

WHITE PAPER

THE DELIBERATE EXPOSURE OF HUMANS TO RADIATION FOR NON-MEDICAL IMAGING PURPOSES IN BORDER SECURITY APPLICATIONS



ODYSSEUS

**Unobtrusive Technologies for Secure and Seamless Border
Crossing for Travel Facilitation**

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INTRODUCTION

Current member state legalisation, within the European Union, requires justification for the deliberate exposure of humans to ionizing radiation for non-medical imaging purposes. An opportunity exists to benefit society with the implementation of ultra-low dose, X-ray screening equipment, deployed into border security applications across Europe.

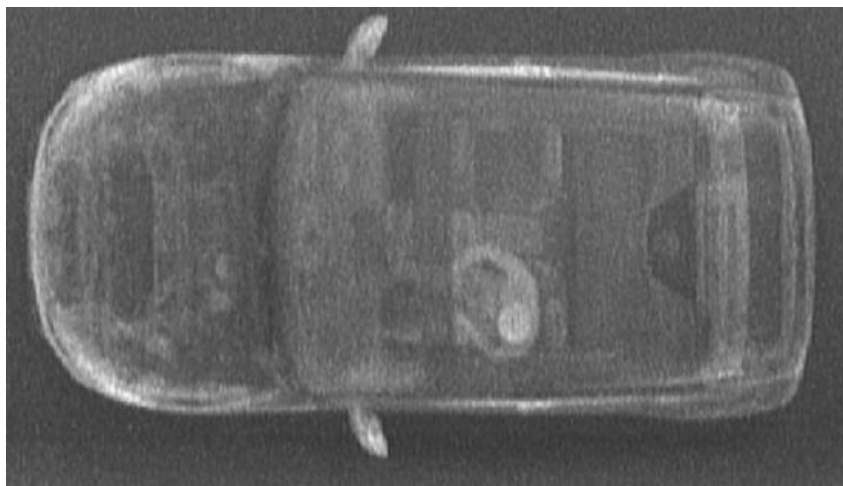
OVERVIEW

The ODYSSEUS project is an EU-funded HORIZON Innovation Action project focused on the design and development of the next generation of border security solutions, delivering seamless, non-intrusive inspection capabilities in a highly secure manner. The project combines X-ray inspection technology with complimentary vehicle interrogation techniques, as well as traveller verification solutions to support border control checks without adversely affecting traveller journey times.

Rapiscan has developed several new technologies under the consortium utilising the AS&E® CarView™ Portal which they intend to demonstrate during project deployments. The AS&E® CarView™ Portal is a multi-technology, top-view inspection system designed for occupied cars and small vehicles at borders, events, parking garages, and high-threat locations. It produces two simultaneous top-down images: a high-quality dual-energy transmission image to detect metallic threats and a Z Backscatter® image to identify organic threats and contraband. The typical radiation dose to the scanned vehicle and driver is 0.04 µSv (4.0 µRem) per screening.

New technologies involve the deployment of an occupancy detection algorithm and implementation of new data capture and processing technologies for both transmission and backscatter detection.





APPLICABLE LEGISLATION

COUNCIL DIRECTIVE 2013/59/EURATOM of 5 December 2013

- **Article 5: General principles of radiation protection** establishes the principles of **Justification, Optimization, and Dose Limitation**:
 1. **Justification**: Decisions to introduce a new practice must ensure that the individual or societal benefit resulting from the practice outweighs the health detriment it may cause.
 2. **Optimization**: Focuses on the "as low as reasonably achievable" (ALARA) methodology, considering the magnitude of individual doses, the likelihood of exposure, and the number of individuals exposed.
 3. **Dose Limitation**: Defines that the sum of doses to an individual shall not exceed the dose limits laid down for occupational exposure or public exposure
- **Article 22: Practices involving the deliberate exposure of humans for non-medical imaging purposes** delegates the responsibility for deciding whether a practice involving the deliberate exposure of humans for non-medical imaging purposes is justified to the member states.
- **Article 12: Dose limits for public exposure** sets the dose limits for public exposure to ionizing radiation. It mandates that the annual dose limit for members of the public must not exceed 1 millisievert (mSv) per year.



REGULATION (EU) 2021/1077

- **Annex 1 lists indicative equipment that may be used to achieve customs control purposes and this includes**

• <u>Indication of hidden objects on humans ⁽¹⁾</u>	• <u>X-ray based backscatter portal</u>
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RISK ASSESSMENT

Security risks

Smuggling and transportation of Drugs

Despite the great work by the Customs authorities and collaborations between the European partners, the smuggling of drugs across Europe is still a problem and there have been various studies that show this. For example:

