobile devices or in critical infrastructures) are to address and improve performance parameters such as response time, sensitivity, selectivity, and false positive/false negative characteristics. Furthermore, the capability to detect, identify and characterize (un)known hazardous agents in a complex background need to be improved. Also, operational features such as robustness, size, mobility, power consumption and the possibility to widely and easily deploy/integrate the equipment into different surroundings and situations are of importance. In addition, sampling capability, for different matrices (air, water, soil, surfaces), as well as the ability to have a reliable chain of custody is required as an integrated part of the DIM process. Finally, the DIM equipment must be manageable by military personnel without scientific background.

Specific challenge

Several of the commonly used DIM technologies are based on collection of a large number of data (e.g genetic and spectral data) that may need post processing and be interpreted or compared to library data bases in order to become useful. As potential threats continue to evolve and technology development proceeds, the data handling becomes more complex.

- Specific challenges for B-DIM

A specific challenge with B-DIM is that microorganisms such as pathogenic viruses, bacteria, fungi and protozoa, or toxins, have to be detected or unambiguously identified in the presence of a high and varying natural non-pathogenic background. Stand-off and/or remote detection as well as continuous monitoring to trigger an alert for potential B threats is a challenge. Another challenge is the ability to identify rare and unexpected pathogens or organisms that have been (genetically) modified, which eludes certain specific identification methods.

- Specific challenges for C-DIM

The capability of detecting low volatile C-agents on surfaces and corresponding aerosols needs to be improved. In particular, non-classical agents and new formulas for distributing agents requires new detection and identification methods and the adaption of existing ones. The stand-off detection capability of vapour phase C-agents also needs improvement. In addition, toxins poses a challenge due to their diversity in size and physical properties.

- Specific challenges for R-DIM

Detection and characterisation of nuclear detonations are important for early warning and fallout predictions in order to minimize consequences and preserve freedom of military action after the use of nuclear weapons. For this purpose, systems that can determine location, yield and type of nuclear detonation (*e.g.* air or surface burst) needs to be developed and refined.

Possible methods that can be used are (but not limited to) seismic-, peak overpressure-, infrasound-, optical-, EMP- and initial radiation detection methods. For example, limitations that R-detection and monitoring instruments may suffer from lack of accuracy, or even overload at high counting rates needs to be overcome.

Scope

Proposals must cover the generation of knowledge, methods and technologies leading to improved capacities for sampling, detection, identification, characterisation, and monitoring of CBRN threats and data management. Proposals may also cover the dynamic mapping of threats, vulnerabilities and capacities to respond at geographical levels as well as mapping of strategic CBRN detection technologies and related production capacities in the Union. Considering maturity and current capabilities, the priority order is: prio 1: B-DIM; prio 2: C-DIM and prio 3 R-DIM. Proposals must cover one or several of the scopes described below.

To improve the decision making process, the quality of the basic input, i.e. data from sensors, needs to be significantly enhanced. Future detection devices need to target a broader spectrum of agents with higher sensitivity and selectivity at relevant response times, compared to existing devices. Their improved capability should preferably be demonstrated via benchmarking against current sensors as well as against agents of interest. The ability to rapidly detect hazards without sampling, preferably at safe distances, is desirable. The main scope of this call is development of technology and components (including algorithms for improved data extraction, risk assessment and spread prediction).

Methodology for identification and characterization of agents in complex bio-samples including sampling procedures also needs to be further developed. Methods that can initially provide indicative results for rapid response, but also provide data for deeper analysis such as characterization of properties of relevance for protection and treatment, as well as identification of previously uncharacterized agents, are preferred. Such deeper analysis can be done in the field or in specialized analysis reference centres. Development of tools (or databases) necessary for the characterization of non-standard or modified organisms and discrimination between natural/antagonistic origin of an outbreak is also required. As part of the DIM concept, sampling capability in different matrices should also be addressed.

Incorporations of novel and/or disruptive technologies is also encouraged, for instance, development of detectors on unconventional platforms and usage of AI for agent classifications. It is essential that the research activities generates new and improved DIM capability according to requirements generated from the operational need of the MS military forces. There is a specific need to reduce logistics in military operations, so next generation CBRN DIM systems should strive towards being mobile, fieldable, modular, scalable and adaptable to the nature of the mission. Also the system should be user-friendly and be as autonomous as possible. Handling must not be entirely dependent on personnel with a scientific background.

The interpretation of comprehensive DIM data into assessments of risk areas, mapping of strategic CBRN capacities and other decision making processes requires development of advanced methods to interpret and present the information (i.e. virtual reality/augmented reality, real-time data fusion methodologies, uncertainty analyses and dispersion model protocols). In addition, methods for background signal discrimination and prediction of potential dissemination source have to be improved.

In order to achieve utilization and adaptation of the latest scientific developments, realization of the technology into products and to ensure applied usage of the systems, several partners are required. It must be outlined in the project proposal how the active involvement from industry, defence research organisations and academia as well as end users will be achieved.

Targeted activities

The proposals must cover the following activities as referred in article 10.3 of the EDF Regulation, not excluding possible downstream activities eligible for research actions 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.

The proposals must substantiate synergies and complementarity with foreseen, ongoing or completed activities in the field of CBRN DIM, notably through EU funded actions under Horizon 2020 and Horizon Europe or in the framework of the European Defence Agency.

Functional requirements

According to important performance indicators, an enhanced discrimination of threats from false targets with minimization of false alarm rates and identification of the type of threat is required.

It is essential that the research activities in this topic generates new or improved DIM capability according to requirements generated from the operational need of the MS military forces (i.e agent range and formula, detection level, response time and selectivity) aiming towards autonomous mobile and field based DIM systems.

Final adaptation to physical requirements regarding for instance mobility, size/miniaturization, weight, power consumption, networking, platform integration, situational awareness capability and general robustness is not excluded, but more suited for a development program phase. Nevertheless, the proposals should include considerations on how the technology development can be driven with these parameters in mind.

Expected impact

Activities should serve as a solid foundation for the European defence research industry to build upon independently from external sources (IP, components and the product or service itself). The expected impact has multiple faces; security and defence of the society being the most obvious ones, but it brings significant strategic and economic benefits for the industry and employment within the EU.

The expected results should provide substantial improvements to the CBRN defence domain for the protection of troops, security forces as well as the population and critical infrastructure in general. Deployment of new DIM systems with improved functional capability will be more widely adopted throughout different levels within the armed forces (not only by specialist troops).