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Development of advanced Radiation Portal Monitors (RPM) for high-speed RN detection

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The use of non-destructive testing technologies is a necessity for safety controls. Dangerous quantities of radioactive materials or Special Nuclear Materials (SNM) could easily be transported and hidden in a car or a truck. This is why controlling the entry of hazardous and illegal radioactive materials via road traffic in Europe with a minimum disruption of the traffic flow is a key issue for EU governments. Following the European FP7 SECUR-ED project [1] and as part of H2020 ENTRANCE, CEA List is in charge of enhancing the current algorithms implemented in Radiation Portal Monitors (RPM) in order to improve the speed detection with the final purpose of positioning these systems at the road toll. Speed detection must be increased from 8 km/h to 30 km/h to avoid traffic jam at tolls. First of all, we lined up along the road three RPMs, called Saphygate G [2] and manufactured by Bertin Technologies in order to increase data collection. Secondly, we developed and implemented dedicated algorithms to correct and then correlate the data in order to detect a moving radioactive source. An important aspect of our approach is the correction of the “shadow shielding effect” [3]. The passage of a large, dense, high atomic number material vehicle in front of an RPM acts as a moving screen that lowers the count rate baseline. To get rid of this effect, the algorithm is based on the determination of the rising and falling edge using a Moving Average Convergence Divergence (MACD) trend indicator also used in technical analysis of stock prices. Through the correlation and the high data rate digital processing, detection should be possible at more than 8 km/h. Tests are currently performed at CEA Paris-Saclay with gamma sources in order to obtain a functional and measurement validation in laboratory environment. Further tests will be held using the reference facility ITRAP+10 located in the Joint Research Centre (JRC) in Ispra, Italy. Final field tests in real experimental conditions will be carried out in Croatia and Bulgaria starting in 2023.



Figure 1. A Saphygate G Radio portal Monitor used in laboratory environment for the ENTRANCE project

- [1]. K. Boudergui, V. Kondrasovs, R. Coulon, G. Corre and S. Normand, "New monitoring system to detect a radioactive material in motion," 2013 3rd International Conference on Advancements in Nuclear Instrumentation, Measurement Methods and their Applications (ANIMMA), 2013, pp. 1-5, doi: 10.1109/ANIMMA.2013.6727914.
- [2]. Bertin's Saphygate G portal monitors, www.bertin-instruments.com/product/radiation-portal-monitors/saphygate-g-portal-monitor/
- [3]. R. Coulon and J. Dumazert, "Shadow-Shielding Compensation for Moving Sources Detection," in IEEE Transactions on Nuclear Science, vol. 64, no. 7, pp. 1641-1646, July 2017, doi: 10.1109/TNS.2017.2716540.