- Around 83.4 million or 29% of adults (aged 15-64) in the European Union are estimated to have used illegal drugs at least once in their lifetime (ref: [European Drug Report 2024 | HRB | Health Research Board](#)).
- The mortality rate due to overdoses in the European Union in 2022 is estimated at 22.5 deaths per million population aged 15 to 64. (ref: [Drug-induced deaths – the current situation in Europe \(European Drug Report 2024\) | www.euda.europa.eu](#))
- a twofold increase in cross-border drug trafficking cases since 2020 has been observed, with over 2 462 cases reported in 2023. (ref: [Drug trafficking network active across Europe dismantled | Eurojust | European Union Agency for Criminal Justice Cooperation](#))

Smuggling and transportation of weapons

- With an estimated 80 million guns, 25 million gun owners and 6,700 gun deaths each year within the European union, legislation and control of firearms is a critical part of border protection activities. (ref: [Firearms and deaths by firearms in the EU - Vlaams Vredesinstituut.](#))

Customs Fraud

- Imports into the European union stand at around 200 billion euros a month, (ref: [Overview - International trade in goods - Eurostat](#)) Whilst it is hard to define the total amount of customs fraud on goods being imported into the European Union, the opportunity to avoid customs duties by smuggling goods into Europe using vehicles exists.

Movement of persons and vehicles across borders

- there is a significant opportunity for these vehicles to make both border crossings within the Schengen area and to cross external borders. When vehicles cross borders, there is a risk of people smuggling or illegal crossings. For instance, the Romanian Border Police recorded approximately 18 million vehicle border crossings in 2024. The Border Police also recorded 13,263 cases of attempted or illegal border crossings (ref: [Evaluation of the Activities of the Romanian Border Police in 2024 - Romanian Border Police](#))

Radiation risks

Dose analysis

The ICRP (International Commission on Radiological Protection) recommends that any exposure above the natural background radiation should be kept as low as reasonably achievable, but below the individual dose limits, for members of the general public, which is 1 mSv per year. (Ref: [Radiation in Everyday Life | IAEA](#)). With the typical radiation dose from the Carview system at a level of 0.00004 mSv the product will have a very small contribution to exposure above background radiation and will only marginally contribute to an individual's yearly dose limit.

As part of the horizon project Rapiscan is demonstrating industry leading dose reductions with the implementation of new detector technology in line with the as low as reasonably achievable (ALARA) guidance.

Dose comparison

Given that the typical dose for a vehicle occupant scanned with Rapiscan's Carview system is 0.00004 mSv, this practice may be justified when compared to other sources of radiation exposure. For instance, a dental x-ray results in 0.005 mSv (ref: [Ionizing radiation: dose comparisons - GOV.UK](#)).

IMPLEMENTATION POLICY SUGGESTIONS

- Utilize risk assessments to generate a justification case for deployment of occupied screening solutions in the security application.
- Submit an application containing justification case for deployment of occupied screening solutions in the security application to the appropriate radiation authority.
- Implement system in compliance with applicable legislation.
- Continue to follow General principles of radiation protection.



KEY FINDINGS

Key Finding 1: Delegation of Justification decision

Article 22 of Council Directive 2013/59/Euratom, dated December 5, 2013, delegates the responsibility for reviewing justification evidence for practices involving non-medical imaging exposure to the respective member state. The justification for deploying X-ray equipment for non-medical imaging in security applications may differ based on the specific deployment location. This delegation allows each member state to evaluate the evidence for potential deployment sites individually.

Key Finding 2: Contribution to yearly dose

Article 12 of 2013/59/EURATOM of 5 December 2013 sets out radiation exposure limits to the general public. The proposed practice would only marginally contribute to the defined dose limits due to the equipment's low dose.

Key Finding 3: quantitative evidence for justification review

Currently standard EN ISO 12100:2010 lays down a quantitative method to assess risk against the Machinery Directive (2006/42/EC). The standard defines likelihood, severity of and exposure for the risk. Similar methodology could be explored for DIRECTIVE 2013/59/EURATOM of 5 December 2013 to help member states effectively categories and compare risks associated with radiation exposure.

Key Finding 4: Integrated Border Management Fund

As detailed in REGULATION (EU) 2021/1077 for Integrated Border Management Fund the union is making prevision for the purchase and implementation of low energy X-ray equipment for the inspection of vehicles in border security applications, The Odysseus project develops technology that would fall within this regulation.

CONCLUSION

The white paper explores the implementation of ultra-low dose X-ray equipment for border security within the ODYSSEUS project, aiming to enhance seamless, non-stop inspections. It highlights the innovative Carview platform developed by Rapiscan, which offers efficient detection of contraband and unauthorized personnel, while ensuring minimal radiation exposure. The project addresses significant challenges such as drug and weapon smuggling, customs fraud, and illegal border crossings, providing solutions that improve public safety and streamline cargo inspections.



Key findings emphasize the delegation of justification decisions to member states under Council Directive 2013/59/Euratom, the minimal contribution of the Carview system to yearly radiation dose limits, and the potential for adopting quantitative risk assessment methodologies similar to those in EN ISO 12100:2010. The white paper underscores the value of the ODYSSEUS platform in achieving robust border protection and offers recommendations for policy and legislative enhancements based on pilot outcomes.

